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PRESIDENT'S MESSAGE

Welcome to our 1985 Annual Conference. This, our 20th Annual Conference, is a significant and happy occasion for us. In honour of our 20th year we are holding a Past Presidents' dinner and I anticipate that all but one of our Past Presidents will be in attendance. It will be a wonderful opportunity to renew acquaintances and exchange social and professional notes with our friends and colleagues.

The theme for our program is «Transportation Priorities in a Changing Environment». This is a particularly apt theme at this time and the speakers at our first plenary session will create the framework for the more specific papers which will follow. As usual, we have had excellent submissions and I have no doubt that stimulating discussion will be generated.

I wish you a productive Conference and a fine visit in Toronto.

Karen Hecks
President
Canadian Transportation Research Forum

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THE CURRENT VIEW OF CANADIAN SHIPPERS TOWARDS DEREGULATION: AN INPUT TO POLICY FORMULATION

Joseph P. Dion

The Canadian Industrial Transportation League, Toronto

INTRODUCTION

This paper considers the deregulation of transportation in Canada, specifically the rail and highway modes, from the shipper's point of view. The goal of the paper is twofold. First, it will quantify support among Canadian Shippers for a significant lessening of the economic regulation of the modes. Second, it will argue that in a deregulatory environment, the views of shippers are essential to the formulation of transportation policy. The paper is based upon the results of a nation-wide survey of the issues related to the deregulation of transportation carried out by the Canadian Industrial Transportation League (CITL) in the early months of 1985. The survey was undertaken by the CITL because it was thought that (a) the views of Canadian shippers had changed as the result of the deregulation of rail and highway transportation in the United States in 1980, and the consequent competition from American Shippers, and (b) it was necessary for shippers

to play a more active role in the development of a deregulatory policy in Canada. For that to happen, documentation of current views was necessary.

I hope to demonstrate that the views of Canadian shippers have changed substantially over the last four years and that now they are quite strongly in support of a deregulatory system that would foster greater competition between carriers.

The paper will proceed in the following manner: first, I will describe the context in which I situate the shippers' views; second, I will briefly outline the form of the survey; third, I will summarize the results of the survey; fourth, I will present conclusions and recommendations that arise from the data.

CONTEXT

The Desirability of Deregulation

It has been stated (Stanbury 1980) that the history of the current movement against the regulation of business, including transportation, began with a meeting of U.S. economists in 1975 following a request of then-President Ford. This move to promote deregulation resulted in the Airline Deregulation Act, 1978; the Staggers Rail Act, 1980; the Motor Carrier Act, 1980; and later the Bus Deregulatory Reform Act, 1982. The Staggers Rail Act and the Motor Carrier Act deregulated rail and highway transportation in the United States. Since that time there has been considerable debate in the United States and

Canada as to whether such lessening or removal of economic regulation of transportation is a net benefit for the country, its economy and consumers. In Canada, as a result of the American deregulation of 1980, we are now in the process of re-evaluating the existing regulatory framework and developing a new system characterized by significantly less economic regulation. This requires the co-operation of government and industry to establish a regulatory environment that will foster competition, while ensuring protection for the transportation community from abusive practices.

The arguments for deregulation are strong. Prof. Waters (Ruppenthal and Stanbury 1976) demonstrates that from an economic point of view the rationale for regulation is either (a) the economic efficiency rationale or (b) non-efficiency objectives. He argues that economic efficiency is simply not achieved by regulation (rather economic efficiency would rather be achieved by open competition) and that non-efficiency objectives, such as redistribution of income, would be much better achieved by other means. The Economic Council of Canada (1981) in looking at the development of the regulatory regime, sees it largely as a reaction to various pressure groups rather than a well-thought out system. The regulatory activity increases in certain political climates, such as the 1930's and the late 1960's and early 1970's, and the cumulative effect is a totally incoherent system, much of which is out

dated.

Such arguments lead one to believe that deregulation would result in (1) increased competition that would give the purchasers of transportation lower prices, and (2) such competiton would lead to a more economic and efficient transportation system. This is the goal of the current Canadian transportation policy as stated in the National Transportation Act, 1967 and one with which I would agree.

The Role of the Shipper

If we accept that an end to the economic regulation of transportation is desirable for shippers and ultimately everyone, then we might ask the following, "What is the role of the shippers in the development of a new policy that would foster this desirable change?"

The parties involved in transportation, or affected by transportation policy, are the carrier, the shipper, and the consumer/citizen (or by analogy to urban passenger transportation, the operator, the user and the non-user).

As the purchaser of transportation services the shipper is the demand side of transportation, just as the carrier is the supply side. Thus, the shipper's role is of paramount importance. However, it appears that until now the government's concern in developing transportation policy, apart from political and administrative issues, has been largely the well-being of the carrier industry and the consumer/citizen. This last is usually referred to as the "public interest".

For example, when the issue of improving transportation to achieve export-led growth is considered, the improvements in transportation are often seen in terms of increasing carrier capacity and not necessarily in terms of increasing overall efficiency through greater competition. In this regard, the views of the shipper are seen as useful input, but neither integral or essential to the process.

Perhaps it has been felt that shipper interests are automatically taken care of by the existence of economic regulations and regulatory agencies. If this is indeed the case, then it follows that in a deregulated environment shipper interests would not be protected. Therefore, shippers, in the absence of regulatory protection, must work hard to express clearly to government their concerns and, I would argue, it is incumbent on government to listen. This new role for shippers replaces their traditional passive role. That role was one of monitoring the carrier's adherence to the regulations and of signalling to government when those regulations failed to protect them adequately.

In summary, then, there are two points. First, it appears that by achieving economic efficiency hence lower prices, deregulation may be beneficial for all groups: the individual shippers, the carrier industry (though individual carriers may suffer from new competition), the consumer and the country as a whole. It should be noted

that in any case it is very likely that it is inevitable: most of Canada's foreign trade is with the United States. Canadian carriers and shippers have both suffered negative effects as a result of the deregulation of their counterparts in the United States. Canadian carriers and shippers operating in the United States cannot compete against lower U.S. carrier freight rates and consequent lower commodity cost at destination, and American carriers and shippers also have this advantage when shipping into Canada on an international movement.

The second point is that in a freer market-place the views of shippers are essential to the formulators of government policy. The reason for this is that as purchasers of transportation service, they are one of the two major players in transportation, the other being the carrier. The rationale for their previous passive role, protection under a regulatory system, will have been eliminated.

It is in the light of these two points that I will consider the results of the survey. First, however, I will briefly outline some facts about the survey itself.

OUTLINE OF THE SURVEY

In late December 1984 the Canadian Industrial Transportation League sent out a survey to 500 individuals who were the senior representative of his member company. By our cut-off date about four weeks later, 107 responses had been received - - a 21% response rate.

The survey included 82 questions of the following description: (a) 72 single reference questions with a three-choice scalar response (yes, no, undecided), and 10 very information-intensive questions the goal of which was to develop a "profile" of the respondent's company.

The purpose of the survey was to elicit the resondents' views on the economic regulation of highway and rail transport in Canada, and related legal issues. Because of its inherently competitive nature, highway transport was the main focus of attention; however, on some questions such as collective rate-making and rate-filing it was useful also to consider shipper attitudes on the issues in regard to rail transport.

The following are the issues addressed in the survey.

(a) collective rate-making. This is setting of prices or rates by two or more carriers acting together. The rail carriers do this through the Canadian Freight Association, and highway carriers through six highway freight tariff bureaux, and four American bureaux that set rates for carriage into Canada.

(b) the Combines Investigation Act. This is the legislation from which carrier groupings must be exempt to set prices collectively.

(c) rate-filing or rate-publication. This is the practice wherein carrier groups must take the rates set collectively and send a copy to be put on file for referral at a government agency, such as a highway

board. This section (c) also investigated shipper views on the role of Bureaux and Boards.

(d) the right of appeal. This is the right of a shipper to appeal to a government agency when he feels he has not been treated by a carrier in accordance with the legislation and regulations. It generally refers to Section 23 of the National Transportation Act, 1967.

(e) the economic regulation of highway transport. This was a major section of the survey in which 22 questions were asked to investigate the shippers' views on all aspects of the economic regulation of highway transport in Canada. Section (e) partly overlaped with some questions asked in (a) and (c) and formed the heart of the survey.

(f) In addition, there was the "company profile" mentioned above.

RESULTS OF THE SURVEY

In this section I will review the data obtained from the respondents on the 82 questions that were asked. Of the six sections of the survey listed above, (a) to (f), I will concentrate on (a) collective rate-making (with reference to both highway and rail modes), (c) rate-filing (with reference to both highway and rail modes) and most importantly on (e) the economic regulation of highway transport. Sections (b) the Combines Investigation Act. and (d) the right of appeal are less directly important and

further, are technical legal issues and beyond the scope of this paper.

(a) collective rate-making.

(i) rail: to the general question, are you in favour of collective rate-making by railways, shippers are clearly not in favour--69% no (24% yes, 5% undecided). Specifically, shippers are against collectively set rail rates of the following types:

1) local/commodity rates*, 81% no (17% yes, 2% undecided)

2) competitive rates, 74% no (22% yes, 4% undecided)

3) agreed charges, 65% no (29% yes, 4% undecided)

(4) general rate surcharge, 69% no (29% yes, 5% undecided)

Also, respondents were similarly against collectively set rates in the following categories: express, intermodal and international (70% or more against).

Shippers, however, were strongly in favour of collectively set rates of the following types:

1) joint interline (but only by participating carriers, 77% yes, (20% no, 3% undecided).

In addition, respondents were slightly in favour of collectively set rates of the following types:

1) class rates, 54% yes (35% no)

2) special arrangements tariff, 52% yes (40% no, 7%

---

* for the definition of this and other rates, see note (1)

undecided)

Further, the following three opinions on independent pricing (the alternative to collective rate-making) by railways were expressed:

1) 75% believe that independent pricing would lower rail rates (12% no, 14% undecided)
2) 61% believe that it would result in better service, and
3) 73% believe that independent pricing would <u>not</u> result in higher transaction costs (a view presented by the railways), 11% yes and 14% undecided.

ii) <u>highway</u>:

respondents are generally quite strongly opposed to the right of highway transport companies to establish rates collectively especially rates of the following type:

1) competitive rates, 88% no (6% yes, 2% undecided)
2) commodity rates, 85% no (13% yes, 3% undecided)

Feelings against collectively set rates are less strong for rates of the following type:

3) class rates, 57% no (39% yes, 3% undecided)

Further, the following opinions were expressed by the respondents on the results of independent pricing in the highway mode:

1) 83% believe that independent pricing in the highway mode would result in lower rates (8% no, 4% undecided)
2) 68% believe that independent pricing in the highway

mode would result in better service (26% no, 7% undecided. (This differential between anticipated lower rates and between service is similar to the views on independent pricing in the rail mode.

3) Respondents estimated the following changes to their annual freight as a result of independent pricing in the highway mode:

	Amount of change	Percentage of respondents
Increase	$ 10,000-$ 99,000	3%
	$100,000-$999,000	2%
Decrease	$ 10,000-$ 99,000	14%
	$100,000-$999,000	20%

Decreases were also expressed as percentages by other respondents:

Percent decrease	Percentage of respondents
1% - 5%	8%
5% - 10%	16%
10% or over	3%

(c) rate filing

Although respondents were strongly against any form of rate approval or rate regulation (91% against), they were evenly split (51% for; 46% against) the elimination rate-filing (putting a copy of the rates at an agency for referral by interested parties).

If rate-filing were continued, the following aspects appear important to shippers:

1) access to filed rates: in reply to a question as to who should have access to filed-rates, equal numbers of

respondents (46%) chose each of the suggested categories: government, carriers, shippers, general public.

2) location of filed rates: the greatest number or respondents (37%) chose "carrier's office" as being able to replace a government agency as a repository for rate records (carrier association 25%, elsewhere 15%, none 7%)

Further, shippers believe that:

1) elimination of the mandatory filing of rates could result in lower rates (63% yes, 24% no, 12% undecided)

2) elimination of the mandatary filing of rates could result in better service (41% yes, 36% no, 22% uncertain)

3) 54% consider interprovincial uniformity to be very important in regard to trucking regulation (on a five choice scale).

(c)i, rate publication and tariff bureaux

These answers refer to rate-publishing which is the actual publication of the rates and the distribution of them to interested shippers.

This publication is done for Canadian railways by the Canadian Freight Association (CFA) and for the trucking industry by six highway freight tariff bureaux and in addition four American Tariff bureaux that publish Canadian tariffs. The question is the following "What would Tariff bureaux do in a deregulated environment in which there was no collective ratemaking, no rate publication, and the rates if filed were filed at the carrier's office?"

On the subject of rate-publication and the role of tariff

bureaux in a deregulated environment, the respondents expressed the following opinions:

1) 73% believe that the bureaux can continue to operate even if their operations are divorced from collective rate-making (14% no, 14% undecided),

2) 60% believe that there is a role for the bureaux in a deregulated environment (20% no, 21% undecided), and virtually the same numbers believe that this role lies in providing interlining service, which, as mentioned above, was the one form of collective rate-making which the respondents clearly supported.

(c)ii, notice of changed rates

The final issue related to this section is that of notice of changes in rates. No matter how rates are set, or filed or published, the respondents went on record as stating that the matter of crucial importance to them in regard to rates was that shippers be given 30 days notice of increases in rates, 96% yes (5% no). A similar notice of decrease in rates was considered far less important, 54% yes (48% no).

(e) the economic regulation of highway transport

As mentioned above, this section is really the heart of the survey and most clearly illustrates the current views of shippers on the subject of the deregulation of transportation in Canada. More conceptual than the earlier sections, this section highlights the simple fact that at this point shippers feel they would be better served by a

carrier industry free from economic regulation than they are by the current system. This principle provides a context for the specific issues of collective rate-making and rate-filing or rate-publication of earlier sections, and taken together, these sections provide an essential input to the current policy debate out of which must emerge a new policy that will direct developments for the rest of the decade and indeed, the rest of the century.

In general terms, the respondents clearly state that they feel that they would be better served by open price competition between highway carriers, 91% yes, (7% no, 2% undecided).

This view is borne out when specific issues are addressed:

1) 75% believe that there should be open entry for highway carriers (14% no, 7% undecided),

2) 77% believe that there should be free exit for highway carriers (14% no, 7% undecided),

3) 81% believe that highway carriers should be free to serve any points they wish (11% no, 8% undecided),

4) 49% believe that there is no danger of monopoly of the market by large highway carrier firms (37% there is danger, 15% undecided); and with virtually the same percentages the respondents believe consequently there needs to be no legislation to prevent monopoly.

This last response implies that shippers want no restrictions on ownership or investment in transportation services. This is not entirely true; in a later question

they state that they are ambivalent both on (a) government ownership of transportation services 50% opposed (20% for, 12 undecided) and (b) government subsidy of transportation 42% opposed (30% for, 15% undecided),

5) 78% believe that there should be no minimum or maximum levels of price set by the government or anyone other than the shipper and carrier involved in the transaction (15% want a level set, 6% undecided); virtually the same figures hold for level of service. However,

6) 61% believe that there must be uniformity across the country before we can have price and service competition that beneficial.

Specific issues in highway carrier legislation.

This stated support for free competition among highway carriers is further borne out in answers to specific issues arising from the proposed legislation in the Province of Ontario for the highway carrier industry--the Public Trucking Act (PTA).

It must be noted that in earlier sections 54% wanted class rates (which provide a ceiling) for rail and 39% want them for highway.

1) 85% are in favour of eliminating the imprecise criterion of "public necessity and convenience" for entry into the highway carrier industry that is in the current legislation in Ontario--the Private Commercial Vehicle Act (85% no, 6% undecided)

2) 91% support the concept of a "fitness test" proposed in the PTA (4% no, 6% undecided)

3) 57% support the concept of a "market test" proposed in the PTA (20% no, 19% undecided)

4) There is strong support for the system whereby shippers and carriers (owner/operator) are allowed to hire a broker by means of a lease--this is known as "single-source leasing". 86% support the right of carriers to do it (3% no, 9% undecided); 88% support the right of shippers to do it (4% no, 7% undecided),

5) 76% support the concept of "one-way leasing" whereby an owner-operator carrier can lease one-way to one party and to another when returning (17% no, 6% undecided). By the way, 42% believe that it is necessary to continue issuing permits for Sunday trucking (39% no, 18% undecided).

Confidential Contracts and Rebates

On this controversial subject, 73% of respondents feel that open price competition implies that a carrier can negotiate confidential contracts that include rebates (24% no), and we must remember that 91% want that open price competition.

However, in a direct question asked in relation to the elimination of rate-filing, only 54% supported the ability of carriers to negotiate confidential contracts with shippers (11% no, and 4% undecided), while 47% supported the ability of carriers to offer rebates as part

of these confidential contracts (17% no, 7% undecided).

Summary of the results of the survey

I will summarize briefly the results of the survey in the following three areas: (1) collective rate-making (rail and highway); (2) rate-filing (and highway); and (3) the economic regulation of highway transport. 1) collective rate-making. Shippers are against this except in a few particular cases. In rail transport they suppport collective rate-making for joint interline rates and Special Arrangement Tariffs. In highway transport, however, there is little support for collectively set rates except perhaps class rates.

2) rate-filing. Despite strong support for an end to the economic regulation of transportation, it appears that about 50% of shippers simply cannot face the immediate demise of rate-filing. They would like to see it remain, although perhaps in a simplified form, for the foreseeable future. More significant is the very strong support for 30 days notice of increases.

3) economic regulation of highway transport. Shippers are for open competition in highway transport, and they feel that the change should be effected within a year. This can be slightly qualified by the fact that some concern is expressed for the small shipper and the shipper in a remote community. In addition, a majority feel that national uniformity of regulations is necessary before we can have price and service competiton that is beneficial.

CONCLUSIONS AND RECOMMENDATIONS

I would conclude from the foregoing that there has been a significant shift in the views of Canadian shippers since the deregulation of rail and highweay transportaion in the United States. If we take the views of the membership of the CITL as representative of these views, we can say that that the curently held views are diametrically opposed to those that were held a few short years ago.

At that time, the League official policy was to support (1) collective rate-making, (2) rate-filing and rate-publication. There was not a clearly stated policy on the issues of the economic regulation of highway transport; however, the status quo was implicity accepted, and all discussion of highway transport accepted the regulatory environment as given, and most likely immutable.

Today, as we have seen, shippers are against collective rate-making, ambivalent on rate-filing and clearly for open competition in highway transport. Also, I would argue that their views are quite consistent between both modes and across all issues. That is to say, they have been consistently for allowing carriers to compete on price and service without government constraint. I feel that the issues of confidential contracts and rebates are significantly different issues, not necessarily implied by independent pricing, and I have not considered them here.

Further, I feel, as has been noted above, that the

part played by the shipper as a participant in transportation policy formulation will become more important and must be played earlier in the policy process. As evidence that this is beginning to happen, I would point out that on the basis of the above survey, the CITL has given full support to (1) the recommendations of the "Staggers Inquiry", (2) the proposals of the Canadian Conference of Motor Carrier Transport Administrators (CCMTA), and (3) Ontario's new Public Trucking Act.

RECOMMENDATIONS

Implicit in the support that the Canadian Industrial Transportation League has given to the above-mentioned government initiatives, and in the League's new policy as based on the survey, are several specific recommendations. They may be of interest to the larger transportation community as an indication of the current feelings of shippers on the business of transportation. They are as follows:

1) that the new national transportation policy require independent pricing by carriers. As a result of this policy, collective ratemaking would no longer be allowed except in a very few specific cases, notably joint interline rates. In the vast majority of cases, carriers would set rates independently or shippers and carriers would negotiate rates, service, and terms of conditions for carriage.

2) a. that the practice of rate-filing be simplified

and the feasibility of abolishing its mandatory use be considered.

b. that the highway tariff bureaux play a significant role in the area of interlining services. As noted in (1) this is a form of collective rate-making that would be allowed.

c. that all carriers be required to give advance notice of rate increases. A suggested time is 30 days.

3) that in the area of highway transport the following point be incorporated into the government's transportation policy and eventually the law:

a. open entry and exit

b. the right of a carrier to serve all points he chooses

c. interprovincial uniformity of carrier regulation - - the CCMTA standard

d. elimination of the criterion of "public necessity and convenience"

e. acceptance of the "fitness test" as the criterion for market entry (and if necessary, the "market test")

There were several more policy positions suggested by the survey which I feel would require further study, e.g. government ownership and subsidy of carriers; or positions on which more information would be needed e.g. "single-source leasing", "one-way leasing" before recommendations could be made.

In closing I would say that the shipping community strongly supports competition among carriers. I would urge the government to take these views into consideration in any changes it makes in transportation policy. Finally, it is my view that a return to greater competition will ultimately benefit both the buyers and sellers of transportation services, and with them the economy as a whole.

NOTES

(1) E.M. Ludwick Associates Inc. (1984)

DEFINITIONS OF RATE TYPES

Class Rates are designed to provide ceiling rates for all classes or groupings of articles or commodities moving between all points in Canada served by the railways.

Local commodity rates are negotiated rates, allowing the movement of a specific commodity between specific points at competitive rates for captive shippers having no alternative modes of transportation except one carrier.

Competitive rates are class or commodity rates designed by railways in recognition of competition from other modes of carriers.

Agreed charges are contractual rates between shippers and railways allowing the movement of specific commodities between specific points at reduced rates for guaranteed volumes. Under existing contractual arrangement, shippers not being party to original agreed charge negotiations are allowed to apply to participate.

Competitive rates are class or commodity rates designed by railways in recognition of competition from other modes of carriers.

Joint interline rates are published as a single through rate jointly by two or more interconnecting carriers involved in the interline movement.

Combination rates are a combination of two or more local rates covering interline movement.

Intermodal rates are rates for moving road transport trailers or containers on railway flat cars. Also known as rates for piggyback (TOFC & COFC).

General rate surcharges are supplementary charges added to the base rate. eg. fuel surcharge.

Transborder rates are designed in concurrence with domestic and foreign connecting carries to provide international through rates.

Special arrangement tariffs are charges covering ancillary services such as switching, interswitching, terminal charges, transit arrangement, stop-off privileges, limited movements of freight (LFT), etc...

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WHAT DO SHIPPERS REALLY WANT?

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INTRODUCTION

The development of transportation policy in Canada is, in many ways, a Canadian ritual. Since World War II, hardly a decade has gone by without a major Royal Commission or policy review which has attempted to come to grips with one or more important national transportation issues. The forums in which issues are resolved and transportation policy is developed have attracted carriers, shippers, groups of shippers, provincial and local governments. It is normal to expect that these various groups will have conflicting goals and it has been the role of the various commissions and inquiries to "narrow the differences" among the parties and to resolve the issues in the "public interest."

While many commissions and inquiries have begun with such idealistic goals, in practice the resolution of issues is often a difficult and hopeless task. Reflecting on the process involved in the Turgeon Royal Commission (1951), Commissioner H.F. Angus commented:

> Our own hearings were treated by the parties concerned more as a forum for advancing claims

than as a round table for the development by consent of a mutually aceptable policy.[1]

Since we are now in the middle of a review of national transportation policy initiated by the Minister of Transport, it is an opportune time to review the process of transportation policy development. This paper focuses on the role of shippers in that process. First, a framework within which the role of shippers can be examined is presented. Then, with a look back at some earlier policy reviews, a shipper profile is developed. The discussion will then turn to the shipper of the 1980s and develop a somewhat different profile which is increasingly being brought to bear on current policy development processes.

SHIPPERS AS INTEREST GROUPS

The interest group theory of politics suggests that the federal government, in "chairing" the policy development process, acts as an "arbiter among competing economic claimants."[2] The federal government's "chairing" role can take many forms: from a process whereby a Cabinet Minister undertakes a policy review to a Royal Commission to a regulatory body acting in response to a Cabinet directive or on its own initiative. Within these various institutional arrangements, carriers, shippers, and governments argue on

two levels. The outward and visible level is couched in terms of a shift in policy or a change in regulation which would lead to greater efficiency, more competition, a higher level of exports, regional economic development, etc. The second level concerns transfers of wealth which each interest group perceives will be the result of a policy or regulatory change.

Proponents of the interest group theory suggest that an interest group will argue in favor of policy or regulatory changes on the first level (public interest factors) and argue against such changes on the second level because wealth will be transferred from them to another group or groups. The interest group theory goes on to suggest that interest groups which are narrowly focused tend to have more success than groups which are more broadly focused. For example, in the case of regulatory reform of the Canadian railway industry, a railway company obviously can focus clearly on whether it would lose or gain wealth under various policy and/or regulatory changes and develop arguments on both public interest and self-interest levels. A shipper, even a shipper of a low-valued bulk commodity which has a high transport component in its delivered price, has a variety of public policy issues to face and transportation policy is only one of them.

The following section explores the role of shippers

from the perspective of interest group theory in relation to various transportation policy developments.

SHIPPERS AS SHEEP

Over the past 20 years in Canada there have been three major transportation policy developments: the MacPherson Royal Commission and the National Transportation Act (1967); the Western Economic Opportunities Conference (1973); and proposed amendments to the NTA and the Railway Act (1977-78). While shippers have had varying degrees of input to these initiatives, it is evident on reflection, that shippers have had little impact in shaping the respective policy shifts which have emanated from them.

The interest group interaction in connection with the MacPherson Commission and the NTA was very similar to the various freight rate cases which were conducted before the Board of Transport Commissioners (and its predecessors) over the previous 60 years. The railways argued convincingly that the world had changed, that intermodal competition was pervasive and that existing regulation constrained them from acting in an efficient manner. There was substantial concern expressed by shippers that "in the absence of intermodal competition the railways would engage in pricing prejudicial to particular shippers and regions."[3] This concern of

shippers was not addressed. Rather, the government's view was that the combination of minimum rate control, maximum rate control and the NTA provision for appealing rates prejudicial to the public interest would provide sufficient protection for shippers against any monopolistic pricing action on the part of shippers.

It is clear now, almost 20 years after the NTA, that the three major pieces of rail rate regulation have been ineffective not only in their failure to provide a forum in which shippers could debate rate issues but in their inability to effect a satisfactory resolution to many shipper problems. The single exception is that Section 23 of the NTA has been, in some limited situations, an effective forum but that, at the present, in the case of transborder rate issues, its ability to effect a solution is virtually non-existent.

It is arguable that in attempting to meet the dual goals of a viable (and subsidy-free) rail system on the one hand and equity for shippers on the other, the government in 1967 chose to ensure a viable rail system. The view certainly appears to have been that pervasive competition would ensure that most shippers would not suffer undue hardship. Within the framework of interest group theory, it appears that the NTA was a victory of a particularly focused interest group (the railways) over a more generally focused group (shippers).

Only six years after the NTA was enacted and amendments to the Railway Act provided increased pricing freedom for shippers, regional concern about the impact of the NTA became focused. The forum was the Western Economic Opportunities Conference in July 1973. At WEOC, the four western provinces argued that the present freight rate system discriminated against the economic development of Western Canada. Specific complaints concerned rate differentials on raw versus finished products and on long versus short haul rates, as well as the lower incidence of group rates in Western Canada. However, the essential problem was that most of the growth in rail traffic since 1967 was in bulk commodities, that these commodities originated in the western provinces, that they were effectively "captive" to rail transportation and that traditional value of service pricing had the effect of creating a rail monopoly with respect to the transportation of those commodities to market.

From the perspective of shippers, the most notable feature of the WEOC meetings and follow-up was their virtual absence. (This is true to an extent for the railways as well who became involved only on an ex post facto basis in defending and/or explaining their pricing practices.) It is worth speculating now that the involvement of shippers in the WEOC process might have

led to some different conclusions. The only visible conclusion was an amendment to the Railway Act which resulted in the provision of rail costing information to the provinces. The lesson which might be learned from this initiative is that major changes in transportation policy are not likely without the involvement of shippers and carriers.

Following WEOC and due to a number of factors exogenous to WEOC, the federal government undertook a transportation policy review. This resulted in a policy statement in 1975 and in two attempts to change transportation policy and regulation in 1977 and 1978 (Bills C-33 and C-20). The main message from these legislative proposals was that the federal government had examined the balance between competition and regulation with respect to rail freight rates and had come down in favour of more regulation.

The increase in regulation focused on the maximum rate provision in the Railway Act. By removing the restriction that only "captive" shippers could invoke the provision, and by allowing Governor in Council to specify the costing parameters as well as the mark-up over variable cost, the proposals sought to lower railway mark-ups over variable cost in those cases where railways were exercising monopoly control.

Generally, railways and shippers were opposed to the

proposals because they would lead to a dramatic increase in regulation. This was the public interest argument that increased regulation would not serve a useful purpose. However, each group had more specific reasons--the railways because they saw reduced revenues and profits and shippers because they felt that the proposals did not go far enough. The failure of these legislative proposals to become law can be traced to the fact that they had the support of no major interest group.

In summary, in the case of the three initiatives discussed above, shippers played a fairly low key opposing role. This passive stance was no doubt influenced by the history of the development of transportation (largely rail) policy in Canada which had been the exclusive preserve of the railways and the government of the day. Shippers appeared to have been content to allow the policy environment to be created and then to have specialists (legal, economic and tariff) to cope with it.

The lack of shipper influence can also be interpreted in two other ways. First, shippers often bring (and are asked to bring) specific rate concerns to public discussions. While on the one hand specific rate issues provide a real-life element to sometimes esoteric policy discussions, such actions are also often viewed as an extension of the rate negotiation process. Thus persons

developing public policy often shy away from addressing shipper representations because they do not want to become part of commercial negotiations. The resolution of this catch-22 situation has led to the second way in which shipper influence is diluted. Policy makers simply assume that shippers' views are homogeneously aligned with the provinces or regions in which they exist. While this interpretation may well be accurate, the consequences are that shippers' views are often assumed to divide along regional lines and to be subsumed in the views of provincial governments.

SHIPPERS AWAKE

Shippers in the 1980s have taken a keen interest in transportation policy development. Evidence of this can be seen in the Canadian Transport Commission Hearings on the Impact of U.S. Rail Deregulation (which will be discussed below), the Spring 1985 CTC Hearings on Domestic Deregulation and the transportation policy review now being conducted by the federal government. Not only are shippers participating more actively but their views are now having a clear impact on the kind of policy shifts now underway.

Three factors can be identified which have contributed to the shipper profile of the 1980s. First, economic conditions such as stagflation during the 1970s

forced us to rediscover the economics of scarcity. It is no accident that the current impetus for regulatory reform began with the First Ministers' Conference in 1978 which focused on the need for new economic strategy. Since then, shippers, carriers and governments have been seriously examining the kind of economic institutions which can best serve the transport sector and the economy as a whole.

The second factor has been the demonstration effect of U.S. deregulation -- certainly rail, motor-carrier and air deregulation, but also telecommunications. In the early days of U.S. rail deregulation, it was widely perceived in Canada that the railways would find ways to retain traditional practices within the new regime and that allowances and rebates would only be offered by smaller carriers who were on the road to bankruptcy anyway. Within Canada, it was widely perceived that the U.S. would make an exception to its deregulated environment for countries like Canada whose regulatory system did not quite fit that of the U.S.

Now, it is clear that U.S. railroads have buried their traditional practices and that virtually all railroads are providing rebates and allowances. To the benefit of both carriers and shippers, railway marketing departments are becoming more like the marketing departments of such companies as Proctor and Gamble.

Within Canada, it is clear that there are significant benefits from deregulation and that companies with both large and small markets in the U.S. are not going to obtain any dispensation because of conflicting economic institutions.

The final factor is that the public interest is dominated by strategies which increase Canadian exports and which contribute to Canada's ability to compete in international markets. Economic institutions including regulatory bodies which detract from these strategies are prime candidates for restructuring or removal. This sentiment together with the view that Canada's transportation system is sufficiently mature to compete without regulatory protection and in a new environment have combined to place the railway system and railway regulation near the top of a list for regulatory reform.

The CTC Hearings on the Impact of U.S Rail Deregulation provided a timely forum for shippers to express their views on the present state of rail regulation in Canada. The views of shippers and shippers associations are clearly spelled out in the CTC Report.[4] What is of interest in this discussion is that the general position in favor of confidential contracts, negotiated independently with no access among railways to each others' contracts was virtually unanimous and without qualification. The shippers'

position also called for a shift of the competition/ regulation balance in favor of competition.

It is also of interest to note that no shipper or shipper group (with the notable exception of the CanadianIndustrial Traffic League which has subsequently changed its position) supported the railways' proposal that the Canadian government intervene with U.S. authorities to seek an exemption from U.S. anti-trust laws for collective pricing on the part of Canadian railways on transborder rail traffic. The position of the railways and of shippers clearly diverged on this issue. On other issues, the railways' and shippers' views coincided (with the exception of the railways' ability to see each other's contracts) but the railways' position was defensive while the shippers' positions were more pro-active.

The Recommendations of the CTC Inquiry reflected the shippers' general stance of increased competition and rejected the railways proposals that they should be privy to each other's contracts and that the Canadian government should seek an exemption from the U.S. government for railway collective pricing on transborder traffic. The Recommendations also went somewhat beyond the terms of reference at the Inquiry, but at the same time reflected the views of some shippers who made submissions at the Hearings, in noting that a deregulated

transborder rail sector could create problems for rail traffic within Canada. The Inquiry recommended that a similar study be conducted of the merits of domestic rail deregulation.

In announcing the current review of transportation policy, the Honourable Don Mazankowski stated that he "was impressed by the CTC's report on the effects of the Staggers Act in Canada." He went on to quote the CTC Report's recommendation on domestic deregulation and noted that he agreed with the proposal and had asked the CTC to proceed with such an inquiry.[5]

For the shipper of the 1980s, these various inquiries have provided an occasion to demonstrate the importance of transportation in a restructuring national and world economy. Shippers and their associations who have rethought the role of transportation in a competitive environment have a unique opportunity to participate in public policy development. Certainly part of that uniqueness is that shippers are leading policy development rather than either following it or trying to understand it.

CONCLUSION

Economic events over the past few years have shifted the perspective of shippers. That shift is from a passive acceptance of transportation costs in a byzantine

private and public regulatory environment to an active awareness that transportation costs are no different than any other input cost. From that awareness has come the view that transportation services should be available in a competitive environment free of regulation and that public policy can and should move in that direction. What shippers really want is to be able to participate fully in a competitive environment and to be judged on their ability to compete effectively and not on their dexterity in wandering through a regulatory maze.

END NOTES

1. Report of the Royal Commission on Transportation 1951, King's Printer, Ottawa, Ontario, p. 285.

2. For a detailed review of the interest group theory as it relates to regulatory reform, see W.T. Stanbury and Fred Thompson, "The Prospects for Regulatory Reform in Canada: Political Models and the American Experience," Osgoode Hall Law Journal, Vol. 20, No.4, December 1982.

3. T.D. Heaver and J.C. Nelson, Railway Pricing Under Commercial Freedom: The Canadian Experience, Center for Transportation Studies, University of British Columbia, Vancouver, B.C., 1978, p. 79.

4. Railway Transport Committee, Canadian Transport Commission, Inquiry Into Effects in Canada of U.S. Rail Deregulation, Minister of Supply and Services Canada, December 1984.

5. Notes for an Address by The Hon. Don Mazankowski, P.C., M.P., to the Canadian Industrial Traffic League, Westin Hotel, Ottawa, Ontario, February 21, 1985, pp. 10-11.

GOVERNMENT INTERVENTION AND UNCERTAINTY IN THE TRANSPORT SECTOR

G. HARITON*

1. UNCERTAINTY IN SOCIETY

Most people in our society try to avoid uncertainty. The best known examples are in the area of potential financial loss.** Thus, individuals and firms will purchase accident, theft, fire, disability and other types of insurance to protect against unforeseen events, even where on average the premiums exceed the expected value of the losses. Similarly, investors will require a higher anticipated rate of return for investments whose returns are perceived to be more volatile (both upwards and downwards). But risk aversion goes much further than financial considerations. For example, brand loyalty is partly explained by the desire for assurance as to the quality of the product.

More particularly, in transport, users often take actions to minimize uncertainty. For example,

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** That humans are risk averse has long been recognized. For example: "A small but certain profit, which can be regularly repeated, is doubtless worth more than risky speculations, about which one can never be sure." Translated from page 68 of Etat et description de la Ville de Montpellier fait en 1768, anonymous, published by Joseph Berthelé in Archives de la Ville de Montpellier (Montpellier 1909).

passengers will plan to arrive at terminals early so as not to miss departures on scheduled carriers. Further, they may plan their trips to avoid connections between different carriers, for fear of something going wrong (missed connections, lost baggage). Receivers of freight shipments may maintain safety stocks to protect against delays in receipt of scheduled shipments. Preferred carriers may be chosen to minimize the possibilities of loss, damage, and delays, even though freight rates may be slightly higher.

It is significant that individuals and firms are willing to spend impressive amounts of money so as to acquire information and so reduce risk. Such information activities range from the purchase of newsletters to the retention of consultants, describing the economic outlook and how it will affect transport, as well as events within the transport sector itself. Even more information may be maintained in the form of large computerized data bases, and analyzed by means of econometric or simulation models which attempt to predict future scenarios. All these activities are attempts to reduce uncertainty.

Of course, because of the widespread existence of risk aversion, individuals and firms who are willing to bear uncertainty, require rewards for doing so. This creates opportunities for deliberately undertaking risky activities and receiving the above-average returns which ensue on average. Such entrepreneurial activities, how-

ever, are normally accompanied by measures to place bounds upon the uncertainty and to control it. As mentioned, collection of information is one such measure.

Another measure is to deliberately plan one's activities so as to guard against unfavourable future events, e.g. diversify one's line of business, or build plants whose capacity can be adjusted more easily in case of a downturn in the economy.

Yet another measure is to shift some of the risk to someone else. For example, a firm may enter into long term contracts for supplies, to guard against price increases. Such an arrangement may also reduce risk to the supplier, who is protected against price decreases. By stabilizing the price of the supplies, the long-term contract effectively pools the risks of the firm and the supplier, and diversifies them away. More generally, shifting of risk does not necessarily mean that it is reduced; it may simply be borne by someone else. This is particularly true of systematic risk*, which is related to changes in the business cycle. In particular, by combining many projects and investments, government may eliminate the nonsystematic risk of the projects it undertakes. However, it will still have to bear the systematic risk of these investments. To that extent, having govern-

* Systematic risk is that variability in an investment which is correlated to the variability of a portfolio of investments representing complete diversification over all investment opportunities.

ment undertake projects makes them neither more nor less risky than leaving them in the private sector as part of well-diversified portfolios of investors.

2. GOVERNMENT INTERVENTION IN THE TRANSPORT SECTOR

The federal government intervenes in the transport sector for a number of reasons.* These can generally be grouped into four broad categories:

(a) Efficiency

In certain cases, free market forces are not sufficient to ensure efficient provision of transport services. For example, because of indivisibilities, economies of scale, long life of assets, and the large initial investment required, much of the transport infrastructure has aspects of natural monopoly. Government provision or control may be necessary.

(b) Externalities

Accidents, noise, air and water pollution are all examples of costs that would only partly be borne by providers and users of the transport system. Restrictions must be imposed so that costs to bystanders are internalized as well.

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* Similar reasons lie behind provincial and municipal involvement in the transport sector.

(c) Equity

Transport has long been considered a necessity. Equal access to the transport system, and through it, to the rest of the country, has long been a concern of various regions and municipalities. Development and maintenance of an adequate transport system may mean that some services need to be supported by direct or cross-subsidies.

(d) Other Social and National Objectives

Transport commonly has been used as a policy instrument to pursue non-transport objectives. For example, provision of transport services may be an aid to economic development, both in various regions and in the country as a whole. Again, an integrated transport system may be seen as contributing to a sense of national unity and cultural cohesiveness; it may also assist in national defense and security.

To achieve these objectives, government has traditionally disposed of five main sets of tools for intervention in the transport sector. The various tools differ in their effectiveness, their cost-efficiency, and the unwanted side effects that they induce. Thus, in different circumstances, different tools may be preferred. This subject amounts to the design of a national transportation policy. The purpose of the present paper is more modest: to examine each tool of government intervention in

turn, to see if it increases or reduces uncertainty borne by carriers and users in the transport sector. A further question is whether government's role reduces uncertainty in absolute terms, by diversification, or whether the uncertainty is merely transferred from the private to the public sector, where it is borne by taxpayers as a whole.

3. TOOL 1: PROVISION OF INFRASTRUCTURE

Most transport infrastructure is very long-lived and cannot easily be relocated. It is subject to rapid obsolescence if traffic forecasts turn out to be wrong, or if technical progress favours another mode or another route. Finally, transport infrastructure can be very expensive to put in place. As a result, provision of transport infrastructure is very risky. Indeed, in many cases these risks are so great that it is questionable whether the private sector would be prepared to assume them.

Most of the infrastructure in the air, road, and water modes is owned and operated by various levels of government. This essentially shifts the associated risks from carriers and users to the government and, ultimately, the taxpayer. Indeed, without government intervention, risk-averse private enterprises might design and operate facilities which are deliberately smaller than the expected value of capacity requirements, to protect against the risks of expected capacity not materializing.

For rail and pipelines, infrastructure is typically provided by the carriers themselves. Pipelines are currently tightly regulated, using a rate base/rate of return methodology which attempts to ensure that the carriers earn a reasonable return on their original investment, including infrastructure. Price-setting by the regulator, including the possibility of some retroactive adjustments, can serve to transfer some of the risks associated with the pipelines from the carriers to the users. Of course, economic regulation has its own risks; these are discussed further below.

For the first half of this century, the railways' situation was analogous to that of pipelines today. Since 1967, however, economic regulation for most of the railways' traffic has been minimal (the exceptions are passenger traffic, export grain, and movements originating or terminating on unprofitable branch lines). It is interesting to note that the diminution of economic regulation has been accompanied by a dramatic increase in direct and indirect subsidies.

4. TOOL 2: CROWN CARRIERS

The formation of crown-owned and operated carriers would seem to have three broad justifications:

(a) New services may be considered very risky, because the potential demand, the required technology, and

the resultant costs are all unknown. Indeed, the risks may be so great that the private sector will hesitate to enter the market; only government may be willing to go ahead. An example is provision of transcontinental domestic air service by Trans Canada Airlines in the late 1930's.

(b) Existing private-sector carriers may be obliged to cease serving certain markets, for example due to bankruptcy. In such an emergency, the government may step in and assure continuity of service, through a crown carrier. An example is formation of Canadian National Railways in 1917 to salvage the services provided by other, bankrupt, railways.

(c) Crown carriers may be created to provide services which are intrinsically unprofitable but which serve certain social objectives, which are considered important. In such cases, crown carriers can be seen as alternatives to direct subsidies or cross-subsidies; in addition, they may provide for tighter government control over operations and level of service. An example is the formation of VIA Rail in 1977 to provide rail passenger service.

The formation of crown carriers falling into the first category transfers risks of new services from the private sector to government and taxpayers. As these new services mature, the risk aspects become less important,

and the impact of the crown carrier, acting as any commercial corporation, is difficult to predict. Similarly, the use of crown corporations, falling into the second category, ensures continuity of services and so protects users from unexpected interruptions; the benefits for the bankrupt private carriers are less evident. As the emergency passes, the crown carriers will also typically be required to act as commercial corporations, and generally become indistinguishable from those falling in the first category.. Certainly, both Air Canada and Canadian National Railways have abandoned unprofitable services, have been accused of exploiting monopoly power in certain markets, and of predatory behaviour in other markets. Nevertheless, to the extent that crown carriers are subject to political pressures to continue existing services, they may be more conservative than privately-owned carriers and so provide more stable services. In addition, crown carriers are typically not allowed to go bankrupt.

Unprofitable services are generally neither more nor less risky than profitable services, in the sense that ignorance of the size of the loss may be as disturbing as ignorance of the size of the profit. Both losses and profits are subject to fluctuations in volume of traffic, and in the prices of such inputs as labour, fuel and materials. In this sense, all mature crown carriers are risky. Implicit or explicit government guarantees against

bankruptcy make them less risky than private sector carriers; on the other hand, extension or modification of crown carriers' obligation to serve in response to political pressure would act in the opposite direction.

5. TOOL 3: DIRECT AND INDIRECT SUBSIDIES

Direct subsidies have been growing in importance in the transport sector, especially over the past two decades, as growing competition makes increasingly untenable cross-subsidies among different transport users. As well, indirect subsidies, such as free provision of government-paid equipment or favourable treatment of income taxes, is increasingly being used to encourage specific investments in rail and marine transport. Such subsidies are designed to induce carriers to undertake unprofitable but socially desirable services (or to compensate carriers for imposed duties).

The impact of such subsidies both increase and decrease riskiness of the services to the carriers and users. On the one hand, the subsidies are usually tailored in various ways to the size of the losses, and so transfer some of the risks of the subsidized services from the carriers to the government and taxpayers. On the other hand, the subsidies may be reduced or eliminated due to budgetary pressures; such actions may significantly affect the users of the subsidized services, and to some extent the carriers.

6. TOOL 4: ECONOMIC REGULATION

Economic regulation typically involves control of entry into and exit from certain markets, as well as control of the prices charged and the accompanying level of service. The three types of control are interconnected, and usually have three objectives:

(a) to curb abuses of monopoly power by carriers, especially as these concern undue discrimination between various users, or prices that are too high;

(b) to provide cross-subsidies, either in the form of broad averaging of prices (charging the same price to classes of traffic that have different costs), or by lowering prices in certain markets which are considered to be socially deserving and raising them in other markets. Such control of prices requires control of selective entry by new carriers into the lucrative markets, and selective exit by existing carriers from the unprofitable markets;

(c) to ensure stability of service, by preventing competition in markets which are judged too small to accommodate several carriers; it is feared that such competition would lead to cutbacks in service and eventual bankruptcy of one or all the carriers involved.

Clearly, the third objective is explicitly to reduce uncertainty, with users paying a "risk" premium, in the form of higher prices, for stability of service. Insofar as the second objective leads to cross-subsidy of services that would otherwise be abandoned, it also leads to reduction in uncertainty of the users of those services. However, with increasing competitive pressures, the cross-subsidies may become impossible to sustain, and by distorting market mechanisms may actually increase risks. Finally, since the outcome of applications against abuse of monopoly power is uncertain, pursuit of the first objective may increase uncertainty, on the part of both the carriers and the users.

It should be noted that a byproduct of economic regulation is the production and release to the public of large amounts of information, both as to the operations of the transport sector and its socio-economic environment. For example, the requirement that all prices be published in the form of tariffs has some of the aspects of a public good: once such information is assembled, the cost of its diffusion to as many interested parties as possible is negligible. The alternative is the solicitation by each potential user of price quotations from all relevant carriers, and occasionally expensive studies of the costs of various alternatives. This byproduct of economic regulation reduces uncertainty to all parties concerned, including government, but at a cost: the cost of production

of the information.

7. TOOL 5: TECHNICAL REGULATION

Traditionally, the principal objective of technical regulation in the transport sector is the prevention of accidents. More recently, such regulation has extended to control of noise and air and water pollution. The approach is to prescribe certain operating rules and procedures, or to set standards for the equipment used and (in the case of pilots) the competence of the people involved. More recently, especially in the United States, there have been proposals that would make carriers financially responsible for such external effects as pollution, and thus would motivate them to control emissions, etc. in the most efficient way they can find; however, these proposals are still experimental.

Clearly, regulation pertaining to safety is intended to reduce risks of death, injury, and property damage. The impact of regulation pertaining to pollution is less immediate. Insofar as it protects the general population from potential harm of which it is unaware, such regulation reduces unpleasant "surprises". In addition, by setting known standards governing the amount of pollution permitted, technical regulation allows adjustment of individual behaviour to a known set of circumstances: for example, depending on allowable noise levels, certain noise-averse persons may choose not to look

for a residence in certain neighbourhoods. In all these cases, uncertainty and risk are reduced to everyone involved. Again, however, carriers, users, and ultimately society must bear the extra cost of the safety and environmental measures.

8. PROCESS

Independently of the level of government intervention in the transport sector, and the tools used, the level of uncertainty and risk created will depend significantly on the process by which such intervention takes place. A useful manner of describing such processes is according to the level and type of consultation of carriers, users, and the general public prior to making any decisions or changes.

At one pole, the public process in non-existent. Decisions are based on policy analyses by bureaucrats, on research carried out by other bureaucrats or by consultants, and on Cabinet's reading of the political situation. Once taken, the decisions are simply announced to the public. This type of process creates the most uncertainty. Changes to the transport system, whether desirable or not, are difficult to predict; they will have less chance of taking into account the specific circumstances of various individuals; and carriers and users will have had little advance notice and so will not have had a chance to begin adjusting their operations in advance of the changes.

At the other pole, the public process is highly formalized, with extensive legalistic public hearings and numerous avenues for appeals of decisions, and can take several years. This type of process minimizes uncertainty.* Changes to the transport system are generally easy to predict well in advance; all concerned individuals have ample opportunity to make their views and particular problems known; and the long lead time allows both carriers and users to adjust in a gradual, phased-in manner.

Between these two poles, there are a variety of possible public processes. Public consultation may be more or less informal, in the manner of public meetings rather than public hearings. The range of people consulted may be limited in various ways, for example to carriers and labour unions. The channels for appeals may be restricted or eliminated.

The choice along each of these dimensions is governed by a variety of factors, including the speed of the decision and the need for its legitimization through wide public consultation. It is important, however, to realize that there are also consequences for the level of uncertainty created for carriers and users of the transport system. There seems to be a wide-spread desire, on the part of those who could be affected, to know just what the government is up to. Public consultation, in whatever

* Some would say that the formalized process eliminates uncertainty because it largely eliminates the possibility of significant change.

form, reduces uncertainty and narrows the range of options which carriers and users must worry about. This is in contrast to decisions which are taken behind closed doors, especially if the public suspects that some kind of decision is in process.

9. CONCLUSION

The undesirability of uncertainty is not accepted by all observers of the transport sector. Thus, in a slightly different context, Lawson Hunter, Director of Research and Investigations under the Anti-Combines Act, has lauded the merits of uncertainty in the marketplace. Commenting on his position before the Restrictive Trade Practices Commission in its inquiry into the oil industry, he is quoted as saying: "What we're trying to do is add some uncertainty [in the market]."*

The question of whether competition is compatible with reduction of uncertainty is beyond the scope of this paper. It needs only to be emphasized that most individuals and firms perceive uncertainty as an evil, and are prepared to take dramatic steps and expend considerable resources to reduce it. Therefore, it seems reasonable to use the impact on uncertainty as one of the criteria for judging government intervention in the transport sector.

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* Quoted in The Globe and Mail, 14 April 1984, page B2.

The present paper has discussed the impact of government intervention in qualitative terms, and has not attempted to quantify it. However, it seems clear that, in many cases, such intervention does reduce uncertainty to carriers and to users. Indeed, sometimes the risks of providing service are so great that they are unacceptable to the private sector; if the government did not intervene, there would be little or no service.

In most cases, government intervention would seem to transfer uncertainty from the private sector to the public sector, and hence to taxpayers, without substantially reducing the level of risk. This would seem to be true of the provision of infrastructure, the existence of crown-owned carriers, and the granting of subsidies to various services. In theory, the risks of such activities could be borne by private investors with well-diversified portfolios as easily as they can be borne by government. In practice, however, financial markets are imperfect and could not easily accommodate risks of such nature, and especially of such magnitude.

In other cases, notably technical regulation, risk is reduced, rather than merely shifted from one participant to another. This reduction, however, requires the imposition of various safety and environmental measures, whose costs are borne by carriers and ultimately by users.

Finally, in the case of economic regulation, the impact on uncertainty is less clear, especially when increasing competition is eroding the basis for such regulation. In this context, the process by which government intervention takes place is extremely important: in general, the more public participation, the greater the reduction of uncertainty.

PRO-COMPETITIVE TRANSPORTATION REGULATORY REFORM IN CANADA

Presented on behalf of the
Canadian Chemical Producers' Association
by D.S. Sandford, C-I-L Inc.,
D.W. Goffin, CCPA

ABSTRACT

The Canadian Chemical Producers' Association (CCPA) represents 66 member companies which produce almost 75% of the $9.3 billion worth of industrial chemicals and synthetic resins manufactured annually in Canada. This paper explains why transportation is of vital importance to Canada's industrial chemical manufacturing industry and discuss the elements of pro-competitive transportation regulatory reform which we see as essential. The paper addresses the rail and highway modes of transportation. The chemical industry is also an important user of ocean shipping, but since the current issues in that transportation mode are unique, they are not considered in this paper.

Although this paper is presented under the auspices of CCPA, the ideas and positions it sets forth are those of the authors and do not necessarily represent CCPA policy in each of the areas addressed.

THE IMPORTANCE OF TRANSPORTATION TO THE CANADIAN INDUSTRIAL CHEMICAL INDUSTRY

The Canadian transportation system is particularly important to the chemical manufacturing industry. According to CCPA statistics, total industry shipments exceed $8 billion annually, representing almost 5% of all manufacturing shipments, and ranking fifth in terms of shipments among such major Canadian industries as pulp and paper mills, petroleum refineries, motor vehicles manufacturers, and meat and poultry processing. C-I-L Inc., Canada's largest chemical company, is an important member of the industry. This company has sales approaching $1.2 billion and creates transportation costs of approximately $200 million annually. Approximately 65% of these costs are in the rail mode, 35% are in the highway mode and marine shipping accounts for the remainder.

A key factor in the industry's success has been its determination to move significantly into export markets. Recently, exports for the chemical manufacturing industry have approached 30% of shipments. A significant proportion of these exports are destined for U.S. markets. Using C-I-L as an example again, approximately 40% of this company's transportation costs are now incurred inside the United States.

This growing dependence of the chemical industry on international trade means that in order to ensure competitive industry access to both export and domestic markets, Canadian transportation policies must be responsive to changes in both continental and global transportation policies. For example, the Staggers Rail Act of 1980 ("the Staggers Act") and the Motor Carrier Act of 1980 ("the Motor Carrier Act") introduced a dynamic regulatory reform to the United States transportation industry. The new policies premising these two Acts are of particular interest and consequence to CCPA member companies because of the extent of Canada's trade with the United States in chemicals.

PRO-COMPETITIVE RAILWAY REGULATORY REFORM

When the United States Congress passed the Staggers Act, it explicitly recognized the critical role of competition in transportation markets. Section 101 of the Staggers Act states that it is the policy of the United States government "to allow, to the maximum extent possible, competition and the demand for services to establish reasonable rates for transportation by rail". CCPA favours a similar policy initiative for railway regulatory reform in Canada. Our position was presented as evidence to the Railway Transport

Committee (RTC) of the Canadian Transport Commission (CTC) during its Inquiry into Effects in Canada of U.S. Rail Deregulation. The RTC's final report in this Inquiry includes a number of findings. In this section of our paper, we will use selected findings as headings to present CCPA's position on the issues and comment on the findings themselves.

"Insofar as circumstances in the U.S. dictate, confidential contracts should be permitted on the Canadian portion of the movement of rail freight traffic between Canada and the United States".

CCPA fully concurs with this finding. In the course of preparing evidence for the RTC Inquiry, CCPA's 66 member companies were surveyed to determine how important confidential contracts are to them now, and how this might change during the remainder of the decade. The questions asked and the answers received were as follows:

Question 1.

What is the total volume of your chemical rail shipments from Canada into the United States, expressed in metric tonnes, and on an annual basis using your experience during the first six months of 1984?

Answer

43 member companies responded to this survey. 21 of these companies reported no chemical shipments by rail into the United States. The remaining 22 companies expected to ship 2.7 million metric tonnes of chemicals and chemical products into the United States by rail during 1984.

Question 2.

What is the proportion of this traffic moving in the whole or in part according to terms of confidential contracts filed with the U.S. Interstate Commerce Commission?

Answer

The average proportion reported by the 20 member companies answering this question, weighted according to the volume of international traffic shipped, was 33%. This proportion ranged from a low of 0% to a high of 95%. Members reporting 0% generally shipped volumes which were too small to qualify for contract rates. Other members had difficulty in responding to this question since in some cases rail charges are paid by customers or forwarders.

Question 3.

What is your forecast of how this proportion is expected to change between now and the end of this decade?

Answer

By the end of the decade, assuming no amendments to current legislation, the proportion of traffic moving under contract is expected to increase to 60% (range 0% to 100%).

The results of this survey demonstrate the considerable importance of U.S. export markets to CCPA member companies and the widespread use of confidential contracts by members to assist them in penetrating this market. At the RTC Inquiry, this CCPA evidence was supported by evidence from many other shipper groups and individual shippers demonstrating the benefits of confidential contracting in the United States. It became apparent that millions of tonnes of Canadian-originated traffic are now moving under the confidential contracts allowed by the Staggers Act and that Canadian railways want the opportunity to offer similar confidential contracts. This is not surprising since railways have increased their share of some transportation markets

through the use of confidential contracting. The chemical industry can provide a number of examples to illustrate this. In summary then, both shippers and the railways should support this RTC finding.

"Canadian railways should not be privy to each other's contracts."

At the RTC Inquiry, the railways proposed that they should be privy to each other's contracts. This request was generally opposed by shippers and shipper groups, including CCPA. In its submission to the RTC, CCPA indicated that the removal by the Staggers Act of the anti-trust immunity which U.S. railways had previously enjoyed, coupled with confidential contracts and rebates, has resulted in intramodal competition between Canadian and U.S. railways, and between the Canadian railways themselves, for international traffic. Where such competition is occuring, CCPA members have benefited from a more market-oriented and aggressive attitude on the part of the railways. This attitude has manifested itself in speedier negotiations with the railways, greater market responsiveness in pricing and better service as evidenced by transit and turnaround times.

Some railways have taken advantage of

independent action to increase their market share. For example, dry fertilizer currently moves out of C-I-L Inc.'s Courtright, Ontario plant on single line scales. Previously, this fertilizer moved by truck. It was the railroad's ability to act independently, without concurrence from non- participating railways, and the implementation of this single line scale, which permitted them to obtain this business.

On the other hand, for traffic where this competition between railways has not developed, CCPA members have reported examples in which railways used their market power to abrogate negotiations with shippers. Accordingly, CCPA fully endorses the RTC's finding.

"Confidential contracts entered into by Canadian railways on international traffic should be filed with the CTC, and that the Commission should publish summaries of filed contracts."

This issue was not specifically addressed by CCPA in its evidence to the RTC, largely because of our position concerning Section 23 of the National Transportation Act which will be referred to below. The RTC made this finding to assist in overcoming discovery difficulties in connection with Section 23 applications. In the United

States, all contracts are filed with the Interstate Commerce Commission and only summaries omitting confidential information are made available to the public. We are not aware of any difficulties this requirement has posed for shippers. Nevertheless, as the RTC report points out, "it is imperative that the contract summaries contain sufficient information to satisfy public scrutiny, while preserving the confidential nature of the details of the contracts". The report proposes statutory amendment, supplemented by regulations specifying the type of information to be included in the summaries to be made available to the public. While CCPA would prefer not to file contracts at all, CCPA can support this approach if Section 23 is to remain the avenue of appeal, provided that the confidential nature of contract details is adequately protected. We would rather, however, review this issue again along with Section 23.

"Section 23 should continue to apply in all situations covered by published rates, and that consideration should be given to maintaining Section 23 with adequate discovery provisions, perhaps by regulation, to cover possible problem areas in confidential contracting."

As the RTC's report notes, during the Inquiry process some criticism of Section 23 was voiced by both shippers and carriers. CCPA acknowledges the efforts made

by the CTC over the past few years to shorten Section 23 procedures, make appeals less cumbersome and costly, and to publicize the availability of CTC staff assistance in resolving problems short of a Section 23 filing. Nevertheless, CCPA was one of the shipper organizations which indicated at the Inquiry that its members have generally found Section 23 continues to fall short of providing useful protection for shippers. We suggested that some alternative form of shipper protection should be devised to address cancellation of routes and joint rates, surcharging of joint rates and protection for the captive shipper. Perhaps the experience being obtained with the Staggers Act in the United States might be of assistance in developing more adequate forms of protection in Canada.

We must admit, however, that the very limited ability of shippers to appeal carrier pricing actions under the Staggers Act continues to generate considerable controversy. The first hurdle in the path of a U.S. shipper wishing to challenge a rate is the requirement to show that the rail carrier has market dominance. A ruling of market dominance will only be obtained if the revenue-variable cost percentage for the traffic is less than a specified level which was set at 180% in 1984. Even after demonstrating market dominance, the shipper must still show that the rate for the traffic is

"unreasonable". Some captive shippers in the United States - those without competitive transportation alternatives - have complained that this appeal mechanism is inadequate and that as a result, they have no option but to pay the higher rates they are charged.

On February 7, 1985 the Railroad Anti-Monopoly Act of 1985 was introduced into both the U.S. Senate and the House of Representatives. This Act would apply anti-trust law when railroads cancel routes and rates to reduce competition and could be useful to curb abuses of market power. Perhaps there is a place for the application of similar principles in Canada. Anti-combines relief could be provided where rail carriers fail to offer a captive shipper of bulk commodities competitive rates, or where they deny other railroads access to limited stretches of their trackage in areas where they have a monopoly. The relief provided in such cases would permit the shipper or another rail carrier to exercise trackage rights, at a reasonable rate of compensation, to sustain competition. The penalties for continued monopolization of trackage would be treble damages or injunctive relief.

CCPA hopes that this approach and other new approaches to appeal mechanisms will receive consideration in the Public Hearings referred to below.

That the RTC "commence an investigation, including public hearings, to determine the advisability of introducing pricing innovations such as confidential contracts for domestic Canadian railway freight traffic and overseas import/export railway freight traffic".

CCPA was extremely pleased to find this recommendation in the RTC's report. In our initial analysis, we had thought that amendments to Canadian transportation law designed to permit confidential contracts and rebates for international traffic only would suffice. We recognized that confidential contracts and rebates in the United States have made it more difficult for Canadian chemical manufacturers to compete with American competitors in both domestic and export markets.

Competitors based in the United States are able to search Canadian freight tariffs and ascertain Canadian freight costs. Thus the U.S. competitor only has to estimate Canadian production costs for his pricing analysis. Canadian companies now have to make greater efforts to obtain similar rate information by intelligence gathering in the United States marketplace. The Canadian company must also estimate the confidential rebate from the U.S. carrier to the U.S. competitor. This is usually overestimated in order to minimize the risk of losing business. Thus, the Canadian company finds it necessary

to estimate both U.S. freight rates and U.S. production costs in completing its pricing analysis. Even when the Canadian manufacturer successfully completes such an analysis, the added transaction costs he incurs in reacting to confidentiality in the United States has a negative impact on his profitability.

As a result of these considerations, CCPA revised its position at the Public Inquiry to advocate implementation of confidential contracts and rebates for both domestic and international traffic, since this would provide U.S. and Canadian railways and shippers with equal opportunity and avoid exacerbating the current Canadian carrier and shipper disadvantage in the Canadian market. We feared that if regulations pertaining to international traffic were amended without amending the regulation of domestic traffic at the same time, and putting it onto the same footing, there could be negative implications in the domestic market.

Following considerable internal discussion, and not without some reservation due to the circumstances referred to above, CCPA decided to endorse the RTC's final report. It was therefore, with considerable relief, that we received notice of the RTC's Public Inquiry for domestic traffic and overseas import/export rail traffic commencing in April, 1985. CCPA will, of course, be

presenting its position at this Inquiry.

SUMMARY

In summary, CCPA suggests that the most prudent railway regulatory reform in Canada would be directed towards a uniformity of regulation within North America in the long term. The size and importance of the trade which exists between Canada and the United States is too large to permit two different regulatory systems to persist. Unobstructed access to the huge potential of the American marketplace for Canadian business is critical to our country's continued growth. The current political and economic environment supports pro-competitive and freemarket transportation regulatory initiatives. It is ironic that the railways often favour opportunities to compete whereas the shipping community has been divided on the mechanism for bringing this competition about. The RTC's Public Inquiry brought forth signs that this division is gradually disappearing. Hopefully the Inquiry process will pave the way for regulatory reform dedicated to creating the intra-railway competition which is essential in making Canada more competitive in both continental and offshore markets.

PRO-COMPETITIVE HIGHWAY REGULATORY REFORM

Highway transportation is important to the Canadian chemical industry. Larger CCPA member companies estimate that they use trucking for approximately 35% of the dollar value of their shipments. Smaller members make even greater use of the highway mode and over 50% of their shipments, in terms of dollar value, are by highway.

In the United States, the Motor Carrier Act amended requirements so that a potential carrier must merely show that it is fit, willing and able, and that its entry will serve a useful public purpose. The Act also phased out the authority of rate bureaus and made private trucking more flexible.

In Canada, the Canadian Conference of Motor Transport Administrators is struggling with reform of extra-provincial trucking regulations. The province of Alberta substantially deregulated intra-provincial trucking years ago. Ontario leads the other provinces in the regulatory reform movement with the recent tabling of the Public Trucking Act, 1985 in the provincial legislature. Most shippers and carriers would agree that the highway economic regulatory systems now in place in Canada are virtually unenforceable and frequently ignored.

In this section of our paper, we will examine some of the current major issues in highway regulatory reform, making reference to the experience of the chemical industry in the United States over the past five years and using the provisions of Ontario's Public Trucking Act, 1985 as a focus for our comments.

SAFETY IN HIGHWAY TRANSPORTATION

Safety in transportation is paramount for the chemical manufacturing industry since it is a major shipper of dangerous goods. Accordingly, the industry has always been cautious in qualifying highway carriers since it can't risk shipping dangerous goods with inexperienced carriers. In fact, CCPA suggests that safety, rather than financial information, should be the basis for the fitness test for entry.

But how would such a fitness test be applied? The chemical industry, for example, ships many different products having a variety of characteristics, making it difficult to evaluate an applicant's competence for carrying one or more of these products. CCPA would offer some assistance in this regard by helping to establish an on-going survey in Canada similar to the Motor Carrier Safety Survey in the United States. This survey is a

program of the chemical and motor carrier industries which has enabled them to improve safety performance, provide better service and improve overall distribution economics. We feel that a program based upon this survey would be the best means of enabling a carrier to demonstrate its fitness to transport dangerous goods safely. CCPA has been in contact with the Tank Truck Carriers Division of the Ontario Trucking Association and we hope to cooperate in introducing a similar survey program in Canada.

It has been suggested that an influx of new carriers following regulatory reform could compromise safety standards and performance. Figures from the U.S. Department of Transportation demonstrate this should not be a concern. Their statistics show that hazardous materials incidents for truck declined from 7,704 in 1981 to 4,829 in 1983. This U.S. experience is supported by a spokesperson for the province of Alberta who indicated that deregulation in that province has not compromised highway safety. Indeed, current economic regulatory regimes often increase the number of highway miles travelled, thus increasing the incidence exposure percentage. Examples of this effect include restrictions on private trucking, and lack of regulatory uniformity between jurisdictions, which can both increase the number of empty and loaded truck miles travelled.

ENTRY REGULATION

Chemical shipping is a market which has barriers to entry independent of economic regulation, including the high cost for the relatively specialized equipment required to carry chemical products and the facilities for cleaning vehicles. The carrier must also be able to convince the chemical shipper that he can operate safely. CCPA favours augmenting these natural barriers by a regulatory fitness test for entry based primarily on safety. When an applicant applies for an operating license, his financial backers should have already assessed the condition of the market and the ability of the applicant to compete. We do not feel that the regulatory board should duplicate this analysis. In most provinces the financial aspects of the existing entry tests are virtually meaningless, since only a relatively small proportion of applicants fail to pass. Furthermore, the test tends to be a snap shot of financial condition at the time of application which rapidly becomes outdated. Accordingly, CCPA recommends confining the fitness test to safety and a test of the applicant's knowledge of operating rules and regulations.

CCPA also recommends a maximum 30 day period between an applicant's demonstration of fitness and the issue of an operating license with a further 30 day period

permitted for appeals. This is consistent with the Alberta experience where the process of application, gazetting of notice, the hearing and ruling is regularly concluded within a 60 day period.

CCPA supports the confining of appeals in the proposed Ontario legislations to allegations that false or incomplete information was given to the regulatory board by the applicant. On the other hand, we do not support the use of a market test. Even if it is applied in only a very small number of applications, it is still an artificial device designed to protect established carriers and hinder new entrants. The market test concepts have caused difficulty for a CCPA member company in British Columbia. This company ships 75% caustic soda and would like to use specialized equipment available from an Alberta carrier. The B.C. board has turned down this operator's request for B.C. operating rights based on market test objections. We do not feel that the test is necessary and we hope that Ontario deletes the market test from its proposed legislation now rather than following the 5 year period that has been proposed.

The U.S. chemical industry has found that ease of entry has promoted competition, particularly in high volume markets, despite the cost of equipment. The enhanced competition has not only created attractive

rates, which benefits society as a whole as well as shippers, but it has also increased the level of service provided by carriers. As a result, use of for-hire carriers by chemical companies has increased in the period following passage of the Motor Carrier Act. Indeed, the American Trucking Associatoin itself has described the Act as a trauma in the short term, but probably good for the trucking industry over the longer term. In our view, easing entry requirements in Canada would lead to the same results here.

COLLECTIVE RATE MAKING AND RATE FILING

The Ontario consultation process which commenced highway regulatory reform in the province found general agreement that the current system of rate filing, which is inextricably linked to the issue of collective rate making is unsatisfactory and in need of reform. The current issues raised by the federal competition bill and the combines cases now before the courts increase the importance and urgency of these issues.

CCPA recommends that collective rate making should no longer be permitted and rate filing or publishing of rates should not be compulsory. The current system of rate filing is being violated by both carriers

and shippers. Often the competitive environment and timing difficulties preclude filing by carriers. As a result, the existing legislation is being ignored and encouraging non-legal trucking and increased use of private trucking.

Defenders of the current system argue that it fosters an orderly trucking industry and assists smaller shippers. We are not convinced by these arguements. The lack of collective rate making in Alberta has not been a impediment to the trucking industry in that province. As for the availability of rate information, the United States experience demonstrates that computerized rate information services will become available to fill any information gaps.

In summary, CCPA views rate publication and collective rate making as anti-competitive practices that should be discontinued.

PRIVATE TRUCKING

Since 1982, private truckers in Ontario have been permitted to carry goods of their subsidiaries or affiliates within Ontario so long as they have 90% common ownership. The level of ownership is not being

reconsidered in the proposed Public Trucking Act and we see this as an important opportunity which is being overlooked. Furthermore, the other provinces have not moved to introduce similar legislation.

CCPA suggests that increasing the opportunity to use private trucking would be an efficient use of resources and reduce accident exposure. We feel that intercorporate trucking should be permitted without regard to common ownership, and compensated backhauls for private fleets as well as the right to use owner/operators in private trucking should also be permitted. If companies use their private fleets to haul goods not belonging to subsidiaries or affiliates, they should be required to satisfy the prescribed entry test.

In the United States the use of for-hire carriers by chemical companies has increased following deregulation but private trucking is still important. This is because common carriers are not always willing to provide the special purpose equipment necessary to carry some chemicals. Furthermore, contract carriers are particularly cost effective for the company which may need specialty equipment but only on a seasonal basis. Thus, private trucking often compliments service offered by common carriers rather than serving as an independent commercial opportunity.

UNIFORMITY

The Canadian Conference of Motor Transport Administrators was created to achieve some degree of uniformity between the provinces in the field of interprovincial transport, thus optimizing the use of equipment and maximizing the economic benefit to Canada. Although the Conference has provided a national perspective and coordinated highway transportation administration, there are still many differences in regulatory requirements across Canada. These range from differences in rules, regulations and specifications to more mundane matters such as the reporting of accidents. CCPA laments this lack of uniformity, particularly when it throws up a barrier to interprovincial trade.

The failure of provinces other than Ontario to move quickly to permit intercorporate trucking is an example of this. Even if an Ontario company can show 90% common ownership of an affiliate or subsidiary in Québec, private trucking will not be available to the company as an option. In CCPA's view, this should have been an important matter for discussion between the provinces and the federal government over the past several years with the goal of implementing uniform requirements across the country. If the provinces are unwilling to consider greater uniformity, we suggest that the federal government

should re-examine the delegation of federal jurisdiction.

THE EFFECTS OF HIGHWAY REGULATORY REFORM

In 1977 Alberta established a select review committee to examine the outcome of regulatory reform in that province. An independent survey of shippers and carriers carried out as part of this review overwhelmingly supported deregulation. A further study which considered levels of service and rates found that deregulation had not jeopardized service to the smaller rural communities. In fact, there was an overcapacity of service to such communities in the province.

Those who oppose deregulation cite a number of perceived problems. For example, unions fear that deregulation will cause a significant loss of jobs in the trucking sector. The experience in the U.S. chemical industry, however, is that use of for-hire carriers has generally increased over the last five years at the expense of private trucking. While this may have caused a shift of jobs from one union to another or even out of a union environment, this is not an important reason for opposing regulatory reform. Labour unions can still play an important role by recognizing the structural and cultural shifts taking place in the deregulated economy

and by addressing these factors objectively. Within Canada, Alberta does not view deregulation as having had a significant impact on jobs. In fact, it could be argued that the regulations existing in other provinces have increased the use of non-union carriers since shippers have been driven to greater use of private trucking and non-union trucking companies.

CCPA does not see deregulation as leading to greater use of private trucking, although we do wish to see private trucking become a viable option available to shippers. In Alberta, there is a high use of contract haulage but much of this involves very specialized equipment for the oil industry. Thus, in this case, Alberta's experience cannot be considered typical. On balance, regulatory reform would probably result in decreased use of private trucking. This has occurred in the United States whereas in Canada, the existing regulatory regimes have caused increased use of private trucking where it is available to shippers.

CONCLUSION

CCPA recommends implementing pro-competitive transportation regulatory reform in Canada without further delay. In both the rail and highway modes, speed is now

of the essence, since we all know that the preparations for regulatory reform are substantial and when new legislation is necessary, the process frequently requires several years. Further delay of this order will only increase the period of uncertainty and unstability which has already been faced by shippers and carriers for too long.

OPTIMIZING DISTRIBUTION OF PEAT MOSS USING A MICRO COMPUTER

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ABSTRACT

This paper discusses distribution of peat moss and related products from production facilities in Canada to markets located throughout the United States and Canada. The distribution system uses a combination of headhaul and backhaul trucking, piggyback and conventional rail services. The availability of low-cost transportation is constrained, as is the production capacity from the various facilities. This paper describes the structure and application of a micro-computer model to identify the optimal flows of these products, and describes results obtained through its use.

INTRODUCTION

This paper discusses distribution of peat moss and related products throughout the United States and Canada. The company in question operates production facilities at several Canadian locations. Each production facility has characteristic unit costs and also has an overall constraint on output.

The company utilizes a variety of transportation methods to accomplish its product distribution. The lowest-cost transportation is available through backhaul truckers, primarily exempt carriers from the United States, who have as their headhaul the transportation of agricultural products from producing regions in the United States to major urban areas in Canada. Unfortunately, this mode of transportation cannot be used universally for all requirements, since the company's production facilities are not generally located near major urban centres, and therefore have no access to such backhaul truckers. Secondly, the volume of available backhaul capacity is dependent upon the volume of northbound trucking for agricultural products; hence it may not accurately match up to demand for peat moss transportation. In addition to being so constrained, the backhaul truckers cannot transport the peat moss to any destination, they will normally be restricted to destinations at or close to their original point of origin.

For that reason, the company is forced to employ alternative forms of transportation, normally at higher cost. Railway piggyback services are one such form, and such are also normally constrained as to either or both minimum annual usage and/or maximum annual usage. Other forms of alternative transportation include conventional railcar and headhaul trucking, both of which involve unit costs higher than those available by backhaul trucking.

In addition to utilization of alternative modes of transportation, the company has also established intermediate depots at locations where

backhaul trucking capacity is available. Such depots are generally located near major central Canada population centres. The company uses both Canadian piggyback and trucking to transport product from its production facilities to these depots, at which locations the product is warehoused and eventually moved to destination via backhaul truck.

In addition to the above-described distribution system characteristics, there is a requirement to achieve specified mixes of traffic as between products on certain transportation routes, in order to make efficient use of equipment.

Peat moss and related products are of relatively low unit value (i.e, relative to weight), so that transportation costs form a fairly large percentage of delivered price. Hence it is of great importance that costs of operating the distribution system be minimized. Also, the effectiveness of the distribution system is measured primarily by its transportation cost, with such factors as costs of handling, carrying inventories, etc., being of very minor importance relative to transportation costs.

APPLICATION OBJECTIVES

Given the importance of distribution cost, the company sought to identify the optimal distribution pattern for peat moss and related products from its distribution facilities to its markets. The need for this information was emphasized by the fact that the company was

bringing a new production facility on-line, thereby requiring a major re-orientation of its distribution system. Travacon Research Limited was retained to develop a methodology for determining the optimal distribution system for the company to possess the capability to:

1. Determine optimum flows of peat moss and related products from the production facilities, through the depots (as appropriate), into market areas.

2. Evaluate of each of the constraints imposed by the existing transportation modes, and the cost associated with each.

3. Determine opportunities for profit enhancement through expansion of capacity at those production facilities where production constraints are effective.

4. Evaluate of cost-effectiveness in the intermediate depot operations.

5. Determine delivered cost and profitability of each of the market areas.

6. Identify opportunities for changes which would increase profits or reduce distribution costs.

A requirement of the project was provision of a capability which could

be used repetitively in the future, utilizing micro-computers available within the company's Distribution Department.

SYSTEM STRUCTURE

The system developed in response to the above objective consists of three major components, namely:

1. A data input and modification module, by which the user can either input data or modify data which has previously been input. This module also converts the input data to a form which can be used by the optimization module.

2. The optimization module, which determines the optimum flow of peat moss and related products through the distribution network. The optimization module utilizes an adaptation of the distribution algorithm of D. R. Fulkerson, sometimes known as the "out-of-kilter" algorithm (see, for example, "Linear Programming," Michel Simonnard, pages 299-323).

3. The report writer module, which produces, upon user command, selected output reports.

DATA INPUTS

Input data considered by the computer model includes the following:

1. Each Production Facility
   - overall production capacity
   - unit production cost
   - fixed periodic costs

2. Intermediate Depots
   - variable unit handling costs
   - fixed periodic costs

3. Market Areas

   Markets are generally defined as either States or Provinces. However some States, those of largest geographic area and demand, are split into two market areas. For each market area, the following inputs are utilized.

   - monthly consumption of each product
   - price of each product
   - usage constraints, which normally express the requirement that some minimum percentage of that area's requirement be satisfied from a specified production facility.

4. Transportation Links--Origin and Destination
   - mode of transport
   - unit cost (per load)
   - load factor

5. Transportation System Constraints

The transportation system constraints describe either or both lower or upper limits, by month, of availability and usage of one or more transportation links. These constraints primarily specify maximum availability of backhaul trucking capacity but also specify minimum and maximum usage of various piggyback services. Some of the transportation constraints apply uniquely to a specified transportation link, while others apply to the collective usage of a group of related transportation links (e.g., backhaul from a specified intermediate depot to a group of adjacent market areas).

6. Forced Routings

The user has the capability of requiring the usage of certain routings to a specified level, even though that might not be the most efficient in the overall. This capability recognizes certain service requirements which must be met independent of cost.

OPTIMIZATION

The optimization module normally is utilized to optimize distribution for a one month period. Where more than one month is involved in the analysis, the module is invoked sequentially to determine optimum routings for each of the months.

OUTPUTS

Several examples of output reports available from the system are presented in this section. The numeric data included in these example reports is for illustrative purposes only, and bears no relationship to actual company data.

Performance Summary Report (see Exhibit 1)

The performance Summary Report presents, in summary form, each month's system performance. Its contents include sales, transportation costs by mode, fixed costs of intermediate depot operation, production costs, total costs and contribution.

Its primary use is as a condensed presentation of overall system performance. It is also of use for planning and budgeting purposes.

Routing Analysis Report (see Exhibit 2)

One Routing Analysis Report is produced for each market area. The report identifies each of the routings utilized for transportation of each product into that market and, for each routing, the volume transported and the unit cost for the routing, together with the profit contribution associated with that movement (expressed as a percentage of sales price).

This report is useful as a summarized annual description of the usage

Exhibit 1

Product Distribution Model

Performance Summary Report - 1984

	January	February
Sales ($000)	600	700
Transportation costs ($000)		
Backhaul truck	150	150
TOFC #1	20	50
TOFC #2	20	10
TOFC #3	30	40
Railcar	10	5
Headhaul truck	10	5
Depot handling	10	10
Total ($000)		
Depot fixed costs ($000)	250	270
A	3	3
B	2	2
C	3	3
Total ($000)	8	8
Production costs ($000)		
A	90	100
B	120	150
C	40	50
Total ($000)	250	250
Total cost ($000)	508	528
Contribution ($000)	92	172

Exhibit 2

Production Distribution Model

Routing Analysis Report - 1984

Lousiana — Peat moss

Shipping Plant	Mode	Eq. Bales (000)	Percent of total	Cost per bale	Percent Contribution
A	Backhaul truck	10	10.0	4.00	20.0
A	TOFC #1	20	20.0	4.00	10.0
B	Backhaul truck	15	15.0	4.25	15.0
C	Backhaul truck	5	5.0	4.75	5.0
Total		50	50.0	4.35	13.0
	Professional Mix				
A	Backhaul truck	10	10.0	8.00	20.0
A	TOFC #2	40	40.0	7.50	25.0
Total		50	50.0	7.60	24.0
Louisiana	Total	100	100.0	5.98	18.5

Exhibit 3

Market Area Report

Louisiana - Peat Moss from Plant A via backhaul truck

Monthly Shipments (thousands of bales)	
January	0
February	2
March	3
etc.	

Cost per equipment bale	
Production	2.00
Depot handling	0.00
Transportation	2.00
Total	4.00
Price	5.00
% Contribution	25.0%

of the various transportation routes. It is also of use in analyzing profitability of the various movements, for the purpose of addressing the question of elimination of low profit operations.

Market Area Report (see Exhibit 3)

One Market Area Report is prepared for each market area and product. One set of entries is prepared for each transportation route utilized to serve that market. The report identifies the monthly volume of product flows and also summarizes, on an annual basis, a breakdown of the unit costs into production, depot, and transportation components, together with price, total unit cost and percent contribution.

This report has basically the same uses as the routing analysis report, except that the flows are presented on a monthly basis.

Transportation Unit Cost Report (see Exhibit 4)

This report summarizes the transportation link data showing, for each transportation link, the highway mileage, the annual usage of the link in loads per year and the unit cost per mile per load and per bale. The report is produced and sorted alphabetically as well as in ascending order of unit cost. The report is useful in identification of high cost links and also in identification of usage of links within the transportation system.

Exhibit 4

Production Distribution Model

Transportation Unit Cost Report - 1984

Origin	Destination	Mode	Miles	Loads	Cost/Mile per Load-$	Bale ($)
A	B	Backhaul truck	1,568	20	1.25	.30
A	B	TOFC #1	1,568	10	1.75	.35
A	B	Railcar	1,568	0	2.00	.40
A	C	Backhaul truck	1,381	10	1.35	.25
A	D	Backhaul truck	892	15	1.50	.35
A	D	TOFC #1	892	20	1.40	.45
A	D	Railcar	892	5	1.60	.60
A	E	Backhaul truck	1,070	15	1.20	.40

Exhibit 5

Product Distribution Model

Constraint Report - 1984

Link Flows

	Jan	Feb	Mar	Apr	May	Jun	Jul
A to B and C							
Loads	50	40	60	30	70	50	60
Maximum	70	40	60	30	100	75	60

Constraint Report (see Exhibit 5)

For each of the transportation constraints, the Constraint Report shows the minimum and/or maximum input constraint for the link or links, together with the usage of that link in the model.

The constraint report is used to identify binding constraints and also to identify any unused capacity which might, with alternative solution strategies, be brought into productive use, thereby reducing costs of more expensive transportation modes.

APPLICATIONS OF THE MODEL

The first major application of the model was to determine the impact, upon the distribution system, of integration of the new production facilty. Execution of the model with the new facility in place identified major shifts in methods of serving market areas in the immediate area and also, by virtue of secondary effects, shifts in methods of serving other markets located elsewhere thorughout the market area. The model also identified the anticipated improvement in overall profitability associated with the new facility.

Execution of the model also revealed that two of the production facilities were, under optimal distribution, operating at or very near their capcity limits. Runs of the model were then executed with the production constraint removed, in order to identify the optimal flow of products in the absence of production constraints. These runs

thereby identified the optimal production capacity for the integrated system, and estimated the improvement in operating profits to be obtained thereby.

Runs of the model were used to assess the cost-effectiveness of the various intermediate depot operations of the Company. This analysis amounted to a tradeoff between the fixed costs of operation of the depots and the reduction in variable costs associated with their operation. On the basis of these analyses, the financial impact of the intermediate depots upon the system was measured, to provide input to the question of whether depot operations of that sort should be continued or modified.

Considerable effort went into analysis of the transportation constraints and their impact upon the system. Through use of the model, it was possible to determine the cost of each constraint in terms of its impact on overall operating profitability of the Company. For each of the constraints which imposed a cost, a determination was made of the additional capacity required in order to offset the adverse cost impact of the constraint. This was used as an input to company distribution personnel to focus their efforts on developing incremental capacity sources, particularly in respect of backhaul trucking.

Despite the fact that backhaul trucking availability constraints in many cases were binding, and hence resulted in increased costs, in most cases there were months during the year when available capacity

of such constraints was not fully utilized. However, in subsequent months, the same constraints were binding and required use, by the company, of transportation options, other than backhaul trucking, having a higher distribution cost. In such cases, if a means could be found to utilize such unused capacity in slack months, to provide transportation associated with demand occuring in subsequent months, a cost saving could be attained.

To evaluate such potential, an analysis was conducted for those constraints where this effect arises. This evaluation utilized the data contained in the Constraint Reports and identified a number of instances where such unused capacity could be effectively put to work. This provided an input to company personnel to identify means of effectively utilizing such capacity, either by some form of intermediate storage at or near destination, or by incentives to bring customer demand forward in time.

SUMMARY AND CONLUSIONS

This paper has described an approach to optimization of a distribution system, utilizing a model designed for use on micro computer. Areas of application of the results of the model are discussed. It is anticipated that the model will be of continuing use to the company in support of its annual planning and budgeting processes, as well as in continued refinement of its distribution system, in order to minimize distribution system costs and maximize operting profitability of the company.

APPENDIX 1

A NOTE ON COMPUTING REQUIREMENTS

The Product Distribution Model was developed and implemented on the IBM Personal Computer. The system is configured with 128K system memory, two 320K floppy disk drives, and a RAM disk (fast disk) of overall capacity 192,000 bytes. The system configuration also includes a 8087 chip, in addition to the 8086 chip which is standard with the computer.

The program runs in compiled BASIC, and its method of compilation permits optimum use of the 8087 chip to maximize system performance.

Virtually all system files are operated in the random access mode. At the commencement of system operation, the data files are copied from a floppy disk to the RAM disk, and all exchanges of data between the files and the program utilize the interface with the RAM disk.

Once the program enters the optimization module, the optimization process requires approximately two minutes per month optimized.

The Application of Computer Technology to the Logistics Process

The title of my presentation is "The Application Of Computer Technology To The Logistics Process."

Its purpose -- to outline the six stages most shippers will progress through when introducing computer technology to logistics management.

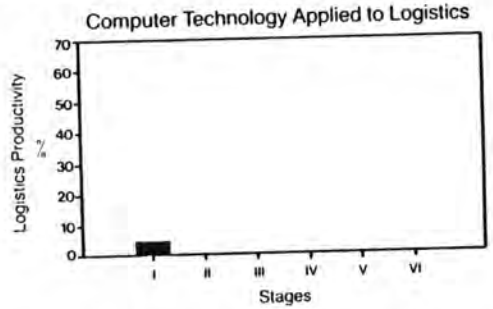
To provide a sound basis for today's presentation, I will draw upon our experience at C-I-L. And, I will extend some important observations on how to avoid the pitfalls commonly associated with the application of computer technology to the logistics function.

I would like to point out that your companies will have different thresholds of investment, operating economies and logistics savings that will determine your progression rate through these stages.

Stage I -- Bean Counter Syndrome

Stage I can be characterized by the absence of any logistics systems strategy.

In this scenario, logistics personnel are totally dependent on accounting-driven mainframe computer systems for shipping statistics. This usually limits productivity improvement opportunities to a maximum of 5% over earlier administrative systems.



When meaningful logistics data is consolidated into financial control information, you could be missing out on several excellent opportunities to reduce costs. In fact, you might want to ask yourselves these questions:

1) Are we maximizing our purchasing power? Do we know, for example, how much of our annual freight cost is paid out to each of our carriers. And, are there opportunities for consolidation?

2) Are we missing out on cost reduction opportunities? Do we have the information to analyze traffic lanes and identify potential back hauls?

3) Are we optimizing freight costs on each movement? Or, should we re-negotiate weight minimums?

If you can relate to the need for this type of timely and logistics-specific information, you are ready to progress to Stage II.

Stage II - Stand Alone Systems

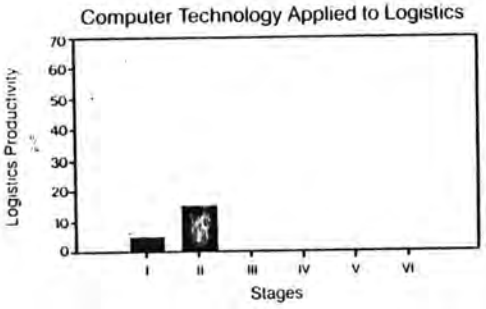
Stage II is usually driven by the need for a particular system solution to a logistics operating or administrative problem. Such systems include;

1. A rail car management system to improve customer service and reduce period costs.
2. A linear programming model to improve transportation scheduling.
3. A new costing model to identify and allocate the costs for individual product movements.

Unfortunately, the solution to the problem is viewed in isolation from any logistics systems strategy.

For example, at C-I-L, we implemented a new on-line freight rate system in response to the proliferation of rates to multiple origin/destination combinations and the desire for greater freight payment accuracy.

Such solutions however do offer attractive productivity improvements. Based on our experience, a 10% improvement would be considered conservative.



The successful implementation of a stand-alone system is dependent upon a number of variables. One of the key variables, however, is user ownership. Although we're fortunate in having a very proactive and innovative systems group specializing in logistics systems--it's critical that logistics personnel be assigned to work with data processing people in the design and implementation of the system.

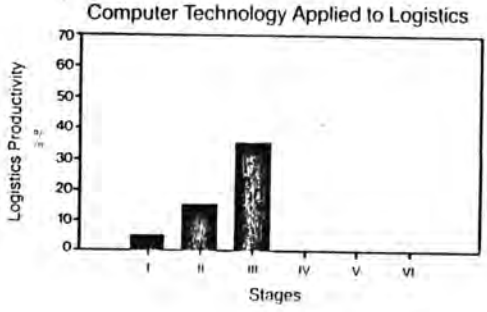
It is also important to stress that Pareto's 80/20 rule applies to system design. C-I-L's experience indicates that only 80% of system requirements are identified at implementation. The remaining 20% are derived from "user experience". Our message to you, therefore, is to

accelerate system implementation, while recognizing inherent omissions and deficiencies.

Stage III - Introduction Of Microcomputers

Stage III -- the introduction of microcomputers -- can, be characterized by the state of confusion it evokes. Unfortunately, computer vendors have perpetuated this confusion by continuing to sell technology rather than applications. If you're entering this maize of alternatives, I offer my empathy. Learning terminology, exploring equipment options and projecting future needs will challenge the best of you.

At C-I-L, we think it important to view PC's as a productivity tool, rather than as a period cost saving. However, if you are forced to justify the purchase of a PC on a cost saving basis, remember -- productivity



increases of 5 to 10 percent will pay for the investment in less than one year. Our experience demonstrates a 20% productivity improvement.

People need to be motivated to increase productivity -- and the PC has served as the paradigm of improved performance. The PC effectively spurs users along through screen - generated prompts. Our logistics personnel are now organizing schedules, tracking events and projects, writing memos, communicating and filing electronically to save time - all with the PC. They also use new integrated software -- such as Symphony and Data Base Management to analyze distribution alternatives through the evaluation of "what-if" scenarios.

Specialized software is also available to evaluate inventory costs, warehouse site locations, modal costing models and mileage calculations.

The successful introduction of PC's into the logistics department is often dictated by the demographics of logistics personnel. We would recommend that a knowledge worker be assigned to facilitate training on the PC. This person should have a strong logistics technical background and good interpersonal

skills. This individual would serve as the catalyst in promoting the use of PC's to improve logistics productivity.

Despite the productivity improvements, cost savings, improved information gathering and processing capabilities of the PC, there are also inherent problems. The advent of microcomputers can lead to organizational problems in terms of altering traditional roles and office structures. And, operational problems can result from the selection of unsuitable applications for automation. I would also red flag one other potential conflict - control problems involving equipment standards among vendors and accounting system control of data. Recognizing and confronting these three major problem areas will lead to the successful progression to Stage IV.

Stage IV - Integrated Main-Frame Systems

At this stage, organizations may recognize the need to update their sales support systems. The marketing of industry-standard transaction systems, and, the limited

capability of on-line or batch processing systems, often creates a logistics opportunity.

Depending on the organization, the culture, the data processing focus, and the availability of a logistics champion - this opportunity will either be seized or missed. It's at this stage where the role of logistics will be cast until a new opportunity develops.

This stage of evolution represents an exciting time for logistics.

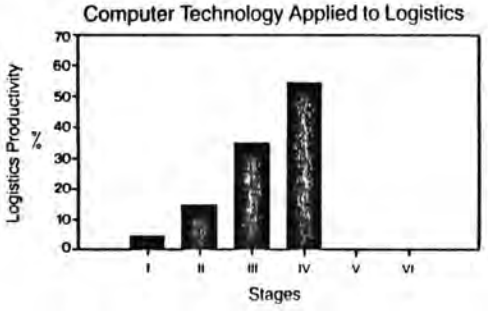
The ability to specify logistics data elements during the design or modification of a new order entry system can make a significant contribution toward logistics productivity.

For example;

- Carrier code - you may wish to breakdown carrier movements on a regional basis. Other examples include;
- Linking bills of lading to customer invoices, carrier pro-bill numbers, and carrier invoices for audit tracing and profitability analysis
- Mileages - to determine cost per ton mile
- Mode - often multi-modal movements are not captured.

In the case of C-I-L, our opportunity surfaced in 1983 when we decided to switch to a new on-line order entry system. This system was integrated with our on-line freight rate system plus a new on-line rail car management system. Our new system was designed to improve customer service, minimize paper handling, speed invoicing, reduce freight payment errors through automatic freight payment and to provide accounting, logistics and marketing data. This integrated logistics system has already produced the following benefits;

- reduced clerical effort
- improved invoicing and freight payment accuracy
- reduced communications costs
- improved cash flow



C-I-L's experience with integrated logistics systems has been successful - generating a 20% improvement in

productivity. The key reasons for success have been a clear vision of how the system should work and the assignment of key logistics and data processing personnel to system design and implementation.

Stage V - Integrated Mainframes With PC's

In Stage V, integrated systems technology is fully applied to the logistics process.

In Stages II and III you focus on a systems response to a perceived problem or opportunity.

In Stage IV you develop a vision of integrated logistics systems. The orientation in Stage V is to mesh Stage IV mainframe system integration with Stage III microcomputer storage and processing capability - or as some vendors like to call it - "gaining the power of the mainframe with the flexibility of the micro".

A major issue confronting today's corporations remains the ability to access timely and relevant decision making data. In Stage V, corporate data bases can readily be downloaded into powerful microcomputers for analysis.

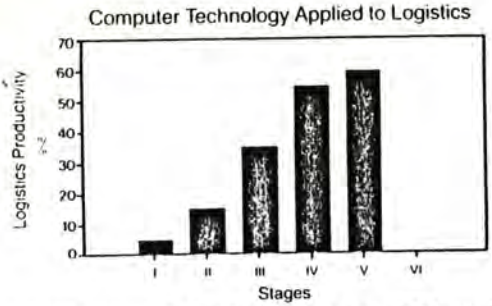
The ability to download files to PC's offer the following advantages;

- more effective use of CPU time
- opportunity for performing correlation and profitability analyses
- ability to link different data fields for relational analyses
- elimination of repetitive encoding
- increased graphics capability

Although local area networks must also be considered in Stage V, the problems of mainframe software and PC software compatibility will delay their installation.

The evolution of integrated voice-and-data digital PBX's is also an important element of Stage V. PBX's offer an impressive array of features and they permit the interconnection of PC's, word processors and telephones.

Although C-I-L is only in the embryonic phase of Stage V, we can forecast that a 5% improvement in productivity is achievable.



We're currently installing a new PBX switch to transport both voice and data in completely digital form. We are also in the process of moving to local area networks. IBM's DB-2 - mainframe data management system is currently being used to analyze corporate data files. The installation of a local area network will then permit us to download corporate files to analyze freight statistics and history. Another area for exploration in Stage V is the application of operations research models to scheduling freight optimization.

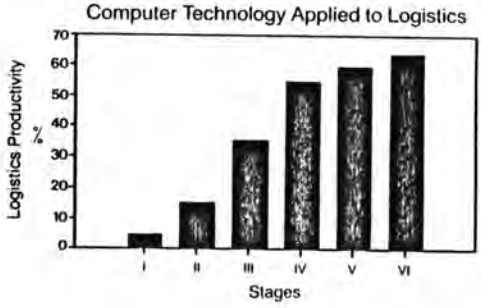
Stage VI - Electronic Data Interchange

Stage VI is on the horizon in Canada and moving to high noon in the U.S. and Europe. Electronic Data Interchange - EDI, represents a major threshold for productivity improvement. The ability to transfer data

electronically from supplier-to carrier-to customer offers major cost savings in terms of;

- reducing clerical and administrative costs
- improving data accuracy and accessibility in terms of freight rates, shipping information, order status
- reducing customs clearance delays and costs
- reducing the cost of working capital

The ability to transmit data electronically, is expected to generate a further 5% increase in productivity.



We are aware that several of our compatriates in the U.S. are well on their way to EDI. At C-I-L, we have initiated discussions with CN Rail and will hopefully have EDI capability by the end of 1985. We recognize that our progress through Stage VI will be a function of our limitations - not technology.

Summary

It is important to recognize there are some compelling reasons why we at C-I-L, and you in this room today are pressing ahead in the application of computer technology to the logistics process. This slide indicates the productivity improvements C-I-L has experienced in progressing through the first six stages. You will note that the most significant productivity improvements were experienced in Stages III and IV. We have yet to specify and measure the expected benefits of Stage VI but we are certain that a further 5% improvement in this stage is conservative. Our objective is to progress through Stage VI by the end of 1987.

Is there a stage VII? Of that we are certain.

THE IMPACT OF MICROCOMPUTERS ON TRANSPORTATION AND LOGISTICS IN THE MARITIMES

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ABSTRACT

This paper outlines the potential for increased efficiency and cost effectiveness in the field of transportation and logistics through the use of microcomputers. An overview of some present applications of microcomputers in Atlantic Canada, in a transportation context, is then presented. Discussion with those involved indicates that the 'microcomputer revolution' has not yet made its mark on the industry, but inroads are evident. Some examples of the possible applications of microcomputers in the field of logistics and transportation are then provided.

There are a number of issues perceived to be affecting the speed with which microcomputers are meeting acceptance in industry. These issues are addressed from the point of view of the computer user, and the supplier. Finally, recommendations are made to facilitate the acceptance of microcomputers in transportation and logistics functions.

INTRODUCTION

The transportation and logistics functions of private sector firms have the potential to enjoy great benefits from the recent microcomputer boom. The ever-increasing storage capabilities of the microcomputer can make tariffs and/or services easy to retrieve, update and store. Increasingly powerful software programs may make the analysis of options for system optimization easier and more cost-effective. For firms engaged in private carriage, route choice, fleet size estimates and scheduling may all be handled by microcomputers. The benefits listed above are in addition to those benefits perceived in any business - most notably in the areas of word processing and computerized accounting.

The types of planning and analysis techniques listed above have long been available to some groups in the transportation industry. Typically the programs were developed in-house to suit the needs of the given shipper or carrier, on a wholly-owned or shared mainframe. Costs associated with such activity were high, allowing only the larger companies to take advantage of the new technology. The microcomputer, a fraction of the cost of yesterday's mainframes and nearly as powerful, makes it possible for even the smaller transportation players to reap the benefits of computerization.

This paper outlines the minor role microcomputers currently play in transportation and logistics in

Atlantic Canada, and the impact they are expected to have in the future. A number of specific areas of concern are identified, based on conversations with users and potential users in the industry. Recommendations on how best to address these concerns are then made, with the hope that their alleviation might enable the microcomputer to more readily assume its potential role in the efficient operation of the transportation and logistics industry in the region.

MICROCOMPUTER ACQUISITION AND APPLICATIONS

One may consider the acquisition of a microcomputer from two general points of view. A larger company with an existing mainframe computer may want more in-house computing power in its local offices, or a smaller company may find that the price of a microcomputer is low enough for the company to take advantage of the available technology. Of the two, the second is of somewhat greater interest. The "downloading" of tasks from a mainframe to a micro implies a shift in computer usage, while the purchase of a sole microcomputer implies a new entrant in the computing market.

A second observation related to the above distinction is that a company with an existing mainframe would enjoy the advantage of familiarity with the technology. This would likely result in faster, more varied, and more effective use of the micro in the short term. In the long

term, as the technology is assimilated by the new user, this difference may not be as important.

The current and potential applications of microcomputers in transportation and logistics fall into two general categories. The first is record-keeping, and includes such things as accounting, vehicle maintenance scheduling, word-processing and inventory. The second is operations research, which may include scheduling, route selection, warehousing policies and site selection. The two are fundamentally different in that the record-keeping is a passive task involving the observation and recording of information, while operations research is a more involved process, dynamically responsive to the user's needs.

Record-keeping is a fundamental part of any business, and as such there is a large market for microcomputer software in this area; microcomputers have demonstrated their effectiveness in the field. As a result, business software research and development has been concentrated in this field, yielding an extensive selection of application programs.

In contrast, most operations research problems in logistics and transportation are particular to that field. In addition, most large companies which perform their operations research on mainframe computers have the potential to 'download' their customized software for use on a microcomputer. This severely limits the potential market for new software, making development correspondingly

less attractive. It is not surprising, then, that software designed for use in logistics and transportation is limited.

AN ATLANTIC PERSPECTIVE

The Atlantic region has a number of important characteristics related to its transportation industry and infrastructure. There are a disproportionately large number of trucking firms in the region, relative to the rest of Canada. The highway and rail networks envelope the region, in contrast to the highly linear arrangement observed across the prairies and in southern Ontario. The presence of several ferry links complicates the transportation network. The population, too, is relatively widely dispersed. These factors underline the need for an efficient physical distribution system. Microcomputers can be used effectively to achieve increased efficiency.

A perspective on the present uses of microcomputers in the industry, and the observed impacts, was obtained through a number of conversations and meetings with the Physical Distribution Advisory Service (PDAS) located in Moncton, New Brunswick. An informal telephone survey of a software developer, and a number of shippers and trucking companies in the Fredericton area provided supplementary information.

The Physical Distribution Advisory Service is a

government-sponsored organization which, as its name implies, provides advice on all aspects of physical distribution. Historically, the primary focus of the PDAS was on small trucking operations and shippers, but there has been a shift in the past several years towards the larger firms. The PDAS itself became a computerized operation in 1983, relying mainly on microcomputers in the field, with some communication to the head office possible.

Since their computerization, the PDAS has supported the move to microcomputers in the industry, recommending this move to most clients. According to Peter Tye, the assistant executive director of the PDAS, most companies view the new technology in a very positive manner, but express a number of common concerns, outlined in the next section. Despite these reservations, Tye maintains that microcomputer usage in the Atlantic region is increasing slowly, but measurably.

The software products that have application to transportation and logistics are not numerous, but Tye is able to recommend several to interested companies. Standard packages for rate and route recording, usually specialized forms of database software, are readily available, as are vehicle maintenance recording programs. These are examples of the "record-keeping" type of software discussed earlier. While undeniably useful, and fairly easy to implement, they have limited potential to

improve efficiency.

On the operations research side, much less software is available, but what little exists has been successfully utilized by a number of Atlantic companies to cut costs. One such company estimates that with the implementation of a microcomputer and a fleet/route rationalization software package, $15,000 was saved in operating costs over several months. Projected operating savings for the first year of use are in the range of $60,000, easily recovering the initial capital expenditures for the system. These savings are directly attributed to the realignment of the fleet based on the operations analysis done on the micro, too complex to be cost-effective using manual techniques.

The selection of production sites is an operations research problem as well. The University of New Brunswick completed a site optimization analysis for CN Rail in 1983, suggesting relocation of railway tie facilities. The work was completed on a microcomputer; potential savings to CN are in the order of $150,000. It is apparent that significant savings are possible through this type of operations research application.

One of the most popular uses of microcomputers in the industry at present is a combination of the record-keeping and operations research functions outlined earlier. Advanced spreadsheet and database software is used in the analysis of "what-if" scenarios. In Tye's estimation, over 90% of the present transportation-related

applications of microcomputers in Atlantic companies is based on spread-sheets and databases. This is undoubtedly a reflection of the flexibility, ease of use and generally good documentation which characterizes these products. This move away from straight record-keeping activity towards an analytical use of the microcomputer is vital if the full potential of the technology is to be realized.

Peter Gee, a partner in Fredericton's Datamaster Corporation, a software development house, completed a major project to link the microcomputers in the local offices of a national carrier through its existing mainframe. The project was primarily a communication problem; the system now allows inter-office transfer of lading bills for truck tracing and billing. This type of activity, he explained, involves custom-made software, typically expensive to develop and specific to the company's needs. These two characteristics limit the market for such software.

Supplementary investigation revealed much the same pattern as observed by the PDAS. A few companies contacted were making use of microcomputers, with positive results, but the majority were of the opinion that the technology was not required or was out of their financial reach. Most of those in the latter group had little or no experience with microcomputers, and were not aware of current costs.

The message above is clear. While microcomputers may

contribute significantly to a company's efficiency, awareness in the industry is not high. If awareness of microcomputer capabilities improves, implementation is likely. Some of the most promising applications of microcomputers are outlined in the next section.

POTENTIAL

It was stated earlier that the field of transportation and logistics could benefit greatly from the implementation of microcomputers. An understanding of the nature of this function is important in assessing the potential impacts of increased microcomputer use.

Transportation and logistics is a broad term, encompassing the efficient distribution of goods at minimum cost. Companies typically concerned with this are those in the transportation business, and manufacturers or producers whose markets are not in close proximity to the production site. The diversity of commodities, vehicle characteristics, and traffic routings makes tariff-setting complex. Warehousing and inventory policy can have a marked effect on a company's success.[1] Operating costs can be significantly affected by site selection, vehicle maintenance and scheduling. Microcomputer use can have a positive impact on all of these areas. A number of specific applications are discussed below.

Data storage and other "record-keeping" functions can improve the overall efficiency on the sales or

administration side of the industry. Computerized data storage can reduce "lookup time" for tariffs or schedules and allow for easy updating of data. Combined with word-processing, these functions can result in significant time savings. These functions can readily be performed using a variety of existing software.

Vehicle maintenance is an important consideration to the owner/fleet operator. Several programs are available to assist in this area [2]. Parts inventory programs can record and project future needs, improving the efficiency of the shop. Mileage, weight and time can be used by the computer to improve the timing of minor and major vehicle overhauls, eliminating much of the guesswork. After "record-keeping", this is the second most popular application of microcomputers in the industry at present.

From a longer-range perspective, site selection can be important it is a complicated process involving a large number of interrelated factors. Rudimentary site-selection programs based on market distances, travel costs and land costs are presently available. Judicious analysis of "what-if" scenarios in this case may result in long-term operating cost savings.

Again on the transportation side, route selection and scheduling is typically a complex optimization problem, difficult using manual techniques. Several software packages have been developed to improve fleet scheduling and route selection. These "route rationalization"

programs represent the potential for significant savings in time, vehicle operating costs, while improving service and vehicle utilization. They represent an attractive, yet underdeveloped, market for microcomputer implementation in the field.

The potential of microcomputers in the field of logistics and transportation is obviously not confined to transportation-related applications. However, in the short term it is likely that transportation problems will receive the most attention. Warehousing and inventory applications, the other side of the logistics coin, typically involve much more sophisticated mathematics, and statistical assumptions not always easily explained. As such, while the potential for improved economic efficiency may be the same as for transportation applications, there is less intuitive understanding on the part of the user, and consequently less attraction. Ultimately, as users become more skilled, it can be expected that microcomputers will be used to optimize total distribution costs - i.e. both transportation and logistics costs.

The above examples are provided as an indication of the wide variety of cost-effective applications possible for microcomputers in the industry. They are by no means exhaustive. Problems associated with microcomputer implementation are discussed in the next section.

PROBLEMS

The potential of microcomputers in the transportation industry is undeniable, but the realization of that potential is not guaranteed. It is often easy, from inside a well-equipped university or research centre to assess the benefits of new technology; the transfer of this technology to the field is rarely so easy. There are a number of factors of importance in this regard.

The discussions with the PDAS, and the telephone interviews with trucking firms and shippers in the Fredericton area revealed a number of concerns on the part of the industry regarding the implementation of microcomputers. The most commonly-voiced of these are outlined below.

The majority of the larger trucking and shipping firms contacted made some use of mainframe computers, typically housed in the head office. Since much of the record keeping was passed on to the head office, any local office's microcomputer use had to allow for easy data transfer to the mainframe. Interchanging programs and data between microcomputers and mainframes is not difficult, but much of the time it is perceived so. This is attributed to the sometimes-complex processes involved in the transfer, despite the efforts of software manufacturers to simplify the procedure. This difficulty is expected to be resolved as more powerful software is developed. Setup costs associated with this interfacing

are often high.

A second major problem perceived by potential users is the lack of suitable software for immediate application. Software development in the transportation and logistics field lags that of the larger commercial markets. The amount of general accounting and word-processing done in the company may not by itself justify the cost of a microcomputer. Furthermore, custom software development is typically time-consuming and expensive, particularly in the case of new users. As such, until better software is available to the industry, micro-computer expansion is likely to be limited. Often exacerbating this problem is the lack of knowledge demonstrated by sales staff in the application of less general software packages, making initial software selection difficult for a company.

Closely related to the above is the availability of after-sales support and service for both software and hardware. The Atlantic region is a low-density market at present, making the provision of technical support difficult. The neophyte computer user is justifiably hesitant to purchase a machine whose potential will only be realized after long hours of study and practice. The same is true of new software, no matter how well-documented. As with the previous problem, this is an issue which must be resolved before microcomputer technology is widely accepted.

The last two problems outlined above lead to a "Catch 22" situation. Until the transportation and logistics industry makes sufficient use of microcomputers to support specific software development, progress in this area will be limited. In addition, no improvement in after-sales service in Atlantic Canada is likely until the market improves. With no improvement in either software or service, microcomputer use will increase only slowly.

A final problem hindering the acceptance of microcomputers in the transportation and logistics field is that the technology level extant is relatively low. Many of the smaller trucking companies were started by a truck owner who expanded his fleet; it isn't realistic to assume that he or she is well-versed in computer operations. In this kind of environment, there may exist resentment of yet another "machine" making things more difficult to understand.

The issues raised above, which limit the rate of microcomputer implementation in the industry, are not uncommon when dealing with a "technology transfer" in any field. A number of suggestions for addressing these issues are provided in the next section.

RECOMMENDATIONS

If the premise that the transportation and logistics industry in Atlantic Canada will be better served by the implementation of microcomputers is accepted, a number of

steps can be taken to facilitate the process.

As pointed out earlier, awareness on the part of the industry regarding available technology is not high. However, the PDAS has found that the companies they visit are positively influenced by their computer demonstrations. If this type of demonstration activity were more prevalent, in or out of a consulting context, awareness and acceptance in the industry would likely grow more rapidly.

While demonstrations of microcomputer capability are certainly a necessary step in the transfer of technology to the field, awareness will not always induce application. However, general introductory courses in microcomputer use are available at a wide number of microcomputer sales outlets and universities. Providing information on the availability and suitability of the courses at the time of a demonstration would identify a positive course of action to those present. Furthermore, with even a cursory introduction which included hands-on experience, much of the "microcomputer mystique" would disappear.

Greater microcomputer use would also be predicated on some improvement in the sales and after-sales service/support currently available in the industry in Atlantic Canada. The microcomputer itself may be of less interest in this context, as sales and support of hardware is generally good; adequate sale and support of software

specific to the industry is more difficult to obtain. An expedient step for the transportation and logistics industry might be the creation of an Atlantic-based clearing house for relevant software, staffed by individuals trained to assist in selection and implementation of the available software. Related activities might include a phone-in advisory service, and the dissemination of information on new software as it becomes available. Seminars to introduce or upgrade microcomputer skills might also be provided in this context. Given the relatively small market segment for microcomputers that transportation and logistics represents overall, this may be the only way the industry can ensure adequate attention to its needs.

The lack of available software has been cited several times as a problem for the industry. Given the current rapid rate of software development, it is anticipated that this deficiency could be corrected in the near future. Through discussion with potential and current computer users, and a knowledge of the most promising cost-effective applications of microcomputer technology, the specific needs of the users can be identified. This information would save a great deal of time in the development of application software, making the project more attractive to a software company.

The above suggestions address some of the problems identified earlier in the paper. Their implementation

might lead to greater acceptance of microcomputers in the Atlantic transportation and logistics industry, with all the benefits that such a move implies.

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THE DATA BASE FOR INTERCITY PASSENGER TRAVEL ANALYSIS: CURRENT STATE AND FUTURE PROSPECTS

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ABSTRACT

This paper discusses the need for improved techniques for the analysis and modelling of intercity passenger travel demand in order to provide an improved factual basis for policy decisions in this area. Improvement of these analysis techniques, however, depends fundamentally on the existence of a high-quality, comprehensive, disaggregated data base pertaining to intercity travel. The current state of Canadian intercity travel data is reviewed and found to be inadequate for this task. The paper then sketches a data collection program designed to remedy this situation.

INTRODUCTION

Intercity passenger transportation policy in this country is currently in a considerable state of flux, as witnessed by the continuing debate concerning future directions for intercity rail passenger services, concerns about the viability of the intercity bus industry in this country, recent initiatives with respect to airline deregulation, etc. Considerations of most, if not all, of these issues would be greatly assisted through the use of demand models which are capable of generating credible, policy-sensitive forecasts of origin-destination flows by mode for the range of economic scenarios and

transportation policies under consideration. Unfortunately, such models are rarely available, particularly in cases in which the interaction between two or more modes is of interest. Several reasons exist for this state of affairs, including: intercity passenger travel demand simply has not been as well studied as the corresponding urban travel demand case; the complexity of intercity travel makes it very difficult to model successfully; and the work to date in the area has tended to be largely oriented towards improving methodological aspects of the models, rather than towards improving their behavioural content. These reasons, in turn, all devolve from a more fundamental obstacle: the very weak and limited data bases upon which work in this area has traditionally been based.

In any field of scientific research, credible, useful theories of system behaviour can only be achieved when suitable data concerning the system in question are available to test these theories against, to help the researcher learn about the system in question, and to provide the environment within which improved theories can evolve. Similarly, the translation of such theories into practical quantitative models of system behaviour requires considerable data for model estimation purposes. Finally, data are also required to use such models to forecast future system behaviour. Hence, data -- quantitative empirical information -- lie at the heart of the development and use of any sort of quantitative tool for systems analysis.

The intercity passenger transportation system is no different in this regard than any other system. The basic thesis of this paper, however, is that a suitable data base for the development of credible, policy-sensitive models of intercity passenger travel demand does not exist in this country (or, for that matter, anywhere in North America), that the development of such models is virtually an impossibility until such a data base does exist; and that intercity

transportation policy decision-making has suffered and will continue to suffer from this lack of good demand analysis capabilities.

The next section of this paper presents a brief discussion of some of the key modelling issues which must be addressed if improved intercity passenger travel demand models are to be developed. From this discussion comes the identification in the third section of the paper of the desirable properties of a data base which would be capable of addressing these model development concerns. The paper's fourth section then critiques available Canadian data bases in light of these requirements, leading to a discussion in the fifth section of potential approaches towards obtaining an improved data base. The final section of the paper then summarizes the major points of the paper.

TOWARDS IMPROVED MODELS OF INTERCITY TRAVEL DEMAND

Recent reviews of the state-of-the-art of intercity passenger travel demand modelling have criticized this state-of-the-art on a number of grounds.[1,2] Much of this criticism stems from the spatially aggregate nature of conventional intercity travel demand models, which results in the introduction of significant aggregation biases into these models, as well as hinders the specification of sound behavioural relationships within the models. Thus, while important methodological advances concerning such topics as the statistical estimation of these models and the statistical testing of constraints on model functional form and parameter values have occured in recent years,[3,4] it would appear that the major obstacle to improved intercity demand models is not methodological, but rather behavioural, in nature. That is, a number of issues exist concerning our understanding of intercity travel behaviour which must be addressed, if improved models of this behaviour are to be developed.

One such issue relates to the identification of travel market segments. Market segmentation is typically done on the basis of trip purpose. It is almost universal within the literature to disaggregate intercity travel, at a minimum, into business and non-business trips and to calibrate separate models for these two trip types, in recognition of the considerably different processes involved in trip generation and modal choice for the two trip types. In other words, trip purpose is generally viewed as a critical variable in the definition of intercity travel markets.

It is interesting to note, however, that while separate models are typically calibrated for business and non-business trips, these models also typically differ only in their calibrated parameter values; that is they possess identical functional forms and identical sets of independent variables. This implies that the same decision structure and the same set of explanatory variables are equally valid for all trip purposes. A trip to visit relatives in Kingston, however, involves a considerably different decision process than a trip to camp in a provincial park or a trip to visit a client in Montreal, and it is not clear that the same set of explanatory variables and/or function forms are equally suitable to characterize these processes, even at the aggregate, correlative level typical of intercity demand models.

A second issue relates to the decision process which is assumed to characterize trip-making behaviour. There is much discussion in the literature of "direct" versus "multistage" demand models. A direct demand model is one in which a single equation "directly" predicts modal travel volumes by origin-destination (O-D) pair. A multistage model, on the other hand, uses two or more equations to arrive at this same result, typically by first predicting the total (all mode) travel volume for an O-D pair and then "splitting" this total volume among the competing modes. The decision processes consistent with

these two model formulations are, respectively, a joint process in which the decision to travel to a particular destination and the mode to be used are simultaneously determined, and a sequential process in which the decision to travel to a particular destination is made first and the mode to be used is then determined, given the prior choice of destination.

Neither decision process can be rejected as being a priori unreasonable. Ideally, the analyst should test the relative merits of these two processes rather than assume one a priori. Such an approach, however, presupposes a model structure which, first, can differentiate between the two processes and, second, facilitate the statistical testing of the hypotheses representing these processes within the model. Such a capability does not exist within the current intercity demand modelling state-of-the-art, primarily because the distinction between current "direct" and "multistage" models is artificial in that the two are mathematically equivalent to one another (i.e., one is derivable from the other through a series of simple algebraic manipulations). Thus, current models cannot differentiate between the two decision processes.

A second difficulty with multistage models in general (i.e., urban as well as intercity models) is how to represent a multimodal transportation system at the first stage level, so that total O-D volumes can be predicted. That is, it is reasonable to expect that the ease of travel between two centres will influence the amount of interaction that will occur between them, but this is theoretically and practically difficult to do when mode splits are "unknown" (since destination is postulated to be chosen prior to mode). Conventional intercity demand modes typically handle this "trip induction" issue (i.e., the sensitivity of trip generation levels to transportation level of service) in very ad hoc ways, which are often found to not perform well in forecasting applications (e.g., they often significantly over-predict the amount of travel

generated by a system improvement).

The only modelling method currently available which consistently addresses both of these issues (i.e., differentiation between joint and sequential choice processes and representation of modal service levels in the first stage of a sequential choice process) is disaggregate choice modelling. No truly disaggregate choice model has ever been developed for the intercity case, although the only practical reason why this is so concerns data availability. A description of disaggregate choice models is beyond the scope of this discussion, but a brief illustration of how such models might potentially be applied to the intercity case is presented in Rice, et al. (1981, Appendix D).[1]

Finally, a third issue relates to the variables chosen to include in the demand function. These variables obviously reflect assumptions concerning "causal" relationships within the system (or at least strong and stable correlations). Intercity demand models are very consistent in their choice of variables: frequency, time and cost are used to characterize modal service levels; and population, employment, income, etc. (as well as various "compatibility" variables such as "linguistic compatibility indices", etc.) are used to characterize the level of interaction between city pairs.

Perhaps the single biggest obstacle to improving the specification (and the measurement) of variables included in intercity demand models is caused by the extreme spatial aggregation of such models. "Catchment areas" for stations and terminals can be very large, and it is not uncommon for such catchment areas to constitute the zone system for the model. The difficulty in generating meaningful access times and costs under such circumstances is only the most obvious of the problems involved. A less obvious, but possibly more fundamental, result is that this extreme spatial aggregation makes it

extremely difficult to think about "causal" factors and inter-relationships affecting inter-city interactions and their attendant travel flows. This, in turn, inevitably results in the use of only the most basic and correlative of factors (population, etc.) within the model. Finally, as has already been mentioned, adoption of such a spatially aggregate approach typically results in the introduction of significant "aggregation" biases in model parameter estimates and hence, ultimately, in model predictions.

In summary, key behavioural issues in intercity model building include:

1. obtaining a clear understanding of the travel markets which exist within the intercity transport system;
2. obtaining a clear understanding of the decision processes (factors and relationships) at work within each of these markets; and
3. working at a level of analysis that is sufficiently disaggregate to enable one to hypothesize and test "causal" factors and inter-relationships.

These issues all appear to point towards the need for a more disaggregate, behavioural approach to thinking about and modelling intercity travel demand, if improvements in the current state-of-the-art are to be achieved. They also clearly point to the need for a comprehensive, dissaggregate data set upon which to base the development of such models.

IMPLICATIONS FOR DATA REQUIREMENTS

Key attributes a data base which would be suitable for addressing issues such as the ones raised in the previous section include comprehensiveness, consistency, and spatial disaggregation. Each of these attributes is discussed in turn.

The data base should be comprehensive in several senses. It should cover the four major modes used in intercity travel: auto, air, bus and rail. It should cover the range of trip purposes involved in intercity travel: business, vacation, visit friends and relatives, etc. It should include a wide range of variables characterizing the trips made (by mode, purpose, origin, destination, duration, etc.), the service characteristics of both the chosen mode and other available but unchosen modes (travel times and costs, service frequencies, etc.), and the characteristics of the trip-makers (age, sex, income, occupation, etc.). Ideally, the data base should also include "attitudinal" information concerning trip-makers' perceptions, preferences, and decision processes.

One of the key points implicit in the items just listed is that trip data must be collected in terms of true origin-destination linkages. Much Canadian travel data, however, typically exists in the form of either link volume counts or ticket lifts. The former case provides little direct information about origin-destination movements, while the latter provides information about the origin and destination of the "trip link" represented by the ticket in question, but does not necessarily define the true origin and/or the true destination of the overall trip. In addition, neither case provides any opportunity to link observed trips with the characteristics of the trip-makers -- a necessary prerequisite for any attempt at explaining the observed travel behaviour in a systematic way.

The data should be consistent in that the data for each mode of travel should be collected using consistent methodology (e.g., essentially the same questionnaire is used in all cases, samples are selected in consistent ways, etc.) and consistent definition of terms and variables (e.g., trip purposes, socio-economic characteristics of the trip-makers, etc.). Ideally, the data for each mode should be collected simultaneously to ensure temporal consistency.

Finally, service characteristics should be defined and collected in a consistent fashion across modes.

"Spatial disaggregation" of the data set simply means that the basic unit of information is the individual trip, made by an individual trip-maker (as opposed to spatially aggregate data concerning flows of trips between cities or zones). A disaggregate approach is fundamental to the analysis of travel behaviour, since clearly it is at the level of the individual trip-maker which travel decisions are actually made and hence it is at this level that such decisions can best be analyzed. While this observation may not seem to imply particularly new needs in data or data collection techniques, since many data bases are constructed by surveying individual travellers, it does, in fact, mean that such surveys must be carefully designed to ensure that they are maximally useful in a disaggregate analysis -- something which is not true for existing data bases which were typically constructed for aggregate analysis purposes.

Ideally, this data base should be time-series in nature. In practical terms, this might mean a fairly large-scale cross-sectional data collection effort to initiate the data base, followed by periodic, smaller-scale "updates". One rarely has the opportunity to exploit time-series data in transportation analysis (intercity or urban), but the availability of such a time-series data base could immeasurably improve the overall utility of the data themselves and of the models which are ultimately derived from them. In particular, time-series data facilitate the identification of shifts in modal preferences over time, adjustment in modal choices in response to system changes, and so on, in ways which generally are simply not possible with cross-sectional data alone.

Finally, the spatial extent of the proposed intercity travel data base has not yet been discussed. "Intercity travel" can mean many different things to different people. To a national air carrier, for example, it may imply travel between all major and medium-sized urban areas in Canada (if not the world). To a provincial government, it may mean generalized regional travel between urban centres of all sizes. With respect to many current transportation policy issues, however, the appropriate spatial context is typically a relatively linear intercity travel corridor, defined in terms of a sequence of large and medium-sized cities (e.g., the Calgary-Edmonton travel corridor or the Windsor-Quebec City travel corridor). It is this last type of problem definition which is the focus of this paper, for three reasons. First, as mentioned, many of the most important current issues in intercity transportation (e.g., passenger rail options; the state of the intercity bus industry) are essentially "corridor issues" and can be best thought of and analyzed in those terms. Second, intercity corridor travel is the best studied of all types of intercity travel and hence constitutes an appropriate starting point for the development of improved models of intercity travel demand. And third, corridor travel is relatively well defined in terms of the modal networks involved and the data required for its analysis, and hence, again, constitutes the most fruitful starting point for any data collection and analysis effort.

CURRENT STATE OF CANADIAN INTERCITY TRAVEL DATA

Major data bases relating to intercity passenger travel in Canada have been documented and/or reviewed in a number of reports.[1,5,6,7,8,9,10,11,12] These data bases include:

1. 1969 CTC on-board survey of common carrier (air, bus, rail) passengers in the Windsor - Quebec City corridor.[5,12]

2. 1976 Transport Canada intercity travel data base.[11]
3. 1976 Southern Ontario Multimodal Passenger Studies (SOMPS) data base.[6,11]
4. 1977-1980 Canadian Travel Survey, conducted by Statistics Canada as a supplement to their Labour Force Survey.[7,8,9,10,12]

The second and third of these data bases were both constructed from a variety of sources and do not contain detailed data concerning individual trips or trip-makers. Hence, while they have proved suitable as a basis for the development of conventional aggregate models of intercity travel demand, they simply are not suitable for the sort of detailed disaggregate analyses which are required for significant model improvements to be obtained. This leaves the 1969 CTC common carrier survey and the 1977-1980 Canadian Travel Survey as the most promising of the existing data sets for future analysis and modelling efforts.

The CTC data are attractive because they contain detailed, consistent data concerning trip-making behaviour in the Windsor-Quebec City corridor for the air, bus and rail modes. At the same time, however, the data base is seriously deficient for current purposes due to its age, its lack of information on the automobile mode, its lack of information concerning non-travellers, and its restriction to a relatively few (albeit major) links within the corridor.[12]

The attractive features of the Canadian Travel Survey, on the other hand, are that it was a home-based survey (as opposed to the "on-board" nature of the CTC survey) and hence able to collect information about trips by all modes, as well as information about the rate at which households make intercity trips (including the observation of households which made no intercity trips during a given time period), and it is a time-series national data base. Its major limitations with respect to disaggregate analyses are a lack of

some key socio-economic variables (e.g., income levels of households not making intercity trips during the observation period), difficulties in the way personal, household and trip information are coded, and the relatively gross spatial scale at which trips are recorded.[10,12]

The general conclusion to be drawn from this brief review, therefore, is that no one data base, or combination of data bases, is suitable for the type of detailed analysis and modelling work described in this paper. This is not to say, of course, that the data sets listed above have not proved to be of value in past analyses or that they may not still prove to be of value in particular applications. But the fact remains that suitable modelling capabilities have not been developed to date based upon these data, and it is very unlikely that such capabilities could ever be developed with these data as the starting point. Thus, it would seem that significant improvements in our intercity travel demand analysis capabilities must await the development of a new, detailed, appropriately designed data base.

ELEMENTS OF A DATA COLLECTION PROGRAM

From the foregoing discussion, a general picture of intercity travel analysis data requirements has emerged, in terms of the need for a comprehensive, consistent, disaggregate data base (ideally time-series in nature). Given that such a data base does not exist, it appears that a relatively major new data collection effort would be required if such a data base is to be established. The detailed design of such a data collection effort is well beyond the scope of this paper. Nevertheless, it is possible to identify at least some of the major elements which are likely to be involved in such an undertaking.

The first such observation is that the data collection effort should probably focus its initial efforts on a single, well-defined major intercity

travel corridor. The Calgary-Edmonton corridor is a strong candidate for these initial investigations due to its simple network structure, as well as due to the strong competition which exists between the various modes operating within the corridor.

Second, the data collection effort itself might well consist of a coordinated set of surveys, of both an on-board and a home-interview nature. On-board surveys are by far the most efficient means of obtaining sufficient numbers of observations for statistical analysis of common carrier (air, bus, rail) travellers. These surveys, however, should be supplemented with home-interview surveys (probably of a mail-back variety) conducted in the urban centres contained within the study corridor, in order to obtain information about intercity trip rates, household decision-making, etc. In addition, detailed information about auto travellers in the corridor might best be collected through a license plate survey of vehicles on major corridor highways, combined with a mail-back survey of the owners of the vehicles observed.

Third, these surveys (in whatever form they finally take) should be developed in an entirely consistent way with one another, should be designed with anticipated disaggregated analysis needs specifically in mind, and, ideally, should be administered simultaneously (or as simultaneously as is practically possible) so as to maximize their compatibility.

Fourth, a detailed survey of modal service characteristics and link volume flows should be undertaken at the same time as the travel behaviour surveys. The first type of data is, of course, of fundamental importance to the analysis of travel behaviour; while the second is required to ensure that the sample data from the travel surveys can be weighted appropriately to yield unbiased population totals.

Fifth, while the importance of time-series data has been stressed throughout this paper, there is no need to leap immediately into an ambitious time-series data collection program. A staged approach is definitely preferrable, in which a good cross-sectional data base is obtained for a single corridor and exhaustively analyzed. Based on the experience gained from this "first pass", a cross-sectional survey and analysis of a second major intercity travel corridor may well be the most productive second step. Once both corridors have been studied in detail, then the design and implementation of an efficient, on-going time-series data collection program should be possible.

Finally, the combination of modern survey techniques[13] and the inherent efficiency of disaggregate analysis techniques in their use of data[14] imply that high-quality, reliable surveys of intercity travellers can without question be successfully and cost-effectively constructed. In particular, properly designed and executed mail-back surveys can achieve very high response rates, while significantly reducing the cost associated with home interview surveys. At the same time, a disaggregate analysis approach implies the capability of performing unbiased, efficient statistical analyses based on smaller sample sizes than are required for conventional aggregate analyses.

SUMMARY

Effective intercity passenger transportation policy analysis depends in no small measure upon the ability to produce credible forecasts of intercity origin-destination flows by mode as a function of alternative policy options. Current intercity passenger demand modelling capabilities have generally proven to be inadequate to this task, thus rendering decision-making in this area a more difficult and uncertain undertaking.

Improvement in the intercity demand modelling state-of-the-art appears to depend in a very fundamental way on first improving the "factual base" upon which we construct our analyses and build our models. Existing data are simply inadequate to the task at hand, particularly given the need to adopt a more explicitly behavioural, disaggregate approach to intercity travel. Such an approach does, indeed, seem to be required in order to achieve better insights into intercity travel patterns, which, in turn, will presumably lead to improved model and variable specifications.

There does not appear to be any major limitation to the collection of a high-quality data base suitable for the proposed research and development work, aside, of course from the questions of institutional commitment to the project (on the part of provincial and federal govenrments, as well as the common carriers involved) and of project funding. In particular, an appropriate mix of on-board and home-interview surveys, employing state-of-the-art survey and questionnaire design principles can undoubtedly be designed to provide a cost-effective, high-quality data collection program.

Finally, the cost-effectiveness of this proposed data collection effort would appear to be very high, despite the fact that it could ultimately cost hundreds of thousands of dollars. VIA subsidies amount to hundreds of millions of dollars annually. The Canadian intercity bus industry has revenues and costs of hundreds of millions of dollars annually. Some Windsor - Quebec City corridor rail options which have been suggested could cost billions of dollars to implement. Presumably the expenditure of less than a tenth of one percent of these sums of money to improve significantly decision-making capabilities concerning these vast sums is a price well worth paying.

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AIR TRANSPORT DEREGULATION AND AIRPORT CONGESTION PROBLEMS "EVERYBODY WANTS TO GO AT THE SAME TIME" (1)

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ABSTRACT:

While several potential problems arising from the deregulation of the American airline industry were foreseen, the serious congestion problems which have arisen were apparently not. This paper applies Hotelling's location theory and open access, common property type models to show that the congestion outcome was inevitable. In equilibrium, the model also shows the tendency toward the dissipation of economic rents by the industry. Finally, it concludes that some form of congestion pricing is required to relieve congestion and to increase the social surplus. The resultant impact on the consumer is not explored.

INTRODUCTION

In 1981, Keeler (2) noted that opponents of the deregulation of the American air transportation system had identified three potential problems. These were: (a) a loss of service on the light density routes; (b) a possible need to restructure the industry to allow it to function effectively in the new environment; and (c) a concern for safety. Airport congestion was apparently not foreseen as one of the emerging problems. However, considerable congestion has developed as have demands on the part of the airline operators for airport expansion. The problem is

widespread (3, 4 and 5), and, intensifying. Excess demand pressures at peaks clearly exist (6).

The objective of this paper is to analyse this problem. Because no obvious framework exists in transportation, one must be adapted from elsewhere. The most promising source appears to be fisheries economics. There the concept of an open access common property resource has been used as an analytical framework. Completely free access to a common property resource leads to a decline in incomes to the point where all economic rent is squeezed out of the industry.

Artifical as it first appears, it is possible to treat the passengers for which a deregulated air transportation industry "trolls" as common property resource. Consider the parallels to the fisheries case. In both, there are the commons: the fish on the one hand, the passengers on the other. In both, there is free access. In both, productive capacity can be easily reallocated to other productive uses: other species or other routes. In both, there is the tendency toward overexploitation with resultant crowding (i.e. congestion) effects. In both, there is a tendency toward over-investment in capital equipment and, concomitantly, toward excess capacity. This list of similiarities makes the two cases parallel, and permits the application of such models to a deregulated air transportation system. In both cases, the rent-dissipating common property equilibrium is inevitable in the absence of

constraints.

This paper applies the fisheries framework to the deregulated air transportation industry. The objective is to assess some of the long-run results of deregulation. It begins by establishing the common property characteristics of the industry. The question of service scheduling is then considered using a model developed for spatial location by Hotelling. Following this, the long-run equilibrium is assessed from the perspective of the industry. Finally, the unconstrained demand for the use of constrained airport runway slots is explored and its impact assessed. It is then concluded that the economic rents which might otherwise be earned in the deregulated environment are competed away through schedule competition, and free entry, that some excess capacity will result, and that demands for infrastructure expansion are inevitable.

Property Rights, Accessability and the Airlines:

Property rights define an individual's claim to scarce resources, and thus help to determine how those resources will be allocated in the production of output (7). Any redefinition of property rights will thus have among its consequences a reallocation of resources. In the process, as Tullock (8) has observed, there may well be transitional gains and losses which affect the players.

Property rights were readily identified in an era of regulated airlines. They took the form of operating

authorities on specific routes, and were protected by a system of entry controls. Typically, potential entrants had to prove public convenience and necessity before entry was allowed. Various opportunities were afforded existing firms to protect both their markets and their financial position. There was little price competition, though non-price competition existed. From the perspective of property rights, deregulation abolishes the values attached to operating authorities. Free access to all markets now becomes possible, as does market exit. In effect, the air transportation markets are converted into open access commons, and can be considered from that perspective.

A recent article by Copes (9) applies the standard fisheries analysis to the retail market for gasoline. This market he considers to be an open access commons, one in which the market under review constitutes only a small fraction of the amount of retail gasoline capacity which is available. Copes follows Carroll, Ciscil and Chisholm (10) in that his focus is on the imperfect specification of property rights and the negative externalities which this creates for existing firms. With that framework, Copes (11) demonstrates that entry into the market will continue until such time as all of the economic rents (perhaps the Marshallian term "quasi-rents" is preferable) which could otherwise be earned are squeezed out. Some excess capacity will develop in the industry and both output and capacity will be above the socially desirable levels.

Such an outcome aptly describes a deregulated airline industry. For a given passenger volume, increases in the number of flights on a given link will occur, constrained only by the number of available landing slots. Economic rents will be dissipated as the industry expands capacity and revenue seats above socially desirable levels. Copes' (12) conclusion that with open access, both the number of firms and the amount of capacity will be excessive applies. Restricting entry will increase the social surplus, but may have adverse effects on the consumer.

Other problems exist. As Hartwick (13) suggests,

> Common property resources are interesting from the point of view of capital theory. An owner of a capital good attempts to maximize his returns over a period of time and so he regulates the intensity of use of the good, say a piece of land. Free entry, however, is inherently myopic. The users of the capital good, say the fish stock, have no concern for the use of the capital good "tomorrow" since it is presumed that any restraint on exploitatin today in the interests of having more tomorrow will result in gains that will be totally dissipated among tomorrow's exploiters.

While the situation above does not exactly fit the present case, it provides a useful analogy. Hartwick's "tomorrow" in the present context is the time of scheduled departures. Any action by an individual carrier to change flights from peak periods to off-peak departures results in peak traffic diversion to rivals, in lower overall traffic and hence profits. The same myopia exists in the scheduling behavior of the airlines as exists in the fisheries.

For the purposes of illustration, a simple model of the

airline industry will be used. There are two markets. Each can be segmented into two parts with appropriate fences between them. Access is open. Firms are profit maximizers, moving between markets in response to differing profit opportunities. In the long run, the profit ratios in all markets are equal, but given potential cost differences, varying profit ratios (that is, intramarginal rents) among firms are possible. There are constraints on the movement of firms. Capacity can be reallocated among markets only at the time of schedule changes. In addition, reallocation in time may be precluded because of the availability of runway slots at the desired time of arrival of a proposed flight.

Service Scheduling:

For considerable time, the low profit ratios of the airlines have been observed. Economists frequently commented that the industry had an inherent tendency to compete away the economic rents which might otherwise have been generated. Such erosion it was thought, was brought about to a significant extent by head-to-head scheduling. This was seen as an outcome of the regulatory preclusion of price competition. Industry consensus was that the best way for an airline to increase its passenger loadings was to schedule its departures so as to meet those of its competitors. There is a considerable element of truth in that position. However, the usual explanation, one

relating the tendency to price and entry controls, is incorrect. It is a natural outcome of the desire of firms to maximize profits.

Long ago, Hotelling (14) sought to determine the best location strategy which could be followed by a new entrant into a market. His example involved the case of a ribbon settlement currently served by one general store located precisely at the midpoint. Hotelling concluded that the optimal strategy for the new entrant would be to locate next door to the existing firm. This results in its maximizing the number of customers, and, given assumed constant costs, also its profits. This phenomenon, known as clustering, is readily observable in a variety of economic activity.

The Hotelling argument runs as follows. Customers are evenly spread along the ribbon community, and are bound to the individual seller only by the distance which they must travel from their origin (homes) to their destination (the store). All other aspects of the stores are identical. Should the new entrant locate at either extremity, he would be able to attract only 25 per cent of the business. As he moves inward toward the center, his market share increases. It reaches its maximum, in this case half of the total market, when he decides to locate immediately adjacent to his rival.

From the perspective of the airlines, the argument can be either temporal or locational, but the concept remains

the same. A schedule change is an example of relocation in time. An attempt to penetrate a new market is an example of spatial relocation. Barriers to relocation may exist. In the case of time relocation, the barrier to change is the constraints of the existing schedule. This suggests that relocation can occur with minimum costs when the next schedule is developed. If start-up costs are ignored with respect to an airline's relocation in space the outcome is the same. In neither case is relocation difficult or costly. The increased costs may delay entry into new markets, but they will not preclude such entry.

The airline market can be divided into two more or less equal parts. The first is the business market. It has a travel demand pattern with a bi-model distribution of early morning and evening peaks. The other, which will be called the recreational market, has a demand pattern which is much more evenly spread throughout the day. One might initially expect the pattern of flights to mirror the pattern of combined demand. Clustering of flights is, however, observed. This is prima facie evidence that the Hotelling clustering theory is valid in the airline case.

One can, therefore, conclude that head-to-head scheduling is an inherent characteristic of the industry. It contributes to excess capacity, and to the dissipation of the economic rents which could otherwise be earned.

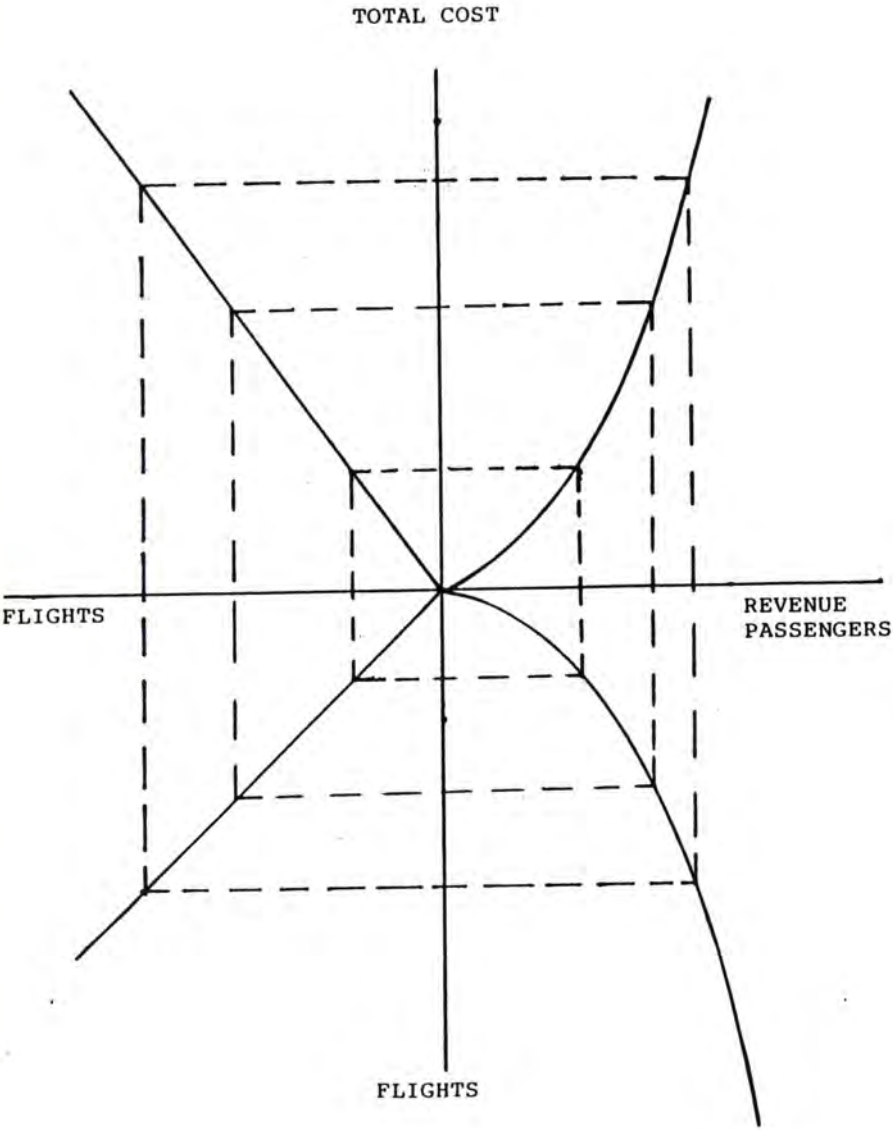
Equilbrium of the Industry:

In order to adapt the fisheries model (15) to the airline case, it is first necessary to construct a cost curve which relates total costs to the number of flights. Given that this is a long-run model, costs are inclusive of the opportunity cost of capital. It is convenient to assume that there is a single type of aircraft, and that it is available only in a uniform configuration. Then flights are a homogeneous variable and synonymous with the standard "effort" variable found in the fisheries literature. Because of the homogeneity assumption, the total cost of flights function is linear. Such a curve is shown in Figure 1(a).

Attention must now be turned to the relationship between revenue passengers (output) and flights (inputs). This relationship is synonomous with the yield/effort relationship prevalent in the fisheries literature. There, the application of more fishing effort to a particular fish stock results in diminishing returns to effort. This means that average catch per unit of effort (i.e. average product of effort) falls. Intuitively, this is what one would expect to find with air transportation. As the number of flights on a particular link rises, so does total traffic, but less than proportionately. Consequently, as the number of flights rises, the load factor falls. In fisheries terms, the yield (revenue passengers) per unit of effort (flights) declines as capacity increases. This curve is

FIGURE 1

PRODUCTION AND COST RELATIONSHIPS



shown in Figure 1(c).

Figure 1(b) has no economic significance. It is merely an expository device to permit the derivation of the relationship between total costs and revenue passengers shown in Figure 1(d). This curve is derived as follows. For a given link, choose a number of flights, thus defining total costs. Using Figure 1(b) to turn the corner, the expected number of revenue passengers that will result on the link is defined. When combined with the total costs from Figure 1(a), this defines the equilibrium total costs for that volume of traffic. Repetition of this exercise results in the derivation of the total costs in terms of the revenue passenger curve shown in Figure 1(d). Then average cost per revenue passenger can be derived from Figure 1(d). It takes the same shape as the total cost curve but at much lower dollar values.

In effect, the average cost per revenue passenger is the supply curve of revenue passengers. Every point on it represents a free entry equilibrium where market rents are dissipated, implying that for any given range of output prices, a specific number of revenue passengers is established by a specific number of flights. Having established the average cost (supply) relationship, it becomes possible to derive the marginal cost relationship. For any given level of output, the difference between the two cost curves is the congestion externality. As the number of revenue passengers increases, so does the

difference between the two cost curves. Social welfare therefore declines.

The derivation of the total revenue function also begins with a relationship centering on capacity measured in terms of the number of flights. In this formulation, the slope of the curve declines as capacity increases. Additional capacity means additional competition, and this results in a downward pressure on price. This will be true for any given level of industry competition. However, each successive decline in price is less productive when measured against available capacity on the link. Neither deregulation, nor the entry which it has occasioned, has an impact on the market demand curve. Rather, both affect the point on that curve at which the industry is located. Each successive reduction in fares is less productive in generating additional passengers. Combining the price (or fare) per unit of output with the production function itself establishes the total revenue function. It may be expressed in terms of flights or in terms of revenue passengers.

The total cost curve derived in Figure 1(d) is combined with the total revenue curve just described to produce Figure 2. For the moment, social costs will be ignored. On the basis of this figure, it is possible to discuss the equilibrium of the industry on any particular link or in total.

Suppose initially, the market has a capacity of OA

FIGURE 2

INDUSTRY EQUILIBRIUM : SINGLE LINK

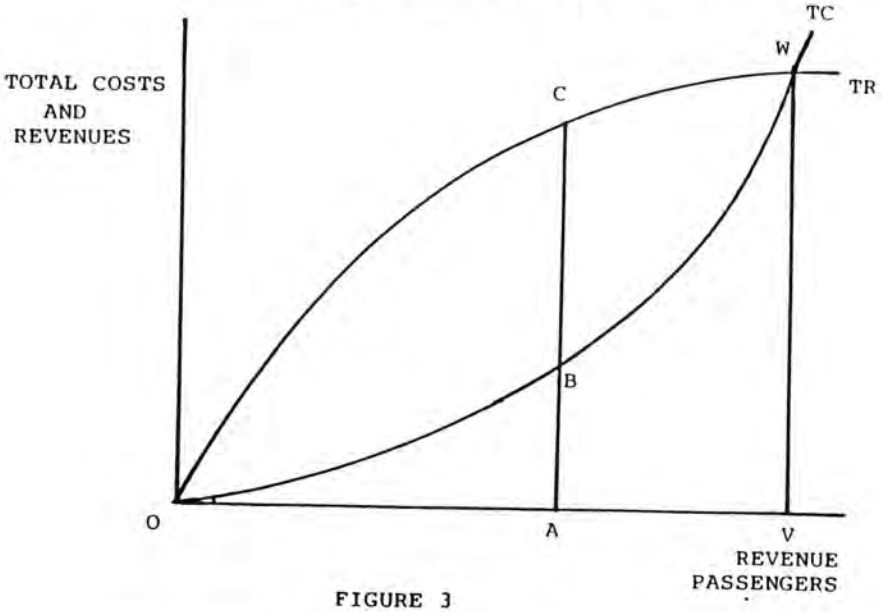
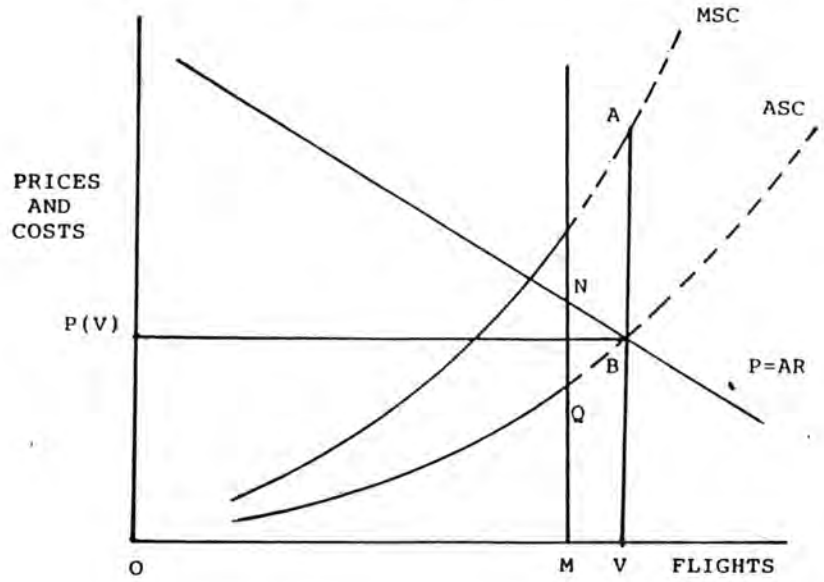


FIGURE 3

SLOT CONSTRAINED CONGESTION EXTERNALITY



available seats. At that level of capacity, total costs are given by AB, and total revenue is AC. There exists an economic profit of BC. Given freedom of entry, the existence of this economic profit will lead existing firms to expand and/or attract additional entrants into the market. With this increase in effort, some of the economic profit will be squeezed out. The process will continue until the industry reaches equilibrium at W. There, economic rents are reduced to zero. Entry into this market stops at that point. The result is, of course, a Chamberlin-type solution in the sense that average revenue, while greater than marginal revenue, does equal average cost, at least for the Marshallian representative firm.

Across the markets, the process will continue until profit ratios are equalized. Capacity will be reallocated among markets whenever differential profit opportunities exist. Across firms, the existence of intramarginal rents is still possible. These interfirm variations aside, all markets will tend toward the solution outlined above with reference to a single market. There will, therefore, be a tendency for industry profits to fall toward zero, a level that will be reached in the absence of constraints on the availability of landing slots.

This is the same outcome as the long-run fisheries case, and the same as the outcome where any commons is involved. As long as economic profits remain above zero, additional entry will occur. When they reach zero, entry

will stop.

The supply of runway landing slots is, of course, limited. For certain routes and airports, their availability may constrain the number of flights (in the fisheries terminology, the amount of effort) possible to a level that is less than desired. As a result, all rents may not be dissipated. This situation is represented by Figure 3. That diagram shows the average and marginal cost curves derived from Figure 1(d) as well as the demand curve. In the absence of a constraint on runway landing slots, the industry will establish the rent-exhausting level of output OV. Let the landing slot constraint now be introduced. In the case of low density routes, it constrains pasenger volume at a level located to the right of the industry equilibrium, and hence will be ineffective. However, on certain high density routes, passenger volume is constrained to the left of the industry equilbrium, say at the point M in Figure 3. When the cost curves encounter the constraint, they become vertical, for the constraint is absolutely binding, and the volume of flights cannot be exceeded. However the unexhausted rent of NQ per flight remains at this output level. Airlines will wish to exploit these profit opportunities. Conflict between them and the airport operators over the availability and/or the allocation of runway slots is therefore inevitable.

Two observations must be made about this constrained equilibrium. Firstly, it does not generate maximum rents

for the industry as a whole. Closely related is the fact that the social surplus (i.e. rent and consumer surplus) is not maximized in terms of output due to excess capacity. Secondly, from the perspective of the individual airlines, the existence of unexploited rents will lead to demands for capacity expansion. Should this occur, total exhaustion of the rents will follow.

It is the congestion externality which makes the airline problem akin to the fisheries problem. The congestion problem and the social costs which it generates are of crucial importance to the operators of both the airlines and the airports, and need to be explored further.

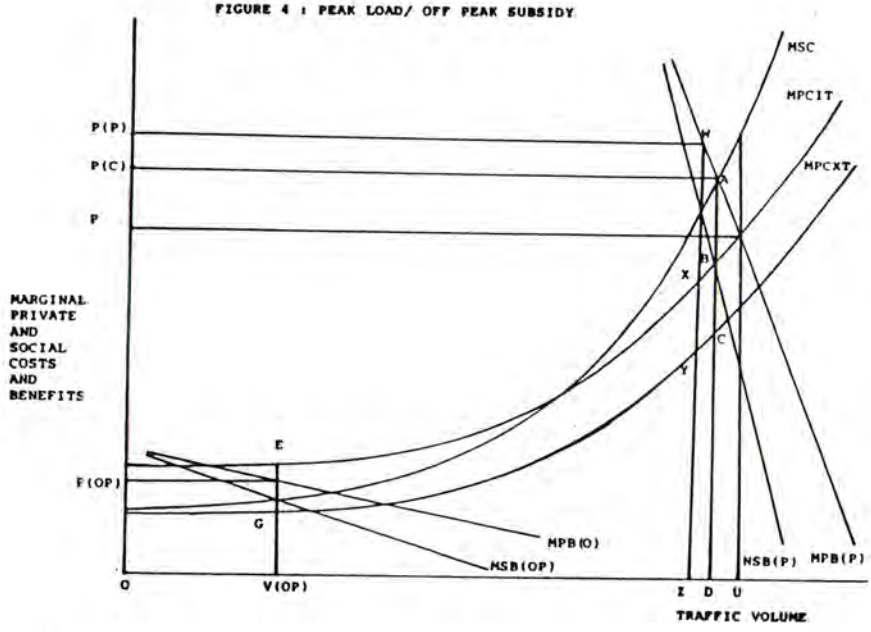
The Congestion Problem and Potential Solutions:

Congestion arises because of the confluence of airport capacity which is fixed in the short-run, and a traffic volume which varies intertemporally. At the limit, it is a problem which arises any time there is simultaneous desire for the use of a landing slot by two or more carriers. Congestion problems are both time and spatially specific. Their impact is to increase both the operating costs of the carriers and the time delay costs experienced by the industry and its passengers.

In the free market environment, the industry will tend to establish the rent-exhausting level of output. This outcome follows a natural consequence of the open access common property nature of the deregulated industry. At

that level of traffic, there are social costs which firms are able to externalize, there will be excess capacity, and the social surplus is not maximized in terms of output. This outcome emerges because individuals make their decisions on the basis of the average social cost and benefit curves which they perceive to be their marginal private cost and marginal private benefit curves. Social costs are not included in the decision-making process. Individuals, operating in isolation, make myopic decisions without recognizing the full societal impacts.

FIGURE 4 : PEAK LOAD/ OFF PEAK SUBSIDY



Two broad approaches to the congestion problem exist. On the one hand, it is possible to expand capacity, increasing slot availability. The analysis above suggests the futility of such an approach. The pressures of excess demand would continue as long as profit opportunities exist. The other solution uses price to ration capacity, and to divert traffic to off-peak periods. The latter approach increases the overall level of utilization and thereby increases system efficiency. The pricing alternative must be discussed further.

To consider the pricing alternative, it is necessary to develop a new diagram, one focusing on marginal analysis. Such a diagram is shown as Figure 4 above. There are two marginal private cost curves. The first, is synonymous with ASC of Figure 3 (16). It is labelled MPCXT and defines marginal private costs exclusive of user charges established to pay the ownership and operating costs of the infrastructure. (Such charges do not vary with current traffic because they are computed on a life-cycle cost basis.) The other, MPCIT, differs from the first in that such fees are included. As in Figure 3, related to the former is the marginal social cost curve. A family of demand curves for runway slots exists, each associated with a different time of day. For the purposes of discussion, only two will be considered. The first of these, MPB(P), in Figure 4, is representative of peak traffic periods. The other, MPB(OP), is representative of off-peak periods.

The distinction between private and marginal social cost has its equivalent on the demand side with the distinction between marginal private and marginal social benefit. As a result, two additional curves, MSP(P) and MSB(OP) must be incorporated into the diagram as shown. These lie below the private benefit curves because of the congestion externality.

The pricing mechanism utilized for allocating runway landing slots is thus composed of two elements. The first of these is the basic user fee, constant throughout the life of the infrastructure in question. The other is a congestion toll which must incorporate these intertemporal variations in demand and vary price to encourage the redistribution of traffic between peak and off-peak periods.

With reference to Figure 4, consider the peaking problem. In the absence of a congestion toll, the traffic volume OV, one equating price (P) and MPCIT, will prevail. At OV, there are social costs which have been externalized. This traffic volume is excessive. The conventional approach is to equate MPB and MSC, resulting in a traffic volume of OD. Marginal social cost here is AD, which is composed of three elements. AB is the peak period congestion toll, BC the basic user charge, and CD represents marginal private costs (17). This volume of traffic is more efficient than the former, but it is possible to do better still. The optimal solution emerges

when MSB and MSC are equal. This results in a traffic volume of OZ and a price of P(P). That price is composed of a congestion toll (WX) higher than before, the basic user fee (XY) and MPCXT (YZ). Peak period demand is thereby constrained, and infrastructure expansion delayed if not avoided.

It has been suggested that the cross elasticity of demand between peak and off-peak is low, and that therefore, a congestion toll would tend to be ineffective. To increase its effectiveness, an off-peak subsidy may be necessary. Such a subsidy can be justified in terms of Figure 4. Consider the off-peak demand curve, MPB(OP). If the same pricing rule is followed as before, i.e. equating MSB and MSC, the resulting traffic volume is V(OP), and the relevant price is P(OP). Yet this is less than MPCIT, marginal private cost plus the basic user fee. This implies that a rebate (or subsidy) for off-peak use of the infrastructure is warranted.

Would the system be better utilized with congestion pricing and demand management? Given the analysis above, the answer is clearly yes. Peak load pricing would reduce social cost during peak loading periods, shifting traffic to less congested time slots and, on average, result in improved utilization of the infrastructure. The aggregate of economic well-being of society would therefore increase.

Conclusions:

There are serious congestion problems in the U.S. air transportation system, problems which can be expected to worsen as time passes. These problems are the inevitable outcome of an open access market in the presence of constrained infrastructure facilities. The fisheries model makes it clear that new entry will be attempted until such time as the economic rents to be earned in the air transportation industry are exhausted. Hotelling's work on the optimal location of firms suggests that head-to-head scheduling is an inevitable characteristic of the industry, and that the unavoidable outcome of this competitive approach is increasing levels of congestion. Peak load pricing is a necessary requirement for the smooth functioning of the system. In adopting it, some sort of auction approach must be employed, and there must be the recognition of the need to subsidize off-peak users in order to manage the demands for the use of scarce infrastructure facilities.

FOOTNOTES

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JET-SET: JEU EDUCATIF AND TRANSPORT/ SIMULATION FOR EDUCATION IN TRANSPORTATION

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ABSTRACT

JET-SET has been prepared to serve as a management and training tool for professionals in the interurban passenger transportation industry. It is a computerized game in which six (6) transportation companies owned and managed by players or teams of players compete in a simulated market environment. The simulation program is composed of four principal components: an operation model, a transportation model, a fleet model and a budget model. The current version of the program operates on the Apple IIe but a second version will soon be available on the IBM-PC.

INTRODUCTION

The interurban passenger transportation industry plays a major economical and social role, both at the provincial and at the national or international levels. This industry now more than ever constitutes the back bone of a diversity of professional, commercial, industrial, scientific and social activities that require individuals to travel. As with many other sectors, this industry suffers from the current economic situation and several companies are now facing severe problems.

While some of these problems are explained by the economic situation, others are caused by the following: poor management, low/high governmental involvement, severe competition or effect of monopolies on regional carriers, cost of labour. The transport companies are facing multiple problems. The overall and detailed comprehension of the complex environment in which they operate represents a challenge. The decision making process relates to different levels: from medium to long term planning to strategic management and short term operational procedures.

The managers work with very few tools to analyse their particular situation and to make decisions. Research in the passenger interurban transportation area has been quite weak. Mathematical models are available to simulate and predict the transportation demands aggregated by mode between different city pairs. However,

these models are not very useful to the transportation companies when the time comes to decide about the level of service they should offer between city pairs, to plan the purchase or lease of vehicles, to request loans, to initiate promotion campaigns, to prepare and evaluate the strategies of competing companies in a sensible market place in constant evolution, and to adapt to the variation in the price of oil.

This paper presents a computerized system prepared for teaching individuals to operate in complex situations like the one previously summarized. The program, named JET-SET (Jeu Educatif en Transport/Simulation for Education in Transportation), has been prepared as a game to help familiarize participants to the internal dynamic behaviour of the interurban passenger market. It will also allow the players to experiment on the effects of their decisions and that of their competitors. JET-SET has been designed for the specialized training of planners or managers in the field of interurban passenger transportation and for the training of students interested in this area.

JET-SET has been developed by the Centre de recherche sur les transports de l'Université de Montréal, under the direction of Christian Lardinois. The development was realised for the George A. Scott Centre of Transport Canada, with the managerial and financial support of the Transportation Development Centre of the same ministry.

The next section presents the basic but essential elements that guided the development of JET-SET; these elements are related to the decision making process in interurban passenger transportation and to the environment in which companies operate when making these decisions. The following sections present the objectives of the game, its functions and the structure of the program. Then the simulation program and the transportation model are described, detailing the route choice and assignment procedure. The conclusion briefly describes the initial user trial, resulting improvements and its potential uses.

DECISION MAKING PROCESS AND ITS ENVIRONMENT

As in many other industrial sectors in an interurban passenger transportation company, decision making is characterized by:

- the multiplicity and diversity of decisions;
- the necessity to make decisions at different levels;
- the high level of interaction between all the decisions;
- the necessity to work in a complex environment which has direct and indirect impacts on decision making.

Figure 1 illustrates this situation. Decisions apply in the first place on the definition of a supply

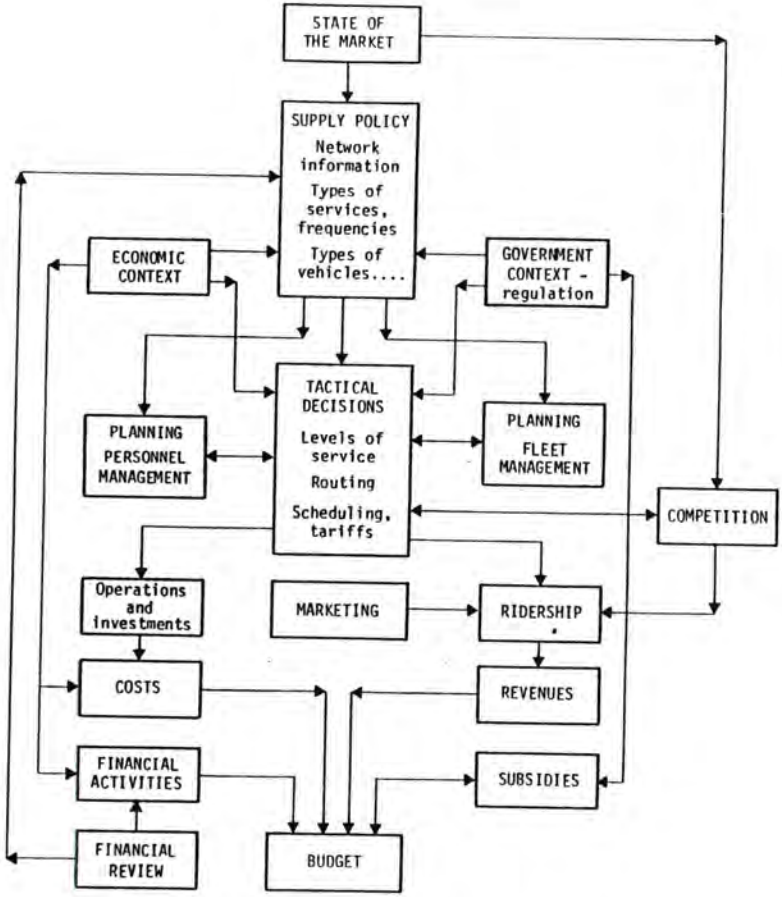


Figure 1: The decision making process in interurban passenger transportation

policy, that is the network configuration, the types of services between each city pair, the frequencies, etc. This network design must take into consideration the state of the market, the demographic trend, the transportation demand, the importance of each mode and each company, etc. It should also consider the economic context (cost of energy, inflation rate, labour cost,...), the government context (transportation policies, support to some modes in particular, regulation,...) and the financial status of the company.

The orientations and choices adopted at this level must be taken for long, medium and short terms and must be related to the planning activities for the development of the company. This procedure will enable the company to introduce services that it desires now as well as others in the coming year. Analyses are necessary at this level to plan the development or the replacement of the vehicle fleet, the hiring or training of personnel, etc.

However, it is mainly at the operational and more tactical levels that questions are raised regarding availability of human and material resources for the company. This level of tactical decisions is the one at which the company decides in detail the level of service to offer between city pairs. In consequence, its multiple operations are organized, taking in consideration the seasonal weekly and daily variations of the transportation demand. The schedules and the capacities assigned to

these schedules are defined; the routing and scheduling procedures are outlined; the assignment of each vehicle category and the personnel for these services is managed; the maintenance activities are organized; the tariffs are chosen. These actions are undertaken, while considering the government's regulations and the competition that other modes or companies exert. These decisions interact with each other; they all influence human and material resources required to ensure the services and vice versa.

The company must evaluate the financial implications on the one hand and the possible effects on the market on the other hand, before choosing its levels of service. The financial implications relate to the operating costs but also to the investments required for the potential acquisition of new equipment. While forecasting, the company must also consider marketing strategies and competing mechanisms that rule the market behaviour.

Lastly, considering its investments, operating costs and operating revenues, the company must manage a budget which often also includes other categories of revenue, and expense for example, government subsidies, revenues related to sales on board of vehicles, taxes, R&D expenses. In addition, the company has access to financial tools such as loans that must be planned in parellel with its investments and its obligations to balance its budget. However, these tools are limited as they are

governed by the financial market (interest rates, credit limit,...).

The process illustrated in Figure 1 is continuous and reiterates from one year to another within each company. The company is operating in a market environment which is determined by the other companies' strategies, but also determined, as mentioned earlier, by the economical context such as the government policies and regulations. In order to plan and manage its activities, each company relies in part on its own historical development; in general, the evolution of its position in each market segment procures a good indication on potentially interesting adjustments on the service to be offered. The company can also use, but less frequently, information systems and performance indicators in order to account and control several components of its operating costs and revenues, to evaluate profits and costs of its investments and to prepare more detailed forecasts.

Managers and planners in the interurban passenger transportation industry (including government managers in charge of policies and regulations) have an arduous task in an environment where they possess few tools with which to grasp the multiple effects of their decisions, apart from their own personal experience. No method or instrument exists to analyze and forecast, in a completely integrated and detailed manner, the correlated effect of all decisions, of the economical contingency

regulation and of the market behaviour, of the companies productivity/competition and of the financial health of these companies.

JET-SET; ITS PHILOSOPHY AND ITS OBJECTIVES

Decision making in interurban passenger transportation represents a difficult task that requires more sensibility to the social and political context than scientific and rational considerations. However, the question that remains to be answered is how to train those individuals in order to help them make better decisions in complex situations. In an attempt to answer this question, this computerized management training game has been prepared.

The objective of the JET-SET package is to create game situations that:

- reproduce, to a great extent, the complexity of the situations in which the interurban passenger transportation companies have to evolve;
- enable the participants to make diverse and interrelated decisions as the ones encountered in practice;
- enable the participants to experiment progressively with the effect of their decisions, the effect of those taken by their competitors and the effect of the economical and regulative environments;

- sensibilize the participants to the underlying market dynamics of interurban passenger transportation, and particularly to the interactions between competing modes, as well as to the mechanisms that determine the equilibrium between transportation supply and demand.

The current version of the game considers most of the mechanisms and interactions illustrated in Figure 1. Simplifications have been made to the detailed management of operations; in particular, specific routes and schedules are not examined in JET-SET[1].

FUNCTIONS OF THE GAME

JET-SET is a computerized game in which six (6) transportation companies compete: one conventional train company, one rapid train company, two traditional bus companies and two air companies one offering STOL services.

At the beginning of a match, each company is in a predetermined financial situation and owns a fleet of vehicles with given techno-economical characteristics (price, capacity, operating costs, age...). Each company also has a specific market share between each city pair that it serves. The complete network includes seven (7) cities, each company has a direct service between 6 of the 21 possible pairs.

Each player (or team of players) owns one of these

six companies and manages it individually. In this regard, the player is required to make several decisions concerning his/her company: level of service offered between each city pair (frequencies and fares), purchases or leases of vehicles to enlarge the fleet or to replace old vehicles, loans or debts repayments,... The player can also decide to initiate special projects, such as promotional campaigns or market studies. Each player must make these decisions at the beginning of each year, using the information contained in the activity report that he/she receives at the end of the previous year (see Figure 2).

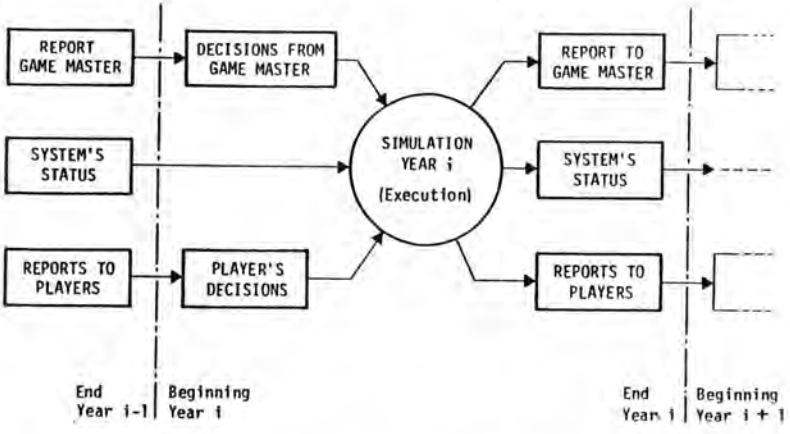


Figure 2: Functions of the Game

The information contained in these reports concern the company: its operations during the year that is terminating, the composition of the vehicle fleet, its

ridership, its operating costs and revenues, the occupation level of the vehicles in operation, the costs of its investments and of its banking activities, its financial situation, its credit limit, and the number of vehicles on order. Other information is also presented in the report illustrating the economic, demograhic and financial context: population per city, interest rate, variations in salaries and energy cost, taxation rate and subsidy rate. Regulatory agencies impose constraints on permitted variations in the levels of service. Additional information is given to the players requesting special projects. This information constitutes a means for a player to analyse in more detail, the environment in which he/she is operating and helps him/her to make decisions for the following year.

A seventh character, as important as the six (6) players(*) intervenes in JET-SET. This is the "game master" who plays the role of the government with the power to influence the evolution of the economic, financial, regulatory and demographic(**), context.

The game master receives, at the end of each year, a report informing him of the status of the transportation network, the market shares of each company, their respective performance, etc. On the basis of this infor-

(*) the number of players can be less than six (6).

(**) through immigration policies, for example.

mation, the master will make decisions to vary some indicators such as the demographic growth rate, the salaries and energy costs, the government subsidy rate, the interest rate. The game master also regulates the permitted variations in the level of service.

The players and game master's decisions are then used as input into the computer program, which creates and evolving artificial environment, within which six companies are simultaneously present (as well as the car which is always present but not controled by any player). The program simulates the multimodal transportation network as well as the behaviour of the users of this network. The program also represents the companies' operation, simulates the evolution of their vehicle fleet and determines their annual budget in relation to their financial status updating. The following section concisely describes these mechanisms.

Each execution of the computerized program simulates one year of activity for all the companies, representing the consequences and interactions of the players' decisions and the choices made by the game master. After the execution of the program, the companies face a new situation which corresponds to the status of the system a year later, which is a new equilibrium between the supply and demand of the six transportation companies. New reports are handed out to the players and the master, and so forth. A complete game covers

a series of simulated years in such a manner that the evolution of each company depends directly on the decisions taken by the players that manage it but also, indirectly by the decisions taken by other companies as well as by the game master. Each player works with the objective of gradually enhancing their decision making capability while experimenting with the dynamic mechanisms of the market.

PROGRAM'S STRUCTURE AND COMPUTER SYSTEM

As illustrated in Figure 3, the program is structured in three (3) major components:

- A data bank grouping several files containing all the information which describes the system's status at the beginning of a match, as well as the status as it evolves.
- A simulation program, computerized, that solves several mathematical models, following a well defined procedure. This procedure describes the relationship between all the system's variables including the complete transportation network on one hand and the individual company's on the other hand.
- An interface between the user and the data bank; a "user friendly" interactive program that enables easy dialogue for the collection of the players' and the master's decisions, for the updating of

the data files and for the editing of the output reports. This interactive program also allows the simulation program execution to be controlled.

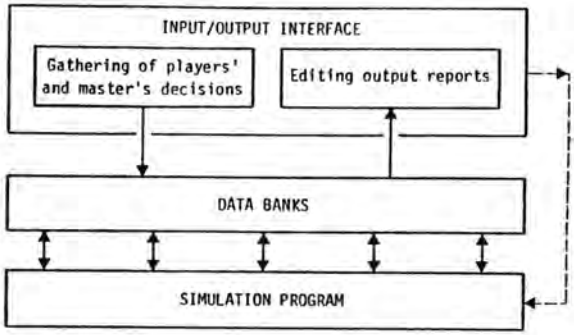


Figure 3: General Structure of the Program

The program is implanted on an Apple IIe microcomputer, and has been written in Pascal. In the near future a version will be prepared for the IBM-PC.

The interface between the user and the program constitutes a key element that characterises the facility and the flexibility of utilizing JET-SET. The presentation of the interface would be too tedious in the context of this paper but the simulation program, particularly the transportation model, needs to be detailed.

THE SIMULATION PROGRAM

The series of operations executed in order to simulate one year of activities for all the companies is schematized in Figure 4. Four (4) principal components

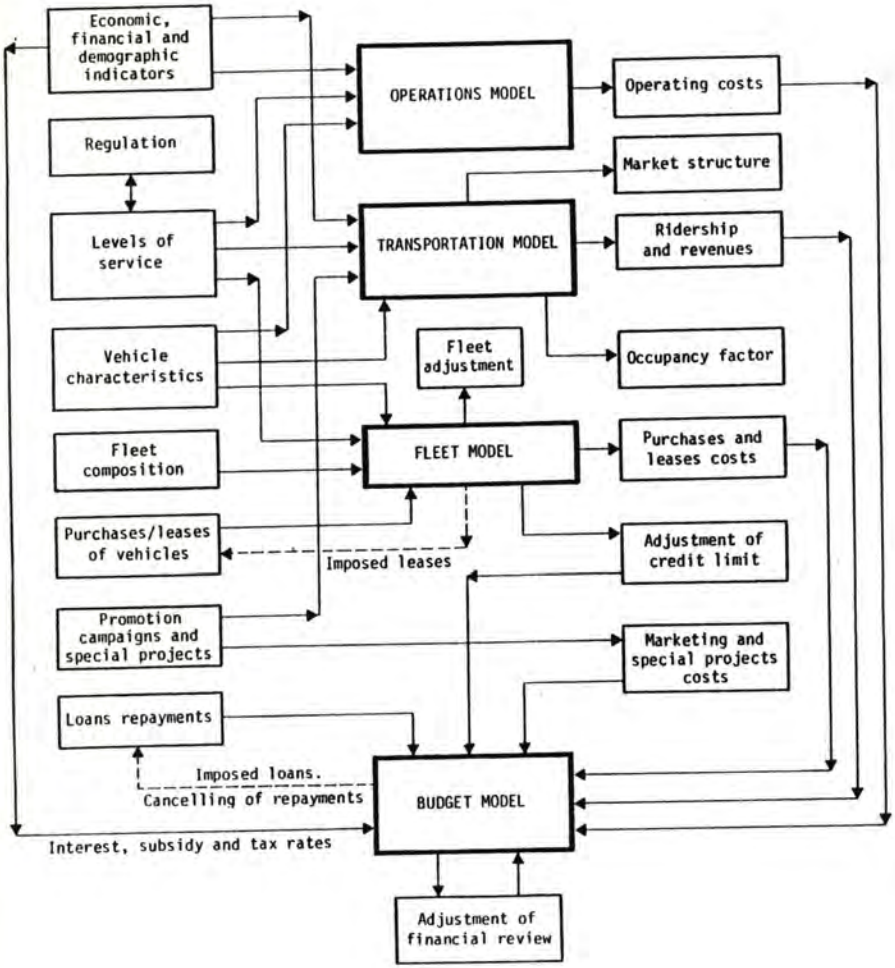


Figure 4: Schematic of the simulation program structure

The operation model is the simplest of all four. Using the techno-economic characteristics of vehicles and the offered levels of service, it accounts for the physical operations of the companies and evaluates their costs. It should be noted that for similar services from one year to another, these costs can vary as functions of the energy costs and salaries.

The transportation model, detailed in the following section, is the heart of the program. It simulates the complete network, the transportation demand, and the behaviour of passengers on the network, in order to obtain the ridership of each company between each city pair and,consequently,the vehicles occupation rates, the detailed market structure and the operating revenues.

The fleet model has four (4) major functions. The first function is to proceed to an annual adjustment of the vehicle fleet, to increase the age of all vehicles by one, to shelve the vehicles that attained the retiring age, and at the same time introduce new vehicles in the fleet to replace the retired vehicles, including those that were ordered previously but for which the delivery was delayed. The second essential function of the fleet model is to verify the compatibility between the fleet size and the offered services: if a company does not have a sufficient number of vehicles to ensure the ser-

vices that it offers(*), the program automatically applies the "impoased leases" policy, forcing the company to lease additional vehicles with a financial penalty. The third function is to update the credit limit of the companies on the assumption that the banks determine these limits as a function of the value of the fleet. The fourth function is the registering of the costs of all purchases and leases of vehicles.

The budget model is a simulation procedure of the financial activities of each company at the beginning and at the end of each year. At the beginning of the year, when companies proceed with purchases, leases, loans and/or repayments, the program verifies if the companies are capable of doing such operations considering their financial situation; if it is not the case, the program will impose additional loans on some companies (at a higher rate than the regular loan rate) and/or postpone repayments. This "imposed loan" rate also applies to companies that want to borrow beyond their credit limit. The program is then used to prepare the budget of each company at the end of a year. All other costs and revenues are then assembled: operating costs, interest to pay, marketing campaigns and special project costs, operating revenues, government subsidies and interests received; the taxes to pay are computer and companies

(*) The required number of vehicles is based on the daily peak period of the transportation demand.

that do not dispose of sufficient financial resources to pay all the expenses are forced again to make an "imposed loan" and/or cancel repayments.

THE TRANSPORTATION MODEL

The transportation model can be broken down into two models (refer to Figure 5): demand model which determines the transportation demand between each city pair, and the route choice and trip assignment model which simulates passenger behaviour on the network while considering the imposed restrictions of the offered capacity.

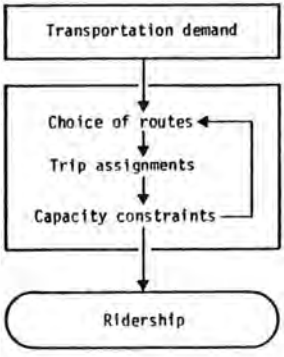


Figure 5: Transportation Model's Structure

The demand model and the routing choice component of the second model have mathematical formulations that originate from the linear log forms of total demand models and market share models discussed by Gaudry and Wills[2]. The essential difference relies on the replacement of the concept of "mode choice" by the one of "route

choice"(*) (or "path choice").

1. THE DEMAND MODEL

The transportation demand T_{ij} between two cities i and j is estimated with a gravity model that has the following form:

$$T_{ij} = \alpha_0 (P_i, P_j)^{\alpha_1} . L_{ij}^{\alpha_2} . S_{ij}^{\alpha_3}$$

with α_0, α_1, α_2, and $\alpha_3 > 0$ (Eq.1)

where α_0, α_1, α_2, and α_3 are parameters,

P_i and P_j are the populations of cities i and j, L_{ij} is the linguistic index that measures the linguistic homogeneity of cities i and j, and S_{ij} is a measure of the level of service offered between i and j; this measure is defined as follows:

$$S_{ij} = \sum_{k \in L_{ij}^*} U_{ijk}$$

with $L_{ij}^* \subset L_{ij}$ $\quad U_{ijk} = \gamma_{ijk} \cdot C_{ijk}^{\beta_1} \cdot D_{ijk}^{\beta_2} \cdot F_{ijk}^{\beta_3}$

with $\beta_1, \beta_2 < 0$ and $\beta_3 > 0$ (Eq.2)

where U_{ijk} is defined as the utility(**) of the path k between i and j, L_{ij} is the set of all "possible" paths

(*) This substitution and the specific data characterizing the particular configuration of our network required adjustment to the parameters estimated by Gaudry & Wills.

(**) U_{ijk} can be interpreted as the inverse of the generalized cost of transportation.

k between i and j, L_{ij}^{*} is the sub-set of four paths that are the most used, C_{ijk} is the transportation cost between i and j by the path k, D_{ijk} is the travelling time characterizing the path (i,j,k), F_{ijk} is the frequency of service on that same path, and β_1, β_2, β_3 are three parameters determining the utility elasticities regarding cost, time and frequency.

It should be understood that "possible" paths are the ones that satisfy certain criteria of plausibility; in particular, all paths that require more than one transfer from a service to another are excluded, but we consider several paths that require one transfer, for example, from i to l using company X, then from l to j using company X. There is a total of over 400 paths considered throughout the network of 21 cities. It should also be understood that for paths with a transfer, the transfer costs and the transfer times from a service to another are taken into consideration in the variables C_{ijk} and D_{ijk}. In order to avoid an unrealistic increase of the demand T_{ij} when companies raise very significantly their levels of service, the gravity relation presented previously (Eq 1) has been restricted asymptotically for large increases of S_{ij}.

2. ROUTE CHOICE AND TRAFFIC ASSIGNMENT MODEL

In the absence of congestion (supposing that there

are no problems relating to capacity constraints), the transportation demand T_{ijk} related to each possible path k between two cities i and j is presented in the following relation:

$$T_{ijk} = (U_{ijk}/U_{ij}) \cdot T_{ij} \qquad \text{(Eq.3)}$$

with $U_{ij} = \sum_{k \in L_{ij}} U_{ijk}$

where U_{ij} is defined as being the "aggregated utility" of the set of possible paths to travel between i and j. (U_{ijk}, T_{ij} and L_{ij} are defined in section 1).

It should be noted that if a company (or companies) operating on a path k between i and j reduce considerably their tariffs(*), the utility U_{ijk} of that path can become very important, to such an extent that the company can dominate almost the whole market between i and j; such a situation, even though not probable, is not impossible. On the other hand, if the frequency of service is augmented considerably for one reason or another, there is a limit to the attractiveness of such an increase on the public; also, the relation that defines the utility U_{ijk} (Eq 2) has been restricted asymptotically for all large increases of frequency F_{ijk}.

Equation 3 solves the problem of simulating the route choice when the network is not congested. It expresses that the travellers try to utilize possible

(*) At the limit, in JET-SET, a company can offer some free services.

paths as a function of their respective utilities. The transportation demand d_a on each arc a of the network(*) is presented in the following assignment formulation:

$$d_a = \sum_{ijk} T_{ijk} \cdot \dot{\Theta}^{q}_{ijk} \qquad \text{(Eq 4)}$$

where φ^{a}_{ijk} = 1 or 0 depending if the arc a belongs or not to the path k between i and j. This assignment procedure does not account for capacity constraints $d_a \leq \rho_a$ where ρ_a represents the offered capacity on arc a. In other words, this procedure does not account for the fact that some passengers can be turned down due to lack of space on the arcs that compose the path that they want to use. To solve this problem, we utilize a route choice and assignment procedure that is iterative and that can be summarized as follows:

- **Step 0**: For each arc a, v_a = accepted volume on a = 0.
- **Step 1**: Knowing T_{ij}, we simulate the route choice (Eq 3) on the network (Eq 4), obtaining values of d_a of the "additional" demands. The demand affected on each arc is $D_a = v_a + d_a$.

(*) An arc is defined by two extremities (two cities) and by a company that serves directly those two cities. For example, the arc a = (u,w,x) is the arc of the network that represents the service offered by the company x between cities u and w.

- **Step 2**: On each arc a where the demand D_a is greater than the capacity ρ_a, we determine the proportion of the additional demand d_a that is excessive. This proportion is $f_a = (D_a - \rho_a)/d_a = (D_a - \rho_a)/(D_a - v_a)$

- **Step 3**: We make the hypothesis that the probability to be rejected on an arc is the same for all travellers that want to use that arc, whatever path (i,j,k) each traveller wishes to use. This hypothesis enables the model to calculate the number of E^a_{ijk} travellers on a path (i,j,k) that exceed the capacity of an arc a; we have:

  $E^a_{ijk} = T_{ijk} \cdot f_a \cdot \Theta^a_{ijk}$

- **Step 4**: We determine the number of E_{ijk} travellers exceeding the capacity of each path (i,j,k). If this path is composed of two arcs a and b, we have(*):

  $E_{ijk} = \text{Max}\ (E^a_{ijk};\ E^b_{ijk}) = T_{ijk}\ \text{Max}\ (fa\ ;\ fb)$ (Eq. 5)

  because if the arcs a and b take on $T_{ijk} - E^a_{ijk}$ and $T_{ijk} - E^b_{ijk}$ respectively; this means that together they take on a number of passengers equal to:

  $$\text{Min}(T_{ijk} - E^a_{ijk};\ T_{ijk} - E^b_{ijk})$$

  that is $\left[T_{ijk} - \text{Max}(E^a_{ijk};E^b_{ijk})\right]$ passengers. Obviously, if the path is composed of a single arc a, we have: $E_{ijk} = E^a_{ijk}$.

(*) We suppose that all paths formed of more then two successive arcs are not possible paths.

- **Step 5:** On each path, passengers are rejected when in excess. We obtain the flux v_a accepted on each arc a:

  $$v_a = D_a - \sum_{ijk} E_{ijk} \cdot \theta^a_{ijk}$$

  the transportation demand that "exceeds" between each city pair is presented as follows:

  $$E_{ij} = \sum_{k \in L_{ij}} E_{ijk} \qquad (Eq.\ 6)$$

  This "exceeding" demand is a demand that needs to be redistributed in the network after eliminating all arcs that are saturated, i.e. arcs where the capacities ρ_a are exactly attained.(*).

Note: To prove the convergence of this algorithm, it is sufficient to prove that at step 5, there is always at least one arc a on which the exact offered capacity is reached, after substracting all exceeding flux. The demonstration follows:

Amongst all the arcs on which there is exceeding flux (see step 2), there is always at least one arc a on which the exceeding proportion f_a is superior to the proportions fe calculated on other arcs e. In other words, there is always an arc a such that:

$fa \geqslant fb$ for any arc b

For that arc a, there is always (Eq 5):

$$E_{ijk} = E^a_{ijk} = T_{ijk} \cdot fa$$

(*) We suppose that vehicles are saturated at 90% of their capacity.

for all paths (i,j,k) using this arc.

Equation 6 becomes:

$$V_a = D_a - \sum_{ijk} T_{ijk} \cdot f_a \cdot \theta^a_{ijk}$$

$$= D_a - f_a \cdot \sum_{ijk} T_{ijk} \cdot \theta^a_{ijk}$$

$$= D_a - f_a \cdot d_a = \rho_a$$

CONCLUSION

The multiplicity and diversity of decision made in order to manage the interurban passenger transportation companies render the manager's tasks extremely arduous, especially as the effects of decisions interact between each other. This complex process is a continuous and iterative process that repeats itself in a market environment determined by the strategies of other companies and/or other modes, but is also determined by the socio-economical and political content and by regulations.

The computerized management training game JET-SET presented in this paper enables the learning of these complex situations that characterize the interurban passenger transportation field. It is aimed at training transportation planners and managers, and in addition, students interested in this area.

A preliminary version of the program was run during the fall of 1984, at the George A. Scott Institute of Transport Canada, during senior transportation management course. This first trial was excellent although the

program presented a few weaknesses: the transportation professionals that participated in this course were in general satisfied with the didactic and scientific qualities of the system. Their criticisms enabled us to better orient our subsequent developments that brought us to this current version.

In a context where planners and managers of transportation companies do not have any choice but to enhance the competitiveness and the productivity of their company, the use of such specialized techniques seem very suitable and desirable. This applies equally in a governmental context where there is a requirement for adequate knowledge of the market and transportation environments in order to generate policies. Using the scientific qualities of transportation models together with didactic capabilities of micro-computers, tools like JET-SET are a step in the right direction.

ACKNOWLEDGEMENT

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HOW TO QUANTIFY THE IMPACT OF REGULATORY REFORMS ON AIRPORT FACILITY REQUIREMENTS - CATA'S AIRPORT PLANNING MODELS

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ABSTRACT

This paper presents an overview of the current methodology and techniques used by the Canadian Air Transportation Administration (CATA) for the functional planning and demand/capacity evaluation of airport terminals. The main steps involved in the application of the methodology are described along with the relevant planning techniques and standards to be used for each step. The relevant aspects and possible implications of the new Canadian air policy are outlined together with a quantification of the impact of a possible change in an air carrier operational strategy on terminal facility requirements using some of these techniques.

1. NEW CANADIAN AIR POLICY

In 1984 the Government of Canada announced a new policy to liberalize the economic regulation of commercial air services in the mature part of the Canadian air transportation system (Southern Canada). The policy, which represents the first phase of a long-term plan to gradually eliminate air regulation, aims, inter alia, at providing travellers with a wide range of price-service options, stimulating air travel growth, improving the efficiency and productivity of the airline industry, and encouraging innovation. Among other changes, the new program[1]:

1. repeals the policies that set aside certain markets for particular air carriers, thereby allowing any new or existing carriers to apply for a licence to serve any domestic route using any type of certified equipment.

2. removes restrictions (frequency of non-stop and turn-around services and kind and size of aircraft) on the unit-toll (scheduled service) licences of the National and Regional carriers, and on the unit-toll licences of Local carriers for services in Southern Canada. The airlines are encouraged to apply to the Canadian Transport Commission (CTC) for consolidation of these licences.

3. reduces the barriers to new entry to scheduled passenger and all-cargo services by directing the CTC to give much greater weight to the benefits of increased competition in judging the licensing requirements of public convenience and necessity, in relation to particular licence applications.

4. provides much freer entry to charter services by calling on the CTC to exempt applications for such services from the requirements of public convenience and necessity.

5. encourages new entry by calling on the CTC to grant freedom of exit to incumbent carriers faced with new entry, and to conduct an inquiry on whether carriers, having withdrawn their services, should retain the freedom to re-enter at any time.

6. promotes lower fares and increases competition by announcing the Government's intent to give the scheduled airlines, starting no later than 1986, unlimited freedom to reduce their fares and to limit price increases to an objective measure of the rise in the price of their factors of production. The long-term deregulation plan also envisages removal of the mandatory booking and travel restriction on Advance Booking Charters (ABC's), thus stimulating further competition by ABC operators, particularly in transcontinental scheduled air services.

7. commits Transport Canada to giving new entrants and competitors fair access to congested airports during peak periods.

2. IMPLICATIONS TO AIRPORT INFRASTRUCTURE REQUIREMENTS

The new air policy will likely place increased demands on the Canadian airports system as the frequency and nature of present air services may change. A number of new carriers (e.g., third-level/commuter airlines) may emerge, which

could, at some airports, require expansion of existing airport facilities. Airport traffic peaking will likely be intensified as a result of attempts by incumbent and new carriers to concentrate their flights during peak periods and to synchronize an increased number of feeder aircraft operations with mainline flights, particularly at large/hub airports (hub-and-spoke).

It is also expected that carriers' corporate strategies will be aimed at rationalization of their services through route restructuring, hub strengthening, optimization of frequency of service and aircraft fleet mix, and cost-cutting for greater efficiencies in order to survive in the new deregulated environment. This will lead to changes in the type (size) of aircraft serving a given airport and the flight arrival/departure pattern. In addition, possible lowering of air fares, elimination of current restrictions on charter travel and increased airline competition will promote growth in the demand for air travel, hence further increases in airport traffic activities.

These consequences will collectively conspire to place significantly different and expectedly greater demands on the various operational and infrastructure facilities of a given airport. Their impact can be quantified through use of detailed planning methodologies and computer analysis techniques capable of handling the complexity of airport operations and the intricate process of passenger and baggage flows through the airport terminal.

3. FRAMEWORK OF THE AIRPORT PLANNING METHODOLOGY

The airport terminal planning methodology and techniques described in this paper have been developed for use by airport planners to quantify the design traffic demands; to assess the terminal subsystem capacity utilization, level of service, and facility requirements; and hence to estimate expenditures in airport facilities.

An airport is considered to consist of four broad systems:
- Taxiway/Runway System,
- Gates and Terminal Apron,
- Air Terminal Building (ATB) Complex, and
- Ground Access (road system, curb, parking facilities).

A number of computerized models have been developed at Transport Canada for analyzing on a system basis the traffic flow and demand/capacity equilibrium for all of the functional components of the above four systems. Due to space limitation, this paper will deal only with the gates and the ATB complex. Exhibit 1 outlines the framework of CATA's airport terminal planning methodology[2]. Its basic steps are described briefly in sequence in the following Sections of the paper.

4. INITIAL TERMINAL DEMAND/CAPACITY ANALYSIS

The first step of the terminal planning process involves quantification of the need for additional airport facilities by conducting an initial demand/capacity analysis and performing a level of service evaluation based on CATA's level of service standards. A number of computer models have been developed to assist in this task. These analyze existing passenger and aircraft traffic flows and peaking

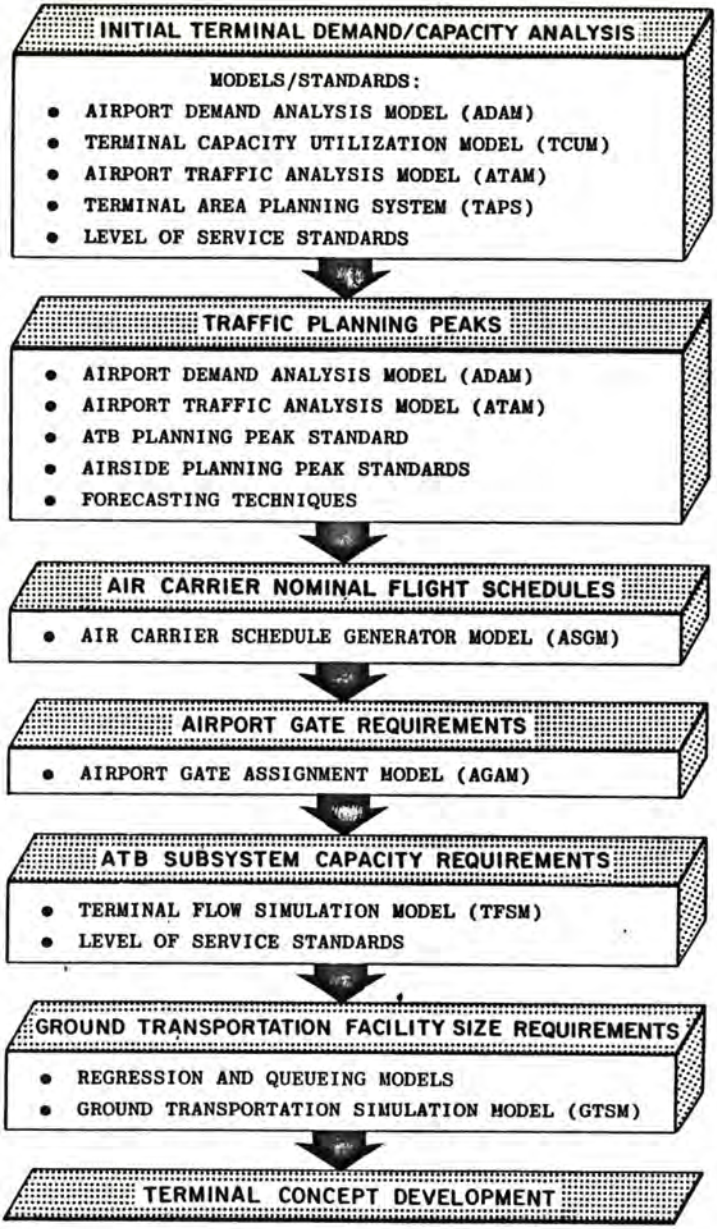


EXHIBIT 1 FRAMEWORK OF THE TERMINAL PLANNING METHODOLOGY

patterns, and evaluate the present and future demand/capacity equilibrium and level of service of the major ATB subsystems and the terminal as a whole. One of these models is described below.

THE AIRPORT DEMAND ANALYSIS MODEL (ADAM)[3]:

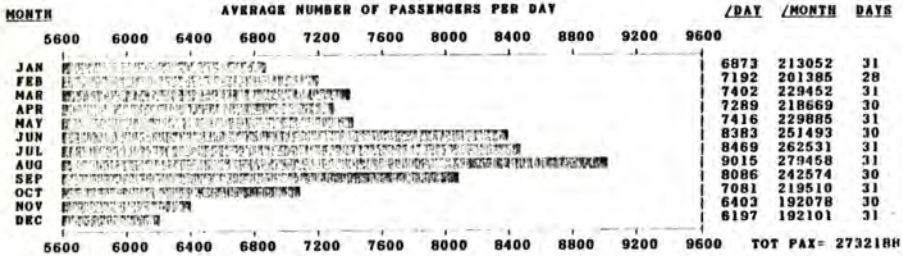
This computer model quantifies and displays airport traffic flow distributions and peaking patterns. The output from ADAM is used to develop detailed airport terminal planning peaks and to compare the overall airport capacity to the traffic demand. The airport traffic flow distributions depict, in tabular and graphical forms, the seasonal (quarterly and monthly), daily, hourly and half-hourly variations in passenger traffic as well as aircraft movements (and total seats) at any airport.

The historical raw data used to arrive at this information are assembled once a year for the top 30 Canadian airports from the computerized CATA Station Activity Data Base which contains detailed information on every arriving and departing mainline unit-toll flight at each airport in Canada. Up to fifteen combinations involving five traffic sectors [domestic, transborder (Canada-USA), other international, total international, and total of all sectors] and three travel directions (enplaning, deplaning, and enplaning plus deplaning) can be synthesized by the model and analyzed in one run. The model will supply the following outputs for passenger traffic (and aircraft traffic, if desired) for any year since 1976, for any of the fifteen traffic sector-

PEARSON INTERNATIONAL AIRPORT — TERMINAL 2

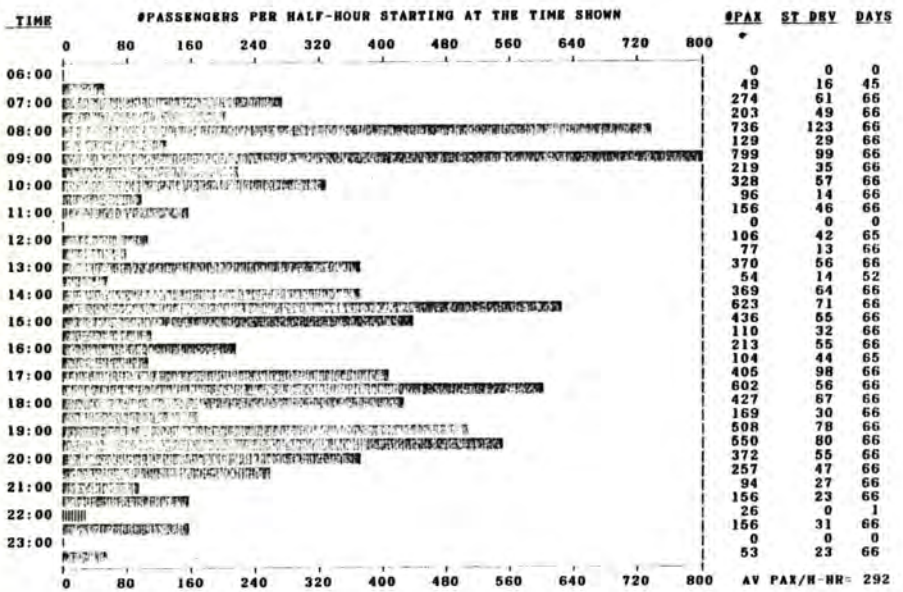
SUMMARY OF TRAFFIC PEAKING ANALYSIS - 1982 ENPLANING DOMESTIC SCHEDULED PASSENGERS

PRODUCED BY THE AIRPORT DEMAND ANALYSIS MODEL (ADAM)



SEASONAL DISTRIBUTION OF PASSENGER TRAFFIC

EXHIBIT 2



PEAK 3-MONTH HALF-HOURLY COMPOSITE PROFILE OF PASSENGER TRAFFIC (WEEKDAYS)

EXHIBIT 3

direction combinations and for any airport included in the Station Activity Data Base:

- A distribution of the traffic demand volume handled each day throughout the year along with pertinent aggregate (annual) measures of traffic activity in terms of total and average demands and periods of utilization.
- Tabular and graphical representations of the seasonal distribution of traffic. Exhibit 2 is an example of a monthly distribution.
- A listing of the half-hourly (and hourly) traffic demand throughput for each day of a user-specified peak season, together with a graphical display of the corresponding composite 30- and 60-minute traffic flow profile representing that season (Exhibits 3 and 4). The composite demand profile is the average of all daily profiles in the time period selected by the user. Six selection options are available: peak month, peak two consecutive months, peak three consecutive month, peak quarter, peak n (user-specified) consecutive days, and any user-chosen date or period of the year. (The model itself determines these peak periods.)

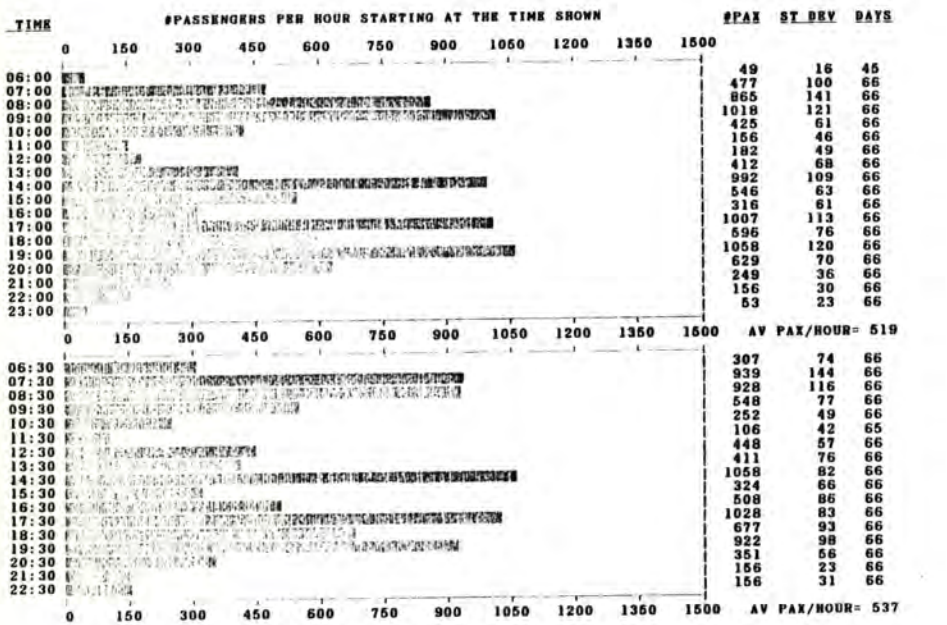
  For any period specified, the model generates four optional composite profiles: one representing a user-specified day of the week (e.g. Fridays), one reflecting the busiest day of the week, one excluding the weekends, and a fourth representing all days of the week.

  The hourly composite profile (Exhibit 4) is produced with

PEARSON INTERNATIONAL AIRPORT - TERMINAL 2

SUMMARY OF TRAFFIC PEAKING ANALYSIS - 1982 ENPLANING DOMESTIC SCHEDULED PASSENGERS

PRODUCED BY THE AIRPORT DEMAND ANALYSIS MODEL (ADAM)



PEAK 3-MONTH HOURLY COMPOSITE PROFILE OF PASSENGER TRAFFIC (WEEKDAYS)

EXHIBIT 4

SUMMARY OF TRAFFIC PLANNING PEAK ANALYSIS

PLAN'G PEAK PERIOD	PEAK START TIME	PEAK VALUE (PAX)	#TIMES IN THE YEAR WHICH EXCEED THE PLAN'G PEAK NO.	%TIME	%PAX	#TIMES IN THE YEAR WHICH EXCEED 1.5 X PLAN'G PEAK NO.	%TIME	%PAX	#TIMES IN PEAK SEASON WHICH EXCEED THE PLAN'G PEAK NO.	%TIME	%PAX	#TIMES IN PEAK SEASON WHICH EXCEED 1.5 X PLAN'G PEAK NO.	%TIME	%PAX
DAY		9170	41	11.2	14.5	0	0.0	0.0						
1/2 HR	9:00	799	101	0.9	3.2	0	0.0	0.0	62	2.2	6.7	0	0.0	0.0
HOUR	19:00	1058	224	3.5	9.5	0	0.0	0.0	123	7.6	17.4	0	0.0	0.0
		*1058	219	3.6	9.4	1	0.0	0.0	90	5.8	12.7	0	0.0	0.0

90TH PERCENTILES OF ANNUAL TRAFFIC .... => DAY: 9451 1/2 HOUR: 643 HOUR: 1054/1050*

90TH PERCENTILES OF PEAK SEASON TRAFFIC => 1/2 HOUR: 735 HOUR: 1107/1080*

NOTE: FLIGHTS SCHEDULED EARLIER THAN 6:00 A.M. ARE NOT INCLUDED IN THE ABOVE TABLES AND GRAPHS
PEAK SEASON (3 MONTHS) IS JUN-JUL-AUG * MID-HOUR TO MID-HOUR (E.G. 7:30 - 8:29) ANALYSIS

EXHIBIT 5

the 60-minute interval starting at the beginning of the clock hour and at the half-hour, thus capturing any uneven half-hourly distributions of traffic flow within the hour and ensuring that the resulting airport planning peaks generated from these profiles are realistic.

- Ranking of the days of the year by daily traffic volume to produce tabular and graphical (cumulative) distributions showing the "traffic percentile" and the "nth" highest day corresponding to each daily traffic volume. Similar outputs are produced for the half-hourly and hourly throughputs, for the whole year, and for any peak season, with the hour starting at the beginning of the clock hour and at the half-hour mark.
- Values of the planning peak day, hour, and half-hour, as determined from composite profiles in accordance with the soon-to-be-promulgated new ATB Planning Standard[4]. These values are evaluated in terms of how often and by what percentage of total passengers each is exceeded (Exhibit 5). This evaluation is conducted with respect to the traffic flow throughout the year as well as during the peak season of traffic activity. It involves assessment of not just those days/hours/half-hours when traffic volume is greater than the planning peak but also those days/hours/half-hours when traffic volume exceeds the planning peak by more than 50 per cent. An evaluation of such instances are critical to the orderly functioning of the ATB being planned. Values of these peaks based on

the existing interim (90th percentile) ATB Planning Standard[4] are also produced by the model in Exhibit 5 for comparison.

- The model also synthesizes the traffic flow profile associated with an existing or future (forecast) daily flight schedule.

5. TRAFFIC PLANNING PEAKS AND NOMINAL SCHEDULES

The second step of the terminal planning methodology involves determination of the passenger and aircraft traffic planning peaks (peak day, peak 6-hours, peak hour, and peak half-hour) using the Airport Demand Analysis Model as outlined above. Forecasting techniques are applied to project on a system-basis future traffic activities at all Transport Canada airports and to estimate the future values of these planning peaks.

The next step involves development of a forecast daily schedule of commercial flights for the planning or performance evaluation of the airport under consideration. Such a planning schedule, which is referred to as a "nominal schedule", gives the flight arrival and departure times and passenger loads and is produced using a computerized schedule generator model[5]. The schedule is developed to "embody" the forecast planning peaks of traffic activity, thus depicting the diurnal distribution of the expected traffic demand in the planning peak day. Further information on the development and application of nominal schedules can be found elsewhere[2].

6. AIRPORT GATE REQUIREMENTS

This step of the methodology aims at determining the number, size and optimal configuration of the gates required to efficiently meet the aircraft peak demands. This is accomplished through analysis of the nominal schedules using the computerized Gate Assignment Model[5]. The model determines the number of gate positions needed at new or existing airports and their most suitable configuration. It also provides a means of evaluating the effect of various gate sizes (aircraft handling capabilities) and assignment strategies on gate utilization and level of service to the aircraft and passengers. An optimal combination of gate configuration, size, and assignment strategy can be found through iterative application of the model and examination of its predictions of the magnitude of delays to aircraft and passengers and the utilization of gates. Tradeoffs between gate utilization, aircraft and passenger delays, and cost can then be investigated.

The assignment procedure used in the model is as follows: Each aircraft is considered for gate assignment in the order in which it appears in the flight schedule. An aircraft-gate assignment score is calculated as a composite index that takes into account the carrier and sector preferences, the delay which would take place if the flight was assigned to that gate, and the aircraft seating capacity-gate size matching. (This is to ensure that small aircraft are not assigned to large-capacity gates needed for larger

aircraft.) The flight is then assigned to the gate with the best assignment score. If a gate has already been assigned to an aircraft and a subsequent flight is found to have a better score, the first flight is re-assigned and the second flight is assigned to that gate.

Upon completion of this initial assignment, a search is made for any delayed flights. If any exist, the model then attempts to minimize the delays through an iterative procedure whereby aircraft needlessly occupying gates are taken off-gate to remote parking positions and brought back on-gate later before flight departure.

Exhibit 6 is a sample illustration of a gate assignment schedule produced by the model for a small airport.

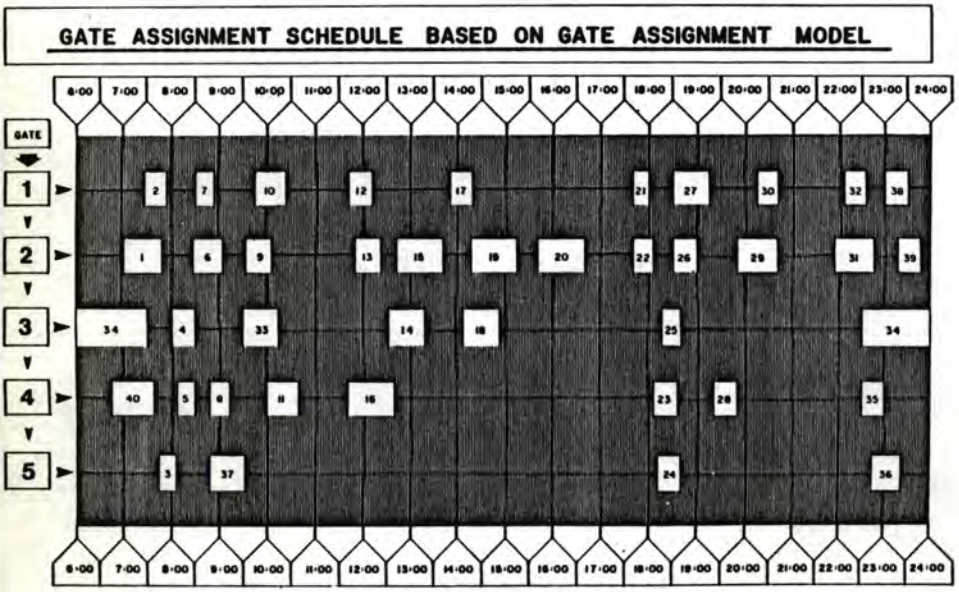


EXHIBIT 6

7. ATB SUBSYSTEM CAPACITY REQUIREMENTS

Having determined the aircraft gate/apron requirements, the next terminal component to be analyzed is the air terminal building complex. To ensure an orderly functioning of the terminal, its subsystems and their individual components should be sized to handle the user demands at an acceptable level of service. This entails performing the following sequential analyses:

- detailed analysis of traffic (passengers, non-passengers, baggage) flows through the terminal complex,
- quantification of the design demand loads for the various ATB subsystems/subcomponents, and hence
- determination of the capacity requirements for all traffic-handling subsystems/subcomponents.

These analyses can be efficiently performed through application of such techniques as computer simulation models which are typically used for large airport terminals with complex traffic flow patterns. Such methods enable the detailed simulation of all traffic movements and processing activities on a terminal-specific basis, and provide the airport planner with a capability to optimize the terminal building layout design through testing of numerous layout schemes in a short time.

CATA's Terminal Flow Simulation Model[5] is an interactive event-oriented computer technique designed to perform a detailed simulation of pedestrian flows through an airport terminal building. It also simulates the passenger/baggage interactions in the baggage dispenser areas. Through a description of the physical layout of the terminal building; the characteristics of users and their flow pattern through

the building; the terminal operating strategy and its sub system processing rates; and the daily (nominal) flight schedule, the model predicts the number of users within each terminal facility at any time during the day. This output is then used to construct the diurnal profile of demand accumulation (occupancy), hence the design peak demand, for each ATB facility.

The model operates as follows: enplaning passengers as well as well-wishers and greeters arrive at the curb according to behavioural distributions (time before flight departure) unique to each flight sector at the airport being simulated. Each terminal user follows a path constructed as a sequential ordering of the various areas of the ATB from the point of entrance to the terminal to the point of exit. Multiple branching occurs at different points along a path whereby each branch is assigned a probability of being taken (percentage split of the traffic flow stream).

In the enplaning direction, the terminal users are processed through the ATB according to specified processing rate distributions, transit times, and waiting characteristics associated with each facility (e.g. ticketing, links, waiting lobby, holdroom, etc.) in their respective paths through the terminal. In the deplaning direction, each arriving aircraft is assigned to a baggage dispenser(s) that best fits the input assignment criteria.

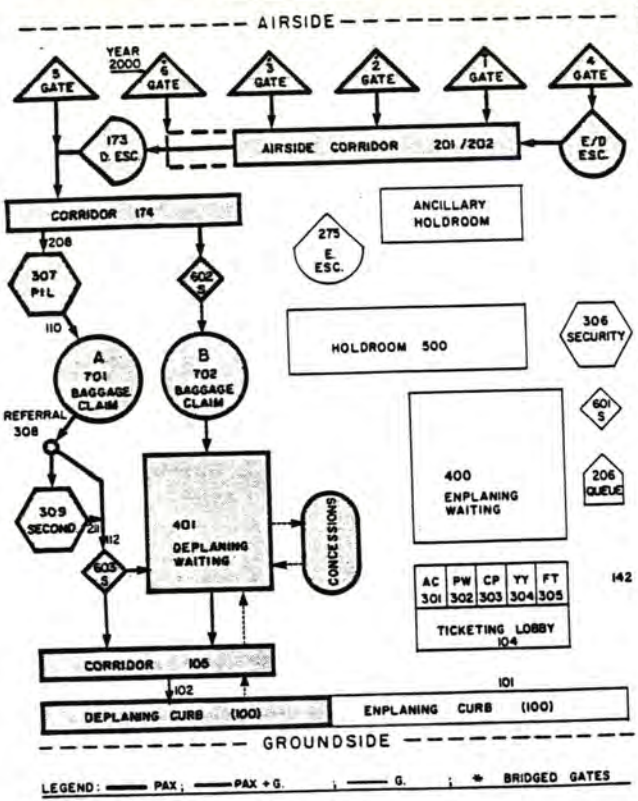
Each passenger is then processed through the terminal

system elements in his/her flow path, e.g., gate, links, primary inspection, immigration/health, baggage claim, secondary inspection, arrivals concourse, and the curb. The baggage is delivered to the dispensers based on the user-specified input data. A probabilistic matching technique is used to match bags to passengers at the dispensers based on the passenger and baggage arrival rates in this area. Statistics are updated by the model's Report Generator whenever a person arrives at or exits from an ATB facility in either the enplaning or deplaning direction. Exhibit 7 illustrates the manner in which the enplaning and deplaning flows are simulated by the model for a relatively small airport terminal.

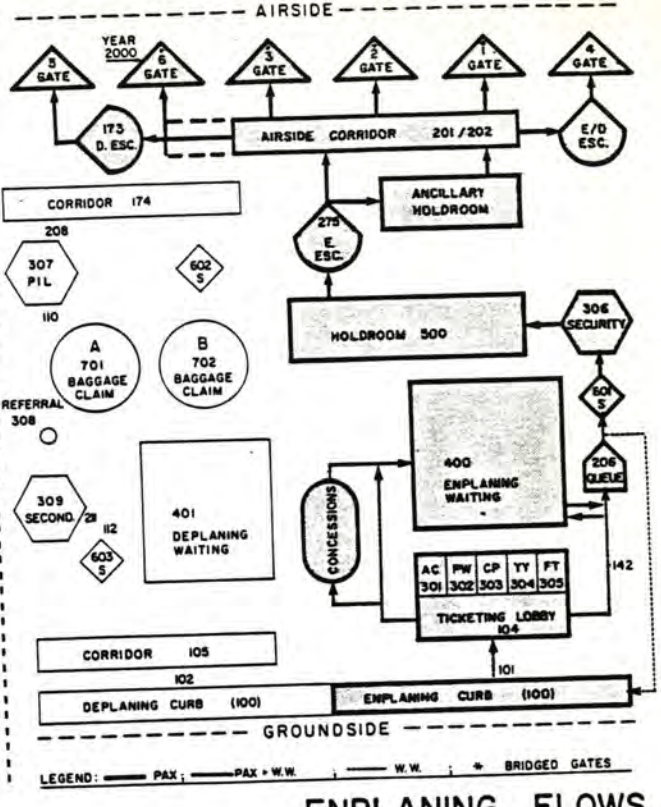
DETERMINATION OF REQUIRED CAPACITY:

The required capacity of an ATB subsystem is determined by the peak demand load placed on it which is obtainable from the results of the Terminal Flow Simulation Model. For example, the size (static capacity) of the holdroom is determined by its peak 15-minute "average" occupancy throughout the planning day, as determined by the model, and a space standard of 1.0 square metre per occupant. The Dynamic (processing) capacity of a subsystem processor (e.g. an airline ticketing facility) required to meet the peak-period demand at a specified level of service involves determination of the number of servers (e.g. ticket counter positions) given the individual server processing rate and the allowable maximum queue size and/or delay time.

CONBINED DOMESTIC AND TRANSBORDER UNIT TOLL
ARRIVING FLIGHTS



DEPLANING FLOWS



ENPLANING FLOWS

EXHIBIT 7

The terminal area functions like a complex and delicately balanced microcosm. Care must therefore to taken in determining the design capacity of its individual subsystems to ensure that an overall "balance" between them is maintained. Increasing the processing capacity of one subsystem may have detrimental effects on facilities further down stream.

CATA'S ATB LEVEL OF SERVICE STANDARDS:

Assessment of the present demand/capacity performance of the various ATB subsystems or determination of their future capacity requirements is based on standards of level of service. The level of service associated with an ATB subsystem is a measure or assessment of its operating characteristics under a particular level of traffic demand. As the demand fluctuates, so does the level of service experienced by the facility users. Capacity must always be related to level of service as traffic-handling facilities are always capable of operating at varying degrees of congestion. An ATB subsystem could, for example, accommodate, within a given time period, 1000 passengers at a "good" level of service or 1500 passengers at a "poor" level of service (i.e., with greater congestion).

CATA's level of service standards[6] are shown in Exhibit 8. Development of these standards was based on studies of passenger behaviour patterns and psychological and comfort considerations. The level of service is specified on a scale consisting of six levels: A to F, similar to that used in highway traffic engineering practice. Level of service

"C" is recommended as the design standard as it denotes good service at a reasonable cost. The static level of service experienced by users of a particular subsystem is a function of their number and the amount of available space.

LEVEL OF SERVICE ➧	A	B	C	D*	E*	F
ATB SUBSYSTEM	(square metres per occupant)					
Ticketing/Check-In	1.6	1.4	1.2	1.0	.8	
Wait/Circulate Areas	2.7	2.3	1.9	1.5	1.0	
Holding Rooms	1.4	1.2	1.0	.8	.6	
Baggage Claim Area**	1.6	1.4	1.2	1.0	.8	
Pre-Inspection	1.4	1.2	1.0	.8	.6	

* for 15-minute maximum duration ** without device

LEVEL	DESCRIPTION
A	Excellent level of service; condition of free flow, no delays, direct routes, excellent level of comfort.
B	High level of service; condition of stable flow, high level of comfort.
C	Good level of service; condition of stable flow, acceptable throughput, related subsystems in balance.
D	Adequate level of service; condition of unstable flow, delays for passengers, condition acceptable for short periods of time.
E	Unacceptable level of service; condition of unstable flow, subsystems not in balance, represents limiting capacity of the system.
F	System breakdown; unacceptable congestion and delays.

EXHIBIT 8

8. AN EXAMPLE

The example given here involves an actual case where four gates and a common holdroom at a certain airport are used exclusively by a particular air carrier. Exhibit 9 presents the actual flight schedule of a typical busy day in 1983 together with that projected by the carrier for 1991. Regardless of its likelihood, the daily passenger volume will more than double between 1983 and 1991, according to the carrier's expectations. The 1991 schedule shows a heavy concentration of flights during the peak periods, which also results in a significant (threefold) increase in the number of enplaning peak hour passengers. The concentration of flights during peak periods stems from the carrier's operating strategy of establishing a "hub-and-spoke" system with the airport in question as the hub.

THE ANALYSIS:

Notwithstanding the fact that planning of facilities at all Transport Canada airports is based on official forecasts of traffic and nominal schedules produced by CATA, the following analysis is intended only to demonstrate the usefulness of some the techniques described in the paper for determining the capacity requirements of the various terminal facilities and quantifying the impact on these requirements of possible changes in carriers' operating strategies as reflected in this (rather simple) example.

The gate requirements entailed by the two schedules were determined by the Gate Assignment Model described earlier.

1983 FLIGHT SCHEDULE				1991 FLIGHT SCHEDULE			
ARRIV. TIME	DEPL. PAX	DEPAR. TIME	ENPL. PAX	ARRIV. TIME	DEPL. PAX	DEPAR. TIME	ENPL. PAX
22:21	10	06:05	34	22:50	---	06:00	67
22:37	46	06:47	34	22:52	67	06:45	99
23:44	21	07:10	21	23:05	96	07:20	105
21:58	57	07:30	77	00:02	49	07:20	34
18:27*	176	08:04	132	21:55	102	07:30	113
				22:43	63	07:35	113
07:44	74	08:04	67	22:50*	---	07:40	200
08:15	57	08:35	26				
08:51	54	09:12	43	07:20	117	07:50	117
08:59	39	09:20	48	07:30	91	07:50	91
09:18	39	09:35	19	07:40	96	08:00	117
09:22*	63	09:55	69	07:35	114	08:30	75
09:47	20	10:05	56	08:30*	168	08:55	124
11:02	42	11:21	54	08:40	106	09:00	56
11:12	33	11:35	64	09:10	93	09:30	106
11:10	66	11:40	54	09:24*	180	09:55	220
12:28	54	13:03	51	09:40	94	10:00	46
13:17	38	13:37	39	10:52	99	11:20	102
14:41	63	15:12	31	10:55	88	11:25	59
14:58	60	15:25	81	10:58	86	11:30	117
15:28	51	15:50	22	21:10	100	12:15	70
16:06*	118	16:41	148	12:40	94	13:00	98
16:17	64	16:51	95	14:08	78	14:30	113
17:12	83	17:30	51	14:40	117	15:00	43
17:46	99	18:06	117	14:38	105	15:00	98
18:17	76	18:50	65	16:20	91	16:35	91
18:39	96	19:06	94	16:20	94	16:45	113
19:02	44	19:34	106	16:20*	141	16:45	140
19:11	79	19:35	65	16:30	102	16:50	102
20:14	36	20:45	39	16:35	114	16:55	75
20:41	39	21:04	55	16:40	98	17:00	117
21:47	44	22:15	12	16:40	91	17:00	91
	----		----	16:40	85	17:05	109
	1841		1869	17:40	78	18:00	117
				18:10	36	18:30	78
				18:19*	151	18:55	220
				18:27	99	19:00	85
				18:40	53	19:15	75
				20:06	60	20:30	72
				21:33	81	21:45	95
				21:56	49	22:15	68
					----		----
					3740		4144

* 225-seater aircraft;
all others are 120-seaters

EXHIBIT 9

The existing four gates were found to accommodate without any delays the 1983 schedule, while eight gates were needed under the 1991 carrier operating scenario, with one aircraft delayed for five minutes due to gate unavailability at the time of its arrival. In both cases one gate was sized to handle the larger (225-seater) aircraft. These results indicate that the extreme peaking of the 1991 schedule translates into excessive requirements for additional gates that will be used for only a small portion of the day.

The size of the holdroom was determined through application of the Terminal Flow Simulation Model. The occupancy profiles produced by the model for the two schedules are shown in Exhibits 10 and 11. It is worth noting that the 1983 profile was verified against an 18-hour occupancy survey during the same day of the simulated schedule and was found to be very close to the actual (survey) distribution.

The required size of the holdroom is determined by its peak 15-minute average occupancy with 1.0 square metre (level of service "C") assigned to each occupant. According to Exhibits 10 and 11, a holding capacity of approximately 145 and 220 square metres is therefore required to meet the 1983 and 1991 schedules, respectively. The results suggest that increasing the enplaning passenger peak does not imply a proportional increase in the design capacity of the holdroom. This is partly attributable to the number of flights and the pattern of passenger arrivals at the holdroom.

HOLDROOM OCCUPANCY (06:00—12:00)

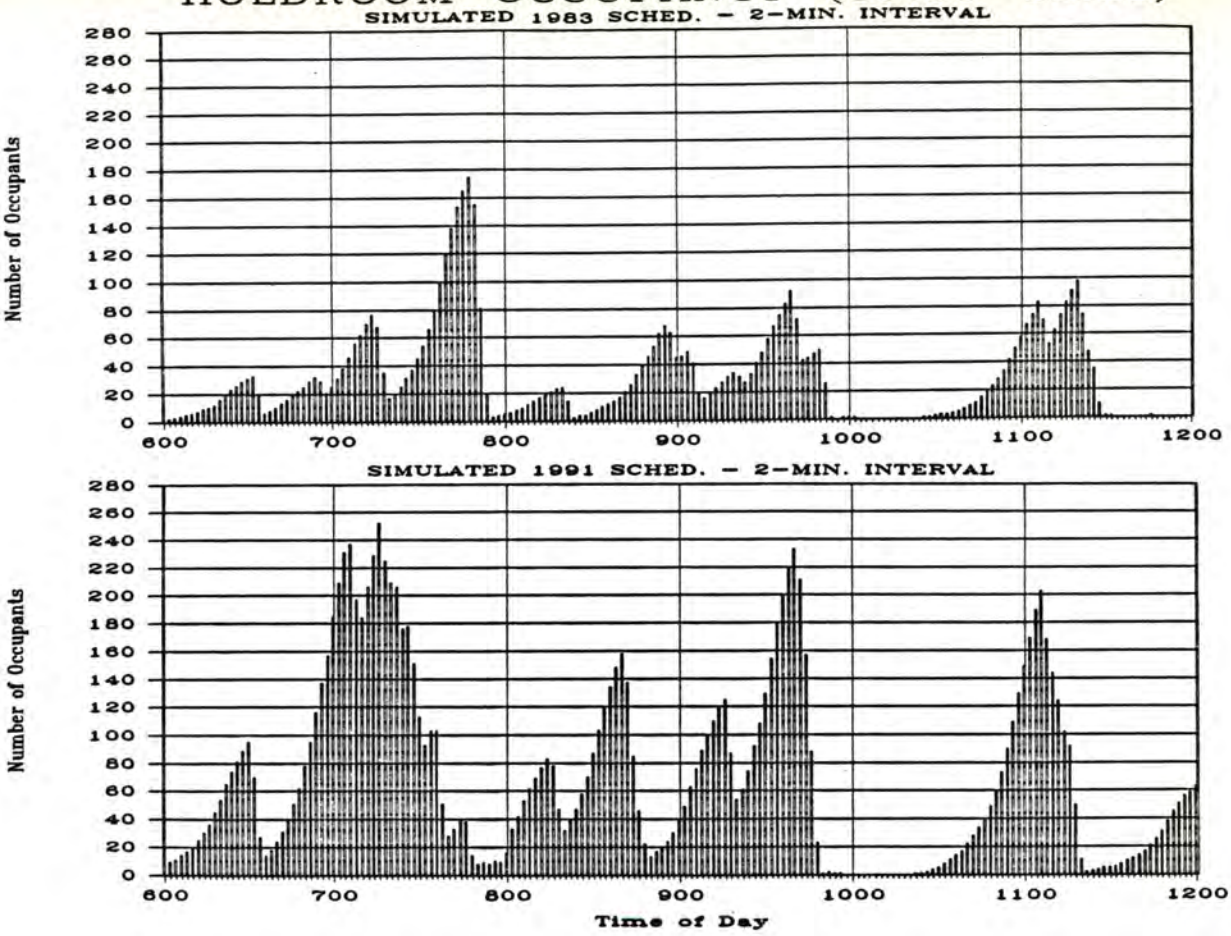


EXHIBIT 10

HOLDROOM OCCUPANCY (15:00—21:00)

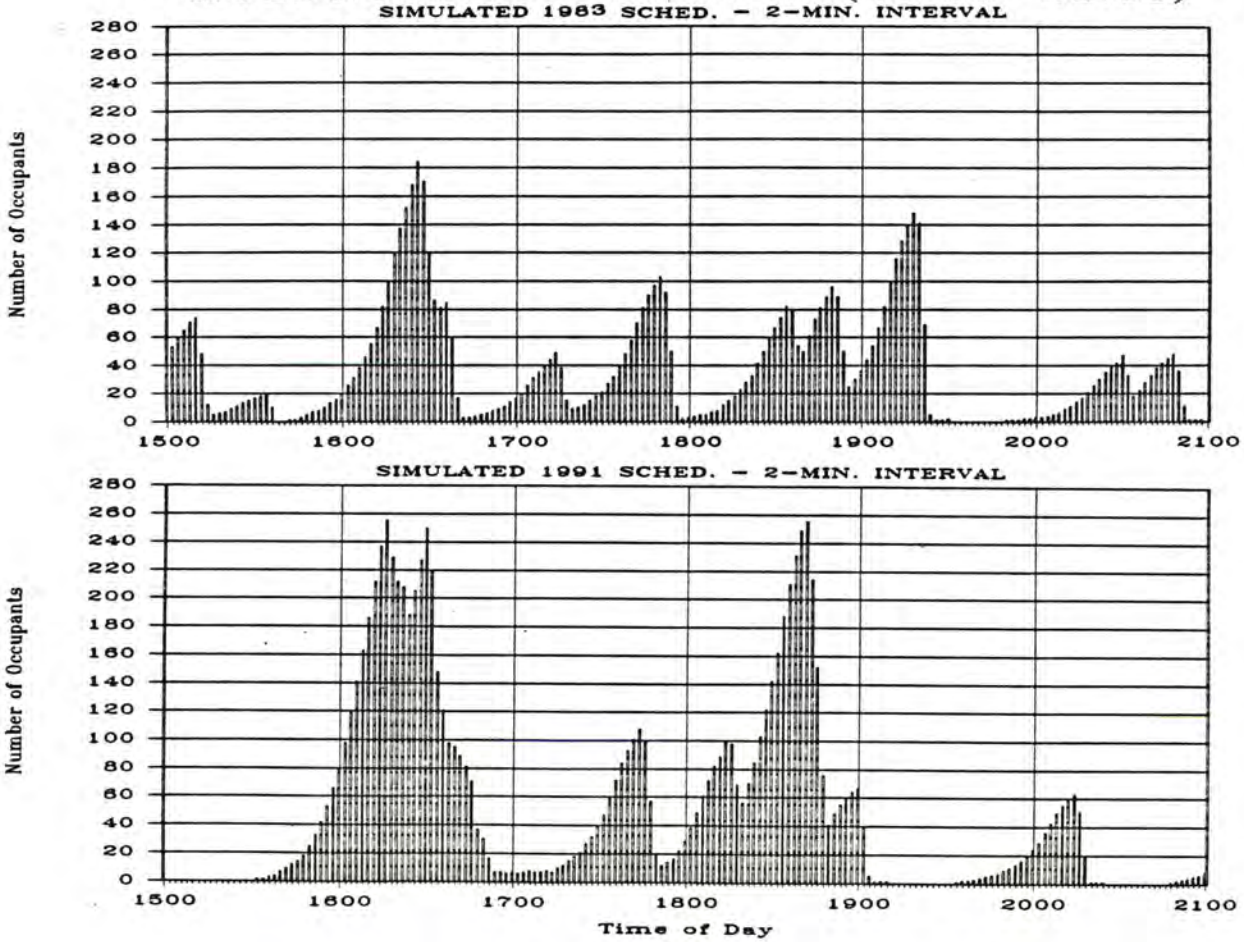


EXHIBIT 11

CONCLUSIONS

The methodology and techniques used by CATA for airport terminal planning and demand/capacity evaluations have been outlined. Their usefulness has been demonstrated through sample outputs and an example of quantifying the impact of an air carrier operational scenario in the context of regulatory reforms.

The sample results presented suggest that extreme traffic peaking creates excessive demands for costly additional terminal capacity which will only be utilized for a small fraction of the day. The risk associated with the provision of such capacity will be higher in the context of deregulation as there is no guarantee that a carrier will find his new strategy successful and stay with it in the long-run.

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THE CANADIAN TRUCKING INDUSTRY [1]

Y. Deslauriers Statistics Canada

S.L. Mozes " "

I - Abstract

This paper describes the size and structure of the Canadian Trucking Industry, both for-hire and private (or own account). The study highlights and analyses the commonalities and differences between these two segments of the same industry. Size and importance of trucking are illustrated within a national economic framework as well as within a transportation framework.

II - Introduction, Objectives, Definitions, Data Sources and Limitations

Introduction

The successful completion of the Private Trucking Survey (1982) by Statistics Canada provides an opportunity, the first since 1964, to analyse the size and structure of the Canadian trucking

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[1] The opinion expressed in this paper are those of the authors and do not necessarily reflect those of Statistics Canada.

industry, the industry being defined as the sum of owners/operators of trucks, tractors and trailers who use their vehicles for the transportation of goods, either their own (private) or of others (for-hire).

This definition shows the progress made in the collection of statistics describing the activity and nature of trucking as, until recently, the conventional, and sometimes the official, definition of the trucking industry related only to that portion of the total which was involved in the transportation of goods for compensation (i.e., the for-hire segment only).

Study Objectives

The objective of this paper is to present an empirical analysis of the structure, size and importance of the Canadian trucking industry with special reference to the relative importance and competitive nature of private versus for-hire trucking in the long distance commodity transport market.

Definitions

a) The trucking industry for the purpose of this study is defined as the sum of all owners/operators of trucks, tractors and trailers engaged in the transportation of goods or freight regardless of whether compensation is received for such services;

b) The for-hire segment of the industry is defined as owners/operators of vehicles who carry freight for compensation;

c) The private segment of the industry consists of owners/operators of vehicles who carry their own freight. Its principal function is to provide logistical - support service to its proprietary shipper. This definition does not, however, preclude the possibility of a private carrier receiving revenue and generating profit from the transport operations.

Data Sources

The principal data sources of this study are (a) the Motor Carriers of Freight and Household Goods Survey of Statistics Canada; (b) the Trucking Activity Survey of Statistics Canada; (c) the Truck Inventory and Use Survey of Statistics Canada and (d) the For-hire Trucking Survey of Statistics Canada. As the concepts and methodology of these surveys vary significantly, the authors used a number of assumptions and prepared estimates when necessary in order to arrive at comparable data. These estimates were based on the analysis of raw micro data as well as on the professional opinion of the authors.

Data Limitations

Limitations of the data sources which may have important impact on the findings of the study are summarized below:

(1) The private trucking questionnaires were sent to each location or address of the operator where there were more than 14 vehicles registered. This meant that activities of large firms were undercounted as some locations of the same firm, where there were less than 15 vehicles, were not part of the survey.

(2) Private trucking estimates for the Province of British Columbia are underestimated due to a technical problem encountered during universe creation.

(3) Private trucking figures are underestimating the true activities of this industry as private carriers using exclusively leased vehicles were not part of the survey universe.

(4) Vehicle kilometres travelled exclude those travelled by broker operators. As for-hire carriers use brokers more extensively than private carriers and since the number of vehicle kilometres performed by brokers is higher than those

of company owned vehicles, it is felt that the average vehicle kilometres as presented are underestimating the true value for the for-hire carriers more than that for the private carriers.

(5) For many private truckers, some of the cost items relating to trucking were not segregated from other costs. Therefore the total cost of operating private trucking fleets is underestimated.

III - Trucking, A General Overview

The growth of the Canadian trucking industry during the last thirty years has been one of the most important developments in Canadian transportation. The phenomenal growth of the industry can be attributed to a number of factors. The most important are: (a) the development of manufacturing industries, (b) technological improvements, (c) urbanization (d) development of better road systems and (d) the decentralization of certain industries. These factors, in conjunction with the flexibility, speed and adaptability of the motor vehicle has resulted in an increase of the industry's estimated share of the gross domestic product (GDP) from an estimated 1.7% in 1950 to 2.7% in 1983. The increasing share of the trucking industry within the transportation sector is illustrated by using gross operating expenses as a statistical yardstick. These data are presented in Table 1.

TABLE 1

GROSS OPERATING EXPENSES, BY MODE OF TRANSPORT
(FREIGHT TRANSPORT ONLY)

Modes of Transport (Industries)

	Truck(1) Exp. ($bill.)	%	Rail Exp. ($bill.)	%	Water Exp. ($bill.)	%	Other(2) Exp. ($bill.)	%	Total Exp. ($bill.)	%
1950	0.1	9	0.8	66	0.1	9	0.2	16	1.2	100
1960	1.5	43	1.0	29	0.3	8	0.7	20	3.5	100
1970	3.8	58	1.4	21	0.4	6	1.0	15	6.6	100
1980	11.5	60	4.0	21	1.1	5	2.7	14	19.3	100
1982	14.5	58	5.2	21	1.1	4	4.3	17	25.1	100

(1) Firms with a fleet size of less than 5 vehicles were excluded.

(2) Includes pipelines, freight forwarders, courriers, etc.

Data presented in this Table clearly indicate that, in terms of operating expenses, trucking has become the dominant mode of freight transport, to such an extent that, by 1982, its share represented 58% of the total operating expenses of the industry. Attempts to provide intermodal comparisons using more conventional transportation-related output measures such as tonnes of freight transported or tonne-kilometres of freight carried have not succeeded due to data limitations.

IV - Private Trucking versus For-Hire Trucking

In spite of the size and importance of the Canadian trucking industry, it is a virtually an unknown entity, unknown mainly because of the scarcity of data. For example, it is only recently that Transportation Division of Statistics Canada was in a position to collect and make available data on private trucking. In this section, an attempt will be made to describe, very briefly, the size and structure, commonalities and differences of the for-hire and private trucking industries.

Private trucking implies that the transportation of goods is performed privately or own-account; that, is the carrier of freight has some, often a direct interest, in the freight carried. However, in order to develop a working definition, other factors such as operating control, risk of transportation and whether the transportation is taking place within a single business entity also had to be taken into consideration. Recent discussions on "intercorporate hauling", "private carrier subsidiary" and "contract carrier subsidiary" have made the development of a working definition even more difficult. After having considered the legal, regulatory and statistical constraints, the authors have defined private trucking in reference to two major criteria, namely:

(1) it is essentially a proprietorial operation of the principal shipper;

(2) its principal function is to provide a logistical support service, revenue and/or profit having secondary importance.

For-hire trucking on the other hand is defined as the sum of carriers who carry freight for compensation, either for the general public (common carriers) or for a selected group of shippers (contract carriers). For-hire carriers using this definition may or may not be regulated.

Unfortunately, the data base used by the authors did not provide all the necessary information to make a clear-cut distinction between the two. It is recognized that some of the contract for-hire carriers, as defined and tabulated, are carrying the products of their principal shippers only and also that some of the private carriers are in the business principally for the profit, and thus may be considered as for-hire carriers. Examination of the data base has indicated the isolated existence of these, however, they are not significant enough to introduce major statistical biases, or distort the results of the analysis. As a matter of fact, the existence of this problem further supports the definition of industry as proposed by the authors.

In order to describe the two often competing segments of the trucking industry, Table 2 is presented.

TABLE 2

A COMPARISON OF PRIVATE TRUCKING AND FOR-HIRE TRUCKING 1982(1)

	For-hire Trucking	%	Private Trucking(2) (Estimated)	%	Total Trucking Industry	%
No. Firms	3,008	5.4	52,623	94.6	55,631	100
Equipment operated						
Trucks	18,795	5.8	303,800	94.2	322,595	100
Tractors	31,730	55.1	25,900	44.9	57,630	100
Trailers	78,816	62.7	46,900	37.3	125,716	100
No. Persons employed (Est)	81,000	22.0	287,000	78.0	368,000	100
Fuel Consumed (bill. L)	1.5	31.3	3.3	68.7	4.8	100
Fuel Cost ($bill.)	.6	30.0	1.4	70.0	2.0	100
Vehicle kilometres travelled (bill.)	2.7	29.0	6.6	71.0	9.3	100
Est total operating expenses, ($bill.)	5.4	37.2	9.1	62.8	14.5	100
Fuel cost/km travelled ($)	0.22		0.22		0.22	
Average number of pieces of equipment per firm	43		6.7		9.0	
Average number of employees per firm	33		5.4		6.6	
Average annual operating expense per firm ($'000)	1,795		172		260	

(1) Includes firms with more than 4 vehicles.
(2) Includes firms with more than 4 vehicles, which are involved in the transportation of goods.

Data presented in Table 2 show that the private trucking industry in terms of number of firms in business, equipment operated, fuel consumed and vehicle miles travelled is significantly larger than its for-hire counterpart. The data presented also reveal that the average size of a private trucking firm is significantly smaller than the average for-hire carrier.

V - Analysis of the Relative Importance of For-hire and Private Trucking on the Long Distance Freight Market

A - Input Structure of the Long Distance Freight Carriers

In this section, a comparison of for-hire and private carriers in a competitive context is being developed.

The market studied is the one where medium and large carriers are coexist and compete. The following criteria were used in defining the two groups for comparison.

a) For-hire trucking group of carriers

- More than 50% of the operating revenues were earned on shipments travelling more than 25 km in length.
- Household Goods movers were excluded.
- 15 or more pieces of equipment (trucks, tractors, trailers) were operated by these companies.

b) Private trucking group of carriers.

- More than 50% of trips were made for a distance of more than 24 km.
- The trucking activity of these fleets was related to one or more of the following industries; agriculture, forestry, fishing and trapping, mining, manufacturing, construction, wholesale trade, retail trade and accommodation, food and beverage services.
- 15 or more pieces of equipment were operated by these companies.

For each of these groups comparative data from the Motor Carrier Freight Survey and the Trucking Activity Survey were compiled and analysed. A summary of this analysis is presented in table 3 on pages 12, 13 and 14.

TABLE 3

SELECTED STATISTICS ON LONG DISTANCE FOR-HIRE AND PRIVATE TRUCKING CARRIERS

	For-hire		Private	
	No.	%	No.	%
1-Number of Carriers	1,025	100%	2,822	100%
2-Region of domicile (number, %)				
Maritimes	80	8%	446	16%
Québec	237	23%	798	28%
Ontario	334	33%	785	28%
West	374	36%	793	28%
3-Number of Province/ Territories Served (number, %)				
one (1)	461	45%	2,040	72%
two (2)	251	24%	369	13%
three (3)	124	12%	196	7%
four (4)	71	7%	81	3%
more than five (5)	108	11%	136	5%
4-Type of Ownership (number, %)				
Sole owner	27	3%	313	11%
Partnership	18	2%	55	2%
Incorporated	972	95%	2,378	84%
Other (e.g. government, etc.)	8	1%	75	3%
5-Equipment				
a) (i) Total number of vehicles operated	102,914	100%	72,527	100%
(ii) average/carrier	100		26	
b) (i) Total Number of vehicles owned	95,219	92%	64,982	90%
(ii) average/carrier	93		23	

TABLE 3 - Continued

	For-hire		Private	
	No.	%	No.	%
c) (i) Total number of vehicles leased	7,695	8%	7,545	10%
(ii) average/carrier	8		3	
d) (i) Number of trucks owned	9,487	9%	40,192	55%
(ii) average/carrier	9		14	
e) (i) Number of trucks leased	237	0%	3,389	5%
(ii) average/carrier	0.2		1.2	
f) (i) Number of tractors owned	23,082	22%	8,433	12%
(ii) average/carrier	23		3	
g) (i) Number of tractors leased	1,820	2%	1,632	2%
(ii) average/carrier	2		1	
h) (i) Number of trailers owned	62,650	61%	16,357	2%
(ii) average/carrier	61		6	
i) (i) Number of trailers leased	5,638	6%	2,524	3%
(ii) average/carrier	6		1	
j) (i) Breakdown of vehicles by type				
Trucks owned	9,487	9%	40,192	55%
Trucks leased	237	0%	3,389	5%
Tractors owned	23,082	22%	8,433	12%
Tractors leased	1,820	2%	1,632	2%
Trailers owned	62,650	61%	16,357	23%
Trailers leased	5,638	7%	2,524	3%
TOTAL	102,914	100%	72,527	100%

TABLE 3 - Concluded

	For-hire		Private	
	No.	%	No.	%
6-Distance				
a) Total Distance travelled (million km)	2,100	100%	2,390	100%
b) (i) Total Distance (Trucks) (million km)	300	14%	1,600	67%
(ii) Average distance per truck (km)	30,852		36,713	
c) (i) Total Distance (Tractors) (million km)	1,800	86%	790	33%
(ii) Average distance per tractor (km)	72,283		78,490	
7-Fuel				
a) Total Fuel Cost ($ million)	410		420	
b) Fuel Cost/km ($)	0.20		0.18	
8-Average Salary/Driver ($)	23,097		21,850	
9-Maintenance Expenses/ Piece of equipment ($)	3,984		5,791	
10-Brokers' Expenses ($ million)	670		110	
11-Rental Cost/Vehicle Rented ($)	9,296		9,144	
12-Insurance and License Costs/Vehicle Owned ($)	1,470		923	
13-Total Operating Expenses ($ billion)	4.2		2.1	
14-Total Operating Expenses/Piece of Equipment ($)	40,811		28,955	

Number of Carriers

There were 1025 for-hire carriers and 2,822 private trucking fleets corresponding to the above-mentioned criteria. The disproportion between those two numbers is, at the same time, impressive and misleading. The fact that private trucking fleets serve generally one main "customer" while for-hire carriers provide services to several clients gives a reason for this situation.

It can also be observed that these 1,025 for-hire carriers represent 34% of the 3,008 carriers operating more than 4 vehicles. The same comparison shows that the 2,822 private long freight carriers represent only 5% of the 52,623 private operators of more than 4 vehicles. These numbers demonstrate how private carriers are much more concentrated in short distance hauling than for-hire carriers.

Province/Territory of Domicile

The distribution of for-hire and private carriers among their respective province/territory of domicile is more or less comparable except in the Maritimes. There are only 80 (8%) for-hire carriers domiciled in this region as opposed to 446 (16%) private carriers.

Number of Provinces/Territories Served

Most of the private carriers (72%) operate in only one province or territory and 13% of them serve two provinces. The distance of the majority of the hauls of that group is therefore expected to be relatively limited. The percentage of for-hire carriers operating in only one province or territory is much lower (45%). Also, 31% of for-hire carriers report activities in three or more provinces compared to only 15% of the private fleets. These numbers show that the area of operation of for-hire carriers is globally larger than that of private truckers.

Type of Ownership

The majority of both the for-hire carriers and private carriers studied are incorporated or related to a corporation. It is surprising to notice that 11% of the private carriers operating more than 14 pieces of equipment are owned by a sole owner.

Total Number of Vehicles Operated

The number of vehicles operated by for-hire carriers is much larger than the number of vehicles operated by private carriers. This fact is particularly highlighted when considering the average number of vehicles per company/fleet. These numbers confirm a main difference between the two types of trucking. For-hire truckers must have the equipment to satisfy the various needs of a

number of clients while the private truckers often carry a very limited number of different commodities for a very limited number of clients.

Number of Straight Trucks Owned and Leased

On average, private carriers own 5 straight trucks more than the corresponding for-hire carriers. Leasing of trucks is not a popular alternative in either case. It should be noted, however, that private carriers using leased equipment only are not included in the Trucking Activity Survey because they could not be identified through motor vehicle registrations files which were used to develop the survey universe.

Number of Tractors Owned and Leased

There is an important difference between for-hire carriers and private carriers concerning the number of tractors. On average, for-hire carriers own over 8 times more tractors than do private truckers. Furthermore, for-hire carriers own many more tractors than straight trucks while it is the contrary for private carriers. Finally, few tractors are leased by for-hire carriers (7% of the total numbers of tractors on average), while in the private trucking industry leased tractors represent 16% of the total.

Number of Trailers Owned and Leased

As a consequence of the tractor situation, for-hire carriers own 12 times more trailers than private carriers. Approximately 8% of for-hire trucker's trailers were leased while this percentage was 13% in the private trucking case. For-hire companies operate 2.7 trailers per tractor and private fleets use 1.9 trailers per tractor.

Number of Vehicles Owned and Leased

Approximately 7.5% of vehicles operated by for-hire carriers are leased, the corresponding number for private truckers is 10.4%.

Classification of Vehicles by Type

This statistic shows the difference in the nature of the fleet between the two groups of carriers. The main components of those of for-hire truckers are tractors and trailers. Private carriers use straight trucks predominantly. This difference in equipment implies a possible difference in the volume of loads carried and the distance travelled.

Total Distance Travelled

In total, private carriers have travelled 2.4 billion kilometres and for-hire carriers, 2.1 billion kilometres; a difference of close to 14%.

Distance Travelled by Trucks and Tractors (excluding broker operators)

In total, straight trucks used by private carriers covered much more distance than the for-hire ones. This situation is reversed when considering tractors. This is supported by each group fleet structure as discussed previously. However, on average, trucks and tractors operated by private carriers travel more annually than those operated by for-hire carriers. Therefore, under the criterion of average annual distance travelled, on an equipment to equipment comparison, private carriers utilize their equipment more intensively than for-hire carriers.

Fuel Costs

For-hire and private carriers have respectively spent $410 and $420 billions on fuel. For-hire carriers spent $0.02 more per kilometre than private carriers. This $0.02 difference could be explained by the fact that for-hire carriers use more tractors and trailers and therefore probably carry heavier loads.

Average Salary/Driver

The average salary of drivers employed by for-hire carriers is 6% higher than the salary of drivers employed by private carriers.

Maintenance Expenses/Piece of Equipment

The amount of maintenance expenses per piece of equipment is close to $4,000 for for-hire carriers and $7,000 for private carriers. Considering the average number of vehicles per carrier, for-hire carriers appear to benefit from an economy of scale in comparison with private carriers.

Brokers Expenses

The for-hire truckers studied reported having spent more than six times the amount spent by private carriers for services of broker operators. The lack of data on the nature of this service prevents linkage of this behaviour to a characteristic of one of the two groups.

Rental Costs/Vehicles Rented

The difference between the amount spent for vehicle rentals, on average, by the two groups is judged insignificant.

Insurance and License Costs/Vehicles Owned

On average, for-hire carriers pay close to 60% more on these items than private carriers. A finer breakdown is unavailable in the case of private trucking and therefore the nature of this difference cannot be identified.

Total Operating Expenses per Vehicle

The average cost of operating a for-hire vehicle is about $12,000 higher than the cost of operating a private one. It must be considered, however, that this difference are includes such items as traffic and sales expenses and administration and general office expenses that were not reported or applicable in the case of private carriers. Total operating expenses of long distance for-hire carriers represent 78% of the total operating expenses of for-hire operators of more than 4 vehicles. The same ratio in the private trucking case is 23%. These results confirm the concentration of for-hire carriers in long distance hauling and of private carriers in short distance freight transport.

The analysis of comparative data between for-hire and private long distance carriers shows that proportionally more for-hire carriers are involved in long distance hauling than private carriers. The distribution of these two groups of carriers is relatively the same across the country with the exception of the Maritimes. For-hire carriers use more vehicles in total. They operate mostly

tractors and trailers while private carriers use more straight trucks. The total distance travelled by private carriers is greater than the distance travelled by for-hire carriers. On average, they utilize their straight trucks and tractors more than do for-hire carriers.

Long distance for-hire carriers pay higher fuel cost per kilometre, driver salaries, brokers expenses and administrative expenses and therefore have higher operating costs than private carriers. Even when deducting brokers costs, the ratio of operating expenses to total distance travelled is two times larger for for-hire than for private carriers. It should however be noted that certain operating expenses such as salaries of executive officers may not be included in the operating expenses of private truckers which may make this comparison somewhat misleading.

B Output Characteristics of Long Distance Freight Carriers

Data presented and analysed in the previous sections of this paper were based on trucking surveys whose principal objective was to develop statistics on the structure of the firms in terms of fleet composition, operating costs, employment, etc. In this section, an attempt is made, based on results from commodity origin-destination surveys of Statistics Canada, to describe the output of the industry in terms of tonnes transported, commodities carried and tonnes-kilometres performed.

The data used for the for-hire carriers originate from the 1982 For-hire Trucking Survey and correspond to all intercity carriers having earned more than $100,000 from intercity trucking in 1981 no matter how many vehicles they used. The data used for the private carriers are preliminary data from the 1983 Trucking Activity Survey which measure the commodity origin and destination movements of large private carriers.

a) Major Origin-Destination Pairs (tonnage)

Table 4 provides the ten major origin-destination pairs ranked by the tonnage carried for the two groups studied. Three things are particularly noticeable: the same origin-destination pairs are in both groups but not in the same order; intra-provincial movements are predominant; tonnages carried by for-hire carriers are much higher than tonnages carried by private carriers.

TABLE 4

TEN MAJOR ORIGIN-DESTINATION PAIRS
IN ORDER OF TONNAGE CARRIED

For-hire		Private	
Origin-Destination Rank	Tonnes ('000)	Origin-Destination Rank	Tonnes ('000)
1-Ontario-Ontario	46,176	Ontario-Ontario	15,030
2-Quebec-Quebec	22,157	Quebec-Quebec	13,382
3-Alberta-Alberta	19,908	B.C.-B.C.	2,234
4-B.C.-B.C.	14,227	Alberta-Alberta	2,076
5-Saskatchewan-Saskatchewan	4,751	Saskatchewan-Saskatchewan	1,574
6-Manitoba-Manitoba	3,618	Ontario-Quebec	1,567
7-N.S.-N.S.	3,379	Quebec-Ontario	1,563
8-Ontario-Quebec	3,109	N.S.-N.S.	1,539
9-N.B.-N.B.	3,013	N.B.-N.B.	1,027
10-Quebec-Ontario	2,944	Manitoba-Manitoba	861
TOTAL	123,282		40,853

b) Major Origin-Destination Pairs (tonne-kilometres)

Table 5 provides the ten major origin-destination pairs ranked by the tonne-kilometres performed. On the basis of that criterion for-hire carriers are heavily involved in intraprovincial movements but also perform considerable amount of interprovincial movements. The predominance of intraprovincial movements is noticeable on the private side. Again, the total freight carried by for-hire carriers is greater than the freight carried by private carriers.

c) Major Commodities Carried (tonnage)

As presented in Table 6, out of the first five major commodities carried in terms of tonnage, three are in both groups. Only one commodity in each group does not appear in the high ranks of the other list. This comparison shows that both groups of carriers carry, in general, the same types of commodities.

d) Major Commodities Carried (tonne-kilometres)

Table 7 shows the five major commodities carried by each group in terms of tonne-kilometres. The observations made in point (c) are still valid. The difference in volumes carried, as noticed previously, remains.

TABLE 5

TEN MAJOR ORIGIN-DESTINATION PAIRS
IN ORDER OF TONNE-KILOMETRES CARRIED

For-hire		Private	
Origin-Destination Rank	t-km ('000)	Origin-Destination Rank	t-km ('000)
1-Ontario-Ontario	7,082,575	Ontario-Ontario	2,576,011
2-Quebec-Quebec	3,561,221	Quebec-Quebec	2,265,050
3-Alberta-Alberta	3,479,485	Ontario-Quebec	622,598
4-B.C.-B.C.	2,169,648	Quebec-Ontario	517,886
5-Ontario-Quebec	1,851,937	Alberta-Alberta	427,745
6-Quebec-Ontario	1,555,410	Saskatchewan-Saskatchewan	415,772
7-Ontario-Alberta	1,303,483	B.C.-B.C.	306,925
8-Alberta-B.C.	1,110,091	N.S.-N.S.	237,051
9-B.C.-Alberta	1,078,241	N.B.-N.B.	165,598
10-Ontario-B.C.	1,017,941	Manitoba-Manitoba	162,525
TOTAL	24,210,232		7,697,161

TABLE 6

FIVE MAJOR COMMODITIES CARRIED
IN ORDER OF TONNAGE

For-hire			Private		
Commodity Rank	Tonnes ('000)	Private trucking ranking	Commodity Rank	Tonnes ('000)	For-hire trucking ranking
1-Sand, gravel and crude stone	9,996	9	1-Petroleum and Coal Products	9,889	5
2-Cement and concrete basic products	4,930	4	2-Other food preparation	4,377	4
3-Fuel oil	4,876	not in first 20	3-Lumber and sawn timber	2,567	10
4-Other food preparations	4,269	2	4-Cement and concrete basic products	2,363	2
5-Petroleum and Coal products	4,049	1	5-Fermented alcoholic beverages	1,812	not in first 20

TABLE 7

FIVE MAJOR COMMODITIES CARRIED
IN ORDER OF TONNE-KILOMETRES

For-hire			Private		
Commodity Rank	t-km ('000)	Private trucking ranking	Commodity Rank	t-km ('000)	For-hire trucking ranking
1-Other food preparation	2,523,551	3	1-Petroleum and coal products	1,299,141	4
2-Lumber and sawn timber	1,479,044	2	2-Lumber and sawn timber	845,333	2
3-Plate, sheet and strip steel	1,199,399	5	3-Other food preparation	725,838	1
4-Petroleum and coal products	1,045,080	1	4-General freight	629,027	15
5-Cement and concrete basic products	1,013,513	11	5-Plate, sheet and strip steel	551,871	3

TABLE 8

NUMBER OF TRIPS OR SHIPMENTS
BY GROUPS OF DISTANCE

	For-hire		Private	
Distance of trip or shipment (km)	Number of Shipments	%	Number of Trips	%
0-100	5,948,765	21.4	1,150,403	48.4
100-500	12,476,577	44.4	1,042,212	43.9
more than 500	9,687,507	34.5	182,507	7.7
Total	28,112,849	100.0	2,374,762	100.0

e) Number of Trips or Shipments by Groups of Distance

The data shown in Table 8 give an indication of the general distance travelled during one commodity movement. Data available describe the movements of for-hire carriers in shipments and of private carriers in trips. The concepts of shipment and trip are not directly comparable. It is often the case for example that a trip would consist of several shipments. Therefore comparing the number of shipments with the number of trips is believed to be misleading. However, it can be seen that the majority of the movements of private carriers are within a distance of 500 kilometres. The distribution of for-hire shipments is less skewed within the distance groups. More than a third of the shipments of that group covered distances of more than 500 kilometres.

Tables 4 to 8 show that for-hire and private carriers operate mainly in the same areas of the country. However, for-hire carriers are more involved in interprovincial movements and carry a larger volume of goods. There are no signs that one group of carriers is specialized in the transportation of a particular commodity over the other. In general, private carriers are involved in short and medium distance movement. For-hire carriers' shipments are of all distances with a third of them travelling over 500 kilometres.

VI - Conclusions

In this paper the authors have provided an indication of the importance of the trucking industry within the freight transportation sector in Canada, and described statistically the trucking industry both for-hire and private.

The main conclusions of this study are the following:

. In terms of operating expenses the trucking industry is the major mode of freight transportation in Canada representing 58% of the total freight transport expenses in 1982. Annual expenditures on freight transportation by trucks amounts to approximately $15 billion.

. Private trucking is larger than for-hire trucking in terms of number of carriers, total number of pieces of equipment, total distance travelled, total number of employees and total operating expenses.

. The average for-hire carrier is larger than the average private carrier in terms of every variable mentioned above. In terms of operating expenses, the average for-hire carrier is ten (10) times as large as the average private carrier.

. There are proportionally more long distance for-hire carriers than private carriers. The vast majority of private carriers are predominantly involved in local transportation.

. Long distance for-hire and private carriers are more or less domiciled in the same areas of the country and carry about the same type of commodities.

. Long distance private carriers use mostly straight trucks. They appear to be predominantly involved in intraprovincial, relatively short distance movements. On average their trucks and tractors travel more annually than those operated by long distance for-hire carriers.

. Long distance for-hire carriers use mostly tractors and trailers. They are more involved in interprovincial movements than private carriers. They carry larger volumes of commodities over longer distances.

. In total, long distance for-hire and private carriers covered comparative distances as measured by total vehicle kilometres travelled. However, for-hire carriers transported a much greater capacity of freight as measured either in tonnes or in tonne-kilometres. There are two factors which may explain this paradox: the predominant use of straight trucks by private carriers implies a smaller load by kilometre driven than for-hire carriers who use more tractor-trailers combina-

tions; private carriers have more empty back-hauls than for-hire carriers. In either cases more detailed origin-destination data for private trucking movements would be required to substantiate these affirmations.

FURTHER RESEARCH

Based on the findings of the study and the experience gained during the research phase, the authors feel that further research is required in the following areas:

(1) Development of better statistical criteria to be used for distinguishing between for-hire and private carriers. As the clear distinction between the two is becoming blurred, an integrated statistical approach is becoming essential.

(2) Development of a better and more integrated data base relating to both the input characteristics of carriers (e.g. fuel, labour, etc.) and the output characteristics of the same carriers (e.g. tonnes carried and tonne-kilometres performed).

(3) Better measurement and analysis of the traffic carried by broker operators, on behalf of carriers. The relationship between broker transported traffic and traffic carried by company owned vehicles will have to be identified, measured and analysed.

RECOMMENDATIONS

Future survey taking activities should take into account the changing nature of the trucking industry and, in the long run, all trucking related surveys should use common frameworks, definitions and concepts.

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REGULATORY ISSUES IN TRANSBORDER TRUCKING: A CASE STUDY REFERENCING TRUCKING BETWEEN MANITOBA AND MINNESOTA

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PURPOSE AND SCOPE

This paper examines regulatory issues of practical importance to transborder trucking between Manitoba and Minnesota.

'Regulatory issues' are considered to incorporate government-imposed legislative, regulatory, policy and procedural considerations which are purposely directed at influencing, or incidentally influence, the performance and characteristics of transborder trucking.

The examination is limited to the identification, categorization and, where possible, assessment of the relative significance of regulatory issues which appear to be of particular import, giving particular attention to the industry perspective as it conducts its day-to-day business affairs.

While it would be unreasonable to extrapolate the observations of this paper to the general question of Canada-United States trucking, at least some of the

issues addressed in the paper can be considered of general concern. Regardless, the traffic lane addressed in the paper - Manitoba:Minnesota - is important in itself to both countries, and deserving of attention even in its uniqueness.

MOTIVATION

Four forces have provided the motivation for writing this paper. First, transborder trucking is an important facilitator of the more than $100 billion of annual trade flowing between Canada and the United States. Reducing inefficiencies associated with regulatory practices in this business can be considered a noble goal in itself.

Second, in the past decade, major changes have been introduced to the regulatory environments governing truck transportation in both countries. Of most importance are: (i) the 'de-regulation' efforts of both countries, but most particularly the United States through administrative relaxation of the application of American regulatory law and certain provisions of the Motor Carrier Act (1980), and; (ii) the relaxation of vehicle weight and dimension regulation in both countries, through the mechanism of the Western Canada and Atlantic Provinces Highway Strengthening Programs in Canada and the Surface Transportation Act (1982) in the United States. The effect of these changes on

transborder trucking has been subject to little analysis. Further regulatory changes are under active consideration in both countries. In Canada, 're-regulation' (meaning lessening economic regulation) is underway in all provinces, and the weight and dimension issue is the subject of a large cooperative research program being conducted by the Roads and Transportation Association of Canada. In the United States, various states - Minnesota included - are investigating opportunities for relaxing weight and dimension regulations. For all intents and purposes, the implications of these (likely) further regulatory changes on transborder trucking have been ignored.

Third, the federal governments of the United States and Canada have - primarily through pressure from industry groups - been 'discussing' transborder trucking issues, and particularly matters relating to 'fairness' concerning accessibility of one country's carriers to the other country's business.

Fourth, there is a dearth of information dealing with the overall regulatory environment governing transborder trucking. This is frustrating for policy-makers, regulators, the trucking industry and the shipper community, and in particular the many small firms involved or contemplating involvement in moving goods by truck across the border.

Given these factors - the importance of transborder

trucking, a 'fluid' regulatory situation, industry pressures on government to ensure fair treatment of industry participants, and a lack of systematic information respecting the regulatory situation - we felt it useful to attempt to clarify the regulatory environment and issues governing or related to transborder trucking, with a view to facilitating informed debate and productive change.

REGULATORY ENVIRONMENT GOVERNING TRANSBORDER TRUCKING

The regulatory environment is complex, and is prescribed and administered by many agencies in all levels of government - often functioning in an un-coordinated manner. This section attempts to classify this regulatory environment as industry might view it in conducting its day-to-day business of moving freight across the border.

Table 1 presents a framework of this regulatory environment, structured as follows:

(a) it identifies elements of the trucking business impacted by various regulations, and in particular: (i) vehicle characteristics and payload handling capabilities; (ii) authority to conduct transborder freight transport by truck; (iii) trucking rates; (iv) travel time and scheduling; (v) driver status and use, and; (vi) other factors.

(b) it identifies the most important types of regulations which directly or indirectly impact the identified elements of the trucking business.

(c) it identifies the source(s) of the identified

regulations, by government level (i.e. federal, provincial/state, and local).

It is to be recognized that there are many agencies and statutes internal to each government level, in both countries, which generate the regulatory environment and provide for its enforcement.

In considering the effects of this regulatory environment on day-to-day trucking, it is useful to recognize the distinction between de jure requirements and de facto realities. In a de jure sense, the regulatory environment is so complex that it may well be impossible to, in practice and figuratively speaking, 'drive a truck through it'. To this effect, it is probably not unreasonable to suggest that 'something' is improper or illegal about the vast majority of individual trucking movements (i.e. a head-light is broken, the payload is not exactly as authorized, one axle is slightly overweight, a permit is not in order, etc.). In the de facto sense, two different issues are at work: (i) how the regulator chooses to exercise its regulatory authority (e.g. in the granting of trip operating authority permits, in the interpretation of 'divisible load' as it relates to overweight permitting, etc.), and; (ii) the scope and intensity of enforcement of particular regulations (e.g. variations by geographical area and time respecting enforcement of hours-of-work regulations, the ease of by-passing weigh scales, etc.). In many ways - particularly in trucking activities involving many small, commodity carriers operating over

diverse routes on an irregular basis - de facto realities of a regulatory environment are as important as, if not more so than, de jure requirements. Characterizing the de facto environment, however, is difficult, often requiring reference to subjective impressions rather than objective analysis.

AN OVERVIEW OF MANITOBA-MINNESOTA TRANSBORDER TRUCKING

This paper references the Manitoba-Minnesota situation in a case study sense to examine regulatory issues of practical importance to transborder trucking. To do so, it is useful to first consider important aspects of the demand for transborder movement of goods between Manitoba and Minnesota, as well as the essential characteristics of the transport system serving this demand.

Demand Considerations

There is no published data which provides a meaningful, systematic appreciation for either historic or current transborder trucking activity between Manitoba and Minnesota. The most objective data base which could be examined for our purposes involved a special computer run of a series of four 1-week sample truck surveys conducted by the Manitoba Department of Highways and Transportation at the Emerson border crossing in 1974, 1975, 1978 and 1981[1]. Table 2 presents summary

statistics prepared from the 1981 survey showing the number of trucks surveyed during the survey period, by origin-destination and 'principal' commodity being transported. The following observations are of interest:

CANADA TO U.S. MOVEMENTS INTO OR THROUGH MINNESOTA: VIA MANITOBA

- there were 130 truck loads originating in Manitoba destined for Minnesota, of which: 52% were 'grain, other crops, feed', 22% were 'timber and other building materials', 8% were 'earth, organic fertilizer (probably peat moss)', 6% were 'equipment and other vehicles', with the remaining 12% distributed amongst a variety of other commodities.

- there were 93 truck loads originating in Manitoba destined for all states east of the Mississippi other than Minnesota (and therefore presumably using Minnesota as a corridor), of which: 55% were 'timber and other building materials', 11% were 'equipment and other vehicles', 9% were 'food for humans (probably fresh and frozen meat and fish)', 6% were 'live animals', 5% were 'paper products', with the remaining 14% distributed amongst a variety of other commodities.

- there were 9 truck loads originating in Canadian jurisdictions other than Manitoba destined for Minnesota using Manitoba as a corridor, all of which were 'earth, organic fertilizer (probably potash)' originating in Saskatchewan.

- there were 5 truck loads originating in Canadian jurisdictions other than Manitoba destined for all states other than Minnesota east of the Mississippi, using Manitoba , and (presumably) Minnesota as corridors.

U.S. TO CANADA MOVEMENTS INTO OR THROUGH MANITOBA: VIA MINNESOTA

- there were 162 truck loads originating in Minnesota destined for Manitoba, of which: 45% were 'grain, other crops, feed', 14% were 'equipment and other vehicles', 10% were 'general

freight', 7% were 'food for humans', 6% were 'timber and other building materials', 6% were 'earth, organic fertilizer', with the remaining 12% distributed amongst a variety of other commodities.

- o there were 112 truck loads originating in all states east of the Mississippi other than Minnesota destined for Manitoba (and therefore presumably using Minnesota as a corridor), of which: 45% were 'equipment and other vehicles', 26% were 'timber and other building materials', 9% were 'general freight', 8% were 'food for humans (probably fresh fruits and vegetables)', with the remaining 12% distributed amongst a variety of other commodities.

- o there were 23 truck loads originating in Minnesota destined for Canadian jurisdictions other than Manitoba (Saskatchewan and Alberta only) using Manitoba as a corridor, of which: 61% were 'grain, other crops, feed' and 39% were 'equipment and other vehicles'.

- o there were 14 truck loads originating in all states other than Minnesota east of the Mississippi destined for Canadian jurisdictions other than Manitoba (Saskatchewan and Alberta only), using Manitoba and (presumably) Minnesota as corridors, of which: 64% were 'equipment and other vehicles', with the remaining 36% distributed amongst a variety of other commodities.

CANADA TO CANADA MOVEMENTS THROUGH MINNESOTA: VIA MANITOBA

- o there were 5 truck loads originating in Manitoba destined for Ontario and 'Other Canada', presumably using Minnesota as a corridor.

- o there were 0 truck loads originating west of Manitoba destined for Ontario and 'Other Canada', using Minnesota and Manitoba as corridors.

- o there were 2 truck loads originating in Ontario and 'Other Canada' destined for Manitoba, presumably using Minnesota as a corridor.

- o there were 2 truck loads originating in Ontario and 'Other Canada' destined for provinces west of Manitoba, using Minnesota and Manitoba as corridors.

U.S. TO U.S. MOVEMENTS THROUGH MANITOBA: VIA MINNESOTA

- there were 0 truck loads between U.S. states including Alaska using Minnesota and Manitoba as corridors.

In summary, it is evident that, as of 1981, the trucking activity of interest here can be generally characterized by the following statements:

(i) truckload movements of low-value commodities, and in particular grain, lumber and potash, dominate the southbound movements, accounting for almost 85% of the movements into Minnesota and about 60% of the movements into other states east of the Mississippi.

(ii) truckload movements of low-value commodities, and in particular grain, lumber and other building materials, also dominate northbound movements, accounting for about 60% of the movements from Minnesota into Manitoba and about 30% of the movements from other states east of the Mississippi into Manitoba.

(iii) 'equipment and other vehicles' accounts for a significant portion of the total northbound movement (about 45% of the movements from states east of the Mississippi into Manitoba).

(iv) corridor movements through Manitoba of international traffic between Canadian jurisdictions other than Manitoba and the U.S. are relatively small, accounting for about 7% of the observed movements.

(v) corridor movements through Minnesota of international traffic between Manitoba and states east of the Mississippi are relatively large, accounting for about 20% of the observed movements.

(vi) U.S. routing of movements between central and western Canada via Emerson is very minor; Canadian routing of U.S. to U.S. movements via Emerson is non-existent.

Similar tables have been produced for each of the other survey years (1974, 1975 and 1978). Instead of presenting them in detail here, Figure 1 has been

prepared, illustrating essential aspects of the dominant movements observed in these surveys (i.e. flows between Manitoba and Minnesota and between Manitoba and states east of the Mississippi). The following observations highlight the findings illustrated by Figure 1, and other points in the 1974, 1975 and 1978 surveys, as related to the 1981 situation discussed in detail previously.

As illustrated in Figure 1:

(i) a doubling of Manitoba to Minnesota trucking movements has occurred between 1975 and 1981, nearly all associated with an increase in the movement of 'grain, other crops, feed'; there was no significant change in other commodity movements on this lane through this period.

This growth in Manitoba to Minnesota trucking has led to a much more balanced flow on this lane than existed in 1975.

(ii) no particular change in the commodity mix on the northbound movement from Minnesota to Manitoba has been observed, with 'grain, other crops, feed' dominating in all survey years.

(iii) movements from Manitoba to states east of the Mississippi have quadrupled between 1975 and 1981, nearly all associated with an increase in the movement of 'timber and other building materials'.

This growth in Manitoba to east of the Mississippi trucking has also led to a much more balanced flow on this lane than existed in 1975.

(iv) northbound movements from east of the Mississippi to Manitoba have doubled between 1975 and 1981, with the growth being primarily associated with increased movement of 'timber and other building materials'; in all years, 'equipment and other vehicles' dominated this northbound movement.

As evident in the raw data tables (not presented here):

(i) no noticeable change in 'Other Canada' to Minnesota or east of the Mississippi via Manitoba movements has occurred between 1974 and 1981.

(ii) movements from Minnesota and east of the Mississippi to Saskatchewan and Alberta via Manitoba have more than doubled between 1974 and 1981, with 'grain, other crops, feed' and 'equipment and other vehicles' accounting for nearly all the traffic.

(iii) with respect to Canada to Canada movements through Minnesota via Manitoba, the following table summarizes changes evident in the surveys between 1974 and 1981:

No of Loaded Trucks Surveyed

	from Manitoba and West to Ontario and East via Minnesota	from Ontario and East to Manitoba and West via Minnesota
1974	4	8
1975	3	11
1978	3	3
1981	5	4

While these numbers are very small, they do support the hypothesis (supported by opinions expressed by representatives of the trucking industry) that movements between eastern and western Canada via the U.S. could be expected to decline due to the relaxation of western Canadian weight and dimension regulations since 1973. These numbers indicate an absolute decline, but more significantly, represent an important relative decline in the importance of this U.S. corridor routing for interprovincial trucking in Canada.

Geographical Considerations

Geographical realities, coupled with regulatory provisions relating to driver nationality and vehicle licensing, tend to work to the disadvantage of Canadian carriers competing with American carriers in transborder trucking. In this regard, American carriers generally

have access to a more extensive traffic base to balance their operations.

To illustrate, consider the case of a Canadian carrier using a Canadian driver competing with an American carrier using an American driver on the traffic lane between Winnipeg and Minneapolis/St. Paul. Driver residency requirements generally prohibit the American carrier hauling intra-Canada and the Canadian carrier hauling intra-U.S. To achieve some semblance of balanced operations, the Canadian carrier would have to access international movements in both directions. The American carrier has the choice of doing the same or dead-heading in the 70-mile Canadian leg of a trip, and accessing intra-U.S. movements.

Broad Transport System Considerations Impacting Manitoba-Minnesota Trucking

Other issues must be recognized about the transport system under consideration, as follows:

(a) Winnipeg and Minneapolis/St. Paul are themselves important generators/attractors of freight as well as major, multi-modal transport centres, serving respectively as important gateways to/from western Canada and to/from the U.S. territory east of the Mississippi.

(b) a U.S. routing through Minneapolis/St. Paul-Chicago-Detroit is a legitimate alternative to the all-Canadian routing between central and western Canada.

(c) a U.S. routing via Minneapolis/St. Paul may be used to bypass Winnipeg for trucking movements to/from Saskatchewan, Alberta, the Territories and Alaska, from/to the eastern

U.S. and central Canada.

(d) trucking between Manitoba and Minnesota and points beyond via the two jurisdictions faces important inter-modal competition from the Canadian and U.S. railways.

(e) an important characteristic of inter-jurisdictional trucking is that its operations are highly mobile, and can be easily modified in an organizational sense to reduce certain costs (e.g. lower total registration fees), accommodate driver residency considerations, etc.

These system considerations, when coupled with wide fluctuations in both the quantity and temporal and geographical distribution patterns of commodity flows themselves, create a 'fluid' transport situation. In such circumstances, cross-sectional data must be viewed with skepticism. Great reliance must be placed on industry comments in attempting to develop a practical understanding of what is transpiring in the field, why, and what might happen in response to changing conditions.

Trucking Industry Considerations

There is no published statistical data characterizing the trucking industry operating on the Manitoba-Minnesota trucking lane. There are a few large and medium-sized for-hire carriers which have operated on the traffic lane for a long period, handling the bulk of general freight and higher-valued commodities. These carriers are well-known in the region, and include (or have included) the following Manitoba or Minnesota-based

firms: CANADIAN-BASED: Motorways, Transx, Arnold Brothers, Penner International, Kleysens, Kingsway, Can-U.S. (the 'old' G.M.W. authority); U.S.-BASED: Hyman Freightways, Gabor Trucking, International Transport Inc., Consolidated Freightways, Twin Cities. All of these carriers are involved in extensive regional or national networks.

Hard information relating to private trucking and the smaller, typically commodity-specialized, for-hire carriers operating on the lane is not readily available. To give some indication of the presence of smaller operators on the lane, an analysis was conducted of the vehicle registration cab cards issued in 1983 and 1984 by the Province of Manitoba to Minnesota-based operators pursuant to the 'full-and-free' vehicle registration reciprocity agreement which exists between the two jurisdictions. (This data base provides, at best, an 'indicator' of the situation, in that the cab cards are issued only to vehicles newly-registered by a particular registrant; once a vehicle has been so registered, re-registration is not required unless its owner changes.) The following table presents summary statistics developed from this 'raw' data base:

No. and Size of Minnesota-Based For-Hire & Private Fleets Registered in Manitoba Pursuant to the Full-and-Free Reciprocity Plan

No. of Vehicles Registered in Fleet	Number of Carriers 1983	1984
1	68	72
2-3	35	29
4-7	28	18
8-15	8	4
16-25	1	9
26-75	7	6
>75	4	3

This table indicates that there is a (fairly) large number of small (1-15 vehicle) operators functioning on this lane. From a cursory examination of the operators' names, many of them (maybe half) are (at least, theoretically) private carriers, and the vast majority are probably specialized-commodity haulers (e.g. grain, lumber). In both 1983 and 1984, over 95% of the vehicles registered under this plan were registered at weight levels requiring at least 5 axles (i.e. greater than 66 kips), with most of these being registered at the 80-kip level (implying that they are mostly standard 5-axle tractor-semi trailer combinations registered to operate at weight-out levels).

The important general conclusion from the above commentary is that the traffic lane in question is serviced by a few large and medium-sized established for-hire carriers (servicing the majority of higher-valued freight movements, including LTL traffic), and a large number of small, commodity haulers (for-hire and private)

servicing the movements of lower-valued bulk commodities.

REGULATORY ISSUES OF IMPORTANCE TO THE MANITOBA-MINNESOTA TRUCKING LANE

This Section identifies and discusses regulatory issues deemed of particular importance to transborder trucking.

Table 1 has been used as the reference point for selection of the regulatory issues addressed here. Only a limited number of the regulatory matters presented in that Table have been selected for discussion, and their selection has been based on the authors' judgment as to what is important for transborder trucking. That judgment, and the subsequent discussion itself, is based on a combination of: (i) factual considerations; (ii) information gathered from a series of interviews with selected Manitoba and Minnesota carriers involved in trucking operations on the traffic lane and others knowledgeable about Canada-U.S. trucking; (iii) information gathered from discussions with government officials involved in regulatory matters, and; (iv) the knowledge of the authors themselves.

In discussing the identified matters, the authors have attempted to clearly distinguish facts and opinions.

The regulatory issues judged to be of importance are:

WEIGHT AND DIMENSION REGULATIONS ARE SUBSTANTIALLY MORE RESTRICTIVE IN MINNESOTA THAN IN MANITOBA

Relevant Facts: The critical difference in the weight and dimension regulations in the two jurisdictions involves gross combination weight limits. Manitoba's limits are 125 and 108 kips on primary and secondary highways respectively, vs. Minnesota's limits at 80 and 74 kips respectively. There is also an important difference in overall vehicle combination length limits, with Minnesota restricted to 65 ft vs. Manitoba at 75.5 ft.

The Manitoba limits permit effective use of double-trailer combinations, having (weight-out) payload capacities of (up to) 85-90 kips. Minnesota weight and dimension regulations, on the other hand, provide only for the effective weight-out use of single-trailer combinations, having (weight-out) payload capacities of (up to) 50-55 kips. Capacity utilization of the double-trailer combinations provide energy and total cost potential productivity advantages of respectively (up to) 30 and 42% per unit payload vs. the single-trailer combinations[3].

Manitoba's weight and dimension regulatory regime, when coupled with the regimes of other Canadian jurisdictions, has led to extensive use of double-trailer combinations in inter-provincial trucking to/from Manitoba. As of 1983, nearly 35% of trucks registered in Manitoba for inter-provincial trucking but based in other Canadian jurisdictions were registered at weight levels requiring double-trailer units[4]. Comparatively, as discussed previously, none of the Minnesota-based trucks registered in Manitoba for international trucking are registered at weight levels requiring double-trailer combinations (although some of the units themselves may be double-trailers).

Implications: There are four important implications associated with the differences in weight and dimension regulations between Manitoba and Minnesota:

(i) the differences encourage all Canadian routing between central and western Canada, vs. routing via Detroit-Chicago-Minneapolis/St. Paul.

One major Canadian national general freight carrier indicated that all its east-west traffic was routed via the U.S. prior to the 1974 Western Canada Highway Strengthening Program which facilitated the first effective use of double-trailer combinations between central and

western Canada. Today, all of its traffic is routed through Canada using (mostly) double-trailer combinations operating in the 90-125 kip g.c.w. range (even though its per trip mileage is, on average, 400 miles or 13%, greater using the Canadian routing).

This point appears to be substantiated by the Emerson weigh-scale truck survey data discussed earlier.

(ii) the differences have also reportedly led to a re-routing of many international movements to/from western Canada from/to north central and north-eastern U.S.

One carrier indicated that some eastern U.S. originating or destined traffic moving from/to western Canada has been re-routed across Buffalo/Toronto (or Montreal) vs. its historic routing through Minneapolis/St. Paul. Factual substantiation of this point is unavailable.

The same carrier indicated that it had recently lost on a bid to handle some 60 loads from Michigan via Minneapolis/St. Paul to Winnipeg (destined for Edmonton) to another carrier which routed the traffic directly into Canada, moving the traffic over a substantially longer but less weight-restricted route.

(iii) the differences tend to lead to re-handling of certain freight movements (e.g. western Canada lumber destined for the U.S.) over Winnipeg.

Such traffic is often handled with double-trailer units within western Canada to Winnipeg, and then transferred to single-trailer units for movement into the U.S.

(iv) Manitoba carriers involved in international operations tend to experience a fleet design problem not experienced by their Minnesota competitors.

To this effect, the vehicle combinations which Canadian carriers might require to optimize their Canadian operations (i.e. doubles) can often not be effectively re-assigned to international traffic into or through Minnesota. On the other hand, the single-trailer unit of the Minnesota carriers can be used in both international and domestic activity without experiencing a particular

disadvantage in the domestic U.S. market.

CUSTOM INSPECTION REQUIREMENTS EFFECT SOME INEFFICIENCIES IN THE USE OF PAYLOAD CAPACITY FOR SOUTHBOUND INTERNATIONAL LTL MOVEMENTS

Relevant Facts: Freight can be moved by truck into Canada 'in-bond' into sufferance warehouses, where custom inspection can be conducted. For southbound movements into the U.S., most freight must be custom-inspected at the border crossing, rather than at sufferance warehouses in the U.S..

To facilitate customs inspections for traffic moving into the U.S., carriers must ensure that their loads can be inspected at the border location - either by unloading or, as is typical, loading trucks such that customs officers can inspect all shipments without unloading. This proves somewhat difficult for southbound LTL traffic, in that trailers must be loaded such that officers can walk the full length of a trailer for inspection purposes.

Implications: such a loading requirement is costly onto itself, but also effects lower productivity in that payloads must be less than might otherwise be handled. One trucking official indicated that southbound LTL payloads are often up to 25% less than what could be handled if other provisions could be made for U.S. custom inspections.

INTERNATIONAL FOR-HIRE TRUCKING OPERATING AUTHORITY CAN THEORETICALLY BE MORE EASILY OBTAINED IN THE U.S. THAN IN CANADA

Relevant Facts: In a practical sense, new U.S. international operating authority can be obtained largely on the basis of a 'fitness test', dealing only with one regulatory agency - the I.C.C. New Canadian international operating authority can only usually be obtained through some form of a 'public convenience and necessity test' (where in a practical sense, the onus of proof rests with the applicant), and must be obtained from each provincial regulatory authority to which the application applies.

There are some exceptions to the 'public necessity and convenience' test requirement in Manitoba of relevance to Manitoba-Minnesota trucking. The first deals with a very limited list of so-called 'designated commodities', for which authority can be obtained more or less for the asking. See [5] for details. The second is associated with the de facto un-regulated state of 'farm

to market' grain movements in and out of Manitoba, as detailed in [6].

Implications: Certain U.S. carriers have expressed the view that Canadian authority acquisition requirements discriminate against them relative to their Canadian competitors, implying that Canadian carriers are given preferential treatment in the 'public convenience and necessity test' relating to the Canadian leg of newly-issued international operating authorities. Such an assertion is, of course, difficult to prove one way or the other.

A superficial review of international operating authority applications processed by the Manitoba Motor Transport Board during 1984 was conducted to see if any obvious signs of such bias are evident. In 1984, some 50 'small' (i.e. commodity and/or shipper-specific) international applications have been processed, with the vast majority (reportedly) being approved, regardless of country of domicile. There were 5 'substantial' applications processed during the year, essential details of which are summarized as follows:

Jan./84: Manitoba-based Can.-U.S. Trucking sought approval to acquire the Manitoba operating authority of U.S.-based G.M.W. Inc., involving general freight to/from Winnipeg from/to various U.S. locations. The authority transfer was approved. This decision, however, has been challenged by a number of Canadian and U.S. carriers, and the case is currently before the courts.

June/84: Manitoba-based Kleysens Transport applied for a TL general freight authority to/from Manitoba from/to the U.S. The application was initially opposed by a large number of both Canadian and U.S.-based carriers, but all opposition withdrew prior to the public hearing. The application was subsequently approved.

Sept./84: U.S.-based Warren Transport Ltd. applied for unrestricted general freight authority to/from Winnipeg from/to the U.S. The application was initially extensively opposed, and subsequently amended to a TL general freight authority using specialized equipment. With the amendment, all opposition withdrew. Officials of the Motor Transport Board advise that the amended application will be approved momentarily.

Nov./84: U.S.-based Maple Leaf Express applied for authority to handle LTL general freight for

and on behalf of Chi-Can Freight Forwarding Co. of Winnipeg (apparently an affiliated company). The application was denied.

Dec./84: Winnipeg-based Gaulco applied for authority to transport fresh and frozen fish for and on behalf of the Manitoba Freshwater Fish Marketing Board to U.S. points. The application was extensively opposed but, subsequent to a 5-day hearing, was approved.

This brief review of recent international authority applications processed by the Manitoba Motor Transport Board contributes little directly to the question of whether or not there is 'unfairness' experienced by American carriers relative to their Canadian competitors associated with economic regulatory differences in the two countries. What it may help to do is to place the question itself into context, in terms of whether or not it is particularly relevant to international trucking on this trucking lane. To this effect, the majority of on-going business activities on the lane, and the majority of apparent opportunities for new trucking activity on the lane (as reflected in the nature of recent authority applications), are associated with movements of low-valued bulk commodities transported in a localized geographic region. In many ways, this type of movement is effectively de-regulated anyway, in that there exists a 'bank' of inactive authority relating to these movements, which could be activated at any time carriers holding such authority felt that the market warranted such a response. At most, the fairness issue would therefore seem to relate to only a few carriers on each side of the border - not the trucking industry per se.

DIFFERENCES IN HOURS-OF-WORK REGULATIONS TEND TO FAVOR THE USE OF CANADIAN VS. U.S. DRIVERS IN INTERNATIONAL TRUCKING

Relevant Facts: Hours of work legislation respecting drivers exists in the U.S., and is enforced to a reasonable extent. Similar legislation is not enforced in Canada.

Implications: The implications of this difference are not clear, although one American carrier suggested that, given other things equal, international operations using Canadian drivers may be advantaged over those using U.S. drivers. To this effect, some of the work done by the Canadian drivers in Canada may not be recorded in the U.S. log book and there is little that a U.S. enforcement officer can do to determine what might have

gone un-recorded.

DRIVER RESIDENCY REQUIREMENTS TEND TO FAVOR THE USE OF U.S. VS. CANADIAN DRIVERS IN INTERNATIONAL TRUCKING

Relevant Facts: In a de jure and for the most part de facto sense, Canadian drivers are normally prohibited from handling intra-U.S. movements as are U.S. drivers prohibited from handling intra-Canadian movements.

Implications: Given other things equal, these residency requirements tend to favor the U.S. international trucker relative to the Canadian.

U.S. PRIVATE CARRIERS HAVE GREATER FLEXIBILITY WITH THE USE OF OWNER-OPERATORS THAN IS PERMITTED IN CANADA

Relevant Facts: For all intents and purposes, 'single-source', one-way trip leasing arrangements are now a reality of U.S. trucking. This is not the case in most Canadian jurisdictions, including Manitoba, where leasing requirements necessitate extended, contractual use of owner-operators, and effectively prohibit the 'single-source' leasing of drivers and vehicles.

Implications: The implications of these different approaches on international trucking are unknown. It is reasonable to speculate, however, that on the Canadian leg of an international movement, U.S.-based private and for-hire carriers are operating with various types of driver-vehicle arrangements which would not be permitted of Canadian-based operations - simply because the responsible Canadian regulatory authority is unaware of the details of the arrangements, and the American carriers are unaware that these arrangements might be contrary to Canadian regulatory provisions.

Other matters identified by industry spokesmen as troublesome or irritating regulatory provisions impacting Manitoba-Minnesota trucking operations included:

(i) several Manitoba-based carriers complained about the need to pay the province's 1.5% payroll tax on incomes paid to their international drivers; their U.S. competitors are not required to pay this tax on incomes earned by their drivers.

(ii) Canadian carriers are obliged to pay import duty on U.S. equipment imported into Canada, unless that equipment is 100% dedicated to international

movements; some consider that this puts them at a disadvantage relative to their international U.S.-based competitors, in that they must often use their international equipment on some intra-Canada movements to achieve adequate utilization levels, thereby effecting a capital cost disadvantage.

(iii) trucking equipment can be depreciated more quickly in the U.S. than is permitted in Canada for tax purposes; some Canadian carriers feel this disadvantages them relative to their U.S. competitors on international movements.

(iv) Minnesota enforcement officials do not recognize Manitoba-issued vehicle safety stickers; one carrier indicated that a reciprocal vehicle safety standard program should be developed to minimize operational disruption associated with safety inspections.

(v) customs operations at the Pembina crossing into the U.S. require that southbound LTL movements must arrive at customs by 10 p.m. in order to be cleared by midnight; otherwise vehicles must wait for clearance in the morning. 'In-bond' LTL movements northbound into Canada are not subjected to this scheduling limitation.

COMMENTARY

The regulatory environment governing international trucking is comprised of a complex mix of legislation, regulation, policy and procedural considerations impacting every aspect of the trucking business. Many of these considerations effect various types of inefficiencies, and are often interpreted by industry participants to create certain types of biases - be it favoring one carrier relative to another, or one type of carriage relative to another, or one country's carriers to the other.

This paper has examined various aspects of the demand for, industry serving, and regulatory environment governing transborder trucking on the Manitoba-Minnesota traffic lane. The following facts and observations appear pertinent:

FIRST: between Manitoba and Minnesota specifically, trucking is dominated by the bulk hauling of grain and fertilizer moved in hopperbottom units by a large number of small carriers.

This is a specialized business of particular concern to the economies of the two jurisdictions, and of little consequence to national trucking interests or federal policy-makers or regulators. The vast majority of carriers involved in this activity might best be described simply as 'truckers', for whom the regulatory environment is as much as anything a 'necessary evil', and certainly not a market stabilizer or protective device.

SECOND: between Manitoba and Minnesota, and more importantly Manitoba and the north central states, the southbound movement of lumber and the northbound movement of vehicles are also very important. A few specialized carriers dominate these movements, and most are long-established in the business. Two of the largest (one Canadian-based and the other U.S.-based) are believed to be heavy employers of owner-operators; both may be considered to be, as much as anything, organizations which in effect rent the use of their operating authorities to owner-operators in exchange for their managerial and marketing strengths in the business.

For this group of carriers, economic regulatory issues - and in particular the retention of a restrictive authority acquisition requirement in Manitoba - are presumably important, to the extent that such provides 'protection' in their established markets.

THIRD: LTL general freight movements on the traffic lane are relatively minor, with an imbalance in the north bound direction. There are both Canadian and U.S.-based carriers involved in

these movements, most being long-established, medium to large operators of regional or national scale.

Based on this examination, we have concluded that the interests of both Manitoba and Minnesota, and the vast majority of truckers based in these jurisdictions, would be best served by simplifying and where possible normalizing the myriad of regulations governing vehicles and their loads, drivers, custom inspections, taxation, vehicle safety, permitting requirements, reporting requirements, spring weight bans and so on. Many of these matters could be best addressed by discussions and negotiations between the provincial and state levels of government.

For this traffic lane, economic regulatory issues would appear to be primarily related to their 'annoyance factor' for many and their 'protective value' for a few. It is suggested that efforts directed at exempting major commodity movements of particular importance to the localized economies (e.g. grain, fertilizer, lumber) from this type of regulatory interference would effect a significant reduction in 'annoyance', and little change for anything else.

REFERENCES AND NOTES

[1] The weigh scale survey at Emerson was conducted one week each season, five days a week (Monday to Friday), between 7 a.m. and 3 p.m. Theoretically, all trucks were required to report to the scale for inspection purposes. However,

some (typically empty) trucks were 'released' without being surveyed, particularly during certain peak traffic periods.

[2] The commodity codes used in this Table were adopted from the most recent version (revised in 1980) of the Manitoba Highways and Transportation Truck Survey questionnaire (prior to 1980, there were about 360 commodity categories; results of the 1974, 1975 and 1978 surveys have been 'manipulated' to conform to the current classification system):

01 - Animal By-Products
02 - Beverages
03 - Building Materials (Gravel)
04 - Building Materials (Other)
05 - Chemicals
06 - Compressed Gases
07 - Containers (Empty)
08 - Earth, Organic Fertilizer
09 - Empty (No Commodity)
10 - Equipment (Automotive)
11 - Equipment (Construction)
12 - Equipment (Farm)
13 - Equipment (Other)
14 - Food (for Animals)
15 - Food (for Humans)
16 - Farm Crop (Grain)
17 - Farm Crop (Other)
18 - Fuel (Heating, Light)
19 - Fuel (Vehicles, Engines)
20 - Household Goods, Appliances
21 - Live (Poultry)
22 - Live (Stock)
23 - Live (Other)
24 - Medical Supplies & Equipment
25 - Mining Products
26 - Misc. Goods, Unknown Comm.
27 - Paper Products
28 - Petroleum Products
29 - Plants
30 - Service Vehicles
31 - Scrap
32 - Sporting Goods & Supplies
33 - Timber
34 - Vehicles, Campers, Trailers
35 - Wearing Apparel

For analytical purposes, the following commodity groupings were used to consolidate individual commodities:

Group (A) represents Commodity Codes 10, 11, 12, 13, 30 and 34 (i.e. 'equipment and other vehicles').
Group (B) represents Commodity Codes 01, 14, 16 and 17 (i.e. 'grain, other crop, feed').
Group (C) represents Commodity Codes 06, 18, 19 and 28 (i.e. 'fuel').
Group (D) represents Commodity Codes 21, 22 and 23 (i.e. 'livestock').
Group (E) represents Commodity Codes 24, 26, 29, 32 and 35 (i.e. 'general freight').
Group (F) represents Commodity Codes 04 and 33 (i.e. 'timber and other building materials').

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TABLE 1
A Framework of the Regulatory Environment
Governing Transborder Trucking

FACTOR(S) AFFECTED	IMPORTANT LEGISLATIVE, REGULATORY, POLICY OR PROCEDURAL CONSIDERATIONS	SOURCE(S) OF REGULATION					
		CANADA			U.S.		
		F	P	L	F	S	L
Vehicle Characteristics and Payload-Handling Capabilities	1. Basic Weight & Dimension Regulations	o	●	o	●	●	o
	2. Over-Weight/Over-Dimension Permitting		●	o		●	o
	3. Spring Weight Bans/Winter Weight Allowances		●	o		●	o
	4. New Vehicle Safety Standards	●			●		
	5. Used Vehicle Safety Standards		●			●	
	6. Minimum Performance Requirements		●			●	
	7. Custom Inspection Requirements	●			●		
	8. Special Commodity Regulations (e.g. Hazardous)	●	o	o	●	o	o
Authority to Conduct Transborder Freight Transport by Truck	1. Distinction between Private and For-Hire Trucking		●		●	o	
	2. Basic Operating Authority Requirements	o	●		●	o	
	3. Special Operating Authority Provisions		●		●	o	
	4. Exemptions from Operating Authority Requirements		●		●	o	
	5. Requirements for Acquiring Operating Authority	o	●		●	o	
	6. Procedures for Acquiring Operating Authority	o	●		●	o	
Rates	1. Provisions Governing Rate Establishment	●	o		●	o	
	2. Provisions Governing Rate Revision	●	o		●	o	
	3. Provisions Relating to Maximums/Minimums	●	o		●	o	
	4. Combines/Competition Conditions	●			●		
Travel Time and Scheduling	1. Custom Inspection Requirements	●			●		
	2. Hours-of-Work Regulations	●			●	o	
	3. Sunday Trucking Restrictions	●					
	4. In-Transit Requirements for Special Commodities	o	o		o	o	
Driver Status and Use	1. Provisions Governing Use of Owner-Operators		●		●	o	
	2. Licensing Requirements		●			●	
	3. Visa/Work Permit Requirements	●			●		
	4. Hours-of-Work Regulations	●			●	o	
Other Factors	1. Insurance Requirements: Cargo/PL-PD		●		●		
	2. Vehicle Leasing Provisions		●		●		
	3. Conditions of Carriage Regulations		●				

NOTES: ● Source of dominant regulation(s) o Source of some regulation(s)
F Federal Authority P/S Provincial/State Authority L Local Authority

Table 2
Summary Statistics: Truck Origin-Destination Survey
Emerson Scale (1981)
(Source: Manitoba Dept. of Highways & Transportation)

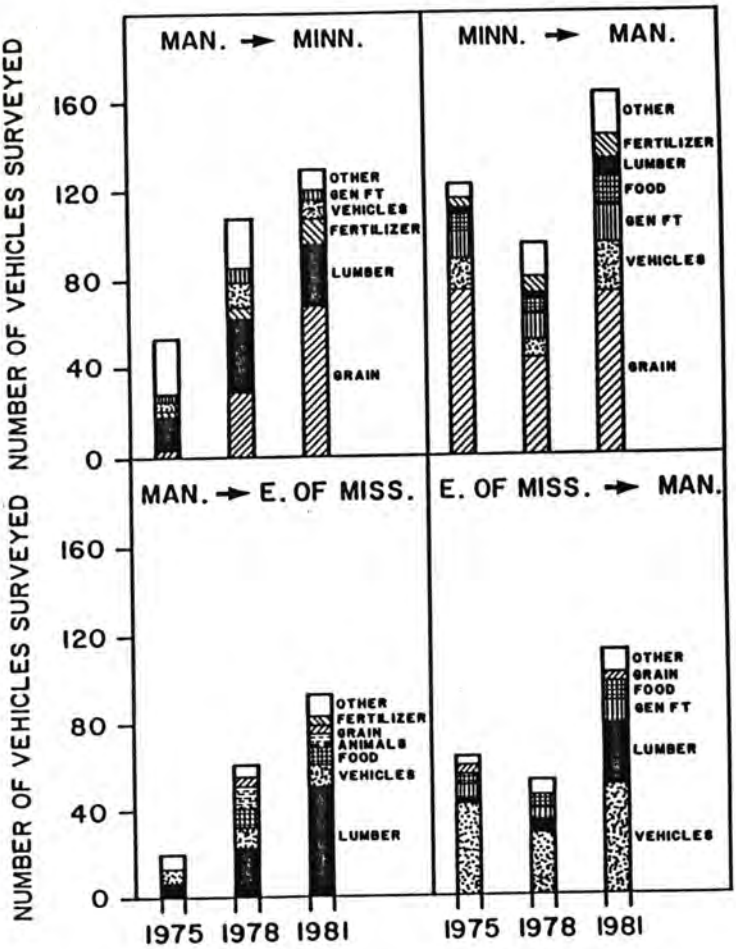
Origin \ Destination	MAN.	SASK.	ALTA.	ONT.	OTHER CANADA	MINN.	E. OF MISS.	W. OF MISS.	ALASKA
MANITOBA			1(F)	3(B) 1(F)	1(B)	68[B] 29(F) 11(08) 8(A) [a]	51(F) 10(A) 8(15) 6(D) [b]	70(F) 47(C) 45(A) 32(B) [c]	
SASKATCHEWAN				NIL	NIL	9(08)	1(A) 1(F) 1(20)	9(08) 1(A) 1(E)	
ALBERTA				NIL	NIL	NIL	1(D)	NIL	
ONTARIO	1(A) 1(15)	1(E) 1(15)	NIL		NIL	NIL	1(E)	NIL	NIL
OTHER CANADA	NIL	NIL	NIL	NIL		NIL	NIL	NIL	NIL
MINNESOTA	73[B] 22(A) 16(E) 12(15) [d]	5(A) 4(B)	10(B) 4(A)	NIL	NIL				NIL
EAST OF MISSISSIPPI	50[A] 29(F) 10(E) 9(15) [e]	3(A) 1(E)	6(A) 2(F) 2(05)	NIL	NIL				NIL
WEST OF MISSISSIPPI	75[A] 27(B) 21(15) 19(E) [f]	2(A)	8(A) 1(B)	NIL	1(A)				1(A)
ALASKA				NIL	NIL	NIL	NIL	NIL	

FOOTNOTES:

1. The letter or number in brackets denotes commodity group or commodity type, respectively. The number preceding the brackets denotes the number of observed truck trips. See [2] for other details regarding the Table.

2. The following presents a complete listing of other movements not listed in the corresponding cells:
   [a] includes 5(E), 4(C), 2(05), 2(15) and 1(D).
   [b] includes 5(27), 4(B), 4(08), 3(E), 1(07) and 1(31).
   [c] includes 23(08), 10(E), 6(05), 5(27), 3(15), 1(07), 1(20) and 1(31).
   [d] includes 10(F), 10(08), 7(31), 4(05), 3(D), 2(27), 1(02), 1(07) and 1(25).
   [e] includes 4(B), 2(D), 2(05), 2(10), 2(20), 1(25) and 1(27).
   [f] includes 13(F), 6(08), 6(31), 3(D), 3(05), 2(07), 2(20), 2(25), 1(C) and 1(02).

FIGURE 1
Comparisons of Manitoba-U.S. Commodity Movements
via Emerson Weigh Scale: 1975, 1978 and 1981
(Source: Manitoba Highways & Transportation)



SOME TENTATIVE FINDINGS ABOUT THE EFFECT OF LEVEL OF ENFORCEMENT ON COMPLIANCE WITH TRUCK WEIGHT REGULATIONS*

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ABSTRACT

Highways agencies all over the world recognize that overweight trucks are a major cause of premature pavement deterioration. Almost all highway agencies, therefore, enforce truck axle and gross weight limits by inspections at permanent weigh scales and by mobile patrol units. However, little is known about the effect of the level of enforcement on the degree of compliance with the weight limits. To fill this gap in the literature, this paper presents the context, methodology and tentative results of three studies of the effect of enforcement on compliance carried out on provincial highways in Saskatchewan.

Analysis of the data from the 12 permanent weigh scales situated on primary highways indicated that as the inspection rate (apprehension probability) increased to about five percent, the violation rate decreased rapidly. Increasing apprehension probability beyond five percent had little impact on violation rate. The data from 18 mobile patrol units confirmed this trend.

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*This paper represents the opinions of the authors and not necessarily the position of Saskatchewan Highways and Transportation.

Data from before and after type studies at two specific locations were used to study the effect of continuous and/or zero enforcement. One location was selected to be representative of a short-haul situation involving timber transportation to a saw mill. The other location was selected to represent long-haul truck movements incorporating interprovincial and intercity truck haul with relatively little local haul. The enforcement levels were employed over a length of time necessary to ensure the trucking industry was aware of the change.

The long-haul study showed that the rate of violation of gross weight limits decreased to a low of 2.8% at continuous enforcement from 5.6% at normal enforcement. The violation rate increased to 18.6% at zero enforcement. A statistical analysis utilizing the t-test indicated that there is a significant difference between the number of overweight trucks at the various enforcement levels. The short-haul study also indicated a significant difference between zero and normal enforcement.

The authors believe this paper provides some insights into the subject of enforcement and compliance to weight regulations. It should form a useful basis for additional studies that are needed, using multi-year data and at more locations, to further quantify the relationship between enforcement and compliance.

INTRODUCTION

Highway agencies across the world spend billions of dollars on providing adequately strong pavements for anticipated traffic loads. Highway engineers and administrators have set up sophisticated traffic counting and forecasting methods and pavement management systems in order to optimize investment in pavement construction and rehabilitation. To protect this investment, legally mandatory maximum gross and axle load limits are imposed by most highway jurisdictions.

Overweight (over the legal gross or axle load limits) trucks cause premature deterioration of pavements and, therefore, should be of concern to all highway engineers and managers. However, it is only in very recent years that highway agencies have attempted to investigate the extent of the problem, its impact, and the relationship between enforcement of and compliance with legal load limits (Ref. 1 to 9).

In particular, little is known about the effect of the level of enforcement on the degree of compliance. This paper attempts to fill this gap in the literature by presenting the tentative results of the following three enforcement versus compliance studies conducted on Saskatchewan provincial highways.

1. The enforcement and compliance data routinely collected by permanent weigh scales and mobile patrol units were analyzed to discern any cause/effect patterns.

2. The first of the two semi-controlled before and after field studies was conducted at a location with mainly long-haul, non-local traffic. This study was dubbed the "long-haul" study.

3. The second before and after study was conducted at a location with mainly local, "short-haul" traffic.

The methodology tentative results and discussion of each study is presented in separate sections below.

WEIGHT REGULATION AND ENFORCEMENT CONTEXT

To help understand the context in which the enforcement versus compliance studies were conducted, this section briefly describes the relevant aspects of truck weight regulation and enforcement practices on the Saskatchewan provincial highway system.

For the purpose of regulating truck weights, the 23,400 km of Saskatchewan provincial highway system is classified into two categories: primary and secondary highways. Table 1 shows their general weight regulations and some other characteristics.

The 'primary highways' system (3,180 km in length) comprises highways with relatively high traffic volumes and heavy pavements that serve inter-city, inter-provincial and Canada - U.S. traffic. Secondary highways (20,260 km) carry low to medium traffic volumes of mainly intra-provincial nature. Exceptions to the general weight regulations shown in Table 1 are made in special circumstances or as limited general exceptions. For details, see Ref. 9, which also reports the incidence of the overweight trucks on Saskatchewan highways.

TABLE 1

GENERAL WEIGHT REGULATIONS ON SASKATCHEWAN PROVINCIAL HIGHWAYS

Item	Primary Highways	Secondary Highways
Weight Regulations		
Steering Axle	5,500 kg	5,500 kg
Single Axle	9,100 kg	8,200 kg
Tandem Axle	16,000 kg	14,500 kg
Gross Weight	53,500 kg	49,000 kg
General Data		
Length (1984)	3,180 km	20,260 km
Average Daily Traffic (1983)	2,500 veh/day	500 veh/day
Average Daily Truck Traffic (1983)	400 Trucks/day	60 trucks/day

Enforcement of weight regulations is the major function of the Saskatchewan Highway Patrol, which is a branch of the Saskatchewan Department of Highways and Transportation. They enforce weight regulations with 13 permanent weigh scales. In addition 18 patrol cars operating from five regional headquarters carry out random inspections throughout the highway system using portable scales. Permanent weigh scales, with one exception, are located on primary highways.

Table 2 presents enforcement data for 12 weigh scales for 1983. Weigh scales are manned for randomly selected eight-hour shifts during which all trucks are required to report for inspection. However, only loaded trucks are inspected (i.e. weighed). The proportion of time a given weigh scale is manned varies from scale to scale, as can be deduced from Table 2, depending upon the truck traffic and various other factors. Using random eight-hour shifts, most of the high volume scales are open for inspection for about 16% of the time.

The percentage of trucks inspected, as shown in Table 2, can be considered to represent the apprehension probability from a truck driver's point of view. Percentage of inspected trucks exceeding the weight limit is the violation rate.

Table 3 shows the number of inspections carried out by each of the eighteen patrol cars in 1983. Since each car randomly covers a relatively large area, it is impossible to estimate the total truck volume, and therefore, the inspection rate (apprehension probability) for data in Table 3.

TABLE 2

1983 ENFORCEMENT AND COMPLIANCE DATA FOR 12 PERMANENT WEIGH SCALES

	Trucks Inspected		Trucks Exceeding Allowable Gross Weight	
Weigh Scale*	No.	% of Total Trucks**	No.	%
1.	150	0.4	18	12.3
2.	1,600	2.2	102	6.4
3.	1,800	1.2	130	7.2
4.	2,100	2.9	46	2.2
5.	2,500	3.4	270	10.8
6.	3,500	1.6	480	13.7
7.	3,800	4.0	293	7.7
8.	5,500	15.1	303	5.5
9.	8,200	11.2	435	5.3
10.	9,600	5.3	355	3.7
11.	10,600	7.3	710	6.7
12.	26,000	15.8	468	1.8
Average	6,280	5.9	301	4.8

*Arranged in ascending order of no. of inspections.

**Equals No. of trucks inspected divided by the estimated total trucks passing that location in the entire year.

TABLE 3

1983 ENFORCEMENT AND COMPLIANCE DATA FOR 18 MOBILE PATROL CARS

Patrol Units*	Number of Trucks Inspected	% of Trucks Exceeding Allowable Gross Weight
1.	50	32.2
2.	140	11.1
3.	250	10.6
4.	250	21.7
5.	250	19.8
6.	260	12.9
7.	350	11.7
8.	380	12.2
9.	450	10.5
10.	580	7.5
11.	650	18.2
12.	650	18.5
13.	650	12.1
14.	670	10.6
15.	1,250	8.3
16.	1,280	12.7
17.	1,400	11.1
18.	1,900	12.8
Average	630	12.5

*Arranged in ascending order of no. of inspections.

OPTIMUM LEVEL OF ENFORCEMENT

Permanent Weigh Scale Data

Figure 1 shows the graphical plot of data from Table 2. The approximate best-fit curve drawn through the 12 observations indicate that:

1. About 16% of the trucks are overweight if the apprehension probability is less than one percent. The value at zero apprehension probability is arbitrary.
2. The violation rate decreases rapidly as apprehension probability increases from zero to about five percent. Any further increase in apprehension probability produces a very small decrease in violation rate. This result is similar to the one reported in the Iowa Study (7).

The above findings have important implications in determining the optimum size of weight enforcement staff in that an inspection rate of about five percent appears to be sufficient to deter almost all the witting infractors.

Mobile Patrol Data

Figure 2 shows the graphical representation of the data from Table 3. Although a violation rate could not be calculated for mobile patrol data for reasons explained earlier, the approximate best-fit curve in Figure 3 confirms the trend from the weigh scale data. The violation rate drops rapidly to about 500 inspections per patrol car per year, and is nearly constant beyond about 1,000 inspections per patrol car per year.

Percent Trucks Overweight Versus Percent Trucks Inspected At 12 Permanent Weigh Scales In 1983

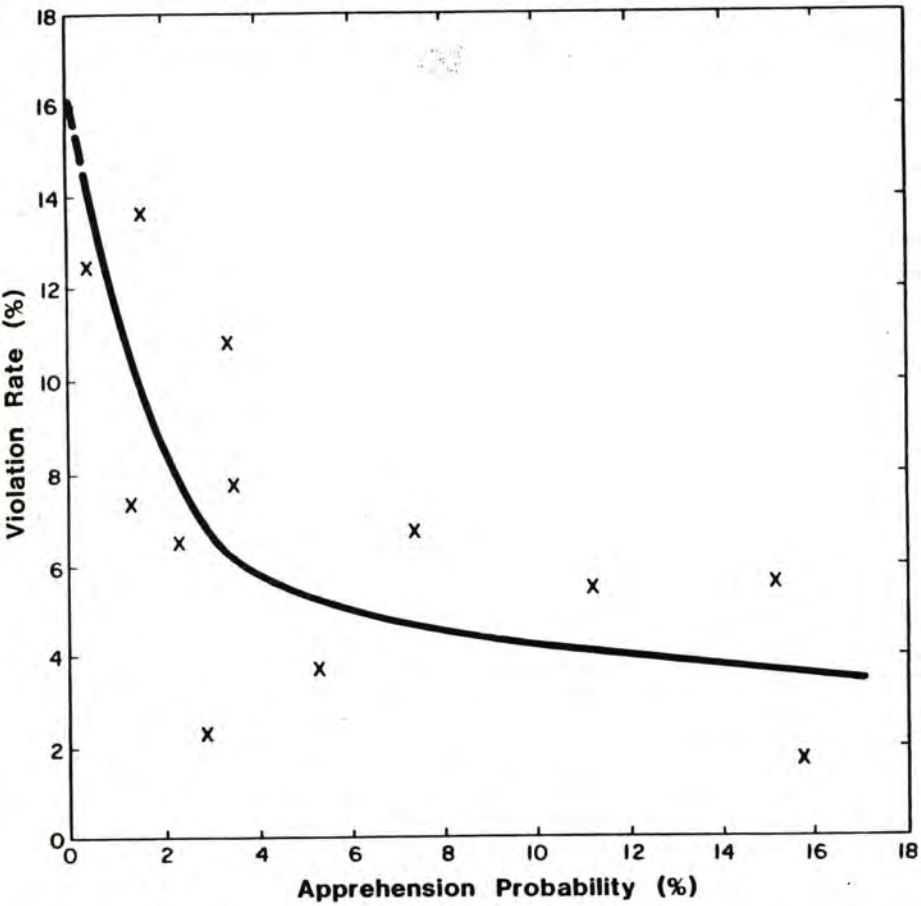


Figure 1

Percent Trucks Overweight Versus

Number Of Trucks Inspected

By 18 Mobile Patrol Cars

1983

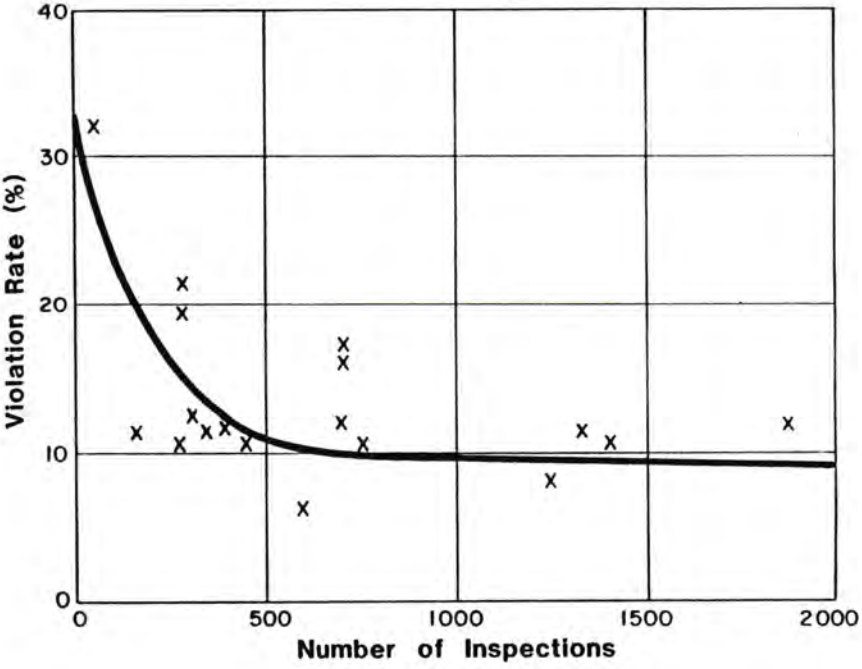


Figure 2

Discussion

The above results confirm that expected casual relationship between enforcement and compliance. They also suggest an optimum level of enforcement. The data, however, were not collected under controlled conditions.

To further study the effect of zero and continuous enforcement, two 'before and after' type studies were conducted. These are described in the following sections.

EFFECT OF ZERO AND CONTINUOUS ENFORCEMENT

The Long-Haul Study

This study was conducted at the permanent weight scale on Highway No. 11 north of Regina. This location provided a sample of relatively long-haul movements comprising inter-city, inter-provincial movements with a relatively small proportion of local, short-haul trips. Nearly 42% of the trips have origins and/or destinations outside the province.

Data Collection. Three random eight-hour surveys were conducted during each of the four time periods described below. The following data were recorded for each truck surveyed:

- weight on each axle, and thus gross weight
- truck type
- commodity carried
- place of registration
- origin-destination of the trip.
- body type
- volume utilization

1. Normal enforcement conditions were surveyed during Feburary 1984. Normal enforcement involves random eight-hour shifts by enforcement staff that occur on all days of the week and all hours of the day. The average enforcement is approximately 180 eight-hour shifts per year.
2. To measure the effect of zero enforcement, the scale was left unmanned by the regular enforcement staff from March 5 to 16, 1985. This period in March is relatively well known to truckers as the period during which the scale is closed due to staff holidays or assignments elsewhere.

   The survey was conducted by traffic counting staff toward the end of the March 5-16, 1985 period at which time the zero-enforcement condition had presumably become known to most of the truckers.

3. Saturation (continuous) enforcement was employed from May 11 to 17, 1984; the scale being manned by the enforcement staff during all hours of the day for this entire time period.

   The data were collected towards the end of the May 11 to 17 period, at which time the truckers had presumably become aware of the continuous enforcement.

4. Another survey of normal enforcement conditions was conducted in June 1984.

Results and Discussion. Table 4 shows the number and proportion of trucks of various types that exceeded the allowable GVW. The following conclusions can be drawn from the table for the Regina North site:

1. Under saturation (continous) enforcement conditions, the GVW violation rate decreased to 2.8% of the trucks surveyed, compared to a normal rate of 5.3% to 5.9%.

   A t-test showed this difference to be statistically significant. However, it is doubtful whether this reduction would be worth the cost of continuous enforcement.

2. Even at saturation (continuous) enforcement, there appears to be a small proportion of trucks that will not be deferred. They appear to be the unwitting infractors.

3. If there is no enforcement at all, the violation rate increases to 18.6%, the difference from normal again being statistically significant.

TABLE 4

PROPORTION OF TRUCKS EXCEEDING GVW AT VARIOUS ENFORCEMENT LEVELS FOR LONG-HAUL TRIPS

Enforcement Level	Truck Type	No. of Loaded Trucks Surveyed	Exceeding Allowable GVW	
			No.	%
Normal (February 1984)	2	9	0	0.0
	3	9	1	11.1
	3-S2	162	6	3.7
	Other	66	6	9.1
	Total	246	13	5.3
Zero (March, 1984)	2	14	1	7.1
	3	59	40	67.8
	3-S2	227	25	11.0
	Other	103	9	8.7
	Total	403	75	18.6
Saturation (May, 1984)	2	15	1	6.7
	3	11	0	0.0
	3-S2	186	6	3.2
	Other	107	2	1.9
	Total	319	9	2.8
Normal (June, 1984)	2	19	0	0.0
	3	13	2	15.4
	3-S2	229	10	4.4
	Other	96	9	9.4
	Total	357	21	5.9
		1,325	118	

This conclusion should be interpreted with caution, keeping the following points in mind:

a) There may have been some unmeasurable proximity effect on long-distance trips of the enforcement still applied by other weigh scales or by patrol cars, thus keeping the violation rate of these trips relatively low.

b) Trucks of "Type 3", hauling gravel relatively short distances, appears to have taken advantage of zero enforcement more than other truck types. Thus violation rate increased dramatically from 11% under normal enforcement to 68% under zero enforcement. This in turn helped increase the rate for all trucks from 5.3% to 18.6%.

Short-Haul Study

A significant amount of timber is hauled from the surrounding forest to the three timber companies in Hudson Bay via this highway. The special weight regulations for timber haul allow a GVW of 49,900 kg with allowable axle weight of 22,700 kg. The allowable weights for non-timber trucks are those of a secondary highway. At this location, there is little long-distance or inter-provincial movement.

Data Collection. The data on Highway No. 9 south of Hudson Bay were collected using a weigh-in-motion scale which measures only northbound traffic (most trucks are loaded) during the following time periods. The weigh-in-motion data were supplemented with 12-hour visual classification counts.

1. Normal Enforcement conditions were surveyed during February 15 to March 4 and March 17 to March 30, 1984. Enforcement is provided by one traffic officer stationed in Hudson Bay who spends on the average four hours per day enforcing weight regulations on all highways in the Hudson Bay area. The magnitude of normal enforcement on this location is not known.
2. Zero enforcement was applied during March 5 to 16, 1984. The patrol officer normally resident in Hudson Bay was absent from work during this time. That fact, and the truck traffic being almost exclusively local, made it reasonably certain that truckers became quickly aware of the change in enforcement level.

Results and Discussion. Table 5 shows the number and proportion of various types of trucks that exceeded the allowable GVW for the short-haul trip study. The following conclusions can be drawn from the data.

1. The percentage of trucks exceeding the allowable GVW increases from 26.0% at normal enforcement to 33.2% at zero enforcement. The t-test indicates that this change is statistically significant.
2. The 3-S2 trucks which is the most predomoninant truck type showed an increase of 3.3% in overweight trucks from normal to zero enforcement.

TABLE 5

PROPORTION OF TRUCKS EXCEEDING GVW AT NORMAL AND ZERO ENFORCEMENT LEVELS FOR SHORT-HAUL TRIPS

Enforcement Level	Truck Type	No. of Trucks Surveyed*	Exceeding Allowable GVW	
			No.	%
Normal	2	386	32	8.3
	3	44	8	18.2
	3-S2	1,202	375	31.2
	Other	33	18	54.5
	Total	1,665	433	26.0
Zero	2	165	211	12.7
	3	36	16	44.4
	3-S2	928	320	34.5
	Other	21	18	85.4
	Total	1,131	375	33.2

*Trucks surveyed in one direction only (northbound) which is the direction of loaded timber trucks. A small number of empty trucks are included.

CONCLUDING COMMENTS

This paper has presented the results of three studies of the effect of enforcement level on compliance with truck weight regulations on Saskatchewan highways. Although the studies are somewhat disparte and some of their findings are location specific, the following conclusions can be drawn from them.

1. The data from the 12 permanent weigh scales indicate that the percentage of trucks exceeding the allowable gross vehicle weight (violation rate) decreases rapidly as the inspection rate (apprehension probability) increases from zero to about five percent. Further increases in apprehension probability produce only slight decreases in violation rate. Data from the mobile patrol units confirms the above trend.
2. A survey of long-haul truck trips indicated that, for that specific site, employing continuous enforcement reduced the proportion of trucks exceeding the allowable gross vehicle weight increased from a normal of 5.6% to 2.8%. At zero enforcement, the violation rate increased to 18.6%. Both of these deviations from the normal were statistically signifiicant.

3. A survey of short-haul truck trips indicated that, for that specific location, the proportion of trucks exceeding the allowable gross vehicle weight increased from 26.0% at normal enforcement to 33.2% at zero enforcement. The difference is statistically significant.

4. Since the definition of normal enforcement, and the magnitude of other variables that may affect compliance, vary from location to location, the above results cannot be generalized. Also, further work is needed to:

   a) measure the violation rate for a range of apprehension probabilities at a given location, and

   b) to employ data for several years from the permanent weigh scales to confirm and quantify the curvilinear relationship between apprehension probability and violation rate.

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IMPROVING PRODUCTIVITY OF FREIGHT TRANSPORTATION IN SASKATCHEWAN*

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ABSTRACT

This paper describes how Saskatchewan has used weights and/or dimensions as a means of fostering productivity improvements in the transportation of freight by road. It sets out the Saskatchewan Bulk Commodity Policy and shows how the Policy has enabled participating industries to realize transport cost savings through higher weights and/or dimensions without increasing road infrastructure costs to taxpayers and without adversely affecting the safety of the travelling public. A comparison of the transport costs for a hypothetical bulk haul at various weights is presented from both the industry's and the province's perspective. A second case study

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* The views expressed in this paper are those of the authors and are not necessarily those of Saskatchewan Highways and Transportation.

will look at the benefits of designing the vehicle for the road system. In conclusion, the paper will look at the success of the Policy to date and future directions.

INTRODUCTION

Transport costs are a significant factor in the cost of Saskatchewan products. Presently, Saskatchewan ships large volumes of low valued bulk products and freight rates range up to 40% of the delivered price.

The continued success of Saskatchewan's economic activities in the agriculture and resource sectors is contingent upon the presence of an efficient and productive transportation network - a network which has sufficient capacity to meet the Province's needs and one that supplies transport service at reasonable costs recognizing the shipper's ability to pay and the shipper's right to earn a profit. Good roads as part of that network are vital for economic development in that they significantly influence the costs of goods and services.

A two tier highway system is used in Saskatchewan; the primary highway system for predominantly inter-provincial and inter-regional traffic and the secondary highway system serving mostly intra-provincial movements. Table 1 summarizes the maximum weights permitted on these two systems.

TABLE 1

Maximum Weights for Primary and Secondary Systems

	PRIMARY	SECONDARY
Axle Weights		
Steering Axle	12,000 lb	12 000 lb
Single Axle	20,000 lb	18,000 lb
Tandem Axle	35,000 lb	32,000 lb
Gross Weights		
Semi-trailers	82,000 lb	76,000 lb
Combinations	118,000 lb	108,000 lb

Axle weights may be increased by 10% during the winter months between December 1 and the last day of February.

In Saskatchewan, as in all provinces, there are no dedicated taxes for road infrastructure. Fuel taxes on road vehicles were removed in 1982. Registration fees paid for by the industry vary with vehicle size and, to some degree, distance travelled. For the most part, however, registration fees

currently can be considered more a business expense than a tax for road construction. The only true user fee charged prior to 1980 was the ton-mile charge levied for single-trip overweight permits issued for non-divisible loads.

THE BULK COMMODITY POLICY

In the late 1960's and early 1970's the Province made it possible for International Minerals and Chemical Corporation to haul potash from Esterhazy to Northgate, North Dakota with vehicles having weights in excess of the legal maximum in return for a road fee. The move allowed IMC to realize some efficiencies in its truck haul and assisted the potash industry in negotiating lower freight rates from the railways.

In January, 1980, the Saskatchewan government introduced a formal policy on the bulk transportation of commodities. It stated that bulk commodities should move long distances by rail whenever possible. However, rail transportation is not always a reasonable alternative, either because it is physically not in place or rates preclude its use.

The Bulk Commodity Policy was established to achieve two major objectives:

1. to enable bulk shippers captive to the truck mode to move their product by road as efficiently as possible; and
2. to provide competition in a market place where rail appeared to have a monopoly.

These objectives were to be realized without jeopardizing highway safety and without creating an excessive cost burden to the road system.

The policy enables industries moving a minimum of 30,000 tons of bulk product per year between one origin and/or one destination in Saskatchewan to use vehicles that have weights and/or dimensions in excess of those specified by regulations. In return for this concession the industry must enter into an agreement with the province setting out the conditions of the haul. One of these conditions is related to payment of any additional road and bridge costs. Others cover vehicle specifications, vehicle operating and maintenance procedures and driver qualifications. The

government always retains the right to modify and, if necessary, cancel the haul should highway safety be jeopardized.

The policy allows industry to improve productivity and lower transport costs while at the same time, the strict conditions ensure that highway safety is not adversely affected. Further, the policy provides an opportunity for government to work with industry in the research and development of safer and more productive equipment.

Figure 1 illustrates the steps involved from application by a shipper for a bulk haul to the signing of a formal agreement and issuance of permits.

OVERWEIGHT FEE ALLOCATION

Road transport system costs associated with a bulk haul include both province and industry related components. The main cost to the province results from the need to resurface the highway to compensate for lost road life. In some cases, bridge

THE BULK COMMODITY PROCESS

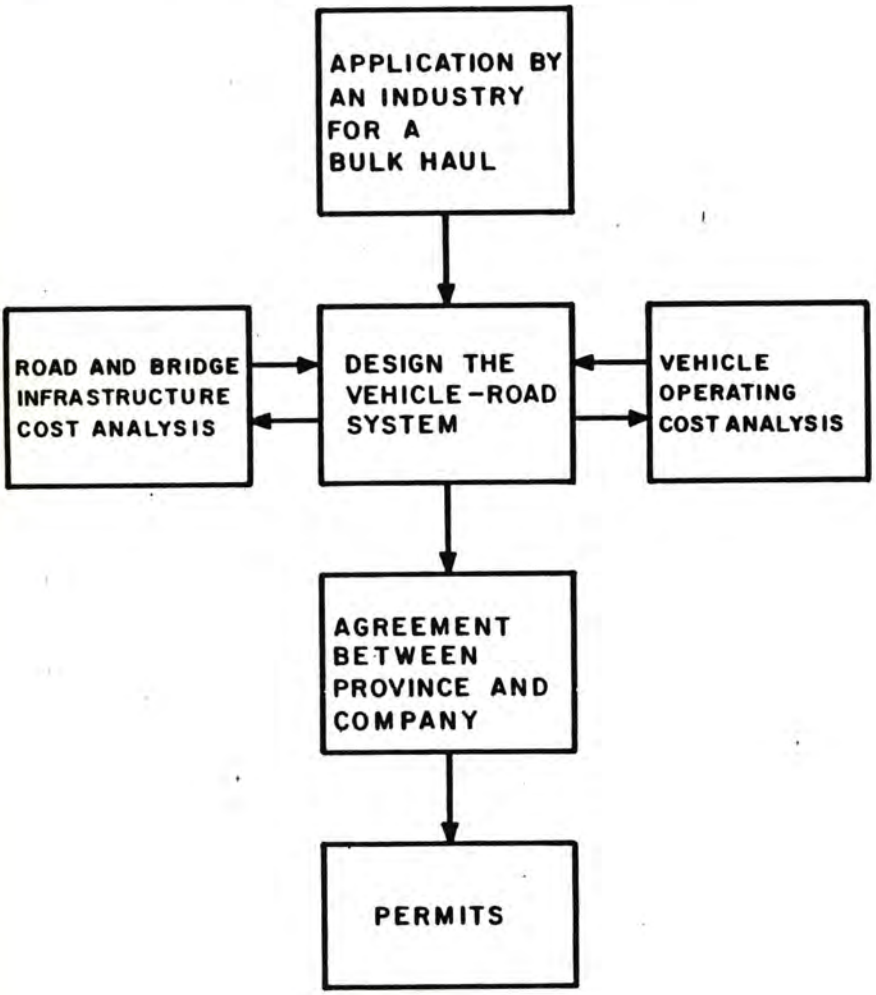


FIGURE I

strengthening may also be required in order to accommodate a bulk haul. Industry related costs include truck rates plus whatever incremental road costs are assigned from the province.

Industry is required to pay 100% of any incremental road and bridge costs that are due to the overweight vehicles. The incremental cost is calculated as the difference between road and bridge costs incurred if the haul operates at high weights and those costs incurred if the haul operates at legal weights. Further, in cases where rail service is available, both physically and competitively, the industry must additionally pay 60% of the road and bridge costs associated with the haul at legal weights. By charging 60% of this fee to industry, it provides a reasonable disincentive for industries to transfer products from rail to road.

In the intervening years since the first formal agreement, the department has developed techniques for estimating the incremental costs and methods for allocating these costs.

In some cases, due to high payloads and relatively low axle loadings the pavement damage factor to payload ratio is lower for overweight equipment than

for legally loaded equipment, resulting in a lower cost for overweight vehicles than for legally loaded vehicles. Industry is credited for this increased productivity relative to pavement damage. While the government does not pay the industry in these cases, it would mean either no fee in cases where rail service is not available or a reduced fee in cases where rail service is available.

Another important component is the salvage value of pavements. The government recognizes that the fee is to pay for additional asphalt. After the term of the agreement expires, department officials have determined that there is a certain amount of salvage in the asphalt which remains. The industry is credited with this salvage.

CASE STUDIES

Two case studies illustrate the dramatic savings that can be achieve by both government and industry.

Case Study No. 1

The first case study is a rail competitive haul of one million tons per year over 150 miles of paved highway for a 10 year period.

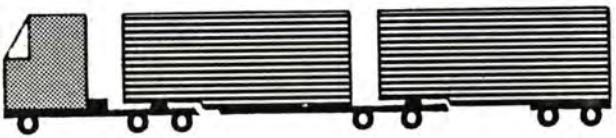
Figure 2 shows the four vehicle types that were considered. The first vehicle is a conventional combination unit with a legal maximum gross vehicle weight of 118,000 pounds. The second is a 9-axle bulk unit which achieves a gross eight of 138,000 pounds while maintaining axle loads at 10,000 pounds and 32,000 pounds for the steering and tandem axles respectively. Axle loadings are 12,000 pounds and 35,000 pounds on the legally loaded unit.

In addition, two vehicles designed to reduce pavement damage while maintaining payload are included. The first is based on the 138,000 pound vehicle with a third axle added to the lead and rear trailers during the spring thaw periods in order to reduce axle loadings while subgrades are softer and more susceptible to damage. The second is a 174,000 pound vehicle with the lead axle of its tri-axle sets narrower in overall width than the rear axles in order to distribute the loading over a larger pavement surface area. The affect, in theory, is to provide higher payload while reducing the overall pavement damage from that of more conventional units.

The importance of designing the right vehicle for a particular haul is readily apparent. As shown by

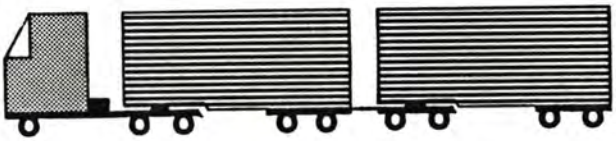
VEHICLES ANALYSED

1) 118 000 lbs.



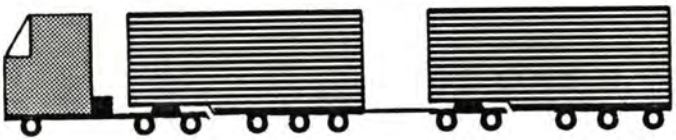
AXLE LOADS 12 000 lbs. 35000 lbs. 35000 lbs. 35000 lbs.

2) 138 000 lbs.



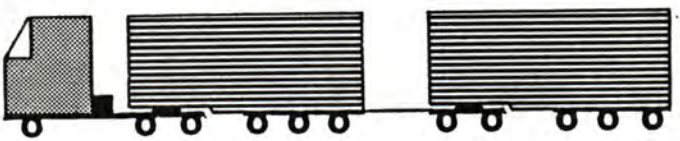
AXLE LOADS 10 000 lbs. 32000 lbs. 32000 lbs. 32000 lbs. 32000 lbs.

3) 138 000 lbs. (TRI-AXLE UNIT)



AXLE LOADS 10000 lbs. 26800 lbs. 40200 lbs. 26800 lbs. 40200 lbs.

4) 174 000 lbs. (STAGGERED AXLE UNIT)



AXLE LOADS 10000 lbs. 32000 lbs. 50000 lbs. 32000 lbs. 50000 lbs.

FIGURE 2

Figure 3, road infrastructure costs are reduced by as much as $3 million by minimizing axle loadings while maintaining or increasing vehicle payloads. However, it is the truck rates that yield the most significant savings, as much as $20 million, when payloads are increased. Further, as is evident from Figure 4, the road costs chargeable to the industry represent a very small percentage of the total.

Case Study No. 2

The second example illustrates the potential for designing trucks to fit the road system. Figure 5 shows three alternative wheel layouts for a vehicle currently being designed to transport tree length logs for the province's forest industry.

The three wheel layouts were the subject of recent analysis to determine the maximum gross loading that could be achieved such that no incremental road costs would be imposed on the company. The three alternatives are as follows:

1. Alternative No. 1 - Both the belly axle and tri-axle are 9 feet 6 inches wide;
2. Alternative No. 2 - The tri-axle is comprised of a 9 foot 6 inch wide tandem axle at the rear and a 5 foot 6 inch wide airlift axle in front;

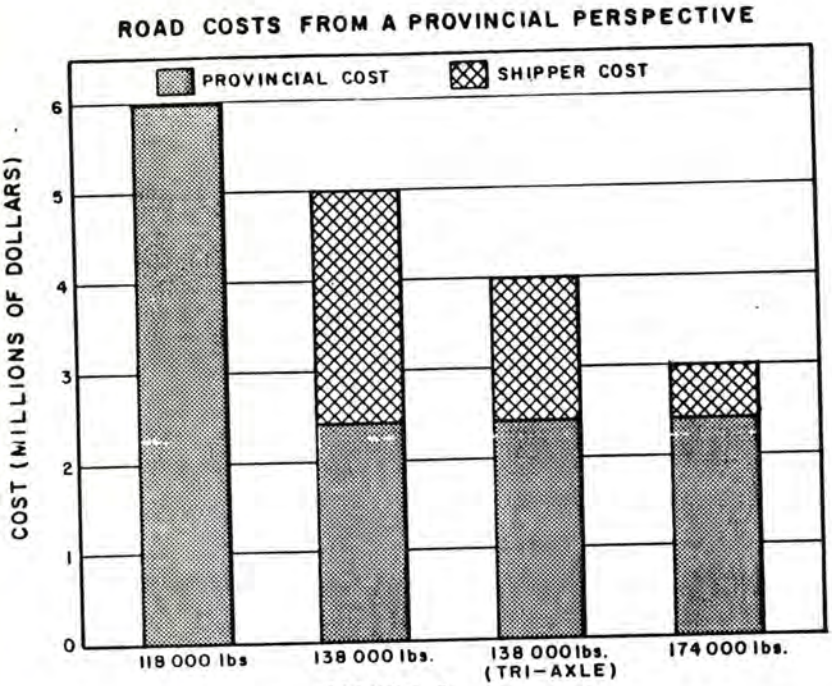


FIGURE 3

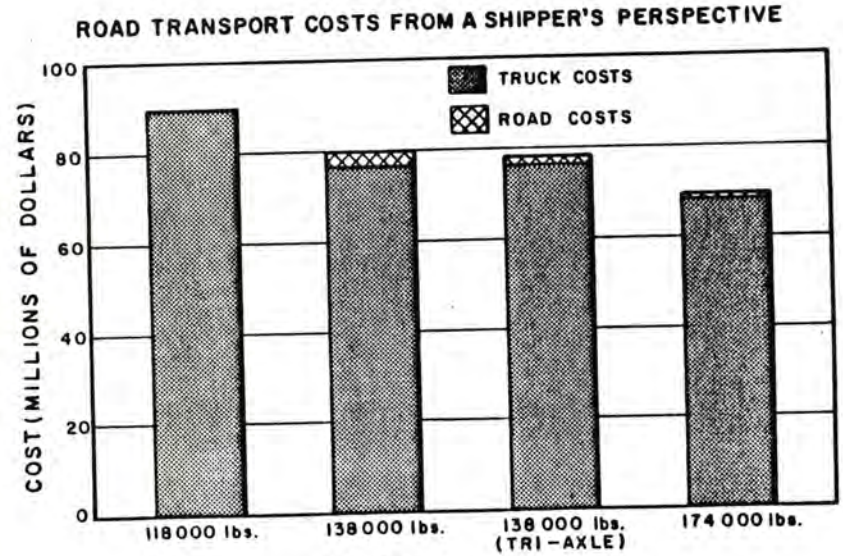


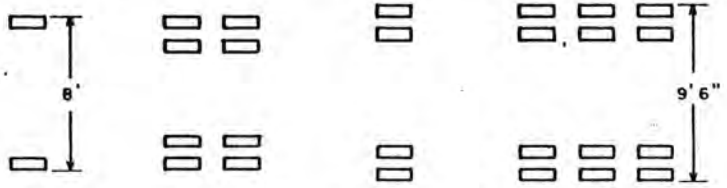
FIGURE 4

ALTERNATIVE WHEEL LAYOUTS ANALYSED

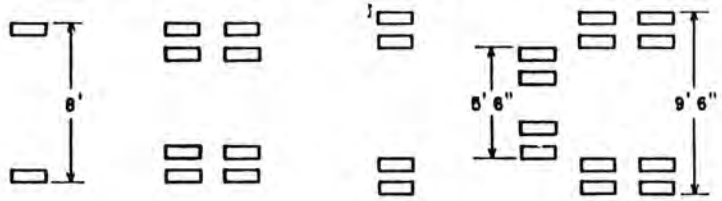


APPROX. TARE WEIGHT = 45000 lb.

1) BEE LINE TRAILER WITH 9'6" AXLES



2) BEE LINE TRAILER WITH STUB AXLE



3) BEE LINE TRAILER WITH OFFSET AXLES

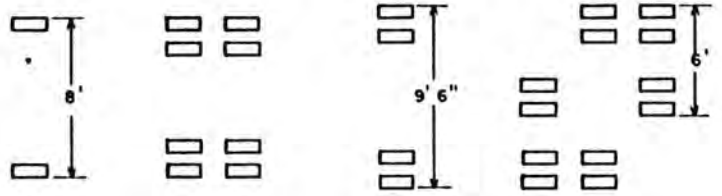


FIGURE 5

3. Alternative No. 3 - The tri-axle is comprised of a 9 foot 6 inch wide axle in the centre, a narrow lead axle set in on the right and a narrow rear axle set in on the left. A spring suspension equalizes the weight distribution between the three axles.

Alternatives 2 and 3 were designed to better distribute the load over the entire pavement surface. A 1983 study prepared for the department by R. MacLeod showed that staggering some of wheels inside the normal wheel paths would reduce the "damage factor" from that of conventional vehicles loaded to the same weight.[1]

The optimum axle loadings were determined for each alternative such that the 18 kip equivalency per ton payload was no greater than that of a selected zero-cost base line; in this case a 5-axle semi-trailer with a gross vehicle weight of 82,000 pounds. Since the wheels for each alternative do not track in the same path, a probability analysis was used to determine the likelihood of a wheel passing over a given point assuming a normal distribution with a standard deviation of 10 inches. It was assumed for the analysis that the left wheel of the steering axle generally tracks 14 inches from the pavement edge.[2]

The probabilities were applied to standard equivalencies calculated for each axle. The resultant equivalency for each configuration was divided by 0.6826 to convert the normally distributed axle loadings to equivalent point loadings. A simple iteration program was used to determine the maximum 18 kip equivalency for a given set of axle loadings for each alternative.

The load distribution versus 18 kip equivalency graph in Figure 6 shows the significant advantage that can be realized by redistributing the load. In the case of Alternative 2, shown in Figure 6, payload can be increased by 135% without creating any additional damage to the road structure. The following table summarizes the results for the three alternatives:

TABLE 2

Results for Logging Trailer

ALTERNATIVE	GROSS VEH. WEIGHT(lbs)	PAYLOAD (tons)	18 KIP ESAL PER TON PAYLOAD
1. Conventional	132,000	43.5	0.234
2. Stub Axle	144,000	49.5	0.234
3. Off Set	143,000	49.0	0.233
Base Line: 5-axle	82,000	21.5	0.234

ESALs PER TON PAYLOAD vs. GROSS VEHICLE WEIGHT
FOR ALTERNATIVE 2

AXLE CONFIGURATION: O OO O ⓈOO
TARE = 45 000 lb

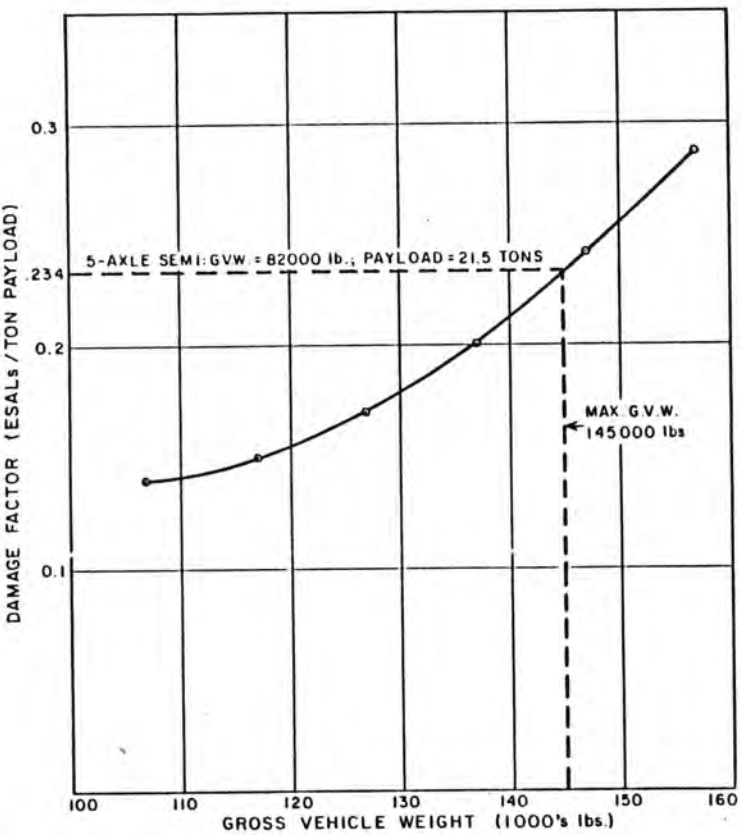


FIGURE 6

The two case studies clearly show the potential benefits that are available; reduced road infrastructure costs for governments and reduced operating costs for industry. There are other opportunities that can also be explored. One currently in use involves increasing axle loadings during the winter months when subgrades are frozen. Another investigated by MacLeod, was the operation of bulk hauls at night, where scheduling permits, to take advantage of higher pavement stiffness. His work showed that significant savings in road costs could be achieved through night hauling.[3]

STANDARDIZATION

Standardization allows for economies of scale. The focal point of the RTAC/CCMTA weights and dimensions study is "uniformity" across Canada. There is great pressure from the inter-provincial carrier community to achieve scale economies by setting a uniform weight and dimension standard across Canada.

The disadvantage of uniformity is that it is in direct conflict with the recognition of regional differences. For example, the most appropriate truck technology for movement of bulk products in

Saskatchewan's north would be totally inconsistent with Highway No. 401 traffic outside Toronto.

The use of a permit system in the Bulk Commodity Policy would appear to be a reasonable compromise between standardization on one hand and the design of technologies appropriate to local conditions on the other.

SUMMARY

By introducing a user fee, significant progress has been made toward designing the truck and the road as a unit. Perhaps the most important component of the program has been to develop an awareness in the industry of the impact of the vehicle on the road system. Also of great importance, has been a better understanding of the interplay between vehicle weight and dimension regulations and the dynamic stability of the road vehicle.

In summary, the Bulk Commodity Policy permits Saskatchewan industries, carriers and the government to jointly design the most effective transportation system for a particular commodity and location at minimal cost to the Saskatchewan taxpayer and without jeopardizing highway safety. It still allows for the

vigorous pursuit of weights and dimensions uniformity at the national level, while recognizing regional differences. The government is clearly in the role of being a facilitator as evidenced by positive reaction from both the shipper and carrier communities.

REFERENCES

1. MacLeod, R. A Study of Potash Haul on Saskatchewan Highway No. 9, April, 1983.

2. IBID

3. IBID

INVESTMENT OPTIONS RELATED TO RAIL LINE REHABILITATION

by Dr. G. Sparks

Department of Civil Engineering
University of Saskatchewan

ABSTRACT

This paper presents a theoretical order of magnitude, comparative economic analysis of the costs of assembling grain in Western Canada utilizing:

1) rehabilitated rail branchlines,
2) off-line elevators, and
3) abandonment of delivery points and rail branchlines in favor of grain assembly from farm to on-line elevators by commercial truck.

It is demonstrated that rehabilitation is prohibitively expensive when annual handlings are low (i.e. annual cost of rail infrastructure approaches the value of the grain shipped). Full abandonment is always more economic than an off-line elevator. Main road infrastructure costs can become significant under situations of heavy annual tonnages and roadways of limited design life.

1.0 Introduction

In recent years there has been considerable debate related to the need for rationalization of the Canadian grain handling and transportation system. This debate has been the primary motivating force behind a number of public inquiries including among others, the MacPherson Royal Commission on Transportation, the Hall Commission on Grain Handling and Transportation, the Snavely Commission on the

Cost of Moving Grain by Rail, and the Gilson Consultation on Western Grain Transportation, etc. This debate reached its emotional peak with the passage of the Western Grain Transportation Act (Bill C-155) in 1983.

A major issue in the debate plus a matter which has received considerable attention in all of the public inquiries is the operation, maintenance and rehabilitation of the rail branchline network in the prairies. Technical studies directed at identifying ways of improving the operational efficiencies and reducing total costs of the existing grain handling and transportation system have invariably concluded that there is a need to centralize country elevator operations, to utilize trucking more extensively in the assembly of grain from farms to delivery points, and to use solid or unit train operations where possible. In short, efficiency and cost studies recommend that existing country elevators be replaced by fewer and larger elevators and that many branchlines be abandoned in favor of the utilization of trucks in grain assembly.

On the other hand, politicians have taken a popular political stance and have maintained most of the branchlines (1). To this end, a Rail Branchline Rehabilitation Program was initiated by the Federal Government, which, by 1983 had spent $495 million

upgrading 3600 km of grain-dependent branchlines on the prairies, and had, prior to the election in August of 1984, committed another $571 million for additional upgrading over the five years 1984-1989.

In the view of some, this branchline rehabilitation program has resulted in unnecessary duplication of transportation infrastructure in many regions of the prairies. That is, the Provincial and Municipal governments have provided an extensive road and highway network at considerable cost to meet general passenger and freight transportation requirements, while the Federal government is in the process of rehabilitating a rail branchline system which in many cases has been abandoned by all traffic except grain.

To illustrate the duplication, in some cases, rail branchlines which have been rehabilitated at a cost in the order of $100,000-200,000 per km, run parallel to recently constructed highways that cost $300,000 per km and that could easily accommodate the truck traffic associated with the grain that the rail line was rehabilitated to accommodate. In short, this duplication of transportation infrastructure results in wasteful expenditures which this country can ill afford.

This paper reviews the Rail Branchline Rehabilitation

Program in terms of the effective allocation of limited resources and analyzes the rehabilitation program in terms of optimizing the investment of public funds from Federal, Provincial and Municipal government sources. The analysis illustrates that there is reason to believe that there are some instances where investment strategies other than the current Rehabilitation Program would result in a more appropriate allocation of public funds.

2.0 Theoretical Framework

In order to more fully understand the issues related to a real world phenomenon, it is often helpful to develop a conceptual or theoretical model of the situation for analysis. The development of such a model facilitates the identification of the relevant parameters and the importance of each by enabling the analyst to carry out a "sensitivity" analysis. Needless to say, the validity of the conclusions derived from the sensitivity analysis utilizing the model are constrained by how well the model represents the real world phenomenon. Thus, while the "modelling" exercise can provide very useful insight, care must be taken in directly extrapolating the "findings" of the model to the "real world".

In initiating the analysis, it is usually most productive to determine the relevant parameters via the analysis of a

"simplest case" and then to pursue the issues identified by adding the required complexities to the model and the analysis.

For the purposes herein, one of the "simplest cases" is as illustrated in Figure 1, wherein a rail branchline parallels a main road (highway) with both serving a single community/delivery point at the end of the branchline. (A review of the rail/highway map of western Canada will identify several such cases. Further, any continuous branchline between mainlines can be divided into "two" of the above noted cases.)

Under the "simplest case" scenario, grain is assembled via farm truck to the "local" delivery point where it is transshipped to rail for assembly on the rail branchline for furtherance by rail on the main rail line to export position. The cost components under this scenario would include:

1) farm trucking costs, farm to delivery point,
2) infrastructure costs for rural roads, farms to delivery points,
3) transshipment (elevator) costs at the delivery point,
4) rail operating costs on branchline,
5) infrastructure costs for rail branchline,
6) rail operating costs on mainline,

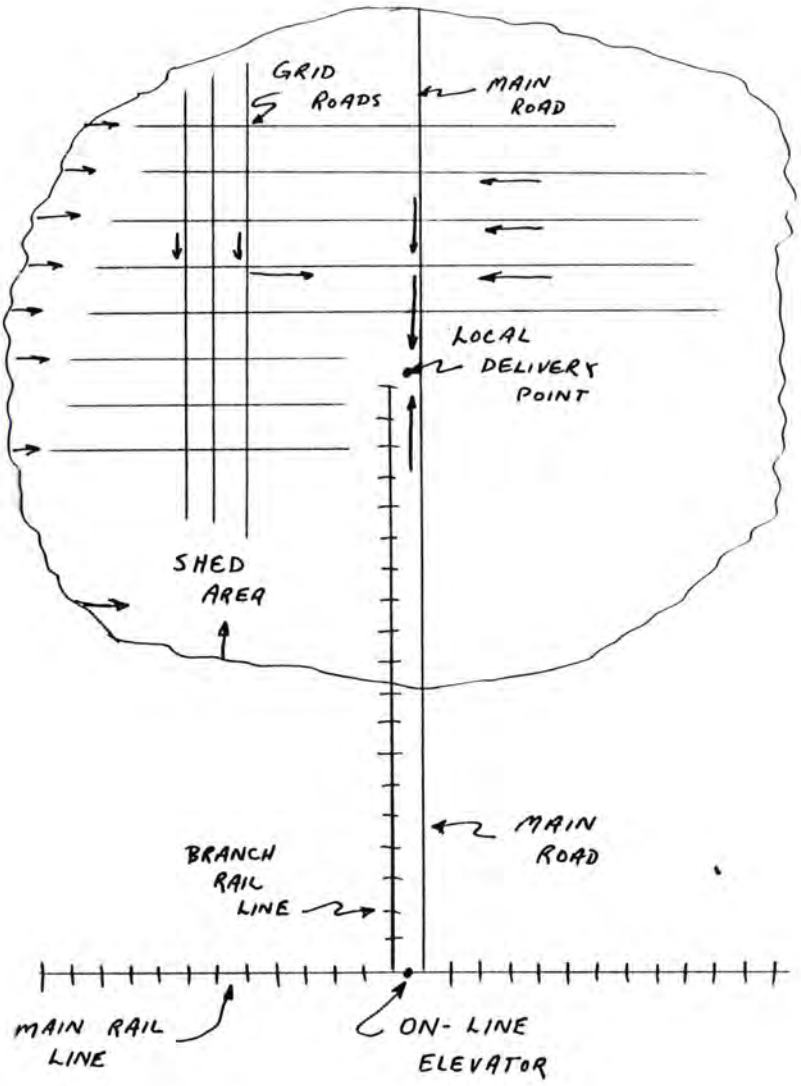


FIGURE 1

"SIMPLEST CASE"

7) infrastructure costs for rail mainline,

8) etc.

There are two basic alternative rationalization proposals which have been put forward for consideration. These include the off-line elevator and full abandonment of the rail branchline and elevator.

Under the off-line elevator option, the elevator would be maintained, however the rail branchline would be abandoned in favor of assembly of grain via commercial truck to an on-line elevator. The cost components of such a scenario would include:

1) farm truck costs, farm to delivery point,
2) infrastructure costs for rural roads, farm to delivery point,
3) transshipment (elevator) costs at the delivery point,
4) commercial trucking costs, delivery point to on-line elevator,
5) infrastructure costs for main roads, delivery point to on-line elevator,
6) on-line transshipment (elevator) costs,
7) rail operating costs on mainline,
8) infrastructure costs for rail mainline,

9) etc.

Using the full abandonment option, grain could be assembled from the farm to the on-line elevator via farm truck or commercial truck. (For the purposes of this analysis, it will be assumed that this assembly is done via commercial truck. This assumption is conservative plus it makes the analysis somewhat "cleaner" by essentially avoiding the issue of the cost of assembly of grain via farm truck.) The cost components of such a scenario would include:

1) commercial trucking costs, farm to on-line elevator,
2) infrastructure costs for rural roads, farms to main roads,
3) infrastructure costs for main roads, farms to on-line elevator,
4) transshipment (elevator) costs at the on-line elevator,
5) rail operating costs on mainline,
6) infrastructure costs for rail mainline,
7) etc.

From the above, it is noted that all costs "downstream" from the on-line elevator (i.e. rail operating costs on mainline, infrastructure costs for rail mainline) are

common to all scenarios. Therefore, they "cancel-out" of a (comparative) analysis.

3.0 The Issues

Two issues related to the above scenarios are of interest, namely:

1) the (relative) magnitude of the "component" costs of grain assembly under each of the scenarios, and
2) the (relative) magnitude of the total costs of grain assembly under each of the scenarios.

4.0 Relative Magnitude of Component Costs

4.1 Farm Truck Costs

Farm truck costs are normally regarded as those associated with moving the grain from the farm where it is grown to the local (nearest) delivery point. A number of studies have been undertaken in the last 15 years related to the structure and magnitude of these costs. This is a complex subject and little purpose is served in debating the issues here. Be it sufficient for our purposes to note that the costs incurred by farmers in transporting their grain from the farm to the local delivery point is less

than or equal to the cost of hiring a commercial trucker to provide the service.

The rate used by a number of commercial grain truckers in Saskatchewan in 1984 for distances less than 50 km was approximately $5/tonne. (Note: the rate had a distance taper beyond 50 km.)

4.2 Infrastructure Costs - Rural Roads

While some work has been done over the years related to determining the impact of increased grain trucking on the cost of providing and maintaining rural roads, no clear concensus has emerged respecting the issue. This is to a large extent attributable to the fact that it is a very complex issue with no "single" answer being appropriate to all locations in western Canada (2). Fortunately, it is sufficient for our purposes to make the following observations.

A typical grain movement pattern associated with the delivery of grain over a grid system of roads to a local delivery point is one wherein the maximum concentration of (truck) traffic on the grid (rural) roads occurs at the intersection of the rural roads with the main roads (2).

The movement of grain over the rural road system under the

existing situation is seemingly "no problem" in that municipal and provincial governments have (willingly?) assumed the responsibility of providing and maintaining the roads required to meet these "limited" demands.

If an off-line elevator operation were implemented, the grain movement patterns on the rural roads would be unchanged in that the grain would still move from the farm to the local delivery point as it has always done. (There would however be an increase in tonnages on the main roads - more about this later.)

If a full abandonment scenario were implemented, the grain movement patterns and magnitudes on the rural roads would (could) be essentially unchanged relative to the existing situation. (Again, there would however be a change in patterns and an increase in tonnage on the main road - more about that later.)

Since it can be demonstrated that the impact of moving a given tonnage over a given roadway is (nearly) independent of truck type and size for a given allowable axle weight, and tonnages and traffic patterns on rural roads do not change (very much) as a result of rationalization of the grain assembly system, then it is reasonable to conclude that changes in the grain assembly system (i.e. use of off-line elevators, full abandonment, shifts from farm

trucks to commercial trucks) would be expected to have little or no impact upon the rural roads (3). (Note: this conclusion is correct for the "simplest case" used, however, it may not be true for other realistic configurations. Intuitively however, it is unlikely that the impact on the rural road network would be dramatic simply because the "concentration" of traffic typically would not occur on the rural road portion of the road network, but rather would, as will be illustrated, occur on the main roadways.)

4.3 Infrastructure Costs - Main Roads

As noted above, the main roads would experience increases in tonnages (truck traffic) resulting from the implementation of various rationalization scenarios.

Under either the off-line elevator or full abandonment scenarios, the main road joining the local delivery point and the on-line elevator would experience an increase in tonnage "up to" the annual handlings of the local delivery point. (While there are some differences between the off-line elevator and full abandonment for various sections of the roadway joining the local and on-line elevators, for simplicity it has been assumed that the entire length of the road is subjected to the full tonnage handled by the local delivery point.)

Estimates of the costs of providing "main road" infrastructure attributable to grain for two roadway types were developed and are summarized in Tables 1 and 2. (Note: these costs are order of magnitude (i.e. " crude") therefore care must be used in their application. They are however reasonable estimates of "order of magnitude" and thereby serve the purposes herein quite appropriately.)

4.4 Elevator Costs

Like most other components of the grain handling and transportation system, the costs related to the country elevator system have been the subject of considerable study. Fortunately there is no need to delve into this issue for our purposes here. It is sufficient to observe that typical elevator charges of $6-7 per tonne for transshipping grain are considered "representative" of the costs associated with providing such services. These typical charges therefore can be used as estimates of elevator costs for the purposes herein.

4.5 Railway Operating Costs on Branchline

There is insufficient space here and as will become apparent later, no need herein to pursue the details related to the cost of operating on rail branchlines. It is sufficient for our purposes to observe that these costs

Table 1

Annual Grain Related Costs of Roadway Infrastructure
Type "A" Roadway (1)

Annual Handling (Tonnes/Yr)	Grain Traffic in eq 80 KN Axle Reps (2)	Actual Time before Rehab (Years) (3)	Sinking Fund Factor (4)	Annual Increase in Grain Related Costs (5) ($/km/yr)	Increase in Grain Related Costs $/Tonne/Km
5,000	615	15	.0302	≈ 0	≈ 0
10,000	1200				
20,000	2400				
30,000	3600				
40,000	4800				
50,000	6000	14	.0344	777	.0155

Table 2

Annual Grain Related Costs of Roadway Infrastructure
Type "B" Roadway (6)

Annual Handling (Tonnes/Yr)	Grain Traffic in eq 80 KN Axle Reps (2)	Actual Time before Rehab (Years) (3)	Sinking Fund Factor (4)	Annual Increase in Grain Related Costs (5) ($/km/yr)	Increase in Grain Related Costs $/Tonne/Km
5,000	615	4.7~5	.1621	≈ 0	≈ 0
10,000	1200	4.5			
20,000	2400	4	.2138	4900	.25
30,000	3600	3.7			
40,000	4800	3.4			
50,000	6000	3.1~3	.3006	13,100	.26

are probably on average in the order of $5-20 per tonne since total (branchline plus mainline) costs are on average $30-40 per tonne.

4.6 Infrastructure Costs - Rail Branchline

The costs of rehabilitating rail branchlines are highly variable with costs being dependent on the existing condition plus the standard to which the line is "brought up to". The average cost to date under the Branchline Rehabilitation Program has been in the order of $140,000/km and as high as $220,000/km where the line had to be essentially reconstructed.

Annual maintenance costs for rail branchlines also vary widely from nearly zero to several thousand dollars per km per year. For our purposes here it will be assumed that little or no maintenance will be required for the next 15 years (i.e. until year 2000) at which time the branchlines will have little or no net salvage value.

Under the above assumptions, the annual cost of providing rail branchline infrastructure is essentially dependent only upon the initial capital cost, the assumed interest rate and the assumed life of the line. Given a 10% interest rate and a 15 year life, estimates of the annual grain related costs of providing grain dependent

branchline infrastructure have been developed and summarized in Table 3.

5.0 Cost Profiles for Alternative Scenarios

Utilizing the order of magnitude estimates of the component cost developed in the previous section, it is possible to develop cost profiles for alternative grain assembly scenarios including:

1) (with) Rehabilitated Branchlines,
2) Off-Line Elevator Operations, and
3) Full Abandonment,

as illustrated in Tables 4-6. These profiles are further summarized in Table 7.

6.0 Conclusions

For the "simplest case" scenario developed it can be concluded that:

1) the costs of rehabilitating rail branchlines in situations with low annual handlings (i.e. 5000 T/yr) are prohibitive (i.e. approach and in some cases exceed the market value of the grain transported). To illustrate how really

Table 3

Annual Grain Related Costs of Railway Infrastructure

Capital Cost of Rehabilitation	$100,000/km	$200,000/km
Sinking Fund Factor (7) (8)	.1354	.1354
Annual Costs (9)	$ 13,540/km	$ 27,080/km
Costs $/Tonne/Km		
5,000 T/Yr	$ 2.71/T	$ 5.42/T
10,000 T/Yr	1.35	2.71
20,000 T/Yr	.68	1.36
30,000 T/Yr	.45	.90
40,000 T/Yr	.34	.68
50,000 T/Yr	.27	.54

Table 4

Cost Profile with Rehabilitated Branchline

	Annual Handlings (T/YR)		
	5,000	30,000	50,000
Farm Trucking (farm to delivery point)	$5/T	$5/T	$5/T
Infrastructure Rural Roads	unchanged	unchanged	unchanged
Elevator Costs - Delivery Point	$6/T	$6/T	$6/T
Infrastructure Costs- Branchline (10)			
$100,000/km rehab (11)	81.30/T	13.50/T	8.10/T
$200,000/km rehab	162.60/T	27.00/T	16.10/T
Rail Branchline Operations (12)	$5/T	$5/T	$5/T
	$97-178/T	$29-43/T	$24-32/T

Table 5

Cost Profile
Off-Line Elevator Operation (13)

	Annual Handlings (T/YR)		
	5,000	30,000	50,000
Farm Trucking (farm to delivery point)	$5/T	$5/T	$5/T
Infrastructure Rural Roads	unchanged	unchanged	unchanged
Elevator Costs - Delivery Point	$6/T	$6/T	$6/T
Commercial Trucking Off-Line to On-Line Elevator	$5/T	$5/T	$5/T
Infrastructure - Main Roadway			
Type "A" Surface (14)	≈0		$.50/T
Type "B" Surface (15)	≈0	$7.50/T	$7.50/T
On-Line Elevator	$6/T	$6/T	$6/T
	$22/T	$22-29.50/T	$22.50-$30/T

Table 6

Cost Profile
Full Abandonment (16)

	Annual Handlings (T/YR)		
	5,000	30,000	50,000
Commercial Truck (farm to on-line elevator)	$5/T	$5/T	$5/T
Infrastructure Rural Roads	small	small	small
Type "A" (17)	≈0	?	$.50/T
Type "B" (18)	≈0	$7.50/T	$7.50/T
On-Line Elevator	$6/T	$6/T	$6/T
	$11/T	$18.50/T	$19/T

Table 7

Summary - Cost Profiles

	Annual Handlings		
	5,000 T	30,000 T	50,000 T
With Rehabilitated Branchlines	$97-178/T	$ 29-43/T	$ 24-32/T
Off-Line Elevators	$ 22/T	$ 22-29/T	$ 22-30/T
Full Abandonment	$ 11/T	$ 18.50/T	$ 19/T

prohibitive rehabilitation is under these conditions, consider that if the money required to rehabilitate a 30 km line, (say at $100,000/km, for a total of $3 x 10^6) were put into Canada Savings Bonds (heaven forbid!) at 10% interest (i.e. annual revenue $300,000 per year), and a "deal" was struck with the affected farmers that their grain would be picked up at their farm at no cost to them (i.e. saving them farm trucking costs of say $5/tonne), the organizers of this "scam" could pay for all the commercial trucking required ($25,000 per year) and have $275,000 per year to make sure everybody was happy. (The organizers might give the rural municipality $50,000 per year and thereby eliminate property taxes payable by the affected farmers (i.e. 5000 tonne/yr ⟶ 50-100 quarters @ $300/quarter taxes/year is only $30,000/yr). They might also give the local town $50,000 per year for loss of the elevator as a tax base (which contributed a few thousand at best per year). The remaining $175,000/year could surely find a good home!)

2) Full abandonment appears cost competitive with rehabilitation even at high annual handlings (i.e. 50,000 tonnes/yr). (While the dollar

per tonne difference between rehabilitation and abandonment may seem relatively small (i.e. $5-13/tonne), it is "big bucks" when it is multiplied by 50,000 tonnes/yr (i.e. $.25 - $.65 million per year).)

3) Full abandonment is always more cost effective than the off-line elevator. This is because of the "double" trucking and "double" elevator costs associated with the off-line elevator. At best the off-line elevator is a "transition" option.

4) Cost of providing main road infrastructure can be significant under situations of substantial tonnages and/or roadways with relatively limited design lives (i.e. Type "B" roadways for situations where there are no other significant sources of truck traffic). This points out the need for the Federal Government to negotiate with the Provinces and Municipalities respecting road costs.

5) The limitations of this analysis must be recognized and therefore further "case specific" analysis is required before the "findings" could be implemented. The insights

gained herein should however help to point the way.

Closing Note: All the time I was crunching numbers for this paper, I had a sinking feeling I was going to discover the obvious! To a large extent, I believe I have, because I know the results will come as no surprise to many researchers and industry representatives. In fact, a few years back, a group of "truckers" spent a lot of time and money trying to convince the "powers that be" to "try" on off-line elevator "experiment" to "demonstrate" its merits as a cost effective alternative to rail line rehabilitation. While they maybe didn't have all the "studies" and "numbers" to put forward with their proposal, they obviously had the right "feeling in their bones". Maybe the relevant question now is "If it's so obvious, why doesn't someone make it happen?"

Notes to Tables:

1) Surface design life of 1 x 10^6 equivalent 80 KN axle repetitions over 15 years (i.e. full depth pavement structure). Rehabilitation assumed to cost $185,000 per km to bring the surface back to the point of serving another 1 x 10^6 eq 80 KN axle repetitions.

2) Assuming a 5 axle semi is used with a gross vehicle weight of 74,000 lbs and a payload of 22 tonnes, each "pass" by the loaded semi is equivalent to 2.7 eq 80 KN axle repetitions. See RTAC Pavement Management Guide for details.

3) Roadway surfaces are designed to accommodate a certain number of equivalent 80 KN axle repetitions during the design life of the surface. If truck traffic is greater than originally anticipated, the surface still accommodates the same number of equivalent 80 KN axle repetitions before rehabilitation is required, however the time of rehabilitation arrives sooner than anticipated. For example, a roadway surface designed to accommodate 1 x 10^6 equivalent 80 KN axle repetitions over 15 years (i.e. 67,000 eq 80 KN axle repetitions per year) would require rehabilitation at the end of 7.5 years if the roadway was subjected to 134,000 eq 80 KN axle repetitions per year.

4) Assuming a 10% interest rate and actual time before rehabilitation as noted in column 3.

5) Annual increase in costs of roadway rehabilitation attributable to grain equals the annual cost of the future rehabilitation with the additional grain traffic minus the annual cost of the future rehabilitation without the additional grain traffic (i.e. under previously anticipated traffic loadings). The annual costs of future rehabilitation equals the capital cost of rehabilitation times the appropriate sinking fund factor. For example, the annual cost of future rehabilitation for a roadway requiring a $185,000/km rehabilitation at the end of 15 years at 10% interest equals 185,000 (.0302) or $5587/km. The annual cost if the rehabilitation were required in 14 years would be $185,000 (.0344) or $6364/km. If the decrease in life from 15 years to 14 years was attributable to increased grain traffic, then the annual costs attributable to the grain would be $6364 - $5586 = $777/yr. If this decrease in time until rehabilitation were attributable to annual handlings of 50,000 tonnes, then the annual increase in cost attributable to grain on a per tonne basis would be $777/50,000 T = $.0155/tonne. For details, see Working Paper entitled "Grain Related Road and Rail Infrastructure Costs" by G. Sparks of which this paper is essentially a summary.

6) See notes to Table 1 - Surface design life of 5×10^4 equivalent 80 KN axle repetitions over 5 years. Assume rehabilitation costs of $95,000/km to bring the surface back to serving another 5×10^4 eq 80 KN axle repetitions.

7) Assuming 15 year life after rehabilitation and no annual maintenance.

8) (A/P 10%, 15 years)

9) P (A/P r,n)

10) This assumes 30 km line.

11) $2.71/T/km x 30 km = $81.30/T etc.

12) The actual cost of rail branchline operations is unknown, however it is probably $5-10/tonne given that the total costs (i.e. branchline plus mainline to point are in the order of $30-45/tonne??)

13) Assumes 30 km from delivery point to on-line elevator.

14) 30 km x $.0155/tonne/km = $.47/tonne.

15) 30 km x $.25/tonne/km = $7.50/tonne.

16) Commercial truck haul direct from farm to on-line elevator.

17) 30 km x $.0155/tonne/km = $.50/tonne.

18) 30 km x $.25/tonne/km = $7.50/tonne.

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2) Manz, B. Towards a Rationalized Grain Handling Industry, Project Report submitted to the Department of Civil Engineering, University of Saskatchewan, 1985.

3) Sparks, G. Allowable Gross Vehicle Weights on Municipal Roads, a Background Paper prepared for the Saskatchewan Trucking Association, December 1984.

THE ROLE OF TRUCKING IN THE GRAIN INDUSTRY

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and E.E. Hopkin, Transport Canada

ABSTRACT

This paper summarizes the results of a study of the same name carried out recently by IBI Group on behalf of Transport Canada. The paper draws largely on the Executive Summary of the Final Report which was released in March, 1985. Neither the report nor the paper necessarily reflects Transport Canada's position on policy issues.

In doing this work we found that we could not separate the trucking of grain from other parts of the grain transportation and handling system. Therefore the paper also addresses ways in which possible future changes in the overall grain transportation system could affect the trucking of grain during the period to 1990/91.

The paper provides a description of the grain trucking industry as it has evolved since 1980 and pro-

vides estimates of tonne-kilometres of grain trucking by 1990/91 under three scenarios reflecting differing levels of consolidation of the number of rail delivery points and primary elevators in the Prairie Provinces. The base case Scenario A assumes 920 delivery points by 1990/91. Scenario B assumes 800 delivery points, and Scenario C assumes 650 delivery points by 1990/91.

The paper presents transportation and handling cost comparisons for the various scenarios discussed above, including detailed analyses of trucking costs and rates, rail rates and handling charges. Agricultural and economic development impacts are also discussed; differences in the economic impacts of the three scenarios are found to be slight. Regulatory issues and possible institutional changes are also discussed in the paper, particularly as these might be used to mitigate any transitional difficulties and/or to help provide incentives for more efficient use of the grain transportation/handling system and thereby achieve greater savings to the producers.

All grain is carried by truck at least for the first lap of its movement, from the farm to an elevator, feed mill or another farm. In recent years the role of trucking has increased in importance and is expected to increase more with continuing consolidation of the primary elevator/rail delivery point system.

THE GRAIN TRUCKING INDUSTRY

Increases in grain trucking have occurred as the primary elevator system has been consolidated and average truck hauls from farm to elevator have lengthened. Over the last 15 years the number of licensed elevators and delivery points have decreased as follows:

Year	Licensed Elevators	Delivery Points
1968	4,999	1,923
1973	4,384	1,617
1978	3,658	1,394
1983	2,800	1,181
1984	1,967*	1,155

* Change in licence requirement allowing two adjacent facilities to be operated as one.

Based on past trends the number of delivery points may be expected to decrease to a range approximately between 650 and 920 by 1990/91 depending upon the rate of evolution of the system. The higher end of this range is more likely if an exponential rate of decline is experienced while the smaller number of delivery points by 1990/91 would reflect a linear trend.

We have estimated that the level of activity of grain trucking in 1982/83 was as follows:

	(Millions of tonnes)	Length of haul (km)	Share (%)	Activity (millions tonne-km)
Farm to Elevator	36	23	100	830
Secondary Movements	3	250	70	476
Specialty Crops & Products	2.6	80	67	140
TOTAL				1,446

Virtually all of the 140,000 producers on the Prairies haul all or part of their own grain from the farm gate to nearby elevators, other farms or other points of consumption, generally using 2 or 3 axle straight trucks. At the other end of the scale, an estimated 400 commercial truckers haul grain from farms to elevators or feedlots, between elevators or, in a few cases, from farms directly to ports, generally using semi-trailers or double bottoms (A-trains and B-trains). There are also an indeterminate number of custom haulers, producers who haul their own and their neighbours' grain, usually in straight trucks or semi-trailers.

PROVINCIAL REVENUES AND REGULATIONS

The tax regimes for roads differ among the three Prairie Provinces. In Manitoba commercial trucks are

charged both fuel taxes and licence fees; farm trucks pay no fuel tax. In Saskatchewan there are no fuel taxes for either type of operator although licence fees are charged. In Alberta there are licence fees, no fuel taxes and farm truck operators receive a rebate on the cost of fuel. In none of the three provinces does it appear that trucking pays its fair share of the total cost of roads through such charges. Thus increases in grain trucking will likely cause some increase in road costs to provincial and municipal governments.

In recent years there has been a very significant relaxation of truck weights and dimensions regulations, with larger and heavier vehicles being permitted. This trend was initiated in 1974 with the Federal/Provincial highway strengthening program which provided funds to encourage the provinces to increase permissible truck load limits on highways in the three Prairie Provinces. It is not anticipated, however, that there will be any significant further changes in truck size and weight limits on the Prairies in the next few years.

The sizes of trucks used in hauling grain have shown significant increases in recent years, with many of the commercial haulers going to 7, 8 and 9 axle A-train and B-train configurations. Review of the literature on the

damage caused by different types of trucks indicates, however, that these larger trucks probably cause less damage to the roads on a per tonne of cargo carried basis than do the smaller straight trucks and semi-trailers typically operated by producers.

TRUCK COSTS AND RATES

A model was developed for the operating costs of various types of trucks used to haul grain. The overall results of this analysis are shown in Exhibits 1 and 2. Also shown on these exhibits are rate quotations that were obtained from commercial haulers. The data suggests that commercial haulers are not interested in very short distance hauls since they do not provide competitive rates for these short distances. The exhibit also shows that for very long hauls the commercial rates are below the total cost of operation of a truck simply for grain (with no backhaul) and, in fact, are below the fully allocated costs of a backhaul operation. It therefore appears that, for these longer distances, truckers are quoting on a marginal cost basis when they have another assured cargo on the forehaul.

EXHIBIT 1

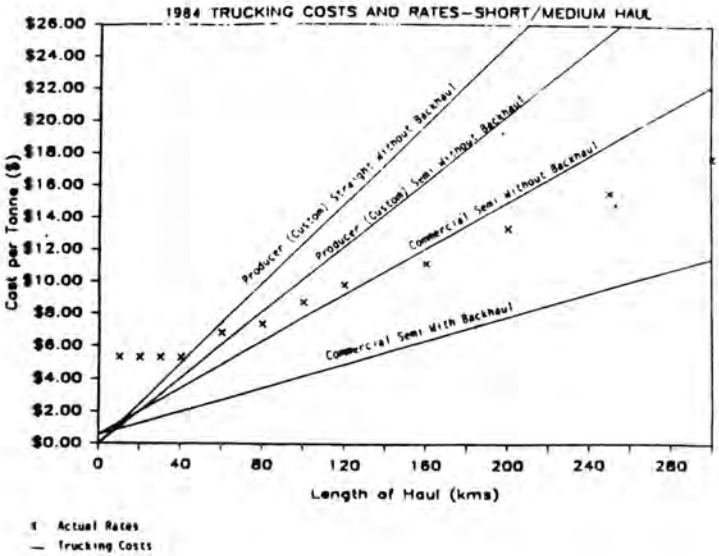
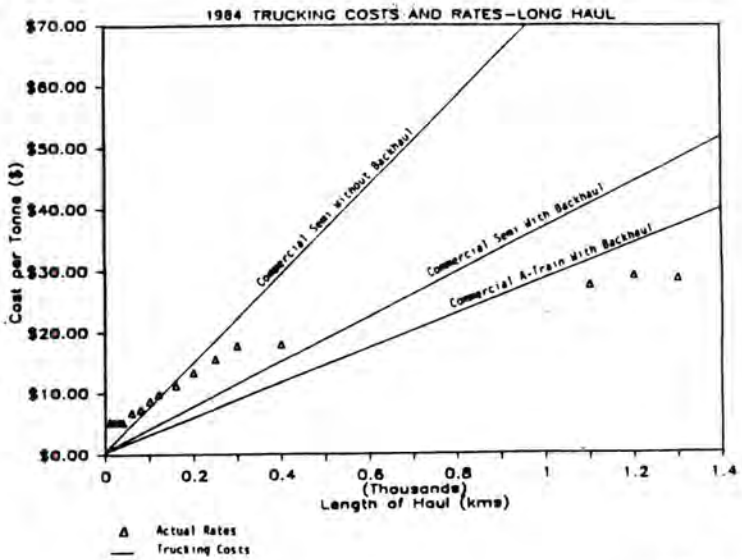


EXHIBIT 2



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RAILWAY RATES

Railway rates for the carriage of grain have been set up through the Western Grain Transportation Act (WGTA). The WGTA establishes a mechanism whereby the railways' costs are audited every four years and rates are adjusted so that the railways recover these costs. The rates are adjusted through the use of a multiplier so that the actual structure of the rates does not change; they are simply adjsted overall to take account of inflation and cost factors. The rates are based upon the rail distance from the loading point to the port and do not reflect the actual costs of operation of specific lines or delivery points. Thus, shippers who use a high cost line or point pay exactly the same rates as those who use a low cost line or point (for the equivalent distance).

Currently only single car, distance based rates are available. There is provision in the WGTA for variable rates which could, for example provide incentives to shippers to use the rail system more efficiently. Such rates have not yet been introduced although CN recently proposed the initiation of an incentive multiple car rate for weekend loading at certain points on its main line. This application was subsequently withdrawn during the CTC hearing on the CN proposal.

ELEVATOR COSTS

As described previously the elevator system is being consolidated and the number of delivery points is expected to continue its downward trend. This is happening because of cost pressures experienced by the elevator companies; elevators with a high throughput have substantially lower unit costs. There is a danger if this is the only factor taken into account as consolidation of the primary elevator system continues, however; simply closing every second or third elevator along the existing railway line system will not have a material impact on railway operational costs. Railway costs are a much higher proportion of the total cost of grain transportation/handling than are elevator costs.

At the present time the cooperatives and companies operating primary elevators generally charge uniform service tariffs at all of their elevators in a given province. This does not necessarily reflect the costs of operation of particular elevators. Discounted elevation rates have become more common at high throughput elevators recently, however, probably reflecting increasing competition for grain as a result of last summer's drought and the lower operating costs of these elevators per tonne of grain handled.

In developing our analysis we have assumed that elevator cost reductions of at least $2 per tonne are available through increased consolidation, because of lower elevator costs per tonne at high throughput elevators. Discounts at this level are not unknown in the trade.

TOTAL COSTS OF MOVING GRAIN

The following table indicates the approximate costs of moving grain to the export terminal assuming a 1,200 kilometre rail haul:

	Total Charges/Tonne	Paid by Producer
Farm to Elevator	$2.35	$2.35
Elevation Charges	6.50	6.50
Railway Rates	22.52	6.84*
	31.37	15.69

* Producers currently pay approximately 30% of the rail rate. By 1990/91 this is projected to increase as follows:

	Percent of Rail Rate Paid
Subsidy paid to railways (current mode of payment)	48%
Subsidy paid to producer	100%

FUTURE DEVELOPMENT SCENARIOS

As noted earlier, three scenarios of the consolidation of the elevator system are postulated for 1990/91. These are shown in Exhibit 3. It can be seen that the average length of haul from farm to rail delivery point is expected to increase in any case but that the different rates of consolidation will have differential impacts on the length of haul.

Exhibit 4 shows the expected total cost impact of these changes. It can be seen that more consolidation offers greater cost savings whether or not the federal rail subsidy is paid entirely to the railways or entirely to the producer. A higher degree of consolidation than anticipated under the three scenarios could provide increased rail and elevator cost savings without causing large truck cost increases as shown in the example where the truck haul is approximately 75 kilometres. This exhibit also indicates that the provision of off-track elevators (elevators to which producers haul grain from their farm and where it is transferred to trucks to be carried to a rail head) does not seem to be competitive, although they may have usefulness in easing transition impacts in some cases.

EXHIBIT 3

ESTIMATED AVERAGE LENGTH OF HAUL
NUMBERS OF DELIVERY POINTS

SCENARIO	NO. OF DELIVERY POINTS	ESTIMATED AVERAGE LENGTH OF HAUL (km. (miles))*	INCREASE IN AVERAGE HAUL (km (miles)(%))	AVERAGE THROUGHPUT PER DELIVERY POINT*** (tonnes per year)
Existing Situation in 1982/83	1217	23.2 (14.4)**	-	28,190
1990/91				
Linear Continuation of Past Trends in Elevator System Consolidation	920	26.7 (16.6)	3.5 (2.2)(15%)	42,650
Accelerated Trend of Consolidation	800	28.6 (17.8)	5.4 (3.4)(23%)	49,050
Accelerated Trend of Consolidation including the closure or disuse of additional branchlines beyond those currently under CTC Review	650	31.7 (19.7)	8.5 (5.3)(37%)	60,370

* assumes that the patterns of country elevator delivery points before and after consolidation are similar so that the average length of haul varies as the inverse of the square root of the number of delivery points.

** based on results of the PHAER Model as provided by the Freight Studies Directorate Branch, Canadian Transport Commission.

*** based on Canada Grains Council projections of primary deliveries in 1990/91.

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EXHIBIT 6

TOTAL TRANSPORTATION AND HANDLING CHARGES TO PORT
($ per tonne)

TRUCKING DISTANCE (KM)	TYPE OF PRIMARY ELEVATOR	TYPE OF RAIL RATE	CHARGES				CHARGES PAID BY PRODUCER IN 1990/91	
			TRUCKING	ELEVATION	RAIL	TOTAL	SUBSIDY PAID TO RAILWAY	SUBSIDY PAID TO PRODUCER
15	Country	Normal	$1.53	$6.50	$22.52	$30.55	$18.84	$30.55
23	Country	Normal	2.35	6.50	22.52	31.37	19.66	31.37
27	Country	Normal	2.75	6.50	22.52	31.77	20.06	31.77
29	High Thru	Normal	2.96	4.50	22.52	29.98	18.27	29.98
92	High Thru	Multiple Car	7.26	4.50	19.52	27.28	17.13	27.28
75	High Thru	Multiple Car	6.20	4.50*	19.52*	28.22	18.07	28.22*
25/50	Off Track	Multiple Car	6.13	7.50	19.52	33.15	23.00	33.15

* could be less if greater cost savings availble through more consolidations.

ASSUMPTIONS: Truck Costs: Sask. Producer Operated Semi Trailer for less than 33 km
Sask. Commercial A train medium haul for 75 km

Elevator Charges: $6.50/tonne for normal country elevator
$4.50/tonne for high throughput elevator
$7.50/tonne total charge for off track elevator and transhipment charges

Rail Rates: 1200/km trip distance, reduction of $3.00 per tonne for multiple car rate

Percent of Rail Rate Paid by Producer in 1990/91:

48% if 100% of subsidy paid to railway
100% if 0% of subsidy paid to railway

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We have also looked at the increased road traffic caused by the elevator consolidation on a case study basis. The additional volumes were not high. The highest volume, resulting from a complete closure of two branch-lines, was 2 1/2 loaded trucks per day on a particular road. Although we did not estimate the increased road costs involved, they are not expected to be large. A more detailed study of this factor is currently being under-taken by the Federal and Manitoba Governments.

An analysis was also made of the possibility of trucking grain directly to the ports from the farm, bypassing the primary elevator system. This scenario does not appear to be economic unless there are large volumes of other suitable bulk materials moving in the opposite direction. An analysis of the possibilities did not indicate that these volumes were available in significant amounts or are likely to be over the coming 5 or 10 years.

Future Grain Trucking Tonnages

The amount of trucking of grain in the future was estimated for the three delivery point consolidation scenarios, based on the Canada Grain Council's forecast of production. The results were as follows, in millions of tonne kilometres:

	1982/83	1990/91		
		920 Delivery Points	800 Delivery Points	650 Delivery Points
Primary Movement	830	1,052	1,118	1,248
Secondary Movement	476	716	716	716
Specialty Crops	140	140	140	140
TOTAL	1,446	1,908	1,974	2,104

EMPLOYMENT IMPACTS

The employment impacts of these amounts of grain trucking were also estimated. Exhibit 5 shows the expected change in employment. It can be seen that there are expected to be increases in employment in the trucking industry and in the industries that support trucking but, for each of the scenarios, there are expected to be reductions in employment in the primary elevator system which would tend to counterbalance this. Overall there are expected to be slightly more jobs in the base case scenario and fewer jobs in the 800 and 650 delivery point scenarios than at present.

REGULATORY ISSUES

The three Prairie Provinces have somewhat different philosophies towards the regulation of the trucking

EXHIBIT 5

ESTIMATED OVERALL EMPLOYMENT CHANGES IN THE PRAIRIE REGION IN 1990/91 DUE TO INCREASED GRAIN TRUCKING

SCENARIO	ADDITIONAL DIRECT JOBS		ADDITIONAL INDIRECT JOBS	NET TOTAL DIRECT AND INDIRECT JOBS	NET OVERALL EMPLOYMENT CHANGE
	COMMERCIAL TRUCK DRIVERS	TERMINAL OPERATORS			
Base Case (920 Delivery Points)	110	-250	210	70	140
800 Delivery Points	126	-370	235	-9	-18
650 Delivery Points	163	-520	295	-62	-124

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industry but all have a relatively liberal attitude towards the trucking of grain. Virtually free entry and exit of haulers into the intra-provincial carriage of grain is allowed in all three provinces. The main regulatory issues appear to be:

- o restrictions on backhauls for the haulers of grain;
- o restriction of entry to extra provincial carriage of grain.

CONSTRAINTS AND OPPORTUNITIES

Our conclusions regarding constraints and opportunities for the trucking of grain are summarized below.

Methods of Payment

Under the current WGTA provisions, railway operational cost savings are, after the next "audit" of costs, returned as a reduction of rates to the benefit of shippers as a whole and possibly, depending upon the application of the subsidy formulae included in the WGTA, to some extent to the Federal Government. Shippers who individually use the railway network in a way which reduces railway costs (eg. through trucking grain longer distance to elevators on main and through rail lines) do not receive any benefit directly. Changes in the structure

of railway rates and the method of payment of the subsidy which allow any cost savings to be directly experienced by the shipper would encourage efficiency of operation of the overall system. Methods to accomplish this could include:

- payment of subsidies to the shipper rather than to the railways as at present;
- changes in the structure of railway rates to reflect the actual costs of specific movements.

The latter could be accomplished by allowing multiple-car rates from points on main and through rail lines. A change under the WGTA to allow the railways to retain part of the cost savings from more efficient rail operations would provide the railways with a greater incentive to introduce such rates.

Road Costs

Current provincial government taxation policies on the Prairies do not result in enough revenues from trucking to pay their costs. Therefore there may be a problem in increasing the amount of grain trucking in that the provincial and municipal governments would face increased net costs. However, the producers who would

benefit from savings in the grain transportation system are the taxpayers of the provinces and municipalities which would face these increased costs as are the commercial truckers who would carry some of the increased traffic. Therefore it would appear that there is scope to allow these increased costs to be met by the beneficiaries.

System Improvement Reserve

Under the Branchline Rehabilitation Program the federal government established a System Improvement Reserve of some $51 million to be made available from 1986 onwards. The Senior Grain Transportation Committee established under the WGTA has been requested to consider what improvements could be made. In our study we identified a number of potential improvements which we believe to be worthy of consideration, as follows:

- to assist in the lengthening of sidings at certain primary elevators so that multiple car shipments can be made from these points (selection to be made by the trade);
- to conduct "mothball" experiments which would suspend the operation of certain railway branch lines and elevators while grain is trucked to more efficient points for a test period;
- for the funding of off-track elevator systems as an interim measure to ease the transitional impacts of consolidation of the elevator system in specific cases where large increases in trucking distance might result.

Institutional Changes

Any institutional changes to achieve system efficiencies would have to be demonstrated to produce acceptable benefits and would have to be agreed upon by the trade. Some possible examples are as follows:

- provide greater incentives to the railways to reduce their costs (eg. by allowing them to retain part of cost savings resulting from system efficiencies rather than giving them all up at the next WGTA audit);
- encourage consultation in planning for the elevator and rail systems such that efficiencies are achieved in both; the Senior Grain Transportation Committee would be a logical forum for this process;
- provide incentive pricing systems to encourage the most efficient use of the rail and elevator systems.

Trucking of Western Canadian grain has increased in proportion to past consolidation of the primary elevator system and can be expected to continue growing under future consolidation trends. This paper assesses and documents possible future trends under several scenarios and shows that greater savings in grain transportation and handling costs are achievable by producers if greater reliance is placed on trucking so that the rail and elevator systems can be used more efficiently. The implications of such changes are explored, along with the constraints and opportunities affecting them, to provide a basis for discussion and decision in this important area.

THE POTENTIAL IMPACT OF CROW RATE RATIONALIZATION FOR DIVERTING CANADIAN GRAIN EXPORTS THROUGH UNITED STATES GULF PORTS

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BACKGROUND

As long as rail rates for Canadian export grain movements were restrained by law (the "Crow Rates") to a level substantially below variable costs, there was no incentive for Canadian export grain to be moved by low-cost land or water routes through the United States. However, our previous research (1) indicated that as transport costs increase as a result of Crow Rate rationalization, the total logistics costs for some of Canada's export grain shipments could be reduced by utilizing barge transportation on the Mississippi River system or unit trains to deep-water ports on the U.S. Gulf. The objectives of this study were to determine the quantities of Canadian export grain that would be moved through the U.S. and the resulting cost savings if such routes were utilized while minimizing the total logistics costs of Canadian grain exports. Our analysis included several combinations of possible rail rate levels and Mississippi barge rate levels. The study looked at actual exports in 1981-82 and projected exports for 1990.

THE GENERAL MODEL[1/]

A linear programming cost minimization transshipment model was constructed. The model provided for moving three export grains from 21 supply regions over five possible routes to North American ports, and then by ocean vessel to 34 importing ports serving 32 importing countries. The three grains were the major export crops of durum, wheat other than durum, and barley.

The 21 supply origins were formed by combining 47 crop reporting districts in western Canada so that each supply region had historical shipments totaling one to 1.5 million tons of wheat, durum and barley. A central location in each supply region was selected as the country elevator rail shipping point for that region.

Each of the 21 shipping points had linkages (i.e., they could ship) to any of the five export ports. Three of the five export routes were by direct rail to the export elevators at Prince Rupert and Vancouver on the West Coast, and to Galveston, Texas on the U.S. Gulf coast. The fourth route from the country shipping points was by rail to Minneapolis/St. Paul for transshipment by Mississippi River barge to Gulf export elevators on the lower Mississippi. The fifth route was by rail to Thunder Bay for transshipment by laker to export elevators on the Gulf of St. Lawrence.

Major grain ports for each of the thirty-two importing countries were selected as destination points. The

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[1/] The model and all data are described in detail in (2).

thirty-two destination countries were those which received more than .5% of Canadian exports of one or more of the three grains in 1981-82. These countries accounted for approximately 98% of total Canadian grain exports (3). Three Russian destinations were included corresponding to Baltic, Black Sea and Far Eastern ports.

Ocean routes between the five export ports and the 34 importing ports completed the model. About 80% of the 170 possible routes were considered feasible and were included in the model.

EXPORT AND IMPORT QUANTITIES

Quantities were determined for two time periods: the actual data was obtained for 1981-82 (the most recent years for which complete data was available), and projections were made for 1990. Export supplies for 1981-82 were based on the shipments in that crop year from primary elevators in each of the 21 supply regions. Projections of 1990 export supplies for each of the supply regions were developed from production estimates for 1990 found in Prospect for the Prairie Grain Industry, 1990 (4). These projections are based on a production target for the prairie provinces of 50 million metric tons of all grains. This represents a production increase of about 9 million metric tons over 1981. The 1990 projections assume an increase in exports of about 18%.

Country imports for each grain for 1981-82 were set equal to their imports from Canada in that year. Import

projections by country for 1990 were estimated by determining each country's average percentage of Canadian exports of each grain for the four years 1979-80 to 1982-83 and applying that percentage to Canada's 1990 projected grain exports (3).

TRANSPORTATION AND HANDLING COSTS

All costs were stated in U.S. dollars. Canadian rates and costs were converted to U.S. dollars at the 1981-82 average exchange rate of U.S. $0.8225 per $1 Canadian (5, p. 20). Model runs using the 1990 grain export projections used 1981-82 costs and rates rather than attempting to estimate 1990 cost levels. This can be interpreted as assuming that the cost relationships between modes will be proportionately the same in 1990 as in 1981-82 regardless of changes in the general price level.

The following logistics costs were included in the cost minimization computations.

a. Rail charges from each of the 21 country shipping points to the five exporting or transshipping points. All rail charges from country locations to points in the U.S. were set at "compensatory levels" using estimates of rates equal to approximately 110% of variable costs. These estimates were derived from a mileage-based linear regression function obtained from actual 1981 U.S. unit train rates (2).

   Rail charges from country shipping points to

Canadian locations varied depending on the analysis and included the Crow Rates and estimates of compensatory rates approximating 110% of U.S. variable unit train rates derived from the regression function described above. Examples of these rates and rate estimates are shown in Table 1.

b. Fobbing costs at the five export ports and two transshipping points. These were the average costs for Canadian ports in 1981-82 (3) and are shown in Table 2. Export fobbing at Galveston was set equal to those at the Canadian west coast ports. Minneapolis fobbing was set equal to Thunder Bay, and Mississippi River Gulf seaboard fobbing was set equal to St. Lawrence seaboard fobbing.

c. Lake transportation costs from Thunder Bay to St. Lawrence ports. The 1981-82 average of U.S. $13.01 was obtained from Canadian Grain Exports (3).

d. Barge transportation costs from Minneapolis/St. Paul to Gulf export ports. Barge transportation rates on the Mississippi River are determined by market demand and can be anywhere from 100 to 400% of the tariff rates in Bargeload Bulk Grain Tariff (6). Barge rates are negotiable and highly variable depending on season, points of origin, and supply and demand conditions.

The average barge rate from Minneapolis to the Gulf during 1981 and 1982 was approximately 170%

TABLE 1

EXAMPLES OF RAIL RATES PER METRIC TON IN U.S. DOLLARS

Shipment Point	To	Rail Mileage	Crow Rate	Variable Cost Based Rate
Brandon, MT MB2	Thunder Bay	553	2.90	11.64
	Vancouver	1,333	5.44	37.83
	Prince Rupert	1,626	5.44	47.68
	Minneapolis	578	--	12.47
	Galveston	1,896	--	56.74
Swan River, MT MB5	Thunder Bay	720	3.45	17.24
	Vancouver	1,359	5.44	38.71
	Prince Rupert	1,551	5.44	45.16
	Minneapolis	745	--	18.08
	Galveston	2,063	--	62.35
Gravelbourg, SK SN4	Thunder Bay	954	3.99	25.10
	Vancouver	1,397	5.62	39.98
	Prince Rupert	1,588	5.62	46.40
	Minneapolis	789	--	19.56
	Galveston	2,107	--	63.83
Saskatoon, SK SN6	Thunder Bay	899	3.99	23.26
	Vancouver	1,088	4.35	29.60
	Prince Rupert	1,280	4.35	36.05
	Minneapolis	915	--	23.79
	Galveston	2,262	--	69.04
Medicine Hat, AB AA1	Thunder Bay	1,076	4.35	29.20
	Vancouver	871	4.35	22.32
	Prince Rupert	1,353	4.35	38.51
	Minneapolis	976	--	25.84
	Galveston	2,294	--	70.11
Calgary, AB AA3	Thunder Bay	1,244	4.71	34.84
	Vancouver	642	3.63	14.62
	Prince Rupert	1,185	3.63	32.86
	Minneapolis	1,153	--	31.79
	Galveston	2,049	--	61.88
Edmonton, AB AA5	Thunder Bay	1,228	4.71	34.31
	Vancouver	765	3.63	18.76
	Prince Rupert	957	3.63	25.20
	Minneapolis	1,241	--	34.74
	Galveston	2,243	--	68.40

of tariff or U.S. $11.60 (7). This was the rate generally used throughout the study, although the impact of barge rates was analyzed in several scenarios. The different barge rate levels are shown in Table 3.

e. Ocean freight rates from North American export ports to the importing ports. Average ocean freight rates for wheat in 1981-82 were obtained from World Wheat Statistics (8, 9). In some instances, rates were not available to specific countries, and rates to importing ports in the same geographic area were obtained from World Wheat Statistics. Actual rates from Drewry's Shipping Statistics (10) were used in some instances where rates were not available in World Wheat Statistics.

Because of the great variability in distances and physical facilities, logistics costs such as the costs of movements from farm to the country elevator, country elevator storage and handling and movement costs from importing ports to interior destinations were not considered.

MODEL RESULTS

Baseline Scenario--Canadian Ports and Crow Rates

A baseline scenario was developed to simulate the actual 1981-82 crop year using the Crow Rates and limiting shipments to Canadian ports. No shipments through U.S. ports were allowed. Two solutions were obtained. One allowed unlimited capacity at both Thunder Bay and Vancouver.

TABLE 2

FOBBING AND TRANSSHIPPING COSTS
IN U.S. DOLLARS PER METRIC TON

Vancouver and Prince Rupert Seaboard Fobbing	$3.59
Thunder Bay Transshipping	$3.31
St. Lawrence Seaway Seaboard Fobbing	$1.13

Source: Canadian Grain Exports 1981/82. p. 27. Rates given in US $ at an average exchange rate for '81-'82 of US $0.8225/Canadian $1.

TABLE 3

BARGE RATE LEVELS

Barge Rate Level	Percent of Published Rate[1/]	Barge Rate U.S. $	Barge Rate Plus Fobbing of U.S. $4.44
0	130	8.87	13.31
1	170	11.60	16.04
2	210	14.32	18.76
3	250	17.05	21.49
4	290	19.78	24.22
5	330	22.51	26.95

[1/] Barge rates on the Mississippi River are quoted as a percentage of Freight Tariff 7, Bargeload Bulk Grain Tariff of the Waterways Freight Bureau. (6)

The other solution limited the total West Coast grain exporting capacity to 10,000,000 metric tons per year. Table 4 compares the results of the two runs with the actual export shipments in 1981-82.

The results of the baseline run with no capacity restrictions indicate that under cost minimization conditions, approximately 12% of total Canadian grain exports (almost one-fourth of the grain exported from Thunder Bay) would have been more efficiently shipped from the Pacific Coast ports given the actual demand, Crow's Nest rail rates, and the ocean freight rates in effect in 1981-82. The results of the baseline run restricting the West Coast capacity to 10,000,000 metric tons indicates that the total logistics cost of this restriction was $25 million or an average of $1.10 per metric ton.[2/]

Scenario A_1--Crow Rates to Canadian Ports, Variable Cost Rail Rates to U.S. Ports and No Capacity Constraints.

Table 5 shows the results of runs using the 1981-82 export and import quantities, Crow Rates from country elevators to Thunder Bay, Vancouver and Prince Rupert, and the variable cost-based rail rates from country elevators to Galveston and Minneapolis. Barge rates were varied from 130 to 330% of tariff, i.e., export movement was allowed by either direct rail to Galveston or by Mississippi River barge via Minneapolis.

2/This is the per ton average increase in logistics cost. The additional cost per diverted ton is, of course, much higher.

TABLE 4

COMPARISON OF BASELINE RUNS WITH
1981-82 ACTUAL SHIPMENTS USING CROW RATES

1981-82 Actual

	St. Lawrence, Thunder Bay, Atlantic Seaboard, Churchill	Vancouver/ Prince Rupert
Wheat	8,965,819	6,695,637
Durum	1,847,809	462,481
Barley	2,574,099	2,946,615
TOTAL	13,387,727 (57%)	10,104,733 (43%)

Actual - No objective value

Baseline Run - No West Coast Capacity Constraints

	Thunder Bay MT	Vancouver/ Prince Rupert MT
Wheat	7,620,689	7,590,375
Durum	796,791	1,425,483
Barley	1,870,287	3,577,238
TOTAL	10,287,767 (44.96%)	12,593,096 (55.04%)

Objective Value: $851,427,291 ($37.21/MT)

Baseline Run - West Coast Shipments Limited to 10,000,000 Metric Tons

	Thunder Bay MT	Vancouver/ Prince Rupert MT
Wheat	8,374,915	6,836,149
Durum	1,860,847	361,427
Barley	2,645,101	2,802,424
TOTAL	12,880,863 (56.30%)	10,000,000 (43.70%)

Objective Value: $876,541,778 ($38.31/MT)

TABLE 5

SCENARIO A_1--1981-82 CROP YEAR

CROW'S NEST RATES TO CANADIAN PORTS
VARIABLE COST-BASED RATES TO UNITED STATES PORTS

1) Barge Rate = $8.87 (130 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	5,466,981	2,153,708	7,590,375
Durum	748,926	47,865	1,425,483
Barley	1,714,028	156,259	3,577,238
TOTAL	7,929,935 (34.66%)	2,357,832 (10.30%)	12,593,096 (55.04%)

Objective Value: $844,131,831 ($36.89/MT)

2) Barge Rate = $11.60 (170 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	6,299,840	1,320,849	7,590,375
Durum	748,926	47,865	1,425,483
Barley	1,817,293	52,994	3,577,238
TOTAL	8,866,059 (38.75%)	1,421,708 (6.21%)	12,593,096 (55.04%)

Objective Value: $848,524,956 ($37.08/MT)

3) Barge Rate = $14.32 (210 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	7,177,003	443,686	7,590,375
Durum	787,328	9,463	1,425,483
Barley	1,817,293	52,994	3,577,238
TOTAL	9,781,624 (42.75%)	506,143 (2.21%)	12,593,096 (55.04%)

Objective Value: $850,758,587 ($37.18/MT)

At a barge rate of U.S. $8.87 (130% of tariff), even with the Crow Rates in effect, the lowest cost solution indicates that 10% of Canadian exports or 2.4 million metric tons should have been sent down the Mississippi River. The least cost solution is a total of 7.3 million or 32¢ per ton less than in the baseline solution with unrestricted West Coast capacity.

At a barge rate of U.S. $11.60 (170% of tariff), which approximates the 1981-82 average, 6% of the Canadian export grain would have gone down the Mississippi River. The cost savings would be $2.9 million or 13¢ per metric ton from the baseline solution with unrestricted West Coast capacity.

At a barge rate of U.S. $14.32 (210% of tariff), 2% of the exports should still use the Mississippi River route. This would allow a total cost saving of $670,000 or an average of 3¢ per ton if West Coast capacity was unrestricted.

At barge rates of 250% of tariff or higher, with no restrictions on West Coast capacity, grain would not move down the Mississippi River with the Crow Rates in effect.

It should be noted that although exports were diverted to the Mississippi River at 130, 170 and 210% of tariff, the variable cost all rail-routes from Canadian origins through the U.S. to Galveston were not used.

Scenario A_2--Crow Rates with U.S. Export Routes and West Coast Port Capacity Constraints.

In Scenario A_1, all the exports that used the river route were diverted from Thunder Bay and the Seaway. There

were no diversions from the Canadian West Coast ports.

As noted earlier, when there were no U.S. routes, the least cost solutions would route more export grain through the West Coast than the actual capacity in 1981-82. Although this situation is changing as West Coast capacity is expanded, a capacity limit of 10,000,000 total metric tons was assigned to the West Coast ports to more closely simulate the actual 1981-82 conditions. The results are shown in Table 6. Under these conditions, and allowing movement through the U.S., the grain diverted from the West Coast all goes to Thunder Bay, i.e., there is no increase in movement to the Gulf.

Scenario B_1--Variable Cost-Based Rail Rates to All Ports.

In this set of runs, all rail rates were estimated using the unit train cost regression function previously described. An initial run was made without the export routes through the U.S. and with no constraints on Canadian West Coast capacities. The general pattern of grain flows was very similar to that obtained in the corresponding run using the Crow Rates. The only change was that 194,000 metric tons of barley was exported through Thunder Bay rather than to the West. The total grain flow went 45.8% through Thunder Bay and 54.2% to the West as compared to 45.0% and 55.0% using the Crow Rates.

Table 7 shows some results when grain movements through the U.S. were allowed. Using the variable cost-based rail rates with barge rates at 130% of tariff, all the Thunder

TABLE 6

SCENARIO A_2--1981-82 CROP YEAR

CROW'S NEST RATES TO CANADIAN PORTS
VARIABLE COST-BASED RATES TO UNITED STATES PORTS
WEST COAST CAPACITY RESTRICTED TO 10,000,000 METRIC TONS

Barge Rate = $11.60 (170 Percent of Tariff)

Including the U.S. Gulf:

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	7,054,066	1,320,849	6,836,149
Durum	1,812,982	47,865	361,427
Barley	2,592,107	52,994	2,802,424
TOTAL	11,459,155	1,421,708	10,000,000
	(50.08%)	(6.21%)	(43.70%)

Objective Value: $873,639,443 ($38.18/MT)

TABLE 7

SCENARIO B_1--1981-82 CROP YEAR

VARIABLE COST-BASED RATES TO
CANADIAN AND UNITED STATES PORTS

1) Barge Rate = $8.87 (130 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	--	7,620,689	7,590,375
Durum	--	1,329,000	893,274
Barley	--	2,145,985	3,301,540
TOTAL	--	11,095,674 (48.49%)	11,785,189 (51.51%)

Objective Value: $1,155,655,545 ($50.51/MT)

2) Barge Rate = $11.60 (170 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	4,181,527	3,439,162	7,590,375
Durum	375,805	796,791	1,049,678
Barley	932,442	1,213,543	3,301,540
TOTAL	5,489,774 (23.99%)	5,449,496 (23.82%)	11,941,593 (52.19%)

Objective Value: $1,183,669,365 ($51.73/MT)

3) Barge Rate = $14.32 (210 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	5,466,981	2,153,708	7,590,375
Durum	375,805	420,986	1,425,493
Barley	1,989,726	156,259	3,301,540
TOTAL	7,832,512 (34.23%)	2,730,953 (11.94%)	12,317,408 (53.83%)

Objective Value: $1,192,937,277 ($52.14/MT)

Bay-Seaway grain was diverted to the Mississippi River. In addition, 614,000 tons, primarily of durum, was diverted to the Gulf from the West Coast. The potential savings from using the Mississippi route at 130% of tariff would exceed $46 million or $2.44 per metric ton.[3/]

Table 7 shows that at 170% of barge tariff, approximately half of the diverted grain would return to the Thunder Bay route and only a small amount of the previously barged grain would go west. At 210% of barge tariff, approximately three-fourths of the grain flow would have returned to Thunder Bay, but nearly 12% of the total Canadian exports should still be routed down the Mississippi River.

Although not shown in Table 7, runs were made at the other barge rate levels. At 250% of tariff ($17.05 per ton) and 290% ($19.78), 10.8% and 9.2% of the export grain should be routed down the Mississippi. At 330% or $22.51 per ton, the Mississippi River would still be the optimal route for 4.5% of the grain. The total logistics cost per ton would be $52.45, $52.72 and $52.95, respectively.

Scenario B_2--Variable Cost-Based Rail Rates to All Ports with West Coast Capacity Constraints.

Table 8 shows the results of simulations for the 1981-82 crop year using variable cost rail rates, a barge rate of 170% of tariff, and West Coast capacity limited to 10,000,000 tons. Under these conditions, 27.7% of the grain would flow to the Gulf. This contrasts with 23.8% when the

[3/]This is a lower bound on savings as no control run was made. The upper bound is $73 million.

TABLE 8

SCENARIO B_2--1981-82 CROP YEAR

VARIABLE COST-BASED RATES TO
CANADIAN AND UNITED STATES PORTS

Barge Rate = $11.60 (17.0 Percent of Tariff)

Including the U.S. Gulf:

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	4,844,508	4,096,469	6,270,087
Durum	640,085	1,031,034	551,155
Barley	1,055,224	1,213,543	3,178,758
TOTAL	6,539,817	6,341,046	10,000,000
	(28.58%)	(27.72%)	(43.70%)

Objective Value: $1,193,400,022 ($52.16/MT)

West Coast capacity is not constrained. This forced diversion from the West Coast is divided with 1,050,000 million tons going through Thunder Bay and 890,000 tons going down the Mississippi. The total logistics cost of $1,193 million when Mississippi River shipments are allowed at 170% of barge tariff with variable cost rail rates is $36 million or $1.55 per metric ton from less than when the West Coast capacity is restricted and barge shipments aren't allowed.

Scenario C--1990 Crop Year, Variable Cost-Based Rail Rates, No Port Capacity Constraints.

As previously described, the Canadian Wheat Board has established a production target of 50 million metric tons of all grains for 1990 and has estimated that exports of wheat, durum and barley total 27.7 million metric tons. This is an increase in exports of nearly 18% over the 1981-82 crop year.

Estimates of supply quantity by region were developed from (4) and estimated import demands were prorated to importing countries based on their four-year average from 1978-79 to 1981-82 (2). This set of model solutions then simulated the projected 1990 conditions.

Table 9 presents the results of selected runs. At 130% of tariff, 12.9 million tons or 46.7% of Canadian exports would go by Mississippi River barge. Almost all of this is diverted from Thunder Bay as only 180,000 tons are diverted from the West Coast. The total logistics cost savings due to use of the Mississippi barge route is $76 million or an average of $2.74 per ton. At 170% of tariff,

TABLE 9

SCENARIO C--THE YEAR 1990

VARIABLE COST-BASED RATES TO
CANADIAN AND UNITED STATES PORTS

Barge Rate = $8.87 (130 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	--	10,115,239	10,565,717
Barley	--	2,807,754	4,198,290
TOTAL	--	12,922,993 (46.67%)	14,764,007 (53.33%)

Objective Value: $1,437,763,991 ($51.93/MT)

Barge Rate = $11.60 (170 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	5,247,491	4,867,748	10,565,717
Barley	1,282,348	1,395,931	4,327,765
TOTAL	6,529,839 (23.59%)	6,263,679 (22.62%)	14,893,482 (53.79%)

Objective Value: $1,471,835,400 ($53.16/MT)

Barge Rate = $22.51 (330 Percent of Tariff)

	Thunder Bay MT	U.S. Gulf MT	Vancouver/ Prince Rupert MT
Wheat	8,476,954	1,638,285	10,565,717
Barley	2,536,984	90,108	4,378,952
TOTAL	11,013,938 (39.78%)	1,728,393 (6.24%)	14,944,669 (53.98%)

Objective Value: $1,508,102,725 ($54.47/MT)

Thunder Bay regains 6.5 million tons of grain exports and Mississippi River barges have 6.3 million tons. Diversion from the West Coast to the Mississippi River is only 51,000 tons. Cost savings are $1.51 per metric ton. Although not shown in Table 9, at barge rates of 210%, 250% and 330%, between 10 and 12% of the grain would be shipped by barge at an average cost savings of $1.10, $0.78, and $0.47 per ton, respectively.

Table 9 indicates that even at barge rates of 330% of tariff ($22.51 per ton), 1.7 million tons would move by barge. Total logistics cost savings would be $5.4 million or $0.20 per ton.

CONCLUSIONS

1. At the recent low levels of U.S. Mississippi River barge rates, it would have been advantageous to ship as much as 10% of Canadian export grain by barge to Mississippi River Gulf ports--even with the Crow Rates in effect. The shortage of logistics facilities on the Canadian West Coast does not have much impact on this result.

2. Similarly, at a barge rate of 170% of tariff, which is somewhat higher than the actual average barge rate for 1981-82, 6% of the Canadian grain exports could have been advantageously moved by barge even with the Crow Rates in effect. Some movements would be economical at even higher levels of barge rates.

3. At low levels of Mississippi River barge rates and unit

train rail rates to Canadian ports equal to 110% of variable costs, 100% of the grain moving through Thunder Bay and the Seaway along with small amounts of West Coast grain could be advantageously shipped by barge to Gulf ports. With variable cost-based rail rates and higher barge rates, between 200 and 300% of tariff (higher than the last several years and equal to or exceeding full cost), 9 to 12% of total Canadian grain exports could advantageously be moved down the Mississippi River. This grain would all be diverted from Thunder Bay and the Seaway.

4. The same results generally hold for the 1990 projection. Ten to twelve percent of Canadian grain exports can profitably be sent down the Mississippi even if barge rates were above full cost if Canadian rail rates are at or above variable costs. Most of this traffic would be diverted from Thunder Bay and the Seaway.

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THE FUTURE OF THE SEAWAY TRAFFIC AND ITS ROLE IN THE ECONOMY OF THE GREAT LAKES-SEAWAY REGION

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ABSTRACT

This paper examines the findings of the Seaway Traffic Forecast study to year 2000, which was prepared with the help of the recently developed Seaway Traffic Forecast Computer Model (STFM). The approach and assumptions used in deriving these forecasts as well as the impact of these future traffic flows on the economy of the Great Lakes-Seaway region will be discussed. Particular emphasis will be given to the major commodities using the waterway such as the Canadian and U.S. grains, iron ore and steel products and coal.

INTRODUCTION

The St. Lawrence Seaway is a major world 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 international as well as domestic 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-St. Lawrence transportation system. It extends from Montreal to Lake Erie and includes two sections; the Montreal-Lake Ontario Section (M.L.O.), consisting of five Canadian and two U.S. locks, and the Canadian Welland Canal with its eight locks. 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, service and transportation charges are maintained at a level which allows the system to be competitive, efficient and safe. As part of achieving these goals, traffic forecasts are prepared as an essential input in the Authority's strategic planning program. Until 1974, these forecasts were prepared by outside consultants. Since then, an in-depth study was undertaken by the Economics Section of the Seaway Authority which culminated with the production in 1975 of the first Seaway internal long-range traffic forecast. Moreover, the Authority, with the collaboration of the Saint Lawrence Seaway Development Corporation, contracted for a consultant study (Acres-DRI) of Seaway Commodity Flow Forecast to year 2000 which was completed in 1982. With the introduction in 1981 of a microcomputer system in the Economics Section, a Seaway Traffic Forecast Model (STFM)

was developed within the Seaway Economic Planning System (SEPS)[1], enabling the SLSA to update periodically both the short and long-range traffic forecasts with greater efficiency. The current projections for the period between 1985-2000 were prepared using this newly developed system. They reflect the dynamic aspect of the economic environment and the changes that have taken place in the market picture for the Seaway commodities since the Acres-DRI study was published. This paper will discuss the findings of these forecasts.

SEAWAY TRAFFIC

Cargo traffic through the waterway includes several types of commodities which can be grouped under five major categories: 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 on the Seaway since they constituted about 77% and 75% of all the 1984 cargo traffic on the Welland Canal and the M.L.O. section respectively. 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 distribu-

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1/ Hazem Ghonima, The Seaway Economic Planning System - Computer Model Program (SEPS-CMP), Paper presented at the CTRF/TRF Conference, Jasper, May 23-24, 1984.

ted over a wide range of commodities such as iron and steel products, petroleum products, coke, stone, salt, etc.

HISTORICAL TRAFFIC DEVELOPMENT - 1958-1984

In 1958, the year before the Seaway opened, total cargo tonnage moving through the old system amounted to 10.7 million tonnes on the M.L.O. section and 19.3 million tonnes on the Welland. In 1959, traffic jumped to 18.7 million tonnes on the former and 25 million tonnes 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 tonnes on the Welland in 1979. Since the record levels reached in the late 1970's, Seaway traffic declined substantially, mainly due to the deep and prolonged economic recession. By 1982, shipments on the M.L.O. section had fallen to 42.8 million tonnes and 49.0 million tonnes on the Welland. Nevertheless, the economic recovery which started in mid-1983 contributed to a slight rebound of Seaway traffic. Cargo tonnages on the M.L.O. section rose in that year by 5.2% above the 1982 level to 45.1 million tonnes. On the Welland Canal, the traffic increased by 2.3% to 50.1 million tonnes.

This upward trend continued during the first half of the 1984 season, reflecting the strong performance of the

North American economy in that period. Cargo traffic on the M.L.O. section was 47.5 million tonnes, 5.4% above 1983. On the Welland Canal, it reached the 53.9 million tonnes level, some 7.5% higher than the year before. The recovery in 1984 traffic was mainly attributed to the substantial increase in iron ore and manufactured iron and steel imports to the U.S., a result of higher steel demand reinforced by a strong U.S. dollar (see Figure 1).

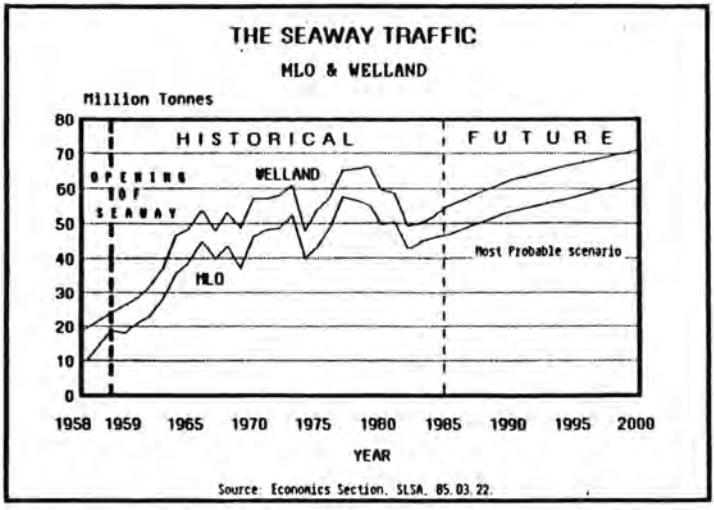


FIGURE 1

Our evaluation of the Seaway traffic performance since 1975 in comparison to alternative routes and modes indicated that the decline of the Seaway traffic is usually the result of a depressed economic situation and/or a decrease in demand/supply of the Seaway's traditio-

nal producing and/or consuming centres. Meanwhile, during the same period, alternative routes and modes have experienced similar and sometimes worse performance than the Seaway.

FUTURE TRAFFIC

The methodology used in deriving future traffic on the Seaway system is based on the SEPS (see Figure 2) concept which visualized the Seaway transportation system and its major components (waterway, locks, ports, etc.) at the centre of a huge North American transportation network comprising alternative routes and modes which compete for various cargo flowing between different domestic as well as international supply and demand centres. This environment is surrounded and influenced by a multitude of inter-related economic and institutional activities at various levels. Therefore, the waterway is not visualized as a regional exclusive transportation route for most of the traffic it carries but rather as an international competitive artery which must compete for its share of the available traffic in the transportation marketplace. This competition is dynamic and is a function of a multitude of factors including the forces of supply and demand, the institutional environment and the service and reliability levels which these routes/modes offer.

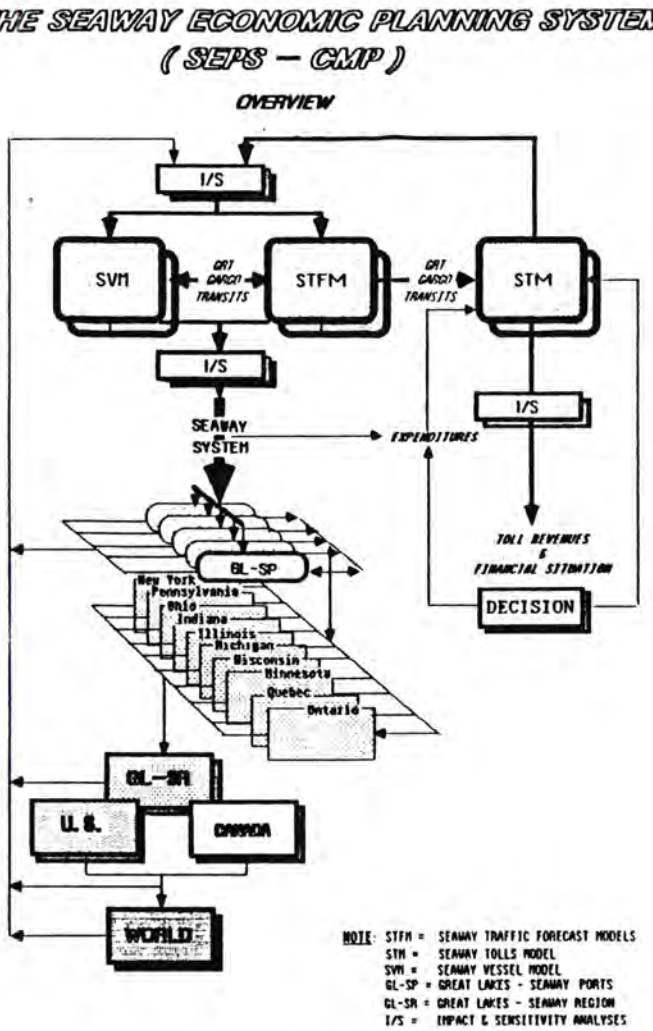


FIGURE 2

THE SEAWAY TRAFFIC FORECAST MODEL

The Seaway Traffic Forecast Model (STFM), which was used to prepare the traffic forecasts, consists of twen-

ty-four (24) modules. The model simulates the impact of the alternative economic, technological and institutional conditions on major cargo traffic moving via the waterway. It provides conditional forecasts to pretest the effect of modified assumptions on world macro economics, regional and modal levels for Canada and the U.S. The STFM is mainly used to produce short, medium and long-range Seaway traffic forecasts for the major commodities which are subsequently used to generate vessel 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, the STFM is used to provide answers to "What if?" questions and 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 exogenous factors which are routinely available from any number of government agencies or private forecasting organizations such as Data Resources Inc. (DRI), Chase Econometrics, Informetrica, etc.

APPROACH AND METHODOLOGY

The approach used in the STFM follows the general SEPS concept 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 may move is applied in order to estimate the Seaway share of this movement.

Since transportation costs are mostly a by-product of the reaction between the forces of supply and demand, they are used only when the (wcf) is not acceptable and when forecasted transportation costs are available on a consistent basis. Moreover, the dynamic fluctuations of transportation costs as well as the vertical integration of certain industries tends to diminish the usefulness of this factor in long-range forecasts. For example, the current rate structure for certain alternative routes/modes may not necessarily reflect the true transportation cost. It may have developed, apart from other factors, as a result of competition to yield a less than desirable, yet temporary acceptable, return on the movement of certain goods. When these competitive circumstances are

changed, adjustments could be made in a manner such that a static measure of route demand elasticity will overstate the true elasticity effect.

The methodology applied to derive the (wcf) as well as the traffic forecast combines both qualitative and quantitative techniques. Correlation and regression analyses which are used to obtain these estimates consist of using constant and weighted exogenous 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 upon the type of commodity and the length of the forecasted period.

The results of the various regression analyses performed for the development of the STFM were very encouraging. Generally, the coefficient of determination (R^2) is high, averaging 0.9, indicating that the factors selected explain about 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 and dependent variables.

FORECAST FINDINGS

Traffic forecast estimates have been provided for three traffic levels: "Most Probable", "Maximum" and "Minimum". The large gap between the maximum and the minimum levels is the result of different assumptions and various sensitivity tests undertaken in this study. They reflect the wider scopes covered and the dynamic nature of the study model. Therefore, these two levels illustrate the best and worst cumulative scenarios respectively, and although they are the least likely to occur, they represent the magnitude within which the actual traffic should fall. The most probable traffic forecast scenario is the most likely to occur at (±) 5% accuracy, within one year from the latest update. For planning purposes, the most probable level is used in the estimation of the Seaway's financial status whereas the "maximum" scenario is the basis for capacity planning.

During the 1985-2000 period the traffic on both sections of the waterway should grow annually by about 2% for the most probable scenario. By the year 2000, cargo movements should reach some 65 million tonnes on the M.L.O. section and 73 million tonnes on the Welland Canal (see Table 1).

THE ST. LAWRENCE SEAWAY LONG RANGE TRAFFIC FORECASTS, 2000[1]

(Millions of Tonnes)

TRAFFIC	1984	2000		
	Actual	Minimum	Most Probable	Maximum
MONTREAL-LAKE ONTARIO				
GRT	48.33	46.62	69.86	93.00
CARGO	47.50	43.21	64.95	85.02
GRAIN	23.50	23.60	34.80	44.00
CANADIAN	15.85	14.90	20.00	21.40
U.S.	7.65	8.70	14.80	22.60
GOV.AID	0.23	0.25	0.25	0.25
IRON ORE	11.42	10.06	14.75	17.87
COAL	0.45	0.55	0.90	4.45
OTHER BULK[2]	6.96	5.75	8.75	11.75
GENERAL CARGO	4.94	3.00	5.50	6.70
VESSEL TRANSITS *	3597	N/A	N/A	N/A
LOADED	2752	N/A	N/A	N/A
BALLAST	845	N/A	N/A	N/A
WELLAND CANAL				
GRT	63.23	57.73	86.71	111.65
CARGO	53.92	49.52	73.34	93.16
GRAIN	24.44	24.60	36.10	45.10
CANADIAN	16.43	15.10	20.50	21.80
U.S	8.01	9.50	15.60	23.30
GOV.AID	0.23	0.25	0.25	0.25
IRON ORE	10.09	9.17	12.94	16.06
COAL	6.73	5.05	7.30	13.10
OTHER BULK[2]	8.16	7.75	11.75	12.75
GENERAL CARGO	4.27	2.70	5.00	5.90
VESSEL TRANSITS *	4555	N/A	N/A	N/A
LOADED	3055	N/A	N/A	N/A
BALLAST	1500	N/A	N/A	N/A

NOTE: (1): July 1984 adjustment.
(2): Includes Coke, Petroleum Products, Stone, Salt and all other Other Bulk.
N/A: Not available at the present time.
* : Non-Toll & Non-Cargo transits excluded from Vessel Transits.

SOURCE: Economics Section, SLSA, 85.CB.21.

TABLE 1

In absolute terms and in percentage share of the total 2000 traffic, grain, at about the 36 million tonne

level, will continue to be the largest component, accounting for 54% and 49% of the overall cargo moving via the M.L.O. and Welland Canal sections respectively. This flow will be split about 57% and 43% between Canadian and U.S. grain respectively on the Welland with Canada contributing 20.5 million tonnes and the U.S. 15.6 million tonnes. Iron ore traffic should constitute about 22.7% and 17.6% of the total cargo moving through the two sections of the Seaway, followed by other bulk (13.9% and 16.4%), coal (1.4% and 10.0%), and general cargo (8.4% and 6.8%). The upbound/downbound traffic percentage split is expected to be about 36/64 on the M.L.O. section and 27/73 on the Welland. In the following pages, we will discuss the grain, iron ore and steel products as well as the coal traffic.

GRAIN

Grain moving via the Seaway consists primarily of Canadian and U.S. export shipments that originate at the Great Lakes terminals and are destined for Europe, the U.S.S.R., North Africa - the Middle East and Latin America. The movement of grain is, together with that of iron ore, the most significant on the Seaway. The downbound movement of grain provides a backhaul for the upbound movement of iron ore and together these two commodities constitute about 64% of all 1984 traffic on the waterway.

Most of the grain traffic is carried by Canadian lakers to lower St. Lawrence ports for trans-shipments to ocean vessels, while a smaller part, consisting particularly of feed grain, is dropped off for domestic use at Toronto, Montreal and other river ports. Beside the laker movements, there is also a considerable amount of grain, mainly U.S., which is shipped directly overseas in ocean vessels.

Grain traffic represents about 50% and 45% of the total traffic moving through the M.L.O. section and the Welland Canal respectively. This bulk traffic increased from only 7.5 million tonnes when the Seaway opened in 1959 to the record level of almost 28 million tonnes in 1978. Last season grain traffic was 24.4 million tonnes on the Welland Canal.

The size of the Seaway grain traffic depends upon the interaction of several factors such as: the world grain market condition; North American grain production; future demand of traditional Seaway markets; agriculture policy in Western Europe, especially within the E.E.C.; the Soviet-North American grain trade situation; the capacity of the transportation system in both Canada and the U.S.; U.S. agriculture and foreign aid policy; development and modernization of the Seaway ports; grain-handling and other facilities; and finally vessel efficiency and costs of transportation, both inland and by water.

Future world demand for grain is expected to increase due to growth in world population. In response to this, North American supplies should grow and subsequently increase the grain traffic proceeding via the Seaway. However, the rate of increase in this traffic is expected to be lower than the average growth in the world as well as the North American grain trade; this is due to the fact that most of the increase in North American exports will be going to the growing markets in Asia and Africa which traditionally were not Seaway grain consuming centres. Meanwhile, Western Europe, which accounted for the biggest part of the grain moving through the Seaway, is expected to reduce its rate of increase of grain imports. Moreover, our analysis indicates that grain traffic on the Seaway is highly sensitive to the demand from the U.S.S.R. and Eastern European markets. Therefore, future grain volume through the waterway will hinge on whether or not the Eastern Bloc will achieve self-sufficiency and whether the political environment between the two superpowers will encourage a healthy bilateral trade.

In Canada, grain is exported from three major terminals, namely the Pacific terminal, the Eastern terminal (Thunder Bay, St. Lawrence ports and Atlantic ports), and the Churchill terminal. All grain shipped to the Pacific is for export whereas grain moving eastward by water (with the exception of grain shipped to bay and lake ports on the Upper Lakes) is for export and domestic use,

both of which contribute to Seaway traffic.

The only competitive potential for Canadian grain traffic may develop from the Pacific route. As mentioned earlier, markets for grain moving via the Pacific terminal should expand at a greater rate than those markets served by Eastern terminals. Conceivably, grain shipments to the west coast should grow and constitute a larger percentage of future Canadian grain exports relative to its present share.

Grain exports from the U.S. take place from four coastal areas: the Great Lakes, the Atlantic, the Gulf and the Pacific. Our analysis indicates that the amount of U.S. grain moving via the Seaway depends upon the demand of Seaway traditional markets as well as the capacity of the U.S. grain transportation system (in particular, the Mississippi-Gulf route). This, in turn, is highly dependent upon the economic situation and the volume of other commodities moving through this system. Moreover, we found that in years when world grain demand was high and the economic situation was robust, the U.S. transportation system suffered from capacity problems and the Seaway grain share showed some growth. But with the decrease in demand for petroleum products in the last few years, the available capacity of the U.S. system increased (barge prices fell) and consequently the Seaway share diminished.

In light of the above, it is concluded that grain

traffic through both sections of the waterway could fluctuate between a minimum of 25 million tonnes and a maximum of 45 million tonnes in the year 2000 depending upon the factors prevailing at that time. The most probable scenario, at this point in time, indicates a level of 36 million tonnes of which 20.5 million tonnes is Canadian grain and 15.6 million tonnes is U.S. grain. During the forecast period 1985-2000, grain traffic should rise by an annual rate of growth of about 2% for the most probable scenario.

IRON ORE AND STEEL PRODUCTS

Iron ore shipments on the Seaway originate primarily from the Quebec-Labrador region. The ore is then brought south by rail to lower St. Lawrence ports and then moved by vessel to Canadian steel mills on Lake Ontario and to U.S. steel mills on Lake Erie. Part of this iron ore continues by rail to the Pittsburgh-Johnstown-Youngstown region. Substantial tonnage is also carried downbound through the Welland to the Hamilton area from U.S. and Canadian mines in the iron ore ranges local to Lake Superior. Ore from Picton and Lake Ontario, which used to move through the Welland Canal to the Buffalo area, has disappeared in recent years.

Seaway iron ore traffic faces direct competition from three major alternative routes/modes; Quebec-Labrador ore transported by ocean vessel to U.S. Atlantic

ports and then by rail movement to U.S. mid-region steel mills; U.S. Mesabi ore moved by vessel from Duluth-Superior to U.S. Lake Erie; and South American ore shipped by ocean vessel to U.S. Gulf and Atlantic ports.

The size of iron ore movement on the Seaway has been second only to grain traffic in importance. It increased from 5.6 million tonnes in 1959 to a record peak in 1977, when 20.2 million tonnes passed through the M.L.O. section as the result of labour disputes in the competitor U.S. mines of Lake Superior. In the following years, the traffic gradually declined until in 1982 it reached only 7.4 million tonnes. This was the lowest level since 1963 and was caused by the prolonged economic recession which severely depressed the automotive and steel industries in North America in that year. Despite the slight recovery of 1984, when the traffic reached 11.4 million tonnes, it is evident that a new situation (post-1977) has developed.

Several factors determine the size of the iron ore traffic through the Seaway. Most important is the demand for finished iron and steel products in the U.S. and Canada. These, in turn, depend upon the general economic condition and the steel usage factor in endmarkets. Other important factors include the share of domestic and imported steel in the total supply; steel-making technology (yield and furnace mix); material uses as well as the performance of steel mills located within the Seaway

region.

Beside these demand factors, the size of the iron ore movement via the waterway depends on supply conditions as well as the ability of the Seaway to compete with alternative routes and modes. The latter factor will depend upon the efficiency of the waterway and is reflected in the total transportation charge it offers. Nevertheless, our analysis indicates that the impact of the transportation cost is usually diluted by the vertical integration in the production, distribution and consumption of iron ore which is a characteristic of this industry.

As can be seen from Figure 3, the Iron and Steel Traffic Forecast Model simulates most of these activities from the production of iron ore in the Canadian supply centres of Quebec-Labrador mines to its consumption in U.S. demand centres. Between these two points, the demand for Quebec-Labrador ore through the Seaway and its competitive situation vis-à-vis alternative routes/modes is simulated and the influence of exogenous factors are estimated. Therefore, forecast figures for iron ore traffic as well as iron and steel products imported to the U.S. via the Seaway could be estimated for a wide range of assumptions. Moreover, traffic forecasts for coke and metallurgical coal consumed by the steel industry are also produced as by-products of this model.

Steel demand is expected to grow between 1983 and

2000 by an annual average of about 0.6% and 1.5% in the U.S. and Canada respectively. Meanwhile, imports of iron and steel products should fluctuate between 25% and 30% of total U.S. steel consumption. Despite this moderate growth in steel demand, raw steel production is expected to grow by a much lower rate until the year 2000. This is caused by the expected improvement in the yield ratio between finished steel and raw steel and by the increase in import share. In addition, steel mills serving the Great Lakes-Seaway region are expected to have even a smaller share of total U.S. production due to steel-making technology's development.

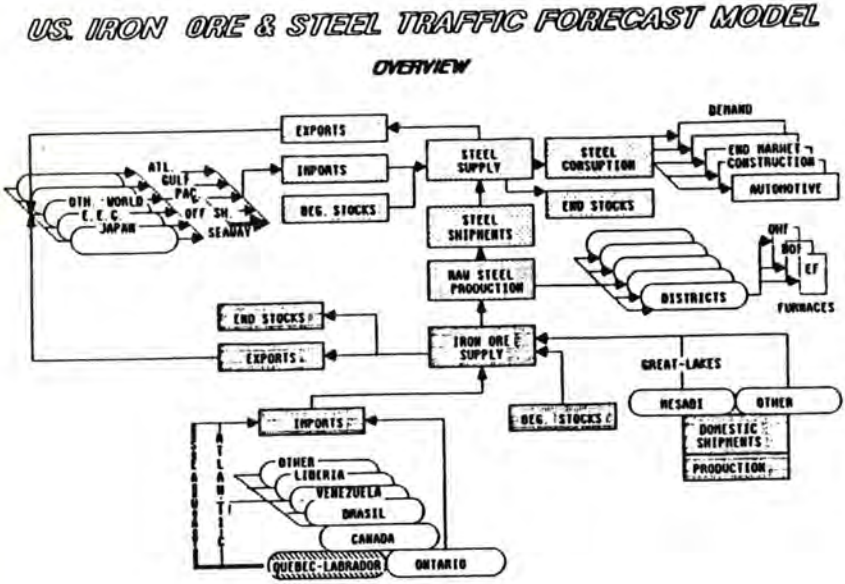


FIGURE 3

By the year 2000, Seaway iron ore traffic has the potential to vary between a minimum of 10 million tonnes and a maximum of 18 million tonnes on the M.L.O., with the most probable scenario presently indicating an amount of about 15 million tonnes. Meanwhile, general cargo, which is composed mostly of iron and steel products, should fluctuate between a minimum of 3 million tonnes and a maximum of 6.7 million tonnes, with a most probable scenario indicating 5.5 million tonnes (see Table 1).

COAL

The principle coal movement on the Seaway is the rail shipment from the U.S. Midwest coal-mines to Lake Erie ports and the transfer to lake vessels for shipments through the Welland Canal to Ontario Hydro's thermal coal -fired stations and the steel-making plants located on Lake Ontario. Ontario Hydro operates one coal-fired station and one dual coal-gas-fired station. Of the three major steel-making industries in Ontario, only Stelco and Dofasco have metallurgical coal-consuming plants within the Seaway region. Cement plants and other users on Lake Ontario and below also generate a small amount of thermal coal traffic on the waterway.

Coal shipments through the Welland represent the third largest commodity movement on the Seaway. This traffic peaked from only 4.4 million tonnes in 1959 to the record level of 9.8 million tonnes during 1969 and

1970. In the years which followed, it gradually decreased until it reached the bottom level of 5.5 million tonnes in 1983. With the strengthening of the economy, as well as stock piling policies, the 1984 coal traffic rebounded to 6.7 million tonnes.

During the 1981 navigation season, about 1.6 million tonnes of U.S. thermal coal were exported to Europe via the Seaway. Originating from the American Mid-West, this coal was brought to lower St. Lawrence by lakers and then transshipped on ocean-going vessels bound for the European market. The primary reason for this development was the sudden increase in coal demand as a result of the escalating price of petroleum coupled with the unstable political situation in Poland, a major coal exporter to Europe. Given the labour problems which temporarily limited the potential of the South African and Australian suppliers at that time, the U.S. coal exports were the only alternative to satisfy the sudden demand. This contributed to congestion problems in the U.S. coal transportation system, consequently increasing demurrage costs and, hence, justifying exports of a portion of this U.S. coal through the Seaway. With the elimination of most of these factors in recent years, and particularly with falling oil prices, this traffic gradually diminished and is not expected to increase significantly in the future.

Meanwhile, thermal coal shipments via the Seaway to Ontario Hydro's power plants should decline gradually in

the future, since most of the coal imported by these facilities will be consumed by its coal-fired stations located outside the Seaway region. Nevertheless, a short fall in the ability of these plants as well as in the nuclear plants to meet future demand could lead to higher levels of electric generation at Lake Ontario plants and to corresponding higher coal traffic on the Welland Canal. Meanwhile, cement plants should increase slightly their thermal coal demand in the future. Finally, metallurgical coal traffic on the Welland Canal is expected to grow moderately, reflecting increasing steel production by the Canadian steel industrial complex in the Hamilton and Nanticoke areas.

In all, coal traffic on the Welland Canal by the year 2000 has the potential to fluctuate between 5 and 13 million tonnes, with the most probable scenario occurring at the 7.3 million tonne level (see Table 1).

CONCLUSION: ECONOMIC IMPACT OF THE SEAWAY

The opening of the North American hinterland to world shipping as a result of the Seaway in 1959 has been in general of great economic benefit to Canada and the world, and in particular to the provinces and states forming the Great Lakes-Seaway region. The area affected by the Seaway is larger than all of Western Europe and contains nearly one third of the combined populations of Canada and the U.S., as well as a great part of their in-

dustrial infrastructure. In recent years, over 50% of all Prairie grain exports have been shipped eastward through the Seaway. The influx of this Canadian grain as well as the U.S. grain to the lower St. Lawrence for trans-shipment to ocean-going vessels led to the growth and development of several Quebec ports. Moreover, the movement of iron ore and coal through Ontario and Quebec has been beneficial to the industrial infrastructure of both provinces.

Apart from the sheer increase in traffic volumes, the Seaway has an important economic impact on the shipping and handling of cargo. A direct impact is on businesses with operations either wholly or partly connected with the shipping and/or receiving of goods, while an indirect impact consists of the multiplier effects of the outlays by the same businesses. Another beneficial factor is the saving in cost for bulk commodity shipments (such as grain, iron ore and coal) resulting from the use of the Seaway. If the Seaway did not exist, the cost of transporting such commodities in huge volumes by rail to ocean ports would add such a substantial constraint that the competitiveness of producers would be markedly curtailed. Therefore, the contribution of the waterway to the Seaway region alone and the benefits it has brought to the shipping industry and, indirectly, to almost every Canadian, is tremendous. It has created thousands of jobs in countless related industries. Goods of all kinds

can still be shipped over long distances at reasonable cost by ships which, after pipelines, remain the lowest energy-consuming carriers. The value of these goods which move through the Seaway is estimated to range from between 8 to 10 billion dollars.

Although world market conditions may alter the flow patterns and demand for certain commodities - causing periodical fluctuations in Seaway traffic - the future viability of the waterway is linked to and insured by the fact that it is first and foremost a bulk cargo route strategically located within the world's largest agricultural and industrial region.

ACKNOWLEDGEMENT

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INVESTING IN URBAN TRANSPORTATION INFRASTRUCTURE IN A CHANGING ENVIRONMENT - THE ALBERTA EXPERIENCE

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EXECUTIVE DIRECTOR

URBAN TRANSPORTATION

I. Overview

On January 10, 1979 Premier Peter Lougheed and Minister of Transportation Dr. Hugh Horner announced a new six-year urban transportation program for the cities of Alberta. There was a commitment to provide over $750 Million through the grants over the six year period beginning April, 1979. The announcement was greeted warmly by the Mayor of Calgary, but not by the Mayor of Edmonton.

Edmonton and Calgary were promised capital assistance of $117.5 Million each for transit (i.e. LRT) and $69 Million for arterial roadways over the six years, plus sufficient funding for each to complete their $80 Million primary highway projects (Highway 2 in Calgary and Highway 16 in Edmonton).

In total, Edmonton and Calgary were to get about $250 Million in capital and operating assistance each over the six years, with the remaining nine cities sharing $250 Million likewise for roadway and transit assistance.

Briefs presented to the provincial government prior to announcement of the new program had stressed the need for regular reviews of the adequacy of funding, significant increases and multi-year committed funding

which would enable cities to better plan.

The multi-year obligation was achieved by signed agreements with each city, committing the province to an annual level of funding for the life of the program. In his announcement, the Premier also committed to biennial reviews of the adequacy of funding, so that the grants might better keep up with population growth and inflation. And the total urban transportation grants jumped from $68 Million in 1978/79 under the previous program to $106 Million in 1979/80 in the first year of the new program with $142 Million committed for the final year, 1984/85, and with annual increases built in. The point of the biennial adequacy review was to determine whether the scheduled increases were sufficient.

During 1979 the economic boom intensified. Population increases and the attendant needs escalated, as did inflation and construction prices, so that by 1980 the original 56% increase in funding was viewed by the cities as woefully inadequate. Indeed, in 1980/81, Edmonton and Calgary submitted briefs proporting to support an immediate four-fold increase in spending on urban transportation facilities and services. The first adequacy review increased funding by roughly 10% for 1981 and by roughly 17% for 1982, over the originally committed escalated levels adjusting for unusual population growth

and inflation, but not for increases in city plans.

At the same time a massive, intensive evaluation of roadway and transit needs was undertaken jointly by the province and the cities to attempt to objectively verify the proper level of expenditure on urban transportation systems for the province.

These needs studies, tailored on the Ontario system but adapted to Alberta, were completed in early 1982 and to a considerable extent supported a need for increased assistance to the cities. Accordingly, work was begun on a new urban transportation program intended for implementation in 1983. But April 29, 1982, the Alsands heavy oil megaproject went down the tubes and almost overnight provincial priorities shifted radically as Alberta got its first taste of what the rest of the country had been living with for several years. By the end of 1982, the saying "the bloom is off the rose" was widely recognized outside the province.

For that first year, however, Albertans were convinced that recovery would begin any day and municipal politicians continued to spend not inconsiderable funds on urban transportation. By 1983, however, municipal cutbacks began, and by 1984 several cities in Alberta were now getting more money than they could use. To make matters

more complicated, since a new, somewhat downsized urban program was anticipated for 1984/85 no procedural changes were instituted. Therefore when the decision was made to run the six-year program for its sixth and final year in 1984/85, the province found itself with the anomalie of honouring the 1979 funding level commitments knowing full well that the monies could not all be spent. Alberta had reverted to the situation of the mid-seventies, when the cities then also had difficulty totally expending provincial grants.

Some projects, such as Calgary's N.E. LRT line and Lethbridge's major continuous corridor (Highway 3) could not be turned off. But cities like Medicine Hat and Grande Prairie, for totally different reasons, had simply stopped building. Edmonton and Calgary chopped first tens, then hundreds of millions from their five year transportation plans along with pink-slipping several hundred dazed employees. Indeed, the turn around in municipal expenditures was remarkably quick in Alberta, contrary to the federal and provincial levels.

No one will ever be sure of the accuracy of the 1981 projections of expenditures. But the 1985 municipal plans and provincial grants would appear to be a realistic compromise among the many reasons for spending on transportation. And with regard to the urban transportation

infrastructure, at this point in time, Alberta's cities are adequately, if not lavishly, served by their transit and roadway systems.

II. City Evaluation of Needs

The two tables presented below are not meant to disparage the efforts of officials or politicians in either city. They grappled, using the best resources and foresight they could muster, with events which changed radically even as they planned. Indeed, municipal governments in Alberta have proved themselves to be very flexible and responsive over the past decade. Nevertheless, it may prove instructive to review the changing perception of needs with the advantage of 1985 hindsight, using the data at hand from our incomplete library resources (hence the "jack-rabbit" approach to the quantitative data).

It is particularly interesting, for example, to look at 1984 or 1985 (See Table 4, page 14, for 1985 actual) for Calgary. Calgary's plans in 1978 and in 1984 are not dissimilar. However in the interval, they had quadrupled. A similar picture emerges for Edmonton.

Moreover, these were't just changed plans. Between 1979 and the end of 1982, significant increases in investment

TABLE 1

CALGARY

Actual and Projected Transportation Capital Expenditures
by Year of estimate
(Millions of dollars)

	1978	1980/81 (Brief)	1983	1984
1977		37.6	37.8	
1978	143.9	71.2	70.5	85.6
1979	139.5	131.0	150.2	149.0
1980	116.1	195.7	218.2	215.7
1981	86.9	215.6	160.8	172.2
1982	70.1	256.6	232.2	235.6
1983	68.7	269.5	149.6	n.a.
1984	73.5	251.8	134.2	99.2
1985	74.2	317.9	98.2	62.1
1986	71.2	311.4	43.9	24.2*
1987	84.6	358.1	47.9	21.3*
1988				21.3*

Source: Variety of city and provincial documents

*Roadway work only

TABLE 2

EDMONTON

Actual and Projected Transportation Capital Expenditures
by Year of Estimate
(Millions of dollars)

	1978	1979	1981	1982	1983	1985
1978	58.2					
1979	55.1	82.4				
1980	58.8	93.6				
1981	71.6	92.7	160.1			
1982	93.6	99.4	196.9	206.3		
1983	97.6	137.9	215.7	247.4		
1984		142.4	309.5	240.6	74.2	
1985			265.7	306.7	93.1	80.8
1986			154.9	385.1	97.6	84.0
1987				280.7	109.5	82.4
1988					112.1	83.5
1989					109.3	77.0
1990					119.3	
1991					126.2	
1992					134.2	
1993					138.0	

	1980/81 Brief
1980-1984	872 M
1985-2000	4.8 B

	5/10 Year Program - 1983
1984	74.4
1985	93.1
1986-1988	319.2
1989-1993	626.0

Source: Variety of city and provincial documents

in transportation facilities did occur in both cities. During that period, LRT construction accelerated, often in conjunction with major roadway improvements.

In this period, also, the historic relationship between provincial grants and city plans was modified. City plans became largely independent of the provincial grant program as the cities borrowed considerable sums to finance annual construction programs. They also submitted briefs to the provincial government exhorting the province to provide better support. Extrapolating the population increases they were then experiencing, both cities projected populations of about a million by the turn of the century, if not a decade sooner. Nothing short of major offensives on both the transit and roadways system would save them from strangling on the congestion of their own success, they contended.

Thus Edmonton and Calgary argued for a four-fold increase in provincial grants only two years into the new six year program, each projecting expenditures of roughly $2 Billion over the next ten years and arguing that the provincial commitment of $35-40 Million per city per year was inadequate to the task at hand.

The newspapers jumped on the municipal bandwagon, particularly the Calgary Herald. Editorials and bylined

articles pilloried the provincial government for misdirecting its priorities. The Heritage fund, highly visable, and growing, was seen as an appropriate source of these additional funds. The cities argued, persuasively but not effectively, that there could be no better place to invest Alberta's own monies than right at home in the transportation facilities of Edmonton and Calgary. One eye-catching headline in the Calgary Herald referred to the provincial level of grants, then totalling about $200 Million per year, as "peanuts". All things are relative.

III. Provincial Evaluation of Needs.

A. Process of Identifying Needs

During this period, the Branch evaluated the cities needs from several points of view. Coming first, in the first half of 1980, was the promised adequacy review. Considerable data was collected which indicated marked increases in spending by the cities, in response to the continued influx of newcomers. However the decision was made to restrict increases in provincial grants for 1981 and 1982 strictly to adjustments for inflation and unusual population growth. The base level was not to be adjusted, given the newness of the program and an assumption that a new program would probably be

introduced in the fall of 1982, two years ahead of schedule. But the adequacy review clearly demonstrated the need for the provincial government to get a better picture of the financial requirements of the cities.

Thus additional work was initiated in the fall of 1980 and again in the fall of 1981. The fiscal capacity studies (1980) were designed to measure the ability of the cities to fund their transportation needs from local revenue sources. These studies suggested that local taxes would have to rise to heights which were probably unacceptable politically, but not out of line with those across the country, if the cities implemented their massive spending plans without additional provincial support.

The fall of 1981 was exceptionally busy as the road needs studies and transit reviews were done in each city in an attempt to either verify or disprove the need for the transportation systems planned. Also, in the fall of 1981, the Minister created a task force of representatives from Edmonton and Calgary and the provincial government which toured North America to canvass the solutions to transit problems which were being implemented elsewhere. The objective, of course, was to assist the provincial government in determining the level of support the government should be giving to the two major cities for LRT.

The results of the road needs studies by and large substantiated the need for additional expenditures on roadways, particularly if population increases continued at their record high levels. The road needs studies had been done in close conjunction with the cities but the results were scrutinized closely by the urban staff and reduced somewhat where our judgement indicated work could be postponed. Nevertheless, by the spring of 1982 we were convinced that major increases in provincial grants could be recommended to the Minister with sufficient justification to warrant a new program. The only question was, how big. (See Table 3).

The results on the transit side were less conclusive and the results of the Minister's task force did nothing to change this. A key concern was that major roadway improvements were often slated to take place concommitantly with, and parallel to LRT. Other concerns were the increased transit operating costs that would be incurred by the cities for the first 10-20 years of LRT operations while the urban service areas grew to one million people. The cities maintained, of course, that it was necessary to construct LRT at that time to build ridership, develop transit-oriented urban dwellers, and to reduce roadway construction costs and roadway congestion. With one line each in Edmonton and Calgary, there was a great deal of local political

support to continue building in advance of demand. Provincial politicians were to remain somewhat skeptical.

TABLE 3

SUMMARY OF TRANSIT AND ROAD NEEDS VERSUS CURRENT PROVINCIAL FUNDING

(All Figures are in Millions of 1981 $)

	Transit Capital	Transit[1] Deficits	Total Transit	Roadways[2] Capital	Roadway Maintenance	Total Roads	Total Needs
1982-1986	$ 626.4	$ 295.0	$ 921.4	$1,706.3	$ 485.9	$2,192.2	$3,113.6
AVERAGE ANNUAL EXPENDITURE 1982-1986	125.3	59.0	184.3	341.3	97.2	438.4	622.7
1987-1991	239.9	362.2	602.1	506.0	563.2	1,069.2	1,671.3
AVERAGE ANNUAL EXPENDITURE 1987-1991	48.0	72.4	120.4	101.2	112.5	213.8	334.3
1982-1991	866.3	657.2	1,523.5	2,212.3	1,049.1	3,261.4	4,784.5
AVERAGE ANNUAL EXPENDITURE 1982-1991	86.6	65.7	152.4	221.2	104.9	326.1	478.5
ACTUAL 1981/82 FISCAL YEAR PROVINDIAL FUNDING	42.7	12.4	55.1	94.0[2]	3.0	97.0	152.1

NOTES: 1. Transit Deficits are for the non-dedicated transit services and exclude depreciation and financing costs. They are based on the cities achieving provincial targets.

2. Roadway Capital Needs are for local, collector and arterial roadways. Current Provincial funding is based on a defined cost-shareable network in each city.

3. Some numbers may not add due to rounding.

B. Comparing and Assessing Needs.

If we take an historical look at provincial grants relative to city expenditures (Table 4), the percentage provincial contributions varies considerably from year to year, but appears to run about 25% of costs over the past decade; prior to that the provincial share was much higher. The big exception occured in Calgary after 1979, when the city's construction far outpaced the grants program. The 1979 grants program was known, of course, when the city of Calgary made those decisions. However they made a conscious, calculated choice that it was more important to proceed then than to wait for new provincial funding. In 1985, however, their capital budget, at $97.0 Million, is still higher than Edmonton's, but in the same range relative to provincial funding.

Needs are relative, and often confused with wishes. To the best of our ability, we had attempted in 1981, 1982 to determine a real level of transportation needs in the province. As events proved, subsequently, we were no more able to evaluate needs in a <u>completely</u> objective way than were the cities. All of us fell prey to the error of accepting the known and present as a situation which could safely be assumed to continue. Thus Table 5 presents a snapshot of thinking in 1982.

TABLE 4

Provincial Grants and Municipal Expenditures
Capital plus Operating*
(Millions of dollars)**

	1978	1979	1981	1982	1983	1985*
Calgary						
Provincial Grant	$ 14.9	$ 49.6	$ 58.4	$ 89.1	$ 46.4	$ 43.4
City Costs	55.4	205.0	418.6	428.7	348.7	97.0
%	27%	24%	14%	21%	13%	45%
Edmonton						
Provincial Grant	16.8	43.7	58.4	60.4	52.9	39.2
City Costs	83.4	162.0	295.3	250.8	250.2	80.8
%	20%	27%	20%	24%	21%	49%
All Cities						
Provincial Grant	38.9	111.1	152.7	207.8	163.1	137.0
City Costs	158.4	413.2	802.2	827.2	732.0	n.a.
%	25%	27%	19%	25%	22%	n.a.

* Capital, only, 1985

** Dollars of the day

TABLE 5

FUNDING OPTIONS FOR ALBERTA TRANSPORTATION URBAN ASSISTANCE PROGRAMS 1983/84 - 1987/88

(Options are in inflated dollars)

	Annual Needs	"Existing" Urban Transportation Funding	Alternative A	Alternative B	RECOMMENDED Alternative C			Alternative D
A. Basic Assistance Program		1982/83[a]	1983/84[b]	1983/84[b]	1983/84	1984/88[c]	1985/89[c]	1983/84[b]
1. Capital	473M	64M	85M	95M	120M	135M	160M	150M
2. Transit Incentives	70M	14M	15M	20M	30M	35M	40M	30M
Total Basic Assistance Program	543M	78M	100M	115M	150M	170M	200M	180M
B. Major Capital Projects Program	224M	131M	70M	85M	100M	130M	170M	170M
TOTAL	$775M	$209M	$170M	$200M	$250M	$300M	$370M	$350M

a For ease of comparison, the existing Urban Transportation Program is shown within the recommended two program structure.
b Funding in subsequent years would be based on annual inflation rates plus growth.
c Funding in these years will be based on a review of general economic indicators.

Alternative D represents the first budget we thought was reasonable, developed before Alsands went down in 1982. It increased the provincial contribution to 45% of the needs we had accepted as legitimate. Alternatives A, B and C were added as the year progressed. But, in keeping with the theme that Alberta would have an early recovery, Alternative C remained our recommended choice with a view to not repeating earlier errors of letting construction lag too far behind demand. Alternative C we labeled the 'Recovery' budget. Ironically, in 1985, provincial grants will cover 45-49% of Calgary and Edmonton's capital costs, but with a total of $82.6 Million rather than $350 Million.

Of some continuing concern, however, is that when we adjusted our needs studies for varying levels of population growth, even down to zero, a substantial amount of work

remained. Therefore, to some extent, either the work is just postponed, or standards of service will effectively be lowered. It is fortunate, then, that we have been able to maintain our level of provincial grants at very close to 1983 levels, or future problems might be considerably worse.

In Table 6, grants in 1982 are compared within Canada. Alberta compared favourably over all, and with regard to capital. The decision to keep operational assistance low is a long standing provincial policy. This data does not support the cities' charges reviewed earlier that grants were low, in comparison to other jurisdictions. It would be more objective to recognize that demands were extremely high and that it was perhaps unrealistic to expect to tackle them on a crash basis.

The above arguments are basically those of an administrator. From a political perspective, there was a radically different point of view in mid 1982, namely that housing - not transportation - was the biggest issue of the year. Interest rates were crippling and unemployment was rising rapidly. The bold, new urban transportation program lost out in the competition for budget dollars to a mortgage subsidy program. And the 1983 urban grant program was cut from its 1982 high by $44.7 Million. The struggle to maintain an adequate level of support had changed radically.

TABLE 6

A COMPARISON - TOTAL PROVINCIAL ROADWAY AND TRANSIT GRANTS FOR URBAN AREAS

	CAPITAL GRANTS PER CAPITA	OPERATIONAL GRANTS PER CAPITA	TOTAL GRANTS PER CAPITA
British Columbia	129.27	39.79	169.06
Alberta	106.81	11.18	117.99
Quebec	29.29	59.06	88.35
Manitoba	35.71	49.91	85.62
Ontario	33.24	36.66	69.90

C. 1982-1985: Constant Downward Pressure.

Having lost the opportunity to bring in a new program in 1983, effort shifted to a new program for 1984. Again, several levels of funding were presented (See Table 7), with our recommendation still leaning towards the high side. As the year progressed, the apparent new budget level declined. At the eleventh hour, the decision was made to stay with the old program, which yielded a budget roughly comparable to level D.

TABLE 7

URBAN TRANSPORTATION ASSISTANCE PROGRAM
(ALL FIGURES IN CONSTANT 1983 $000's)
OPTION A THROUGH D

ELEMENT TITLE	1984/85			
	A	B	C	D
1. Basic Capital	117,500	113,854	107,200	107,200
2. Major Continuous Corridors and Primary Highway Connectors	50,000	41,500	38,977	28,977
3. Public Transit Operating*	16,350	16,350	16,350	16,350
4. Primary Highway Maintenance*	3,000	3,000	3,000	3,000
TOTAL	186,850	174,704	165,527	155,527

* These are estimates only as funding for public transit operating is calculated on a per capita basis while funding for primary highway maintenance is calculated based on lane-miles of primary highway extension.

At that stage, of course, a new program appeared essential for 1985, although the government did toy briefly with the idea of a one year lapse in funding for urban transportation. We were, however, able to bring in a new three-year program, with annual funding held at its 1984 level, in competition with all the other uses the government might have made of $158 Million dollars for 1985. At this stage both we and the cities were greatly relieved that funding had not been cut; furthermore, the level of funding seemed to mesh fairly well with the cities' plans.

IV. A Socio-economic assessment of urban transportation investment during the transition.

Transportation provides mobility for people and the means of distributing goods and services. The type and level of transportation facilities and services within the province therefore have a direct impact upon the provincial economy and upon the quality of life of her citizens.

Beyond that basic premise, there is always the question of whether you provide infrastructure as an inducement for a desired type or location of economic activity or urban development. The alternative, of course, is to wait until the demand develops and then provide what is required. There are costs and benefits of each approach. Providing facilities or services in advance of demand does

not ensure that demand ever develops; if demand already exists, the cost of providing the facility or service may be higher due to higher right-of-way costs, less efficient routing, etc.

With the economy in a tailspin in 1983, provincial and municipal governments had to re-evaluate their transportation plans. The increase in demand had slowed, disappeared, or, in some cases,become negative. Yet since municipalities felt that their systems were inadequate to serve existing population levels, they were reluctant to significantly reduce or eliminate transportation construction plans. They also had just built up staffs capable of providing the engineering and planning necessary to the continued development of their communities and did not wish to reduce staff if recovery was just around the corner.

At the same time, both provincial and municipal revenue collections were down considerably. Therefore it became a financial necessity to make some adjustments downward. These downward adjustments, of course, in turn added to the downward pressures of the economic downturn. Employment in the construction and consulting industries dropped, as did income levels for the province. Contractors and consultants streamed back out of the province and prices of construction dropped dramatically. Between the

provincial and municipal governments maintaining a reasonable level of spending and the drop in construcion costs, the quantity of work done, in fact, remained at a fairly high level.

A strong argument was made and accepted for maintenance of the level of provincial grants, to provide some base support for industry and employment in Alberta, as justification for the three year program beginning April 1, 1985. It was recognized that, in some cases, cities would probably be building in anticipation of future demand. That this argument succeeded is indicative of a fairly radical shift from a decade earlier, when the focus was entirely on decreasing the gap between transportation needs and supply.

The transportation impact of these decisions can only be measured a few years from now, when it is known how well the planners anticipated future needs. For the present, the Alberta approach - municipal and provincial - has undoubtedly assisted the provincial economy during the worst days of the recession.

V. Prognosis

If provincial revenues and population increases do not pick up significantly in the next couple of years, it seems most likely that the next urban transportation program would be funded at a somewhat lower level. From a transportation point of view, this would appear to be appropriate (assuming that the cuts were not extreme) since demand would still be down and supply would have increased. From a socio-ecconomic point of view, it might further depress the economy, unless the funds were diverted to a higher priority but equally job-producing industry. From a political perspective, it would be difficult to continue to increase the supply of transportation infrastructure significantly in excess of demand.

Of course, as recovery finally comes, as the rose blooms again, the pressure for expansion will return. In that case, modest expansions in transportation infrastructure investment would probably be most appropriate. Having leaned against the wind on the downside, we should be in good shape to do the same on the upside. It would, indeed, be unfortunate if we once again spurred inflation with large-scale government spending in the midst of a boom.

TRANSIT PRICING ALTERNATIVES

EFFICIENCY AND EQUITY

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ABSTRACT

Government subsidization of Canadian urban transit systems is steadily increasing. The financial insupportability of the industry is in part due to a flat fare revenue policy. This paper discusses the efficiency and equity of typical transit fare systems and introduces a number of alternative fare policies.

The findings indicate that the current fare policies of the transit systems in Saint John, New Brunswick and Halifax, Nova Scotia are inefficient and inequitable. Cross-subsidization among routes and socioeconomic groups is observed. The implementation of any of the differentiated pricing systems discussed herein might serve to reduce inequities and improve efficiency.

INTRODUCTION

Interest in urban transit fare policies has grown over the past thirty years in Canada. Increasing geographical coverage, lower passenger revenues and the resulting escalation of government subsidies have

prompted a search for a means of reversing the financial deterioration of the Canadian transit industry. In general, transit systems have two sources of revenue: passenger fares and operating subsidies. With growing pressure to reduce government subsidy levels, transit managers are faced with the task of re-evaluating current pricing practices. As a result, fare systems are being restructured to become more responsive to budgetary constraints and escalating costs.

Transit fare policies involve two somewhat conflicting, yet necessary, concepts: efficiency and equity. The transit industry, as a revenue-generating service, strives for economic efficiency and employs pricing techniques to achieve maximum productivity. However, transit is also a public service, and must be provided equitably. Flat or simple zone fares which are commonly used in the Canadian transit industry are often uniformly increased throughout a transit system to combat rising operating costs. This action, although generally acceptable to government bodies and transit patrons, is not the most efficient revenue-generating method of covering costs. It fails to focus on the routes which are the most expensive. Another consideration is uniform fare increases regressively transfer pricing benefits from lower income patrons to the higher income, long-distance, peak-period riders.

Transit systems obtain maximum revenues when

there is a rapid passenger turnover. The long-distance rider during rush hour receives relatively more expensive service due to the additional employees required to extend service to outlying areas and to accommodate rush hour loads. System-wide fare increases cause the off-peak short-haul patron to absorb a disproportionate percentage of increased system operating costs. This overpricing of short-haul, non-rush hour periods helps to maximize pricing efficiency.

The literature (2, 8, 10) provides several examples of cross-subsidization among the services and routes in transit operations and in the redistribution of income from general taxpayers to transit patrons. The issue of cross-subsidization involves "who pays for, and who receives, services". The examination of transit cross-subsidies is important with respect to distributional equity.

This paper examines current transit fare policies and the role which alternative pricing strategies play in improving the efficiency and equity of transit services. Differentiated pricing structures have been proposed as a method of increasing revenues and ridership, while achieving a more equitable allocation of costs. The methodology, similar to current research in the United States, uses two Maritime urban transit systems (Halifax and Saint John) to illustrate analyses of smaller Canadian operations.

PRICING EFFICIENCY

Pricing efficiency, typical of traditional micro-economic theory, is based on marginal costs. Since transit is a public service, Cervaro (3) suggests that efficiency is realized when the price of goods and services is set equal to the marginal social cost of producing them.

The benefits to society from transit operations, such as reduced congestion and pollution, are difficult to measure. Similarly, quantifying the social costs of transit is more a philosophical than analytical exercise. This paper therefore examines only direct costs and benefits from the point of view of the transit rider and the transit operator. This simplification is similar to Cervaro's; it is assumed that efficient transit pricing is to be "viewed as setting fares which equal the direct incremental costs of providing additional units of transit services, holding current subsidy rates constant" (3).

EQUITABLE PRICING

Concepts of equity are based on the ideal of justness and fairness to all. Lucy (5) suggests five inter-related equity concepts: equality, need, demand, preferences, and willingness-to-pay. Equitable fares result in pricing systems which enable transit-dependent patrons to pay for the transit trip. This suggests

that there is little redistribution of income related to fare levels.

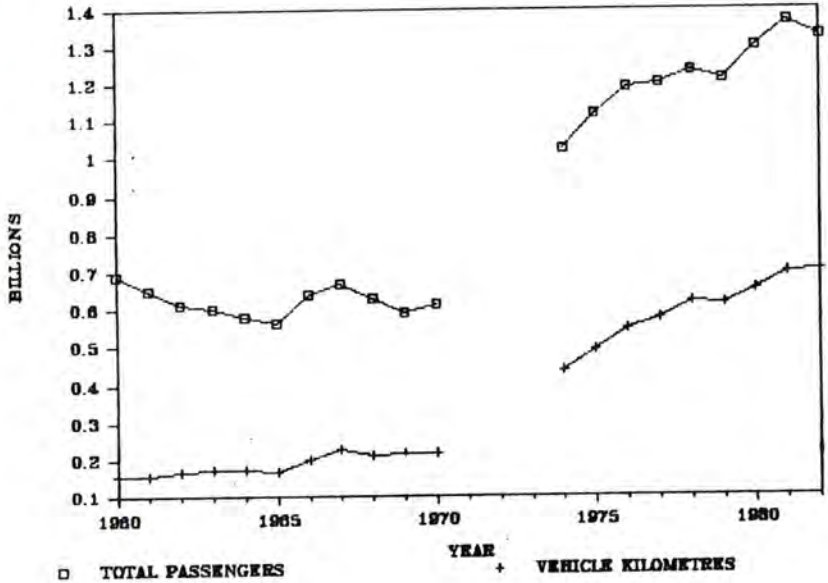
Subsidy levels are an important consideration in assessing the equity of a fare structure. Pucher (8) notes that the U.S. transit subsidy program has redistributed income from high to low-income households. The net benefit of transit services should then be evaluated, based on the differing tax rates and ridership rates of the two income groups.

THE CANADIAN TRANSIT INDUSTRY IN REVIEW

The energy crisis of the late 1970's highlighted both the potential importance of urban public transportation and the financial crisis it faces. As shown in Figure 1, after falling steadily for over two decades, urban transit ridership has begun to increase.

This increase in transit ridership has not been without cost. In 1960, Canadian urban transit networks provided service to 4.4 passengers per kilometer of bus route. By 1982, ridership attraction had been halved to 1.89 passengers per route-kilometer (9). Escalating operating costs coupled with relatively stable fare levels resulted in increased operating subsidy requirements.

There has been a tendency in the Canadian urban transit industry for operating expenses to be almost double the passenger revenues (1). Table 1 illustrates



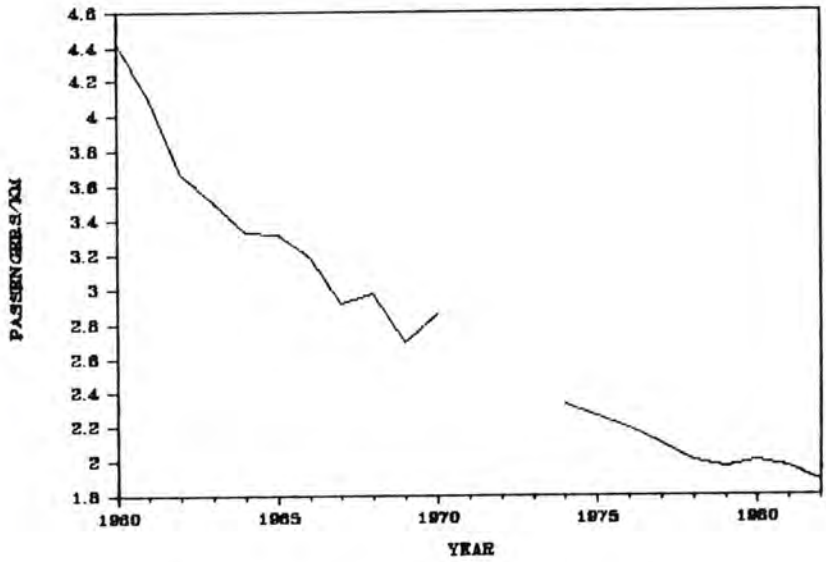


Figure 1: Passenger Bus Statistics
Source: Statistics Canada 53-215
(Data not available 1971-73)

this situation in Halifax and Saint John; revenue/cost ratios averaged 60 percent for the 1981-83 period.

Increasing costs per kilometre of route and pressure to maintain fare levels, coupled with reluctance to increase subsidies, has forced transit operators to trim costs through productivity improvements. Unfortunately, productivity gains have been minimal, usually due to the fact that service cut-backs on low revenue routes are targets of public attention.

Table 1. Operating Revenues/Costs (1981-83)

Transit System	Year	Operating Revenue	Operating Costs	Rev/cost Ratio	Required Subsidy
Metro Transit	1983	$8.5M	$13.5M	.63	$5.8M
(Halifax	1982	8.2M	12.8M	.64	4.6M
Dartmouth)	1981	5.7M	10.4M	.55	4.6M
Saint	1983	1.5M	2.7M	.56	1.2M
John	1982	1.3M	2.2M	.59	0.9M
Transit	1981	1.3M	2.1M	.64	0.8M
			Average	.60	

Source: Canadian Urban Transit Association, 1983/84.

The obvious solution to the problem of inflating costs is to increase fares. However, decades of experience have shown fare elasticity to be high; increased fares generally result in reduced patronage, lower revenues, and ultimately, reduced service. The reluctance to increase fares also reflects political opposition based on negative public input.

Large operating deficits have been subsidized by federal, provincial and municipal governments. Public funding to cover operating deficits reflects a changing attitude toward transit pricing policies. Historically, fares were set at a level sufficient to defray operating costs and contribute to an overall return on capital investments. The decline in transit ridership, previously described, resulted in the public takeover of transit systems and the birth of transit operating subsidies.

Canadian transit operators are currently re-evaluating fare structures and pricing policies. The Metro Transit Commission in the Halifax-Dartmouth area has returned to a zonal fare structure in an attempt to provide a more efficient and equitable public transportation service. The transition from a flat fare to zonal fares met with much opposition. In the mid-1970's, six of Canada's largest cities abandoned multiple-zone pricing in favor of flat fares (6). As of 1983, only three cities have reverted to a zonal fare structure.

An examination of fare structure options for Canadian operators is presented in the following section. These pricing mechanisms must reflect the perceived role of public transit. Pressure on public agencies to hold down costs in a recessive economy may lessen the role of transit as a public service. Conversely, escalating

subsidies based on service-maximizing transit policies may result in increased public funding.

TRANSIT PRICING OPTIONS

Transit pricing based on marginal costs is commonplace in most urban transit systems. In a simplified flat-fare system, the system-wide marginal cost is divided by the ridership to produce the fare. As can be seen, there is little market differentiation possible in this case.

Where differentiated marginal costs are available to the planner, differentiated pricing mechanisms can be used to more equitably determine fare levels. The transit market may be differentiated spatially, temporally or by level of service. However, this necessitates some type of market segmentation.

Market segmentation and market research is extremely important in establishing a transit pricing scheme. It should be noted here that a municipality's objectives for transit define the individual markets that the system should attempt to develop and serve. It is these markets towards which fare policy should be directed. If, for example, a municipal objective is to provide downtown mobility for the lower-income city core residents, then an off-peak, low- or free-fare system could be implemented. However, objectives of reduced congestion, air pollution, or energy consumption would

not be addressed through this policy; the affected market segment is not responsible for the majority of these problems.

The type of information necessary for market segmentation is often not readily available. Market segmentation requires specific information which transit operators do not generally collect. System-wide user characteristics and fare elasticities may be known, but usually are not disaggregated. For example, the Metro Transit Commission in Halifax/Dartmouth maintains an inventory of system and route performance indicators. This data base is service oriented and does not provide an overview of the users of the system. The only on-going consumer input is obtained by recording consumer complaints.

Ultimately, the pricing process should establish a set of fares and related service characteristics which reflect the objectives of the transit system, while providing an efficient and equitable service to the municipality. Innovation in establishing new fare policies based on price differentiation must also be accompanied by innovative fare collection methods. A number of alternative pricing concepts are examined here, with emphasis on their efficiency and equity implications.

TIME OF DAY PRICING

Peak period transit services are much more costly to provide than non-peak services. Higher peak costs exist because transit service cannot be produced in small quantities; drivers and vehicles committed for peak service often remain idle for much of the day. Transit is a perishable good and as such it operates under the "level supply" economic theory (as opposed to a good which can be produced in the short run to "chase demand"). Keck explains that "extensive demand 'shift' from peak to off-peak periods does not usually result from higher peak (or lower off-peak) fares, though lower off-peak fares can generate significant new ridership"(6). In this light, an efficient fare is developed by a levelling of demand through differential pricing. Keck also points out that the "equity perspective stresses that users' fares should reflect costs attributable to the services they consume" (6).

In targeting transit services for the poor, a concentration of available subsidies for the maintenance of low off-peak fares would provide this income group with greater benefits than directing the same subsidy amount to lower overall flat fare structures.

Time-valued fare pricing is somewhat different than time-of-day pricing. The mechanism is theoretical and difficult to implement. Time of day structures attempt to reflect the value of time to the user. For

example, commuter-type peak period riders receive transit service from/to the suburban areas to/from the central city core; higher rush hour fares reflect the congestion of slower, crowded buses. Conversely, off-peak, short haul users would have lower fares due to less congestion, fewer patrons and decreased trip time.

DISTANCE-BASED FARES

Pricing alternatives based on trip distance are beginning to resurface in Canada's transit industry. Distance-based or zone fares focus on transit operating costs as a function of the length of the bus route. Normally the service area is divided into circular zones having an origin at the city's central business district (CBD). A metropolitan area such as Halifax-Dartmouth has a two zone fare structure such that a suburban commuter from the County of Halifax passes through two zones to reach a CBD destination.

As previously noted, commuter services to suburban areas of a city are operationally more costly since they require additional vehicle mileage to serve these low-density areas. Pucher cites an example from the Dallas bus system where passenger revenue in the innermost zones covered 71 percent of associated operating costs and patrons in the outermost suburban areas covered only 40 percent of related operating costs (8). This is also evident in Maritime transit services. Table

2 illustrates profitable routes running within the CBD and the heavily subsidized long haul routes from the subsidies.

Table 2. Route Performance
Saint John and Halifax/Dartmouth

Route Name	Description	Rev/Cost Ratio
Metro Transit:		
Spring Garden	Innercity route running between two business cores (1 zone)	1.02
Macdonald	Connects Halifax and Dartmouth CBD's (1 zone)	1.21
Clayton Place	Suburban run to downtown Halifax (1 zone)	0.36
Purcell's Cove	County run to downtown Halifax (2 zones)	0.28
Sackville	County run to downtown Halifax (2 zones)	0.48
Saint John:		
East and West	Cross city route	0.90
North End	CBD route	0.91
Champlain Heights	Suburban run to downtown Saint John	0.59
Millidgville	Suburban run to downtown Saint John	0.48

Zonal fares address the issue of higher transit subsidies for the higher income suburban patrons who use transit as a commuter service. Distance-based fares can be established to maintain revenue and ridership levels

while improving equity. An example of this might be the application of subsidies to lower the base zone fare; this would most benefit lower-income households, who generally travel in the same zone as they reside.

Market research is important in the implementation of zone fares. Fare elasticities must be carefully examined when establishing the outer zone fare so that the lower expected ridership levels do not result in lower overall passenger revenue. A reasonable compromise must be achieved to maximize revenues and minimize ridership loss.

QUALITY-BASED FARES

A third method of price discrimination is the setting of fares according to the quality of service provided. Transit quality is a perceived value and is therefore related to the needs of different population groups. This pricing system reflects a person's "willingness-to-pay" (10). Again, market segmentation is vital, to help decide which services should be marketed to identified target groups.

Quality-based fare policies reflect the observation that transit demand is more sensitive to changes in service quality than to changes in price (7). Transit captive users rely on a basic service package which offers point to point transportation. Suburban patrons may be willing to pay for an air-conditioned

reserved seat on a commuter line. From this it can be inferred that if transit fares are raised selectively (e.g., in peak periods only, for services or routes where the perceived level of service is higher, or for new services which are developed for the quality-conscious user), transit revenues will be increased without significant reductions in ridership.

This change in direction for transit operations would require a strong emphasis on quality of service rather than maintaining an obsession with low, flat fares. From an efficiency standpoint, proper marketing which focused on service levels could increase revenues and ridership. Service and fare elasticities must be examined with respect to specific market segments. Efforts should be made to establish combination elasticities for price and quality for both existing and potential user groups. Quality-based transit normally focuses on the patrons in higher socio-economic groups. However, providing a quality service which recovers a greater percentage of operating costs is more equitable than a flat fare system in which cross-subsidies are prevalent.

AN ANALYSIS OF EXISTING FARE STRUCTURES

This section examines pricing options in two Maritime urban transit systems. The analysis identifies flat, distance-based and quality-based fares which are in

operation in these systems. These fare systems are then compared on the basis of efficiency and equity.

FLAT FARES

Flat fares are considered an inefficient means of revenue generation, they promote cross-subsidization. Some transit routes are more heavily subsidized than others and this is evident in the two observed Maritime urban transit systems.

As can be seen in Table 3 the least profitable routes in Saint John operate in the low-density, suburban areas while the most cost-efficient routes run along the dense corridors within the city. The regressive nature of the transit cross-subsidies in Saint John is also evident; the suburban areas receive a higher per-kilometre subsidy at the expense of the lower-income inner city resident. The majority of patrons reside and travel within one to two kilometres of the Saint John CBD. Another statistic, passengers per kilometre of route, shows that the least efficient routes are travelling to the suburbs, or less dense areas of the city.

Table 4 reveals that off-peak users are cross-subsidizing their rush hour counterparts under a uniform or flat fare pricing structure.

As shown in Table 5 and 6 similar results are observable in the Halifax-Dartmouth Metro Transit system. The routes which are profitable (Spring Garden and

Table 3. Performance Statistics April 1983 - Saint John Transit

	Champlain Heights		Millidgville		Milford	
Census* tracts	1.02	29	27.02	27.01	14	16
SES**	43.34	45.59	48.22	49.05	47.91	44.89
Population Density/ km²	473	100	105	465	1191	1525
Distance from CBD (km)	7.2	12.9	4.8	3.0	3.0	3.6
% Low Income Families	12.2	9.4	12.8	7.8	13.7	10.1
Rev/Cost	0.38		0.48		1.37	
+Profit (-Loss) $ Per km	(-.66)		(-.60)		+.49	
Passenger per km	1.0		1.7		4.2	

*Census tracts at the extremities of the bus routes.

** SES is the census tract's average socio economic status based on occupations, income, education and prestige.

Table 4 Peak/Off-Peak Route Performance - Saint John Transit

Route	Rev/Cost	Subsidy/km
Milford	1.37	-0.49 (profit)
Haymarket (Peaks only)	0.39	+1.04
Portland Place (Peaks only)	0.67	+0.44

Table 5. Performance Statistics 1982 - Metro Transit

Route	MacDonald Bridge		Wedgewood	
Census tracts	110	10	26	25.02
SES	38.06	40.2	51.3	50.6
Population Density /km²	3149	6659	974	1638
% Low Income Families	36.6	34.4	4.3	10.0
Rev/Cost Ratio	1.21		29	
Deficit/km ($)	(+.37)*		1.24	
Deficit/ ($) Passenger	(.05)		1.22	

*( ) denotes a profit

Table 6. Express Routes - Metro Transit

Route	Census* Tract	SES	Rev/Cost Ratio	Deficit /km ($)	Deficit/ Passenger ($)
Cowie Express	002	42.7	.89	.20	.10
Sackville Express	132	39.8	.89	.20	.10
Clayton Express	25.01	47.5	.79	.37	.23
Fairview Express	24	46.8	.69	.54	.39
Bedford Express	123	52.3	.54	.80	.69
Rockingham Express	26	51.3	.53	.86	.74
Forest	104.02	51.7	.47	.93	.96

* Census tract is the suburban originating point.

MacDonald Bridge) travel the densely populated downtown corridors. The least efficient route is located in an affluent suburb of the city.

In spite of considerably higher vehicle occupancy, the fares from peak hour service recovered an average of only 57.5 percent of associated costs whereas fares from all-day services recovered an average of 62.4 percent. This difference may not be significant, but it does suggest that peak hour transit services are more costly to provide and should be priced accordingly to reduce cross-subsidization.

DISTANCE-BASED FARES

Metro Transit operates a zonal fare structure with a service area divided into two zones - an outer circle encompassing the County areas and an inner ring circling the city boundaries of Halifax and Dartmouth. Generally, the two-zone fare is double the single-zone fare, reflecting the greater distance to the CBD. An examination of the two-zone routes (Table 7) reveals that although the zonal fare system better approximates distance-based costs, cross-subsidization has not been reduced to any great extent. The average per-passenger subsidy for the two-zone routes is about double that of the central city routes. The suburban riders pay a lower per-kilometre rate than inner city riders, mainly because they must travel farther to reach their destination.

An interesting route to examine is the Burnside route, which collects downtown, central city residents and transports them to the Burnside Industrial Park on

Table 7. Zone Performance Statistics - Metro Transit

Zones Travelled	Avg. Rev/Cost Ratio	Avg. Subsidy Per Passenger ($)
One	67.5	.32
Two	51.6	.59

the outskirts of Dartmouth. This route is highly subsidized, having a revenue/cost ratio of 0.35 and $1.13 deficit per kilometre. This operation may be equitable, but is not efficient. A common complaint of transit service is that it caters to suburban residents and neglects the blue collar workers who must travel out of the city for employment; the Burnside route serves this socio-economic group.

QUALITY-BASED FARES

The only quality-based fares observed in this study are the express routes; they may also be considered distance-based. These routes are provided in the Halifax-Dartmouth system and serve the suburban resident commuters. These routes are all two-zone fare routes and are priced according to the service; express patrons pay higher fares.

The quality received is reflected in the route structure; express buses travel from the suburbs to the downtown core, making fewer stops than a regular bus. Table 6 indicates that these routes are more profitable than some of the regular routes, but they still cover only an average of 57.5 percent of their operating costs. This is in comparison to the regular routes which recover 62.4 percent of their operating costs.

Quality-based fares, in conjunction with a distance-based pricing methodology can be an effective revenue-generating mechanism. The implementation of such a system relies heavily on extensive market research such that revenues are maximized and ridership loss is held to a minimum.

OTHER FARES

A fare group which has been neglected in the discussion so far is reduced fares, typically offered to students, the elderly, and the disabled. In Saint John and Halifax/Dartmouth, senior citizens and children receive reduced fares. Students in Saint John pay lower fares. These recipients of fare discounts are major beneficiaries of cross-subsidization; they pay only a fraction of the cost of providing the transit service.

Metro Transit operates a service for disabled residents, the Access-A-Bus service. Metro Transit is funded by both the federal and provincial government and

operates a service costing $26, with a fare of $1.30 (rev/cost = 0.05). Clearly, this operation is a public service and is neither efficient nor equitable when examining the transit system as a whole. However, the Access-A-Bus program satisfies a goal of the community to provide transportation and mobility to the registered users, the disabled.

FARE POLICY IMPLICATIONS

The previous discussion outlined various pricing options available to transit operators which might result in more efficient and equitable service than that observed with a flat-fare policy. Socio-economic profiles of the transit route areas served indicate that the higher income suburban dwellers are receiving greater per-kilometer and per-passenger subsidies. The short distance off-peak passengers are paying inequitable higher fares to offset the losses incurred in serving the long-haul, peak hour traffic.

The bottom line in establishing any pricing formula is "what does it cost to produce?". Transit operators must identify their marginal costs and design the fare structure accordingly. Differentiated fare structures based on marginal cost pricing are more efficient and equitable. The examples illustrate that although fares based on the distance, time of day and quality are not totally efficient, they represent an

improvement over a flat-fare system. Revenue levels increase and cross-subsidization is reduced through the use of fares differentiated by distance and time of day.

With changing fare structures, innovative collection methods may be required, in addition to extensive public information systems and marketing (advertising) efforts. Public education on transit passes and tickets is essential in implementing new fare collection techniques.

Inherent in all pricing decisions is political will. Increasing fares to reduce cross-subsidization will probably generate public opposition. In the face of this, a conscious decision may soon have to be made to either reduce transit subsidies or to operate transit systems as a wholly-subsidized public service. There are essentially two choices. First, fares can be increased using across-the-board uniform fare increases, multiplying the inefficiencies and inequities in transit system operations. Secondly, fares can be increased using the differentiated pricing systems outlined in this discussion. Ultimately, it is a policy decision which should be made at the political level.

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RURAL MOBILITY
CHANGES IN PUBLIC TRANSPORTATION SERVICES
and the
EMERGENCE OF RURAL TRANSIT DEMAND
IN ALBERTA

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1. INTRODUCTION

As late as 1979, although little was known with respect to the number of public transportation services/ programs in smaller urban (non-city) and rural municipalities, it is believed they were extremely limited and virtually nonexistent save for those programs dealing with the handicapped.

The Province of Alberta recognized an emerging demand for public transportation services for the elderly and handicapped in smaller urban and rural areas. As a result, in April of 1979 the Public Transportation Operating Assistance Grant Program (PTOAG) was implemented. Its prime objective was to provide assistance to all municipalities where public transit was not available in two major areas.

- The development of specialized services for the elderly and handicapped.

- The subsidization or upgrading of existing transit services in municipalities, benefiting the elderly and the handicapped.

This paper will touch upon the evolutionary process of the grant program, initial funding and recent changes in the funding formula commensurate with present demand.

Primarily, however it will reveal the variety and types of applications devised by municipalities through their own local initiative, including various schemes of local administration, inter-municipal co-operation, as well as problems in the provision of services for the elderly and handicapped.

Discussion will focus upon the level of service which in many communities is still evolving, the introduction of subsidized transit programs, the emergence of taxis in a rural setting, the extent of private funding, and volunteer commitment, etc. In addition pioneer work in the area of Transit Estimating For Communities Under 20,000 undertaken by Alberta Transportation, will relate factors such as cost to these emerging transit systems and suggest some general rules of thumb to consider in assessing the level of transit service that can be accommodated.

In short, this presentation will portray observations and real world experiences in what is a natural evolution of rural transit demand in Alberta Communities ranging between 3,000-10,000 population.

2. PUBLIC TRANSPORTATION OPERATING ASSISTANCE GRANT

Alberta's current population is approximately 2.3 million. An examination of population distribution reveals that 68% live in cities where public transit services have been in existence for sometime, 14% reside in a number of other urban communities between 1000 and 10,000 in population ie. Towns, Villages, Summer Villages and 18% in rural municipalities, where the demand for any form of public transportation services did not previously exist and is only now emerging.

Although figures are not available it has been estimated that Alberta's seniors and handicapped account for some 8%-10% of the provincial population, the majority of which reside in major urban areas primarily cities where public transportation services are more readily available.

Residents of smaller communities and rural areas who are elderly, or handicapped have a greater need for specialized forms of transportation than perhaps those who reside in cities.[1]

There are a number of reasons for this.

- Conventional public transit systems are not commonly found in communities of less than 10,000 persons.
- There is often insufficient demand in smaller communities to support a taxi operation.

- Distances to Major local activity centres are usually greater due to the central pattern of institutional development around which small communities were formed.
- Lower densities and linear rural development patterns have tended to increase walking distances and in turn fostered feelings of isolation amongst the elderly and handicapped.

It was in response to these needs that the Province of Alberta implemented the Public Transportation Operating Assistance Grant Program (PTOAG).

Funding under the program was by in large unconditional, leaving regulatory and control functions to individual municipalities to determine its best use in the provision of transportation services for the elderly and handicapped.

The program has assisted a number of smaller communities both urban and rural, to establish and maintain specialized transportation services and has contributed greatly to the evolution of elderly and handicapped or E & H Systems.[2]

Perhaps the greatest achievement has been realized through the encouragement of community spirit by providing seed money for community sponsored public transit programs which local service clubs are now helping to support. In fact a multiplier effect has occurred to the extent that the impact of each dollar given under the grant has been

TABLE ONE: Public Transportation Operating Assistance Grants

	1979-80	1980-81	1981-82	1982-83	1983-84	1984-85	1985-86
Towns	$574,576	$554,298	$602,248	$629,908	$672,188	$640,798	$1,012,128
Villages	98,398	102,334	91,920	91,670	93,506	93,796	141,018
Counties	-	427,560	433,806	443,936	444,530	445,622	756,573
Municipal Dist.	-	195,832	197,814	192,828	192,414	192,172	328,827
Improvement Dist.	-	132,548	133,894	133,894	146,434	143,874	207,525
Special Areas	-	12,522	12,522	12,522	12,084	12,084	18,126
TOTAL	**$672,974**	**$1,425,094**	**$1,472,204**	**$1,504,758**	**$1,562,156**	**$1,528,346**	**$2,463,657**

magnified through matching private contributions and volunteer commitments of community service groups.

2.1 Funding Levels

Table one perhaps best illustrates the evolution of PTOAG which was initially only provided to Towns and Villages on a simplified formula of $2.00 per capita.

Eventually monies were extended to other local jurisdictions to reflect a pattern of eligibility in funding levels which increased from approximately $673,000 in 1979 to $2.5 million in 1985.

Subsequent to a program review last year identifying the good things being done, the grant has been increased to $3.00 per capita per year for a three year term and is based upon the latest population figures derived from self reported municipal census.

In addition as recent as April 1985, through special legislation, Indian Reserves and Metis Settlements, are now eligible to receive grant funds. The only requirement for all recipients is that they must report each year on the general types of projects towards which PTOAG monies are being applied.

2.2 Utilization of PTOAG Towards the Provision of Public Transportation Services

Based upon a recent sampling of approximately 100 municipalities which accounted for 57% of funds allocated under the 1984 program, we were able to observe and

identify a number of social benefits as well as problems associated with emerging demands and rising levels of expectation for increased public transportation services in smaller urban and rural areas.

2.2.1 Local Perceptions

- The grant enables seniors, disabled and handicapped persons to remain living in their own community, instead of moving to a larger centre ie. City where public transit is available.
- Through increased mobility the grant allows seniors and handicapped to remain in their homes as opposed to having to move to a senior citizens' lodge or nursing home.
- It facilitates arrangements for medical appointments, visiting friends, or participation in organized outings.



- It encourages community spirit and interaction by supporting trips from rural areas to service centres and trips between service centres.
- It encourages community participation by providing seed capital for community programs which local service clubs are now helping to support.

2.2.2 Primary Observations

Throughout our review and discussions with municipalities it became obvious that while the PTOAG Grant was contributing reasonably well towards its intended purpose, because of its unconditional nature, there was and still is a degree of confusion and misconception amongst rural and urban municipalities in terms of the types of uses towards which funds can be applied. Because it was a government grant a small number of communities tended to guard it carefully often banking it rather than risk misuse and consequently losing government funding in subsequent years.

In addition there was considerable lack of knowledge on the part of elderly and handicapped individuals and associations that this type of funding was available to them through the municipality.

- A number of communities primarily in northern regions of the Province had mistakenly assumed the grant was to be used only for capital projects (ie. road paving). Consequently, requests from seniors'

groups for funding of special trips/outings, have been denied until recently.

Many communities are keen on maximizing the utility of their grant dollars and as such expressed an interest in being made aware of those initiatives undertaken by other neighboring centres. In addition communities suggested further clarification and publicizing with respect to the intent of the program. The Department has responded through the preparation and circulation of a pamphlet outlining program objectives and information with respect to typical applications by other municipalities as well problems experienced.

- While there was repeated concern for increasing the grant, of more importance to the users was knowing whether or not the program would continue beyond 1985.

The major reason for this concern involves many communities where the level of service or the introduction of subsidized transit programs. Many of these initiatives have only recently been undertaken. In the case of equipment leases or purchases, continuation of the grant would allow vans, wheelchair lifts, etc. to be amortized and would encourage extended private funding or volunteer commitment.

The grant is working well and fulfilling its original objective. Seniors, disabled and handicapped Albertans

are receiving new or improved public transportation services.

Municipalities have demonstrated a great deal of initiative and employ a variety of applications specific to their local transportation needs. Examples of this include the provision of **wheel chair curb cuts** and **wheel chair ramps** to public buildings.

As suggested in my opening remarks a multiplier effect has occurred inasmuch as the impact of each dollar given under the grant has been magnified through matching private contributions and volunteer commitments of community service groups.

Rural municipalities frequently allocate portions of their grant to senior citizens groups in urban communities. In a few instances retired seniors still residing on farms are provided with free snowplowing service to their doorstep.

A few smaller municipalities simply transfer grant monies received into general revenue because they perceive the initiation and organization of projects/services for the elderly and handicapped too difficult to administer.

All of this newly acquired knowledge in terms of how grant monies are performing still has to be boiled down into major contributing factors that we as a government agency disbursing monies and municipalities responsible for front line expenditures under the program must recognize in order to respond to emerging demands.

Supplemental Funding

The $3 per capita while certainly unable to sustain operations and start up costs of basic para-transit service has provided seed capital and an incentive to initiate a public transportation service for seniors and handicapped, but in partnership with private charitable efforts.



For example local service clubs (eg. Lions, A.C.T., Kinsmen, Masons, Elks, Legion, etc.) have often donated funds, driver volunteers, administration volunteers, or vehicle maintenance. Similarly, users have raised funds through bingos or other means to provide a higher level of service. It is an excellent example of a private-public partnership which has fostered community spirit in many Alberta communities. **As a result of the volunteer support, the program impacts many more people than the actual**

users, and the grant is spent in large part on the users, and not on administration.

Administration

The grant appears to have been handled in a responsible manner with minimal direction or control by Alberta Transportation. To a large extent lobbying by user groups ensures local councils are responsive to community needs. In turn, the local councils keep close watch on the local user groups.

In some communities, Family and Community Support Services (F.C.S.S.) have been delegated the job of administering grant funds between potential users (eg. community seniors clubs or disabled or handicapped organizations) and overseeing the operations of various user groups.

In other municipalities the council prefers to retain this control, whereas still in other communities, local service clubs or user organizations have a special transportation committee to operate services supported by the grant. The flexibility of the program permits this variation in methods of day to day administration. While widespread problems are not found on matters of administration, some communities experience temporary problems involving disputes over who should control allocation of funds. These are usually resolved through the local political process.

Inter-Municipal Cooperation

There are several examples where the grant program has fostered intermunicipal cooperation. Generally, a county and major centre within the county or two towns adjacent to each other have collaborated and pooled their funds to provide a better service to all area residents. A county may give its funds to a town in return for the town administering the funds and agreeing to pick up county residents for planned outings. Stettler, Westlock, the County of Leduc, Bonnyville, the County of Red Deer and the County of Lethbridge are a few examples of municipalities which have cooperative ventures with adjacent municipalities.

Redcliff is another example where residents ride twice a week on a Medicine Hat supported van. Redcliff uses its grant to pay Medicine Hat for this service. In this area as well, arrangements vary widely depending upon local situations.

Level of Service

The level of service offered is commensurate with local community needs. Virtually, all of the communities we examined provided van, bus or taxi service for seniors, and many satisfied the demands from disabled or handicapped persons via specially equipped vehicles. In some cases towns **subsidize taxi fares** through vouchers issued to seniors and handicapped persons. In other communities

the grant and local donations have combined to purchase and operate small vans or buses.

There is a direct relationship between the types of services offered and community size. Smaller centres are more likely to use the grant to fund planned out of town bus trips, wheelchair ramps etc. Larger communities have established phone-in dispatch service, and some have regular bus schedules to take people from their homes to the doctor or shopping. The level of service appears to be a function of:

- percentage of seniors, disabled or handicapped in a given community;
- distance between nearby towns (eg. Redcliff and Medicine Hat have a joint use agreement);
- distance to major recreation areas (eg. communities near Waterton Lakes National Park organize regular trips to the park);
- level of local volunteer support;
- evolving demand. Over time, some municipalities have evolved from a used school bus to a van equipped with a wheelchair lift or from a van driven by volunteers, to a regular day time bus service operated by paid drivers. This evolution is still occurring.

The types of trips supported by the grant varies from community to community; and includes medical trips to town and to larger centres, shopping trips, social trips, and

planned group outings to other Alberta towns for social or recreation purposes. **Medical trips have priority in many communities.**

Vehicle Purchase/Subsidy

Many communities have used the grant to purchase a van or bus for use by seniors, disabled and the handicapped. In some cases vehicles were donated by service clubs.



Operating and maintenance expenses are similarly supported by a variety of funds ranging from totally grant supported to private charitable support. Where users are issued vouchers to subsidize taxi fares, communities have had to restrict the amount of subsidy per ride and the number of rides per user to allow the grant funds to last an entire year.

Alberta
TRANSPORTATION

TABLE 2
PUBLIC TRANSPORTATION OPERATING ASSISTANCE GRANT
SELECTED MUNICIPALITIES

AUGUST, 1984

MUNICIPALITY	COMMUNITY POPULATION 1983	USE OF PTOAG. FUNDS				SUPPLEMENTAL FUNDING IN ADDITION TO PTOAG.		OPERATOR	INTER-MUNICIPAL COOPERATION	TYPE OF SERVICE	USER FEES	REMARKS
		SENIOR TRIPS	HANDICAP TRIPS	OTHER USES	PURCHASE VEHICLES	FUNDS	SERVICE					
VULCAN	1,507	▲	▲	(1)				M		Taxi Bus	Free (2)	(1) Wheelchair ramp, meals on wheels; operated through Legion Auxiliary. (2) On overnight bus tours, individuals pay their own accommodation.
WAINWRIGHT	4,477	▲	▲					M A		Taxi Bus(2)	(1)	(1) Taxi vouchers worth $1.50 are distributed to the Senior Citizens and handicapped of Wainwright. (2) A bus is rented to go to Drumheller.
WESTLOCK	4,432	▲	▲		Handi-van	H A ACT	M(1)	M	MD	Handi-van(2)	$1.00	* Restricted use of handi-van to the handicapped and elderly in the town and M.D. of Westlock. (1) Town provides insurance. (2) Van operates similar to transit service with scheduled stops at designated areas.
WHITECOURT	5,408	▲	▲					M		Taxi(1)	(2)	(1) Dispatch service subsidizing door-to-door taxi. (2) Taxi tickets (full fare) granted weekly to seniors and handicapped.
COUNTY OF ATHABASCA	5,974	▲	▲		Handi-van	Le ACT		M	Co	Handi-van(1) School-bus(2)	(3)	(1) The handi-van is used to transport senior citizens and handicapped persons in and around the county. (2) The van drivers may now use local school buses after school hours for seniors' transportation. (3) Fares are dependant upon destination.
COUNTY OF BEAVER	5,347	▲	▲	(4)		(1) (2)		Co		(3)		(1) Group using bus hires drivers. (2) Bus insured through county. (3) Bus is owned and operated by county - used mostly for trips to Edmonton for leisure, medical and shopping. (4) Pays ambulance operation costs.
M.D. OF BONNYVILLE	9,407	▲	▲				A	FCSS	MD	Taxi(1) Bus	50¢	* Grant is divided amongst 3 municipal areas. (1) Subsidized taxi in Bonnyville and seniors club in Glendon.
M.D. OF FOOTHILLS	9,725	▲	▲		2 Handi-vans			(3)	M	(1) (2)	(2)	(1) Handi-buses are operating in two of the three areas. (2) Type of costs and utilization of services is determined by the towns. (3) Operated by Senior Citizens' Association in High River and Municipalities in Turner Valley and Okotoks.

A - Senior Citizens Association
C - Community Action Group
F.C.S.S. - Family & Community Support Services
H - Handicapped Association
I - Institution
Ki - Kinsmen Club
Li - Lions Club
Le - Canadian Legion
M - Municipality
Co - County
MD - Municipal District
P - Private Society
ACT - Associated Canadian Travellers



User Fees

Some communities recoup part of the cost of providing transportation services to seniors, and the handicapped from the users themselves. With taxi voucher systems, the user will often pay for extra long trips or when the user exceeds the maximum number of trips subsidized by the town. In bus/van services, users pay about $1.00 - $1.50 per return trip or in some instances no charge is levied. For longer group outings users are sometimes asked to pay for a portion of the operating costs. User fees vary according to the local situation.

Information Summaries (Extract)

Inasmuch as Alberta Transportation is committed to the program for another three years at least, we will continually be updating our current base of knowledge. One of

ADMINISTRATIVE & UTILIZATION CHARACTERISTICS

SUMMARY

(% of Communities Examined)

SUPPLEMENTAL FUNDING	50%	Private (includes service clubs and businesses)
	29%	No supplemental
	21%	Public Funds
ADMINISTRATION	30%	Community Corps
	60%	Municipality
	10%	F.C.S.S.
INTER-MUNICIPAL COOPERATION	34%	
USERS	54%	Seniors plus handicapped
	12%	Seniors only
	30%	Seniors and handicapped and other (usually children)
	4%	Seniors plus other (usually no handicapped in community)
VEHICLES USED	78%	Van or bus
	7%	Subsidize taxi
	15%	Van plus taxi
USER FEES	71%	Yes (Above a basic amount)
	29%	No

the major problems is in the presentation of this type of data for comparative analysis. Table 2 is simply an extract of an information/inventory sheet we developed with assistance from MANOP Services Ltd.

3. RURAL MOBILITY & THE EMERGENCE OF RURAL TRANSIT DEMAND

The upshot of our examination of the PTOAG has identified that there is an increasing demand for transportation services for the elderly and handicapped in rural Alberta. These services however are at various stages of evolution and are delivered in a variety of ways.

We see public transportation services organized and administered by local service clubs, senior citizen associations, social service agencies, handicapped associations, community action groups, municipalities and institutions such as hospitals. For example the Town of Provost turns over the $3 per capita PTOAG to the Lions Club Handi-van Committee, who operate the service. Several other service clubs in the community (eg. Legion, Kinsmen etc.) assist with additional financing a service which caters to both the elderly and handicapped.

Another specialized transportation service is operated by the Senior Citizens Association in Vermilion. The Seniors, through a local taxi firm have arranged for a transportation service based upon a voucher system which provides a $1.00 subsidy toward the taxi fare. Only one

voucher is allowed per trip, which generally runs $2.00. The number of vouchers are recorded by the Senior Association. There are no limits on the purpose of the trip and service is available 24 hours per day seven days per week.[3]

Our evaluations to date suggest that the level and type of public transportation service provided is usually a reflection of the organization delivering the service. Seniors' Associations tend to provide exclusive services for the elderly, while a municipality or community action group normally caters to overall community needs.

Presently in Alberta there are 30 evolving para-transit systems servicing the elderly and handicapped, all in communities of less than 10,000 in population.

Current demand, we have found, consists primarily of the following trip purposes in descending order of priority.

- Medical appointments
- Shopping and personal business.
- Social recreational
- Out-of-town excursions.

These trip purposes are more characteristic of the elementary level of transit demand now present in smaller urban and rural communities. To some extent however, there is evidence of transportation services being used for school trips and work trips, which adds a new dimension for potential ridership.

Many of the services are free or with only nominal charges ranging between 50 cents and $1.50 per ride one way. Flat rate and zone fare systems are also common.

Public transportation services are primarily localized within a community, however the beginnings of a **regional service** are present in the CRAB's system which simply involves a joint venture between the four municipalities of Crossfield, Rockyview, Airdrie and Balzac.



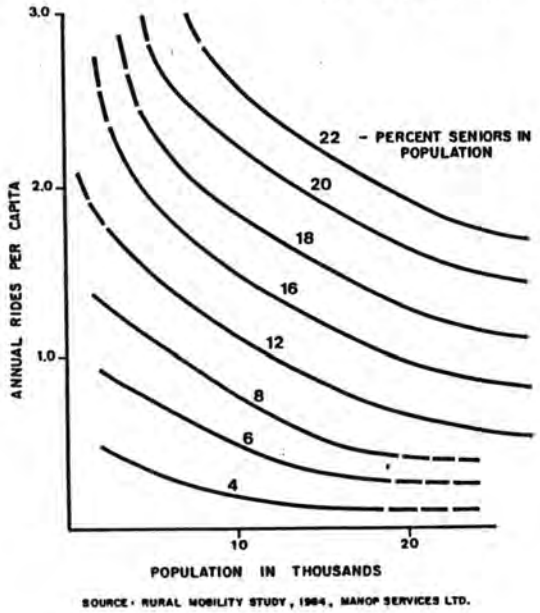
All of the transportation systems identified offer primarily **on-demand services** with little scheduling. The exception is excursion trips where vans and buses must be reserved in advance.

In most cases staffing to operate these rural transportation services is volunteer or part-time with less than 20% engaging full-time paid drivers.

Graph I illustrates the relationship between the number of seniors and ridership in communities of certain populations.

GRAPH I

PER CAPITA RIDERSHIP EXPERIENCED
IN SMALL COMMUNITIES
Vs POPULATION



SOURCE: RURAL MOBILITY STUDY, 1984, MANOP SERVICES LTD.

Generally we found a range in the number of rides per capita in smaller communities from 0.3 to 2.7 depending upon the percentage of seniors in the overall population.[5]

Table 3 perhaps best illustrates the average costs per capita for those Alberta Communities examined. These vary

TABLE 3

SELECTED E & H SYSTEM AND COMMUNITY STATISTICS

Community	Population Served (1983)	% Age 65 +	Service Provided	Ridership (1-Way Trips)	Fare	Op. Cost Per Ride	R/C Ratio	Annualized Rides/Capita	Cost/ Capita
Claresholm area	3,493	19.5	Subsidized taxi	9,300 est.	$0.75	$1.50	50%	2.66	$4.00 (1)
Crowsnest Pass	7,306	12.6	Bus (limited)	3,200 ?	$1.00	$5.15 ?	23% ?	0.44 est.	$2.25 ?
Edson	6,210	6.3	Subsidized taxi	1,041 (2)	$1.00	$3.86	26%	0.35	$0.65
Edson & I.D. 14	7,110	6.3	Handi-Van	3,967 (3)	N.C.	$3.31	0	0.56	0.91 $1.85 $2.50
Fort Saskatchewan	12,169	4.8	Subsidized taxi	4,300 est.	$1.00	$3.25 est.	30%	0.35	$1.11
High Prairie and area	5,642 (4)	10.2	Regional van	4,524	$1.00 avg.	$4.62	19%	0.80	$3.42
Lac La Biche	2,069	8.7	Subsidized taxi	1,300 est.	N.C.	$1.50	0	0.64 est.	$1.35 (5)
Pincher Creek (a)	3,757	10.8	Subsidized taxi	2,000 est.	$1.00	$3.00	33%	0.53 est.	$1.60 (6)
Pincher Creek (b)	3,757 +	10.8	Van services (6)	-	N.C.	-	-	-	-
Provost and area (7)	4,367	21.3	Handi-Van	2,400 est.	$0.50	$4.60	11%	0.55	$2.53
Stettler and area (8)	6,000 est.	15.1	Handi-Van	4,000 est.	$0.75	$3.75 est.	20%	0.67 est.	$2.50 est.
Taber and area	6,500	12.4	Handi-Van	3,800	$0.75	$4.17 est.	22%	0.58	$2.44
Vermilion (10)	3,745	17.1	Subsidized taxi	9,230 (9)	$0.71 avg.	$1.71	42%	2.95	$4.21

NOTES:

(1) The M.D. of Willow Creek does not contribute funding.

(2) For six-month period (service limited to funding available).

(3) Includes school trips.

(4) Serves Faust, Kinuso, Joussard, Driftpile, Grouard and part of I.D.

(5) Operates at a surplus.

(6) Two van services are also provided (no statistics available to date).

(7) Serves part of the municipality.

(8) Serves Gadsby and the County.

(9) For 9 months of service in 1982; funds carried over from 1981.

(10) The Vermilion Association for the Mentally Retarded also operate a van.

Source: Rural Mobility Study, 1984 MANOP Services Ltd.

with the level supplemented funding or degree of volunteer support.

Costs per ride on the other hand can be used as a measure of the efficiency of these public transportation systems. We found that where subsidized taxi operations were in place the cost per ride was less than in areas where specialized vans or buses were being used. Costs for vans and buses in smaller urban and rural municipalities range from $4.00 to $10.00 per passenger trip. Typically in small communities where taxi service is viable, there is a flat rate of between $1.50 to $3.00 per person trip.[6]

Revenue/cost or R/C ratio is another effective measurement of the viability of these emerging transportation/rural transit systems. Obviously a desirable R/C ratio would be 50% but certainly this can only be a goal for a mature system. For the most part our communities fell well below the 50% R/C level with the exception of one (Town of Vermilion). However, in Vermilion's case when PTOAG funds were used up, rather than subsidize through fare increases or other means, the service was terminated. Thus Vermilion has only been able to operate a service for 9 months of the year.

Consideration of all of these factors particularly with respect to revenues and costs have formed the basis for further work in the area of estimating transit demands in smaller communities of under 20,000 in population.

4. TRANSIT ESTIMATING FOR COMMUNITIES UNDER 20,000 POPULATION

Approximately 3 years ago Alberta Transportation engaged the services of MANOP Ltd. to develop a quick and dirty methodology for determining various criteria against which the merits of public transit could be evaluated. A series of more detailed investigations into the transit service options again in smaller Alberta Communities ensued with some very interesting results.

Factors considered involved the shape or configuration of a community, patterns of development and its impact upon the demand for public transportation relative to travel times and walking distances.

Other factors such as the presence of physical barriers ie. railways, rivers etc. were also considered in relation to trip length and time. The population and age structure, vehicle ownership per household and general nature of the community in terms of whether it was a self-supporting resource or agricultural centre, a bedroom community etc. were all assessed as contributing factors affecting transit demand.

A number of transit options including Car Pooling, Van Pooling, Shared Ride Taxis, Contracted routes for bus, van or taxi, and fixed route bus service were then tested against these community factors for some seventeen selected communities. These studies we called **Transit Feasibility Studies.**

Out of this work which is still experimental and ongoing, we identified some general rules of thumb for municipalities who are thinking about implementing transit systems.

1. The feasibility of transit for any community under a population threshold of 12,000 is questionable.
2. Only more mature communities where there is a greater percentage of seniors or a resident institution ie. homes for the disabled and mentally handicapped which generates transit type trips can sustain some form of transit option.
3. While 50% is a desirable R/C ratio there are a number of para-transit systems operating at a 40-45% R/C ratio.
4. Transit evolution begins in the form of subsidized-taxi or van pooling in smaller communities. Municipalities who are inclined to jump directly into implementing a full transit system will surely fail unless a minimum demand level has already been established. Our work thus far suggests that of the emerging public transportation/transit systems those most likely to succeed are experiencing a significant lag between the level of service provided and increasing demands.

1 through 6

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SHIPPING, DECEPTION AND POLITICS 1.

Paper presented at the Twentieth Annual Meeting of the Canadian Transportation Research Forum on May 29,1985

by John L.Eyre, member

INTRODUCTION

Like a captain's chair, the shipping industry stands on four legs;

1. Ship Operations
2. Finance
3. People
4. Politics

This paper argues that politics is the most important and least understood of the four. It also forecasts that government supported National Flag Ship Lines will fade away as their evils become apparent to the people who pay for them,chiefly farmers, miners, factory workers, and forresters.

This is not an attack on third world attempts to solve their maritime problems. The saddest tales concern Australia, France, New Zealand, Spain, Italy, Ireland and the USA. This is proof that a government inspired line which needs subsidies and protection works against the interest of its people.

Every ship at sea is touched by political facts. She is Liberian if her true owner decides not to fly the flag on his passport. She was built in a subsidized rich country yard, or elce in a low cost Asian yard. If she has a US operating subsidy most of her crew wages are paid by the government. If her cargo is for Venezuela, it must be vetted by a complex flag preference system. If her owner is a Bermuda corporation , there are tax benefits. If she carries the right charts, navigation gear and officer licenses, she satisfies IMO (an agency of the United Nations) conventions and can pass port state inspections. Eighty percent of the loan that financed her was probably guaranteed by some government to assist a politically sensitive shipyard. If she is headed down the African coast her cargo must bear the right rubber stamp showing that it is in tune with the UNCTAD Code of Conduct as interpreted by the official gent weilding the stamp.

Most important, about a third of the ships at sea are owned by governments. In this category fall fleets of the Russians and their affiliates, big lines such as LLoyd Brasiliero, and the national shipping companies of Australia, India, New Zealand,France, Venezuela and Argentina.One party governments in Africa, Ghana and Guinea for example, own most of their industries including ship lines.

A container ship is part of a system which includes ports, railroads, truck lines, seaways and rivers. Government grants and loan guarantees build most ports, especially in Canada .The Canadian National Railroad, a Crown Corporation might like to own a Montreal based ship line. Liberal Party appointees in the Canadian Transport Commission may well say yes. An American shipping company , APL (American President Lines) runs trains across the USA via Los Angeles, but asks the US Government to say no when the Port of Seattle tries to do the same thing.What would happen if the Polish Ocean Line tried to run a train across Texas? What kind of ship lines can integrate with the Trans Siberian Railway, or will NVO's (non vehicle operators) solve the problem?. Being integrated and intermodal, container ships touch the political heart of every nation.

TWO POLITICAL SYSTEMS

A Toronto ship owner can choose between two political systems if he decides to join the "salties" and go into deep sea foreign trades. If he selects the Canadian flag, he will have trouble avoiding the Seamen's International Union. On a standard Seaway type bulk carrier his officers and crew will cost four million dollars each year. These will resist compulsory arbitration and insist on the right to strike. He will need ship plan approval by a classification society such as Lloyd's Register. In addition he needs to deal with a separate Canadian Ship inspection service run by the Coast Guard. Naturally he will pay Canadian Federal, Provincial and local taxes and amortize his ship over many years. An antique code of difficult maritime laws will govern his activities, and many of his disputes will be litigated in Canadian Courts. He will be pressed to build his ship in a Canadian yard. If he does not, he will pay a large import duty. These are samples,- an incomplete list of the things he must do under the his home flag.

If he decides against the Canadian flag, he can form a Bermuda ship owning corporation and fly a Flag of Convenience (FOC), say Liberian. Now his costs for a good Asian crew will be eight hundred thousand dollars. His excellent Korean built ship will cost about a third of the Canadian yard price, and he will pay no duties or taxes. To be insured and credible in the eyes of big customer corporations he will need ship plan approvals from a classification society, but not the Canadian Coast Guard.

These conveniences save money. A US flag ship will need about $30.00 a ton to carry grain to Europe. A free market ship will do the job for less than ten.. Some US grain AID cargoes must by law (PL 480) be carried under the US flag. If Canada had similar laws, our farmers would also have their rates tripled.

Opponents of convenience flags argue that they lead to unsafe ships and abuse of seamen. The opposition is led by rich country seamen's unions, and the United Nations delegations of Russia, her affiliates and those of many Third World nations. They have mounted a series of efforts to "phase out" Flags of Convenience (FOC's). However the campaign is running out of steam. FOC's are here to stay. The opposition will now settle for reform.

If our Toronto owner turns his back on the Canadian flag he still must live with a well developed international political/ regulatory system. Stung by criticism, Liberia has tightened conditions for the use of her flag. The Liberian Maritime Administration, largely managed in New York City, is influenced by big cargo owners(oil, steel, aluminum, grain, coal,ores and chemicals). These insist that unscrupulous ship owners be weeded out, and that an inspection system have real teeth. Owners banished from the Liberian flag have other options, in Cyprus for example.

At sea ships are ruled by international conventions on safety of life (SOLAS), pollution and navigation. In ports a new system is gaining strength. Known as "Port State Control", this involves inspection of ships and their documents by host ports eager to guard against sub standard vessels. Ship owners who don't pay their bills are often caught in an international data exchange system that grows more sophisticated every day.

In addition a UK based labour organization,the International Transport Workers Federation (ITF) has its own "de facto" disciplinary system. It issues blue cards to FOC vessels that meet its standards on crew wages and working conditions. Enforcement rests on cooperation with sympathetic labor unions (mostly port workers) in each host port.

The Toronto owner can select the courts in which he litigates disputes with his customers. Not eager to deal with Liberian or Panama courts, he can stipulate in his freight contract that certain issues will be arbitrated in New York and others decided by the courts and laws of the United Kingdom. No sensible cargo owner will deal with a ship that is not "in class", that is inspected and approved by the American Bureau of Shipping (ABS), Lloyds or another good classification society.

There is a third option for ship owners who reject their home flag, but worry about FOC's. Great Britain welcomes foreign owners, and the Union Jack was once popular with Europeans and Americans. In 1982 two fifths of the British fleet was beneficially owned abroad. Singapore, Hong Kong and South Korea and Taiwan are not FOC nations. However, through the use of bare boat charters, special contracts and other devices their flags are available. Evergreen, one of the giant container ship owners, is a Taiwan line. But the press suggests that there is Japanese money in the background. A ship built, manned, and flagged in South Korea can match any FOC for efficiency and low cost. Though far below rich country wage levels, her officers and crew are handsomely paid by Asian standards.

The variations are endless. It is normal for a Canadian corporation to contract with the Bermuda office of a Hong Kong ship owner for movement of Brazilian cargo to Spain on a Liberian ship with Packistan officers and a Philippine crew. The ship could have been built in Korea and, financed in Geneva. Such a package deal would be routine for a London ship broker, though the parties might seek advice from a New York lawyer on tax and liability questions.

Since World War II the heart and soul of shipping have changed. General cargo ships once spent most of their time in port and most of their money on people. Now longshoremen have priced themselves out of jobs, replaced by container cranes and computer based automated terminals. A fifty man ship crew was normal, but the standard is twenty five now. It will be fifteen in a few years. The Japanese are experimenting with crewless ships. Many of these will be at sea in the year 2000.

In the good old days a politician could say that shipping creates jobs. Today according to a World Bank Staff Working Paper (No. 502 by H. Hansen Nov. '81)

> "... shipping is, despite large variations, a relatively capital intensive industry in terms of capital cost per job." (3.36)

> "The net (unrevalued) fixed assets of the Shipping Corp. of India in 1978 was about $58,000, as compared with an average of $5,000 per employee for 22 other major Government of India undertakings." (3.42)

A new containership will cost about sixty million dollars and produce about thirty jobs.- two million dollars per job. Most other industrial investments produce ten or fifteen times that number off jobs for the same capital outlay. Shipping has a negative impact on employment because it takes large sums of money away from labour intensive industries.

No one knows where the size limit will be for fourth and fifth generation containerships. Evergreen and the United States Lines have in 1985 begun express round world services with massive (3000 to 4000 TEU) ships designed to barely squeak through the Panama Canal. The fourth ship generation will be too big for Panama, but at the Suez maximum. These will ply the "Horseshoe Trade ", that is from the US/Canadian Atlantic Coast to Europe, the Mediterranean, Suez, Asia, Japan, the US West Coast and return. Like tankers, containerships can lower their costs per ton carried by going up in size. Crew, capital and management costs do not go up in porportion.

With these big ships come sophisticated feeder ship systems and marriages with land carriers. The American President Lines owns and runs trains between Los Angeles and Chicago, also New York. That gives them a transport system that links most of the USA (and central Canada) with Asia and the Far East all moving under one management at a cost of about two cents a ton mile.

Once shipping people could tell politicians that they were a " Fourth Arm " of the national defence system. Merchant ships fought well in both world wars. But the modern military machine needs small fast versatile ships that can service the fleet and go into shallow draft ports. Containership monsters, tankers and bulk carriers are not what the armed services want. They are too specialized and too slow.

Norway, England and Greece were homes of the most brilliant shipping men. Now the bright stars are Japanese, Korean and Chinese. The center of world shipping has, in one generation, shifted from the Atlantic to the Pacific.

Shipyards on the Tyne, in Piareus and Oslo built great and profitable vessels after World War II, but now government subsidies protect them from bankruptcy. There is a surplus of ships in every category, shipping rates are depressed , and this will not soon change. Shipyards and steel mills are filled with votes. Political leaders can only close them in slow painful stages. But close they must because the Japanese and Koreans build cheaper better ships, and have sixty percent of the orders.

A hungry shipyard may not hesitate if some Minister of Transport mentions a "commission" for his Swiss numbered bank account. Such deals have launched too many ships. Worse still is the easy money that flows to any brave soul who wants to be a shipowner. An agreed limit was eighty percent for eight years at eight percent interest, but better deals are easy to find. In today's climate almost any " Joe " in the street can be a shipowner.

Salen in Sweden, Hansa in Germany, Hellenic in Greece, these were once solid rocks in the European shipping scene. They are now bankrupt. In the USA American Export, Grace and a half dozen other subsidized stars are gone via sales, mergers, and section eleven of the US Bankruptcy Act.

OLITICAL PHILOSOPHY
dam Smith vs Ed Broadbent

Political philosophy is rarely discussed in shipping ircles. But just beneath the surface lies the classic struggle etween protection and free trade, between Harold Laski socialists nd Thatcher/Reagan/Mulroney capitalists. Today, like break ancing, the current fads are deregulation, private enterprise and ree trade. The US government is trying to sell Conrail, its ortheastern railway complex. Mrs. Thatcher seeks a buyer for ritish Airways and Brian Mulroney will sell shares in Air anada. Australia's Labor Party Prime Minister , Bob Hawke ants to sell The Australian National Line. Even in France and pain, where socialists rule, there is a hold on government akeovers.

The pendulum swing carries with it all transport modes . US irline deregulation has inspired a house cleaning nside big airlines such as United and American. Labor costs re down and management is sharper because the government has pened the game to People's Express, and a host of non union ewcomers. Sir Freddy Laker terrified the European establishment ith his threat to compete on the Continent. There inefficient overnment airlines cling to inflated but protected fares.

Sadly there is a second stage as the pendulum swings back to omething economists call ologopoly. Already many of the upstart IS airlines have gone broke.In 1984 the big five (United,American elta,Northwest and US Air) had about half of US passenger miles, ut they had 94% of the profits. Leaner and meaner, they are ready o eat the newcomers including People's Express. There is a attern. Fifty years ago in free enterprise America there were wo dozen auto makers. Today there are four, and three of these re struggling. From a mass of airplane builders there are only hree big time survivors, Boeing, McDonnell Douglas and Airbus. hese openly collude to stay alive.

9.

Like passengers on People's Express, containership customers are happy now. Rates are low on main lines where most (80%) of the traffic moves. These main lines cover much of the developed world, the Americas, Europe,Asia,Japan,and Arabia, but not South America or Africa.The big operators of third generation superships (Evergreen and US Lines) and their rivals are in the early jungle warfare stage. All weapons are fair game including any tax breaks,subsidies, preferences or cheap loans that may be lying around. Overstaffed government lines and small timers will be easy prey. After that comes the real shakeout when old timers like Maersk, Hapag-Lloyd, Sea-Land, Canadian Pacific, Wilhelmsen, Tung and Pao must either go it alone or consort.

The charms of maritime ologopoly were neatly displayed in the recent gyrations of US Defence Department ocean rates. In 1982 an outsider American Coastal Line (AMCO) challenged the established US Lines and Sea-Land. AMCO managed to capture 67 percent of the enormous the US Military Sea Lift Command tonnage. Promptly Sea-Land reduced its rate (USA-Europe) from $49.15 per measurement ton to $24.45. Later the US Lines quoted $16.74. Today AMCO is gone and the establishment is again in command.

The current leap forward in container shipping is partly a product of Ronald Reagan deregulation. The USA generates about a third of the world's package freight tonnage. Under the US Shipping Act of 1984 the lines gained something called "single factor intermodal pricing". This allows the American President Line (APL) to quote one rate Chicago to Singapore (via Los Angeles) and do the job in one system which APL controls all the way. The Russians are eager to promote their Trans Siberian Railway, and the Mexicans dream of a Trans Isthmus land bridge starting at Coatzacoalcos .

10.

In Canada there is an unanswered political question about Crown Corporations. The Canadian National Railroad thought it could prosper by buying CAST, a Montreal based ship line. But the CNR is the only rail link between Halifax and North America. While enjoying such a monopoly, can it place its chips on a Quebec port? If it does, should Canadians not expect that the monopoly be surrendered by giving the Canadian Pacific free access to Halifax? Logic will overflow in this debate, but politics will play a part.

Politicians seem less interested in bulk cargo trades where success flows with skill. Scandinavian ,British and Greek owners thrived in the early post war days because they ventured into greater sizes and novel ore/oil combinations. Their shipyards built good bulk carriers at modest prices. They were great ship operators and knew their market well. Today in the Pacific Japanese cargo owners bank Hong Kong ship owners who incorporate in Bermuda and fly FOC flags. The game has lossened up. There is abudant ship managenemt talent in Hong Kong. Singapore Asia-Pacific yards have most of the building business because they do a better job. This raises a political concept which haunts Democrats in the USA, Liberals in Canada, and the Labour Party in England.,- something called "Industrial Strategy".

Every nation cannot have steel mills, a Silicon Valley, a banking center and an oil refinery. There must be selection. Worse still, things change. Smokestack industries in Pittsburg and Gary, Indiana, once enjoyed cheap handy raw materials and competitive labour forces. Today the Mesabi Ore Range is tired,and third world labour is hungry. Eventually even politicians must face reality. Gary Hart and some Cambridge, Mass. liberal thinkers toyed with this subject during the primary days. But they dared not be specific about their new ideas. The Democrats nominated an old style "New Dealer" who promised to protect the auto workers.

Why is it that nations with no maritime skills still want to have their own merchant fleets? Why would Canadian farmers agree to having their ocean freight rates multiplied by three? The best answer involves balance of payments.

BALANCE OF PAYMENT DECEPTION

There are three levels of accuracy in balance of payment discussions. The lowest is practiced by those who claim that changing a vessel's flag transfers a hundred percent of her revenue to the home national account. On the surface this seems right , and many people beleive it.

At the second level one admits that eighty percent of a ship's expenditures are constant and not changed by a flag transfer. A Chilean named Brown (World Bank consultant) devised a simple formula for balance of payment score keeping. He noted that about 30% of liner costs are for stevedoring (say in Rotterdam) inland transport, and port expenses. These are not influenced by vessel flag. Another 25% is for capital, - the purchace price for the ship plus finance costs. The best and cheapest ships are built in Japan and Korea, while most money is borrowed in big US/UK/European banks, or from rich Arabs. For a nation without finance or competitive shipyards, again no gain. Fuel is 20%, purchaced where it is cheapest and best. Insurance, say 7% usually comes in the London market. When all cost elements are looked at separately, only two offer balance of paymment gains, for a total of about twenty percent. This covers management and crew.

At the third and only honest level the costs of subsidy and protection are included. Unbiased maritime studies are rare jewels. Third level honesty was evident in a 1984 report of the US Congressional Budget Office. (U.S.SHIPPING AND SHIPBUILDING-TRENDS AND POLICY CHOICES). The budget office looked at a proposal to reserve twenty percent of bulk cargo and thus to induce commercial orders for about 20 U.S. flag ships per year. The price would be three to four billion each year, this to come out of the pockets of farmers, miners and forresters. They concluded;

> "..it seems doubtful today, however, that the cost of supporting the U.S. flag merchant marine could be justified solely by commercial considerations... The substantial gap in costs between U.S. and foreign operators must be filled by some kind of subsidy or cargo reservation program for the U.S. operators to survive. The costs of these programs are borne either by the taxpayers or by the economy through higher prices arising from increased shipping costs."(page xvi)

When the cost of protection is added shipping gains (say 20%) vanish. This is true because a quota or percentage plan gives some part (say 50 or 60 %) to non national ships. With rates artificially held up, the foreigners enjoy windfall profits at the expense of the host country. Several U.S. flag lines have enjoyed this happy situation in Latin American trades where tight 50-50 deals are in force.

Venezuela offers a good example. Her general cargo freight payments are about 600 million dollars (US) a year.(.04% of 15 billion). Shipper studies indicate that rates would by 33% lower (and services better) if Venezuelan trades were completely open. This means that Venezuelans are paying two hundred million dollars more than they should. .(one third of their annual bill) If, per the 40-40-20 Code, outsiders carry 60% of Venezuelan general cargo, 120 million of these overcharges go overseas.- a negative entry in the balance of payment account. That is a high price to pay for the twenty million that the Venezuelan Line may contribute on the positive side.

The World Bank staff working paper (No.502) suggested that a nation should hesitate if its shipping enterprise could not earn profits. The author was too polite to say that government shipping lines are famous for cooking their books. The opportunities are great. Private lines pay taxes, but their government rivals pay less (or none). Ship values can be juggled; preferences reduce sales cost; overhead is buried in operating accounts or carried by another government agency. Subsidies are treated as revenue, and loans carry low (or zero) interest rates. It would be difficult to find a government shipping line that earns a profit under strict commercial accounting standards. The Shipping Corporation of New Zealand offers an entertaining example. In 1982 they lost about five million dollars (NZ) on their service between Aukland Tahiti, The Cook Islands and Niue. An efficient service could easily break even in that trade without raising rates. However, the loss was charged as "Foreign AID" to the Cook Islands. Thus on the books the service showed a small profit.

Canadians are often told that they must indulge in cargo preference because "everybody is doing it". This is not supported by many facts. While most OECD nations have signed the UNCTAD Code, they have in "The Brussels Package" said that they will play by their own rules. The USA, Canada, Australia and New Zealand did not sign up. Since the Code touches only conference cargo, outsider shipping is not covered. This means that it influences about seven percent of general cargo and no tanker or bulk business. The greater threat comes from the 50-50 deals that prevail in US-Latin America trades. These are being questioned on both coasts of South America (especially in Brazil, Argentina and Chile), and the Reagan administration would dearly love to get rid of them. Washington has refused to make similar deals in the Philippines and China. The French protect part of their coal and oil import movements, and the Americans protect some AID grain exports. However, more that ninety percent of bulk cargo and tanker shipments move free of preferences.

14.

CONCLUSION

This is a plea for honest numbers. Shipping in the post war years has become more visible, - thanks to a host of good papers and magazines. Everywhere people are bolder in questioning subsidies and protection. South Korea was once a champion of restrictions, but recently Choi Hoon, Director General of the Korean Maritime and Port Authority told Seatrade; (4/84)

> "A system of strong protectionism is a sign of weakness in shipping and disturbs the world pattern."

That same issue found Alhaji Banda, Chairman of the OT Africa Line wondering about West African capital expenditures on shipping,and concluding;

> "Has it been worthwhile? There is a growing feeling that it has not."

These remarks are modest compared to some of the things that Brazil"s Minister of Transport (Cloraldino Severo) is saying as he wades through the tangled finances of Sunamam, his maritime administraton.

The debate is more open and fair.

OWNERSHIP AND CONTROL IN SHIPPING: PROBLEMS IN DEVELOPING NATIONS

Mary R. Brooks*

ABSTRACT

In the early 1970s the United Nations called for the development of a New International Economic Order and the redistribution of world wealth through, for example, greater participation by developing nations in international shipping. Although international conventions, such as the UNCTAD Liner Code of Conduct, provide the means by which developing countries can increase their share of the shipping pie, many nations are introducing additional national legislation designed to promote fleet development even further, particularly as fleet registry does not necessarily imply control.

This paper reviews fleet ownership and control, examining the extent of public and private sector ownership in the ASEAN countries of Singapore, Malaysia, Thailand, Indonesia, and the Philippines. Othermechanisms designed to increase control, such as theformation of shippers' councils and national legislation, will also be dis-

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cussed, as will the ability of such countries to engage in increased shipping control. The author will draw conclusions on the future control of shipping exerted by developing nations in general.

AN HISTORICAL OVERVIEW

International shipping, for the ASEAN countries, has been dominated for years by companies headquartered in the developed world, largely due to the colonial status held by many of these countries until recent years. Dutch control of shipping in and around the Dutch East Indies, now Indonesia, was not severed until after World War II. Malaysia did not achieve independence fron Britain until 1957 and, although the State of Singapore cane into being in June of 1959, Singapore did not gain conplete independence from Britain until 1965. Although Thailand was never colonised, it has never had a strong fleet of its own. Of all these countries, the Philippines, which won independence from the United States in 1946, has had a strong private sector in domestic shipping and a steadily growing national flag fleet throughout the 1950s and 1960s.

The efforts of the ASEAN nations to gain greater control over international shipping are based on the rationale that the benefits which accrue to the carrier - foreign exchange generation, employment for nationals,

the development of spin-off industries, etc.- should accrue, in some measure, to the cargo generator. It is this philosophy coupled with the political diversity of the ASEAN region which has led to a variety in the efforts made to gain control of shipping.

Historically, cargo control and national flag fleet promotion have been suggested as solutions to the problems of freight rate costs and shipping control. Yeats, in his study of shipping and national development, concluded that "shipping costs may pose a far more important barrier to developing country exports than current MFN [Most Favored Nation] tariffs."[1] One of the institutional solutions that he proposes for such disparities is national fleet development.

In the late 1960s Singapore and Malaysia believed that their trade was being strangled by the Far Eastern Freight Conference (FEFC), and this belief was reinforced by the continuing European chairmanship of the conference.[2] By developing national flag liner services which could operate within the conference structure, both Singapore and Malaysia had hoped to be able to influence conference pricing and service. The admission of Neptune Orient Line (NOL), the national line of Singapore, and the Malaysian International Shipping corporation (MISC), Malaysia's national line, to the FEFC appears to have had little influence on the continued dominance of the FEFC

by its European founding members. The conference has retained its reputation for toughness in itsdealings with shippers, and it is questionable whether conference membership by developing countries has benefitted their shippers or not; of the 33 members of the FEFC, those companies affiliated with developing or newly industrialized countries still form a minority.[3]

Chia and Lim, in their study of Southeast Asian shipping, conclude that:

> "The ability of the liner conferences to maintain and in fact to continue to increase freight rates in the face of strong objections by shippers demonstrates the firm hold on the liner trade by the conferences to the chagrin of ASEAN shippers and governments."[4]

But first, let's examine the extent of public sector ownership and participation in ASEAN the national flag shipping.

GOVERNMENT PARTICIPATION

Singapore and Malaysia

In Singapore, the promotion of national flag shipping was undertaken by two means: the opening of the register to foreign shipowners and the development of a national flag line, NOL, supported by public funds. It was hoped that both would increase the measure of control exerted by Singaporeans and provide an effective means of gaining Singaporean expertise in shipping.

In 1968, only ships belonging to Singaporeans could register under the Singaporean flag, and the register totalled 133,855 grt.[5] By 1980, just after Singapore "tightened" its register,[6] Singaporeans beneficially

EXHIBIT 1

OWNERSHIP OF LARGEST SINGAPOREAN SHIPPING COMPANIES

SHIPOWNER	1983 (000) DWT	1980 (000) DWT
Kapal Management (1)	387	100
Neptune Orient Lines (2)	1,258	492
Straits Shipping (3)	63	24
Subtotal (4)	1,708	616
Total Singapore Register	12,028	12,800
Singaporean Owned Ships Registered Under Singapore Flag	n.a.	3,400
Singaporean Ownership Registered Under Other FOC's	n.a.	623

NOTES: (1) Kapal is the shipowning and management arm of the Keppel Group of Companies. The 1980 figure does not include the 22,687 dwt held by Straits Steamship.
(2) Neptune Orient Lines began to be publicly traded on the Singapore stock market in 1981 but Temasek Holdings, the government holding company, retained 67.7 percent of the shares.
(3) A regional subsidiary of Straits Steamship.
(4) Some government equity holdings in these companies, although the Keppel Group did not buy Straits Steamship until 1983.

SOURCE: Seatrade. Far East Shipping 1984, pp 69-75. Lloyd's List of Shipowners 1980-81, cross referenced to Lloyd's Register of Ships 1980. United Nations Conference on Trade and Development. Review of Maritime Transport, 1980. TD/B/C.4/222 .25 May 1981, p 13.

owned 322 vessels totalling 3.4 million dwt, representing 26.5 percent of the register.[7] Singaporean participation has increased, and not solely through government participation (Exhibit 1).

In comparison, Malaysia's register is a closed one. It grew from 40,465 grt to 702,145 grt (1.0 million dwt) over the same period,[8] while the world fleet had only doubled its 1968 size.[9] An open register does enable expertise to filter through to nationals but Malaysia has shown that government equity can also be an effective means of gaining greater participation for nationals.

In the 1960s, Malaysian shippers were also disgruntled with the level and number of freight rate increases and the control of shipping exerted by the FEFC. The Malaysian government established the Malaysian International Shipping Corp. (MISC) in 1968, as a private limited liability corporation, with equity participation from both government and private individuals, not all Malaysian (Exhibit 2). In fact, Hong Kong's Sir Frank Wen-King Tsao is Deputy Chairman of MISC's Board of Directors, bringing to the Board the shipping expertise missing from the NOL Board.[10] This organisational structure differs significantly from the Singapore government's participation in NOL, sufficiently that MISC has been deemed by the US Federal Maritime Commission not to be a state-controlled carrier. In addition, the line

EXHIBIT 2

MISC CORPORATE OWNERSHIP

STATE SHAREHOLDINGS		
Federal Government	21%	
6 State Governments (or their nominees)	30%	
Statutory Bodies (such as the Federal Land Authority, The Pilgrim Board, etc.)	12%	63%
PRIVATE HOLDINGS (which include some non-national shareholders)		37%
TOTAL		100%

SOURCE: Interview, Mr. Panchacharam, Assistant Manager, Corporate Planning, MISC, 14 March 1984.

has considerable freedom from government interference in its operations.[11]

Initially, the prime means of promoting fleet development in Malaysia has been through government participation; the major beneficiary of this support has been MISC.[12] Over the past decade, MISC's fleet has accounted for an average of 87 percent of the total Malaysian register.[13] However, MISC has not remained the sole beneficiary of government interest. In 1982, a second national line, Perbadanan Nasional Shipping Line Berhad (PNSL), was incorporated with the government

EXHIBIT 3

OWNERSHIP OF THE INDONESIAN FLEET
1982

OWNER	NUMBER OF VESSELS	TOTAL GRT
Admiral Lines	9	39,696
Gesuri Lloyd	24	154,756
Karana Lines	3	41,848
Sanudera Indonesia	10	58,263
Trikora Lloyd	12	99,755
TOTAL OF THESE 5 (Private International Liner)	58	394,318 (21.4%)
Bahtera Adhiguna	16	27,027
Pelni (1)	61	95,456
Pertamina (2)	153	405,237
Djakarta Lloyd	16	149,456
Government of Indonesia	189	153,441
TOTAL OF THESE 5 (Government owned)	435	830,617 (44.9%)
OTHER OWNERS (3)	826 (62.6%)	792,166 (33.7%)
TOTAL INDONESIAN FLEET	1319 (100%)	1,846,824 (100%)

NOTE: (1) Including those managed for the Government.
(2) Does not include those "agent for," but does include those managed.
(3) Includes those under Pertamina agency. A large number of Indonesian vessels account for a smaller percentage of Indonesian grt. Of these, 14 vessels account for 93,880 grt or 10.5 percent of the total Indonesian fleet.

SOURCE: Lloyd's List of Shipowners, 1982-83. Lloyd's Register of Shipping Statistical Tables 1982.

holding 100 percent of its equity through its holding company, the National Corporation of Malaysia. By the end of 1983, the PNSL fleet totalled five vessels of 253,840 dwt,[14] and is truly a "state controlled carrier."

Indonesia

More than any other ASEAN country, the Indonesian government is a very active participant in the shipping industry. This situation has its foundation in the country's constitution (1945) which states that the

> "branches of production which are important for the state and which control (the supply of) the basic needs of the masses are to be controlled by the state."[15]

Control through regulation, licenses and permits is a key policy of this government; shipping is no exception. In addition, an examination of the Indonesian register reflects the control also exercised by government equity (Exhibit 3).

Pertamina, the national oil company, is wholly-owned by the Indonesian government, and is one of the larger ship operators in Indonesia. Although the company owns no vessels larger than 10,000 grt, the Pertamina fleet accounts for 22 percent of the Indonesian registry. During the period November 1983 to August 1984, Pertamina began an active ordering and chartering programme; this fleet expansion is dependent on government funding, as

the corporation has had cash flow difficulties for almost a decade.[16]

P.T. Pelni, an inter-island operator, was converted into a linited liability corporation in 1975 but remains wholly-owned by the Indonesian government, as does P.T. Djakarta Lloyd, the international liner operator. The true extent of government control in these two companies is illustrated by their April 1983 management reorganization. Five directors were replaced at Pelni and two left Djakarta Lloyd. The managing director of P.T. Bahtera Adhiguna, another limited liability shipping company owned by the government, was transferred to Pelni as its new managing director.[17] This direct control is very different from that exerted solely through the appointment of board members or directors, as seen in the other four ASEAN countries under discussion.

Although Exhibit 3 details the fleet controlled by the government to be 45 percent of the register, the size of the fleet "influenced" is considerably larger. The big five private liner operators account for 21 percent of the national flag fleet but their operations on the largest routes are rationalized with those of the state-owned Djakarta Lloyd. The government also has tremendous influence on the day-to-day operating decisions of the privately-owned fleet through its decrees, regulatory policy and numerous licensing requirements. Some of

these cobwebs were cleared away when, recently, the government eliminated 17 of the licenses required in the inter-island trades,[18] but licensing remains a major control mechanism for the government. Perhaps it is to avoid government influence in operations that Indonesian shipowners registered almost 1.2 million dwt (75 vessels) under flags of convenience in 1980.[19]

The Philippines and Thailand

Although the Philippines has cargo-sharing philosophies in common with Indonesia, the Philippines has relied less on government participation in shipping than most of her ASEAN partners, prefering to leave shipping development to the private sector. In fact, many of the large shipowning corporations do not register their vessels solely under the Philippine flag, but operate under joint registry (with Panama). However, this is not to say that there has been no government participation, although such participation has been limited, and limited to the past decade. The oil crisis of 1973 forced government involvement in PNOC Shipping and Transport Corportion, a subsidiary of the state-owned Philippine National Oil Company. PNOC Shipping and Transport Corporation, in spite of working capital and foreign exchange difficulties, has managed to operate as any other private sector shipping company;[20] its methods of finan-

EXHIBIT 4

OWNERSHIP OF THE PHILIPPINE FLEET
1983

OWNER	NUMBER OF VESSELS	TOTAL GRT
National Galleon	6	78,809
Philippine International Shipping Corp. (1)	6	249,774
PNOC Shipping and Transport Company	11	339,776
TOTAL GOVERNMENT OWNERSHIP	23	668,359
% OF TOTAL FLEET	2.6%	22.5%
PHILIPPINE REGISTER	884	2,964 k

NOTE: (1) Company bankrupt; ships attached by the Philippine National Bank during 1983.

SOURCE: Lloyd's List of Shipowners, 1983-84 and Lloyd's Register of Shipping Statistical Tables 1983.

companies, Jutha Maritime Co. Ltd., Thai Petroleum Transport Co. Ltd., Jalaprathan Cement Co. Ltd. and Vanakarn Co. Ltd., are state-owned (the equity percentage in each is not indicated) bringing the government total to 20 ships, totalling 142,735 dwt, or 21 percent of the fleet.[22]

In future, the government plans to expand the Thai fleet through new acquisitions by TMC,[23] with the intention of increasing Thai participation in the carriage of

her foreign trade, but has indicated that further development of the fleet through government equity in new companies is unlikely in the short-term.[24]

Commentary

The ASEAN countries are not the only ones embarking on a course of fleet development and growth; newspapers and trade journals announce the new plans of many developing nations on a regular basis. In the traditional shipowning countries, however, government participation in the industry has been very low; these governments have tended to leave shipping as a private sector industry and place greater emphasis on its regulation. The relationship between the industry and government has generally focussed on those measures intended to insure a competitive and efficient world market for shipping services. Government response has generally not been participatory, although it has played the role of "godfather" on occasion, promoting shipping investment through fiscal benefits.

MECHANISMS FOR CONTROL

We have already seen the extent of public sector ownership in the shipping development of each of the five ASEAN countries. This development has been supported by government policies, such as cabotage, fiscal incentives

and cargo-sharing. However, registration of a national flag fleet does not necessarily imply control, and governments have sought alternate methods of increasing national control by, for example, mechanisms designed to shift negotiating power from the carrier (often foreign) to the shipper (a national).

To counter the power of the conferences serving the area, strong shippers' councils are considered essential.Co-operation between shippers' councils was formalized with the establishment of the Federation of ASEAN Shippers' Councils (FASC) in Manila in October of 1974. Mr. Warut Siwasariyanon, in his thesis on ASEAN shipping costs, concludes that the FASC has not been influential in preventing the frequent FEFC rate increases.[25] The Federation continues to complain of problems encountered by ASEAN shippers in their dealings with the FEFC, calling the conference "intransigent."[26]

In addition to the formation of shipper's councils, umbrella organizations, such as Thailand's Office of the Merchantile Marine Promotion Commission, have been established to develop a co-ordinated national shipping policy; Indonesia and the Philippines have given the Directorate of Sea Communications and Maritime Industry Authority (MARINA), respectively, similar mandates. These agencies provide a means of potential governnent control overprivate sector activity. MARINA, for exam-

ple, can direct investment through the allocation of foreign exchange providing a measure of government control over private sector investment in ships.

The development of cargo affreightment/consolidation agencies and the establishment of freight study units have also been touted as the means to counter conference strength. The former enables shippers to negotiate from a position of strength; sufficient cargo may even lead to the ability to charter vessels and bypass the conference structure altogether. Through Malaysia's new Freight Booking Centre, it is anticipated that Malaysians will control carrier selection for 70-75 percent of Malaysia's exports.[27] On the other hand, freight study units provide the information necessary for successful negotiation: the volune, seasonality and vagaries of cargo flows into and out of a particular country. However enthusiastic the individual ASEAN countries are about such units, data collection problems have been encountered, and so their impact can not be readily assessed.

Recently the strength of the FEFC has dwindled slightly. This situation has been caused by the increasing incursion of non-ASEAN non-conference carriers into the traditional conference-dominated trades. Therefore, control of conference shipping, as exemplified by the FEFC, has not shifted from European hands due to the presence of NOL, MISC or Unithai within the conference or

from pressure exerted by shippers' councils. The shift to a shipper orientation has been attributed to non-conference pressure by outsiders, such as Taiwan's Evergreen line.

FACTORS WHICH ASSIST OR HINDER THE INVESTMENT IN CONTROL

Finally, the ability to gain increased control of shipping through government measures designed to promote private sector investment in shipping is tied to the ability of companies to engage in such investment.

First of all, there is the ability of companies to consider any form of expansion whatsoever. Given suitable market conditions, companies considering expansion must be financially capable of weathering short-term losses until the revenue generated by the investment is sufficient to counter the capital repayments and operating expenses of the investment. Of the largest Filipino shipping corporations, the Maritime Company of the Philippines (MCP) is the most able to meet its debts (liquidity) and is one of the more profitable,[28] but this company withdrew from operations during 1984 because it was incapable of meeting its financial obligations. Consider the ability of the balance of the Philippine fleet to undertake expansion.

Assuming a particular company has acceptable liquidity and profitability, the ability to raise funds (with

or without government guarantees) in the marketplace is also important arises. There are two major commercial sources of funds available to shipowners: equity markets (where an infusion of funds can be garnered from private investors through the sale of shares) and commercial lending institutions. The ability to use the latter depends very much on the individual company's ability to support additional debt, unless government guarantees waive this requirement, as has been the case with MISC.

One measure of the debt capacity of the shipping company is the debt/total assets (or gearing) ratio. The greater the level of capitalization of a company, the less reliance the company must place on banks and other lenders and, generally, the lower the amount of operating profit which must be used to cover interest payments on the debt incurred by the company. Too much reliance on equity, and the company is not taking advantage of leverage possibilities to ensure its survival. This is not usually the problem. Throughout Thailand, Malaysia, Indonesia and the Philippines are numerous undercapitalized, bankrupt shipping companies. Only the Singaporean companies have maintained the ability to seek commercial funding for expansion activities.

In addition to borrowing funds for expansion, shipping companies can interest private investors in financing expansion through acquiring shares in the corpora-

tion. This option is available only where government restrictions on this particular source of capital permit, and when existing shareholders are not adverse to the dilution of their shares. For example, NOL was recently forced to raise funds through a rights issue of unsecured loan stock as Temasek Holdings (the government holding company) would not allow its shareholding to be diluted by a share issue.[29]

Therefore, the strength of local capital markets can abet or hamper a company's ability to take advantage of government measures or market opportunities. Singapore's stock exchange has seen private investor support for shipping,[30] whereas the stock markets of Thailand, Indonesia and the Philippines all have problems. The Stock Exchange of Thailand is a poor equity market, with little hope for improvement in either the short- or medium-term.[31] Indonesia is faced with a similar situation,[32] and Malaysia has not managed to counter difficulties with stock market manipulation.

Indonesia and the Philippines are also faced with severe currency exchange limitations which prevent fleet expansion in spite of cargo reservation legislation to support such fleet growth. Such cargo reservation can only be effective if the beneficiaries are able to develop the capacity to carry their share. In spite of cargo reservation legislation, Filipino operators were

unable to take advantage of this legislation in the Philippines/US trades in 1983, because of an inability to finance the necessary expansion. The success of legislation to increase participation in shipping is tied to the ability to finance the expansion.

Finally, countries may resort, as Indonesia has done, to financing fleet expansion through government budgetary means. However, such expansion must be absorbable by the market. Financing alone is inadequate; market demand must exist. The most popular means of achieving this has been cargo reservation, the success of which is tied to the political reactions of one's trading partners, and the ability to increase capacity as required. In ASEAN over-capacity exists; load factors average only 60 percent,[33] when 80 percent is more acceptable level for efficient and profitable operations. Perhaps cargo reservation will solve this difficulty but time must be given to allow current excess capacity to be absorbed.

CONCLUSIONS

Future economic growth in ASEAN is not expected to equal historical growth rates and the current rate of fleet expansion is questionable if substantial additional cargo is not generated. Without a strong capital market like Singapore's, and without sufficient company strength

to generate capital from commercial banks, fleet expansion for many ASEAN companies will need to continue to be supported by government funds. In the case of Thailand, these funds are needed for the economic development projects currently planned, and it is unlikely that fleet development will be any more rapid than its recent pace. The inability of many Indonesian or Filipino companies to purchase ships from international shipyards, because of currency problems, suggest limited growth in private sector shipping for these two as well. The influence of government in shipping will grow if these governments are determined to achieve national objectives. With chronic overcapacity and current load factors, the region's existing direction of fleet expansion is a questionable strategy likely to result in greater debt, not greater wealth.

The experience of the ASEAN countries is typical of many developing and newly industrialized economies; traditional developed country shipowners, who are flagging out for tax benefits or to avoid the high labour costs, are retaining operating control. So in spite of all efforts being made by developing nations to promote greater control over shipping, they are hampered by financial difficulties and chronic industry overcapacity. Therefore, the institutional solutions cur-

rently being attempted will take a long time to change the balance of control.

Footnotes

1. Alexander J. Yeats, Shipping and Development Policy: An Integrated Assessment, New York: Praeger Press, 1981, p 74.

2. Eric Jennings, Cargoes: A Centenary Story of the Far Eastern Freight Conference, Singapore: Meridien Communications Pte Ltd., 1980, p 57.

3. Ibid., p 69

4. Chia Lin Sien and Teresa Lin, "Shipping Development in ASEAN: Problems and Prospects" in Southeast Asian Seas - Frontiers for Development, Chia Lin Sien and Colin MacAndrews, eds., McGraw-Hill, 1983, p 181.

5. Lloyd's Register of Shipping Statistical Tables.

6. The new registry rules included age limits and full disclosure of beneficial ownership.

7. United Nations (UNCTAD), Review of Maritime Transport 1980, TD/B/C.4/222, 25 May 1981, p 13.

8. Lloyd's Register of Shipping Statistical Tables.

9. Ibid.

10. Ibid, compared with figures provided in NISC: A Corporate Insight, a company publicity brochure.

11. Ibid.

12. Based on a review of the Board of Directors of Neptune Orient Lines as provided in the 1983 company publicity brochure, The Trident Service, p 6.

13. Shipping Times, 5 January 1984, p I; Containerisation International, February 1984, p 33 and April 1984, p 9.

14. Shipping Times, 4 April 1984, p I.

15. Robert C. Rice's translation as quoted in Robert C. Rice, "The Origins of Basic Economic Ideas and their Impact on 'New Order' Policies" in Bulletin of Indonesian Economic Studies, August 1983, p 61.

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17. Cargonews Asia, April 1983, p 2.

18. Business Asia, 27 April 1984, p 136.

19. UNCTAD, Op Cit.

20. Based on operating information supplied by Mr. E.F. Verano, Vice President and General Manager, PNOC Shipping and Transport Corporation, Manila, Philippines.

21. Containerisation International, September 1983, p 59.

22. Based on detailed fleet statistics provided by the Sea Transport Economics Division of the Merchantile Marine Promotion Commission, Bangkok, Thailand.

23. Maritime Asia, November 1981, p 49.

24. Government interest has waned because private sector support is not forthcoming. Asian Shipping, January 1983, p 3.

25. Warut Siwasariyanon, The Incidence of Shipping Costs in ASEAN International Trade, M.Ec. Thesis: Thammasat University, Bangkok, 1981, p 125.

26. Lloyd's List, 20 August 1984, p 1 and 21 August 1984, p 1.

27. Shipping Times, 1 February 1984, p I; Maritime Asia, March 1984, p 7.

28. SEC Businessday's 1000 Top Corporations in the Philippines, Quezon City: Businessday Corp., 1980.

29. Containerization International, February 1984, pp 31-3.

30. Both in the NOL public offering and more recently in the listing of Chuan Hup Marine. (Seatrade, Far East Shipping 1984, p 69).

31. Business Asia, 4 May 1984, p 143.

32. Business Asia, 1 June 1984, p 175.

33. Maritime Asia, March 1981, p 18.

This paper has been developed from materials collected for a forthcoming monograph by Mary R. Brooks entitled, "Fleet Development and the Control of Shipping in Southeast Asia", to be published by the Publications Unit of the Institute of Southeast Asian Studies, Heng Mui Keng Terrace, Pasir Panjang, Singapore 0511 in the fall of 1985.

CANADIAN MARITIME POLICY: THE THREAT OF OVERREACTION TO INTERNATIONAL DEVELOPMENTS

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The twentieth century has been a time of unprecedented technological and social change. In many respects, the world is much smaller today than it was eighty-four years ago.

Two factors have played a large role in effectively bridging the physical separation between peoples of the world: the development of sophisticated communications technology and the establishment of an efficient, economic and highly competitive global shipping network.

It is hard to dispute that the society in which we live today is largely the result of earlier civilizations' attempts to expand international trade and develop new trade routes. We have evolved from very isolated, local economies based on barter, to a world where

highly sophisticated international trade drives the economy.

Since biblical times, when the Phoenicians traded in the Mediterranean Basin, to the nineteenth century, when fast clipper ships opened up the world's oceans, deep-sea shipping has been one of the most free and international of enterprises. As sail gave way to steam, international trade expanded a hundredfold. Now it is not unusual for iron ore - transported by ship from Brazil to Japan - to be combined with coal transported from Australia - to be manufactured into automobiles - and transported by ship to markets in Vancouver and Montreal.

Unfortunately, the freedom of the high seas is threatened. Several countries are attempting to control both domestic and foreign shipping operations for their own national advantage. Developing nations in particular are intent upon getting a larger share of world trade through the reservation of cargo, sometimes exclusively for their national fleets.

The most significant manifestation of the growth of maritime protectionism has been the United Nations Code of Conduct for Liner Conferences, otherwise known as

the UNCTAD (United National Conference on Trade and Development) Code. This Code, to which Canada does not subscribe, reserves a portion of liner cargo (or cargo on vessels travelling between designated ports on a regularly scheduled basis) for the merchant fleets of the exporting and importing countries involved. The formula used apportions 40 percent of the cargo to each of the importing and exporting nations, leaving 20 percent for open competition. Pressures exist to place similar restrictions on bulk cargo movements.

In a more recent development, the United Nations Conferences on Trade and Development (UNCTAD) has convened a conference on conditions for registration of ships. The intent of this conference is to place restrictions on the use of countries of open registry. While this has the possibility of "throwing a monkey wrench into the works", initial reports indicate there is a strong likelihood of a workable compromise, and that implementation may not be until sometime in the 1990's.

In addition to multilateral agreements such as the UNCTAD Code, political intervention in the shipping market by individual nations takes various forms including:

- Cargo reservation policies which state that some or all imports and exports must be carried by national flag vessels;
- Discriminatory port access or treatment of vessels in port which favours the national line and gives low priority to non-national vessels;
- Commercial and financial measures that favour the national line through preferential exchange rates, special credit terms, insurance provisions and the granting of import/export licenses;
- Subsidies, tariff and tax-related measures which give preferential treatment to shippers and receivers using the national line.

Government intervention in the shipping market often has many aims including increased employment opportunities for domestic workers, foreign exchange earnings, business opportunities for local entrepreneurs and assurance that vessels are available for strategic purposes.

While these may be considered desirable aims, in practice, when one nation attempts to control the shipping of other nations for its own benefit, other countries inevitably retaliate. The result is a free-for-all ending in either the strongest emerging

the winner or in a clumsy compromise which does more harm than good.

Political intervention to limit competition inevitably reduces the incentive of ship owners to innovate and keep costs down. This can be particularly serious for a nation like Canada that is highly vulnerable to any factor which increases costs or inhibits the free flow of trade.

Canada thrives on international trade. In 1983, exports of goods and services amounted to over $100 billion. More than 30 percent of the country's Gross National Product is generated by exports, and approximately 3 million Canadians are employed in areas directly or indirectly related to exports. In fact, Canada's economy is more dependent on exports than any other OECD country.

It is against this background of growing protectionism in world shipping and Canada's dependence on export trade that the federal government decided to undertake in 1984, a review of Canadian maritime policy. Much of the credit for the commencement of this review must go to the proponents of a Canadian merchant marine, whom have been ceaseless in their lobbying.

Canadian ship builders, maritime unions, and ship owners argue that the creation of a domestic fleet would represent a solution to the problem of foreign intervention in the shipping market. They further claim that a Canadian fleet would create vast employment opportunities, massive balance of payment benefits, would increase domestic security and would improve our ability to retaliate when our interests are threatened.

Canadian exporters, on the other hand, doubt not only the veracity of these claims, but also the wisdom of an approach that fights protectionism with further protectionism.

With regard to job creation in the shipping sector, it is agreed by most parties that due to high crew costs, Canadian ships could not be competitive with those of most other nations. Some parties have suggested that this could be alleviated through exempting Canadian crews from personal income tax while at sea. Canadian crew costs would then tend to be at the same level as those in many Western European countries. The danger with this is that, once you start the ball rolling, how do you stop it? Soon other industries with equally valid claims would be pressing for equal treatment.

Significant evidence exists in support of the argument that Canadian costs are or would be well above those of efficient European operators. Mainly because of differences in crew size, it is estimated that a wage disparity of approximately $1,000 (U.S.)/day exists between the wage costs of an efficiently operated Norwegian or Dutch flag ship and a Canadian vessel. It has also been estimated that, for a medium-sized bulk carrier, the spread between Canadian and far eastern crewing costs is at least $2,250 (U.S.)/day or between $750,000 to $800,000 per vessel per year.

If Canada is to have a viable deep-sea fleet, it must be world competitive, not just OECD competitive. The decline in OECD tonnage over the last few years points to the folly of the latter case. Crewing cost differences between Canada and other OECD nations and between Canada and eastern nations are a good indication of the size of the subsidy that would be required from government to achieve a competitive position.

Job creation policies should be developed with an eye to the future, not the past and, in this regard, deep-sea shipping does not possess the potential often attributed to it. There is a downward trend in employment in shipping worldwide. For example, where it used

to take 35-40 people to operate a bulk carrier, today, sophisticated bulk carriers have crews of less than 20. Significant work is taking place to reduce this to 18, 16 and eventually as low as 12 persons.

All in all, the benefit to employment would be minimal, and the problem that there is not a pool of suitably trained workers to man the ships would still exist. In fact, there is considerable doubt whether the country could provide willing and able men in sufficient numbers to crew a merchant fleet of any great substance. The much vaunted Maple Leaf Shipping experiment with full Canadian crews, complete with special agreements with the SIU and CMSG, was rather short-lived. Once the company started attempting to trade further afield than nearby US west coast ports, the Canadian crews rapidly displayed their unwillingness to spend, what they saw as, protracted periods away from their home ports and the company abandoned the experiment. Even some Great Lakes operators have had to look to foreign nationals for assistance in filling their berths, especially in the skilled officer ranks.

Proponents of a Canadian flag fleet argue that Canada would be able to recapture the $5 billion per year that is currently paid to foreign ship owners to move our

export product. This they allege would be a benefit to Canada's balance of payments.

Substantial portions of freight charges will never be retained in Canada, irrespective of the vessel's flag or ownership. Canadian earnings of foreign exchange from shipping revenues would be offset by purchases abroad of fuel, port charges, ship supplies, equipment, maintenance and cargo handling services. On the other hand, these same supplies and services are now purchased in Canada by the existing carriers.

As a result, only capital costs and crew costs are items which can impact on the Canadian balance of payments. Proponents of a deep-sea fleet agree that most of the vessels would have to be purchased abroad, and would provide no direct benefit to Canada.

Even if 100% of Canadian exports went on Canadian ships, the benefits to Canada would not likely exceed five percent of the total ocean transportation costs. This benefit would be offset by the cost of incentives provided by government to get the fleet going in the first place.

The policy of the United States in supporting national flag operations is often cited favourably, by Canadian unions particularly, as a model for Canada. However, the cost-benefit experience of American marine policy has not been a happy one for the American taxpayer. In 1983, it was calculated that the U.S. government paid 72¢ for every dollar of wages paid aboard subsidized U.S. cargo vessels. As for the balance of payments effects, a 1966 study by the U.S. Maritime Administration concluded that the net gain in the balance of payments for each dollar of support to the U.S. merchant marine was 30¢.

The security argument is repeatedly used to justify the call for an expanded Canadian deep-sea fleet but no recent work has been done to either identify or quantify these requirements. This is a major area of neglect in Canadian policy development as compared with the U.S. or the U.K. Recent work done by both of these countries has indicated that RO/RO (Roll-on, Roll-off) vessels are the most desirable type of ship for national security purposes. Yet, all indications point to bulk carriers as having the greatest growth potential in a merchant fleet. This raises the very real possibility that, if a Canadian fleet is encouraged, the types of vessels required by Canadian owners would

not bear any relationship to the types required for national security purposes. This is obviously an area that requires further study.

It must also be remembered that a Canadian fleet is not the only nor necessarily the best means of protection. Canada would do well to also study actions taken in the U.K. prior to World War II. At that time, contingency plans were put in place that resulted in the U.K. chartering the bulk of the Norwegian merchant fleet when war was declared. This is an important option that has been neglected. The portion of the international fleet "controlled" by Canadian shippers has important security implications in the event of trade disruptions. For example, American owners of offshore vessels (the Federation of American Controlled Shipping) must provide assurance to the U.S. government that their tonnage will be put at the government's disposal in the event of a national crisis. Most open registry flags have specific provisions assuring that such actions can be taken.

The final and perhaps most important factor to consider is the international environment within which a Canadian fleet would have to operate. It is no longer entirely one of free enterprise or free trade. Like

many markets in the world, this one is becoming more restricted by formal or informal bilateral agreements, the UNCTAD Code and discrimination in port fees, agency fees and taxes. Many countries want to create rules and codes restricting cargo, flag and crew.

This is a worldwide phenomenon which has not yet peaked in international shipping. However, those who favour such a direction should heed the warnings provided by the craze for total deregulation now popular in North America. Regulation, especially in the presence of conflicting regulatory regimes, like deregulation has many undesirable side effects. Both often overshoot their objectives, resulting in inefficiencies. This concern is perhaps behind the fact that EEC and OECD countries have exempted themselves from the UNCTAD cargo sharing provisions. As a result, an overwhelming proportion of the world's bulk trades, and a substantial majority of the world's liner trades, will continue to operate in a competitive market place.

If one examines protectionism, it is patently obvious that, first of all, a protectionist policy is anti-competitive. Hardly a surprising observation! This lack of competition will ultimately lead to higher costs and inefficiencies in providing service. This in

turn will ultimately backfire on the advocates of such a policy, and everyone will end up paying higher rates.

The reliance by many developing nations on protectionist shipping policies may eventually drive up transportation costs and lead their trading partners to seek alternative, lower-cost sources of those goods or to develop import substitution policies.

Exporters justifiably fear proposals to fight protectionist shipping policies with further protectionist shipping policies. Fighting fire with fire usually compounds the problem by making a larger fire. The net result would be higher costs for imports and lower prices for exports. Some jobs would be created in the shipping sector and import substitution industries; however, these jobs would be more than offset by lost jobs in export-reliant industries.

Essentially, the question of protection for a Canadian merchant marine is the same as for any other industry. The last decade has seen the federal government take various means to protect the shoe and textile industries in Canada. Employment has not been maintained in those industries and the prices of those

products have increased considerably even when taking inflation into account.

From the exporter's viewpoint, the option with the best possibility of protecting Canadian interests from the protectionist shipping policies of other countries is the implementation of a defensive deep-sea shipping policy. Such policies are now in place in many countries and appear to be effective deterrents to the spread of protectionism.

Adoption of defensive legislation would be an elaboration of, rather than a departure from, current Canadian shipping policy as established in the National Transportation Act which states that: "It is hereby declared that an economic, efficient and adequate transportation system making the best use of all available modes of transportation at the lowest total cost is essential to protect the interests of the users of transportation and to maintain the economic well--being and growth of Canada, and that these objectives are most likely to be achieved when all modes of transport are able to compete under conditions...having due regard to national policy and to legal and constitutional requirements". To assist in carrying out this mandate the Canadian Transport Commission has

the duty to "inquire into and recommend to the Minister from time to time such economic policies and measures as it considers necessary and desirable relating to the operation of the Canadian merchant marine, commensurate with Canadian maritime needs".

The defensive strategy which is under consideration would be the prime step, under the shipping policy, which could be undertaken to protect the Canadian interests when they are threatened.

Defensive measures would not aim to reduce free access to shipping trades as it only would be implemented in response to restrictive actions by other countries where actions of other countries have already reduced the competitive environment. Indeed it would be designed mainly in the hopes that it would act as a deterrent to other countries considering intervention in Canadian trade since their actions may generate government as well as commercial reaction from this country.

The possible measures which the government might reasonably consider include:

a) Prohibition of the vessels of the intervening

country

b) cargo reservation

c) designation of Canadian carriers or vessel operators

d) service restrictions - range of ports served, frequency of sailings, volume lifted, etc...

e) tariff control

f) countervailing or equalizing taxes

g) re-assessment of foreign aid

h) assignment of low priority in port handling to vessels of offending nations.

While much of the debate over an appropriate Canadian maritime policy has focussed on the merchant marine issue, exporters believe that the solution lies in developing defensive strategies. In terms of responsiveness to changing circumstances, a policy of government advice, assistance and defensive measures appears to be superior to any other.

The protection of Canadian commercial interests from the actions of foreign governments must be separated from the issue of promoting a Canadian deep-sea fleet. The first is a legitimate intervention in the market-place to counter foreign actions harmful to Canada's interests while the second is merely an emotional and

patriotic appeal by parties with strong vested interests. The threat of over-reacting is real and of great concern to Canadian exporters. It has the potential of disrupting international trade. Protectionism may be here to stay, and we would be well-advised to deal with it rationally, and on a case-by-case basis, rather than over-react and then have to deal with the inevitable unfortunate consequences.

AIR CARGO - THE CANADIAN CONTEXT

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Preface

The purpose of this paper is to set out, in a brief fashion, several problems which are seen to exist in the Canadian air cargo industry. To a certain extent, many of these problems are said to be related to the regulatory framework within which Canadian air cargo carriers must operate, and as such, could and some say must, be alleviated by a change in the regulations.

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* The following represents the views of the author and should not be construed as representing those of the Director of Investigation and Research.

It is not within the scope of this paper to suggest major policy initiatives which would address these and other perceived problems. Also, the paper is not designed to be exhaustive, but will focus on certain issues relating to the air courier industry in Canada, the aircraft charter rules which prohibit the chartering of aircraft to freight forwarders, and the problems faced by Canadian unit toll carriers as a result of certain tariff filing and compliance requirements. In turn, these issues will be examined in an effort to determine if they impact on industry competitiveness, efficiency and pricing.

In an effort to place these issues in perspective, there will be a brief examination of the overall regulatory regime in Canada and the somewhat special economics associated with air cargo. Reference will also be made to developments in the United States.

For purposes of clarity, the term "cargo" shall be considered to include general freight, courier material and mail.

Canadian Perspective

The recent examination of the regulations affecting the airline industry in Canada culminating in

the Honourable Lloyd Axworthy's "New Canadian Air Policy" (May 10, 1984) and the "Interim Report of the Air Transport Committee of the Canadian Transport Commission on Domestic Charters and Air Fare Issues", illustrated that air cargo in Canada is essentially viewed as a by-product of passenger service. This, of course, is not to say that the air cargo industry did not benefit from these recent studies. Certainly the interpretation of some of the entry, exit and operating requirements on combination and all-cargo services, both scheduled and chartered, have been relaxed. Nevertheless, suffice it to say that at present, cargo services in Canada are regulated in the same manner as, but as an adjunct to, passenger services. Given some critical differences in the nature of demand for these services, which will be set out below, this appears to impose inefficiencies in terms of higher costs and poorer quality service.

Air cargo can be carried either in freighter aircraft, combination aircraft (bellyhold plus part of maindeck) or in the bellyholds of passenger aircraft. An accurate breakdown of the volumes for each is not available, however, one source has indicated that 70% of air cargo in Canada moves in passenger or combination aircraft.[1]

Air cargo is carried by both unit toll and charter carriers. Overall volumes, domestic plus international, favour unit toll carriers which, in 1982, carried almost 300 million kilograms of cargo or about 70% of a total volume of 427 million kilograms. The following table presents a breakdown of cargo carried by Canadian air carriers in 1982.

1982 Operating Statistics

Cargo carried by Canadian Air Carriers[2]

(Domestic and International, in millions of kilograms)

	Levels				TOTAL	SHARE
	I	II	III	IV		
Unit Toll Share	262 (89%)	15 (5%)	16 (6%)	2	294	(69%)
Charter Share	42 (32%)	36 (27%)	55 (41%)		133	(31%)
Unit Toll + Charter Share of total	304 (71%)	51 (12%)	71 (17%)	2	427	(100%)

These statistics show the predominance of the Level I unit toll carriers which carried, by far, the lion's share of cargo in Canada - about 61% of the total. This was followed by the Level III charter carriers which carried about 13% followed by Level I charter carriers which carried about 10% of the total.

G.R. Ashley

This concentration of cargo traffic in the Level I carriers increases when one notes that Air Canada, CP Air and Pacific Western are reported to haul, by far, the majority of cargo hauled by Canadian carriers.[3] In fact, Air Canada alone has been identified as carrying 55-60% of the total cargo carried by Canadian carriers.[4]

In terms of revenues, Air Canada was identified as having air cargo revenues of $264 million in 1982. C.P.Air had $77 million in 1982 and Pacific Western $26 million.[5] For 1985, an Air Canada executive has stated that he anticipates his company's 1985 air cargo revenues will rise to $300 million.[6]

In relative terms, in 1982, air cargo contributed 11.4% to Air Canada's total revenue and 11.7% and 8.3% respectively to the revenues of C.P. Air and Pacific Western.[7] More recent relative revenue figures are not available although estimates put the 1985 air cargo contribution to total revenues for Air Canada at 15%.

More importantly, and showing firstly that cargo is predominantly carried in passenger and combination aircraft and secondly, showing the lower marginal costs of

carrying cargo in these aircraft , the 12% contribution made by cargo to Air Canada's total revenue represented a 40% contribution to its profit.[8] As will be seen, this lends credence to "economies of scope" arguments associated with the carriage of cargo in passenger aircraft and the potential subsidization of passenger service by cargo carriage. Above all, it illustrates the importance of air cargo to Air Canada's overall operations and may suggest the existence of monopoly rents via the existence of barriers to entry.

Economics

Air cargo consists mainly of four types of commodities: time sensitive materials like courier mail, spare parts and medical supplies; perishable goods like foods; goods with a high obsolescence risk like magazine periodicals; and high value goods like precious metals and electronic products. There are of course, many exceptions. One notable exception is in the Canadian north, where lack of other transportation modes necessitates that air freight include all types of goods.

There are few studies which deal with the nature of shipper demand for air freight although one study,

prepared in 1978 under the United States National Aeronautics and Space Administration[9], indicated that there were five factors affecting shipper demand. In decreasing importance, this study identified gross national product, cargo tariffs, delivery time, cities served and truck tariff competition as the major determinants of air cargo demand. Certainly, it is no surprize that shippers of "urgent" goods are more sensitive to good service than they are to price thus, the demand may be said to be price inelastic.

Regarding intermodal competition, generally speaking, there are two main reasons for shippers to choose air over surface transportation: speed beyond short distances, and lower risk of damage or loss. In practical terms, this puts air cargo in competition with trucking and ocean shipping but only for a narrow range of goods. Note should be made, however, of terrestrial and satellite facsimile as an increasing substitute for courier mail. Rail freight is generally not divertable to air.

As an alternative to air, trucking may become attractive on overnight truckload hauls, where truck rates are likely to be substantially less than those charged for

air freight. However, this attractiveness may pale on LTL trucking where either the time sensitivity disappears or truck rates increase.

From the shippers' perspective, intermodal competition becomes important during an analysis of total distribution cost. This is where air transporation can become attractive, as is evidenced by the increasing acceptance of "just in time" inventory management. That is, if the total door-to-door cost is calculated, the cost of air transportation can be lower than that of surface transportation. For example, the higher cost of air transport relative to other modes can be offset if it produces savings in other areas including lower inventory charges, reduced risk of obsolescence or deterioration, reduced risk of in-transit damage, and lower packaging costs. These savings can produce further savings in the nature of reduced costs of working capital, rents, labour, warehouse handling and insurance. Many airlines also claim that their in-transit pilferage is lower than competing modes.[10]

Attention must also be given to the fact that air cargo and passengers, at least from an economic viewpoint, are very different and should be treated

differently. First, passengers demand the convenience of morning and early evening flights whereas shippers want night time service to coincide with late afternoon pick-up and early morning delivery. Second, passengers demand non-stop or through plane service while air shipments require only that the service needs are met regardless of an indirect routing. Third, passengers generally fly round-trip while cargo tends to fly only in one direction. This translates into poor load factors particularly in Canada where cargo tends to move from east to west and south to north - an imbalance not seen in passenger traffic.

As a final point, this joint supply of passenger and cargo service results in what has been referred to as "economies of scope". That is, joint production of separate products enables lower total production costs than if the products were produced separately. Thus, while air cargo has a joint supply function, it has an individual demand function. It is this phenomenon which creates the potential for cross-subsidization although, notwithstanding some allegations, there is no conclusive evidence as to whether this is actually taking place. The contribution of air cargo to Air Canada's profit at least suggests that there are low marginal costs associated with movement of cargo in passenger aircraft.

Canadian Regulatory Process

The Canadian Transport Commission (CTC) is given explicit powers to regulate certain economic aspects of the aeronautics industry, including entry and exit, rates and fares, and the terms and conditions of service. These powers are supplemented by detailed provisions in the Air Carrier Regulations which, in turn, contain detailed provisions dealing with: classification of commercial air services and air carriers; route operating licences and restrictions; changes of control, mergers, charter rules, passenger and cargo tariffs and tolls; and carrier recording/filing of information with the CTC .

Of particular importance is the power of the CTC to issue a licence to operate a commercial air service, scheduled or chartered, passenger and/or cargo, only after being satisfied that the proposed service is and will be required by the "present and future public convenience and necessity". In granting licences, the CTC also has the power to prescribe the routes which may be followed or the geographical areas to be served by the carrier and to suspend, cancel or amend licences.

Regarding air cargo, strictly speaking, there are no legislated provisions dealing expressly with the

industry. Instead, cargo and passenger services are treated the same. Perhaps this is not unusual for in Canada, cargo rights are almost always granted along with passenger rights. Accordingly, cargo carriers are required to meet the same licensing, tariff filing and information reporting requirements as the passenger carriers. The only exception to this exists in respect of domestic and transborder carriage of courier material by chartered aircraft. This will be discussed later in more detail.

Overall, these regulations evolved over a period of time during which the airline industry in Canada was in a developing state. During this period, due in part to the investment costs associated with operating an airline and the policy to foster a national integrated air transportation system, certain mechanisms were set up to replace the operations of the market with regulations to govern supply and prices. Accordingly, numerous regulations were put in place including regulations to restrict entry, exit and price competition.

It cannot now be said that the Canadian airline industry is in a developing state. This, of course, is well recognized and was a guiding principle in the "New

Canadian Air Policy" proposed by the Honourable Lloyd Axworthy. It was also recognized in the "Interim Report of the Air Transport Committee" (May 9, 1984). From the viewpoint of passenger service, and to the extent that almost all licences allow cargo carriage, these recent initiatives will improve the competitiveness of the market. However, given that they focus on passenger travel it is worth asking whether additional changes to the new policy would improve the competitiveness, efficiency and pricing of air cargo.

Before examining some of the problems associated with these existing regulations and their implications, an examination of the "deregulated" air cargo environment in the United States will be presented in order to serve as a benchmark for comparison purposes.

American Situation

a) Pre-Deregulation

Prior to the deregulation of the air cargo industry in the United States, the regulation of air cargo was quite similar to that of Canada. The Civil Aeronautics Board set and reviewed rate structures,

restricted entry, assigned routes and set other operational restrictions. In respect of new entry, the applicant had to satisfy the Board that the proposed service would meet the test of public convenience and necessity.[11] Also, the Board did not identify as separate markets, passenger, freight and courier services. As in Canada, this system was set up in an effort to balance supply and demand and thereby avoid instability which was perceived as the threat of an unregulated market.

Yet, the regulatory framework in the United States pre-November 1977 was viewed by many to be counter-productive. Some commentators felt that the regulation produced an artifical environment in that, "it provided stability for planning but on the other hand the price was lower productivity. Transportation rates during this period were founded upon historical relationship rather than costs. The regulations were burdensome and created low utilization and much wasted resources."[12]

Some commentators felt that the CAB tended to devote most of its attention to point-to-point passenger operations, and took a protectionist attitude insofar as it tended to maintain route restrictions and geographical limitations. These regulatory barriers to entry were

viewed to be "patently opposed" to an efficient competitive transportation system. Certification procedures were claimed to average more than two years, and it was felt that such a delay frustrated innovative service offerings, precluded flexibility and granted incumbent carriers the opportunity to catch up to competitors. The required rate filing and rate making rules were also seen to protect high rates and inhibit pricing flexibility.[13]

It was suggested that in qualitative terms, the costs of this regulation could be viewed in the reduced efficiency of the industry and, in the redistributions of income. Quantitatively, the loss was viewed as "substantial". A "crude estimate" of the total efficiency loss due to air freight regulation was $57.3 million in 1977.[14]

As a result of arguments like these, the air cargo industry was "deregulated" in November 1977. This was followed by the "deregulation" of passenger services one year later.[15]

(b) Cargo Deregulation Act[16]

The amending legislation provided that market forces would be regarded as the principal guide for air cargo industry structure and performance. It granted a one year transition period for incumbent carriers but, commencing November 9, 1978, "any citizen of the United States" could be given carrier rights as long as the applicant met a test of fitness, willingness and ability. Coincident with easy entry was easy exit and domestic cargo rate regulation was eliminated except with respect to discriminatory, unduly preferential, prejudicial or predatory pricing.

Thus, the amending legislation virtually removed the Board's authority over U.S. air carriers' domestic, all cargo and combination air freight operations.[17]

Passage of this law, particularly the removal of air cargo tariffs and filing requirements, prompted some commentators to suggest that shippers would be prejudiced by an inability to obtain adequate notice of shipment terms. Fears were expressed that rates would vary widely on a daily basis and that the information costs to the small occasional shipper would be large.

There was also an apprehension that easy exit would destroy the service to small centres. Freight forwarders claimed that the new ability of air carriers to become forwarders would be disastrous and finally, shippers felt that they would become subject to the whim of the carriers in respect of price and service. These problems did not materialize in the years following passage of the law.

c) Post Deregulation

One of the first results of deregulation in the United States was the curtailment by the larger passenger air carriers of their cargo services in secondary markets. Following their exit, however, smaller carriers began to expand and soon many grew into regional carriers offering passenger/cargo and all-cargo services. This type of reaction to changing market conditions has been a characteristic of market dynamics in the new unregulated environment.

Cargo rates were seen as rising significantly during the first two years after deregulation although this phenomenon could have been attributed to aircraft

fuel price hikes.[18] Others felt that the increases were due to the elimination of cross-subsidies from passengers to cargo.

In the longer term, cargo rates stabilized. This is said to have been attributed to the newly-acquired right of shippers to negotiate rates and levels of service. Carriers began offering various innovative service options and volume discounts to coincide with the exact needs of shippers.[19] In addition to a broader variety of service and price options, there were also more scheduled all cargo frequencies.[20]

Deregulation in the United States, both in air and surface modes, has also allowed what has been referred to as "cross-over" or intermodalism. That is, air carriers were no longer prohibited from engaging in alternate transportation modes. Thus, while deregulation allowed companies like Federal Express to buy and operate larger aircraft on more routes, it also allowed them to set up ground transportation networks to provide door-to-door delivery services.

This ability to become vertically integrated has not been limited to large operators like Federal Express.

Many of the smaller regional air carriers operate their own trucking networks, and it has been said that such integrated carriers sometimes transport freight which never gets onto an aircraft. Instead, the air carrier minimizes transportation costs by utilizing its trucks. The argument in favour of this system is that the regional air carriers are selling a service and not a mode of transportation. As long as the package is delivered on time, the shipper does not care how it is to be delivered.

This "cross-over" has also allowed freight forwarders to acquire aircraft and allowed air carriers to become freight forwarders. While some carriers have become freight forwarders, most freight forwarders have continued to use the scheduled and chartered aircraft of the direct carriers. Some concerns have been expressed that freight forwarder airlines will operate only between the major (lucrative) markets and thereby "skim the cream away" from the direct carriers. Accordingly regulation of "cross-over" is advocated.[21]

It is within the context of the American experience that the following Canadian problems can now be viewed. It must be noted, however, also in this context, that deregulation in Canada should not be regarded as a

panacea to all problems in the industry. Nevertheless, given the similarity of the Canadian system to that of the United States pre-1977, and given the estimated air freight efficiency losses in the United States attributed to the regulation, it appears that efficiency losses in Canada may also exist. The following will explore evidence with regard to the existence of these losses in Canada.

Courier Air Services

(a) Background

In Canada, there are various kinds of couriers including local or city surface couriers which, licensed either municipally or provincially, operate within specific city or urban boundaries. Intercity markets are also served via connections with affiliated surface carriers. A third type, the national and international couriers, provide much broader geographical coverage and accordingly rely upon air transportation. These companies will be referred to as air couriers.[22] Together, all three generate an estimated $700 million annual revenue of which $150-200 million is attributed to air courier revenues.[23]

There are reported to be about 20 air courier companies operating in Canada all of which offer the pick up and delivery of small packages, on a next day basis. A non-exhaustive list includes: Federal Express, Emery, Airborne Express, UPS, TNT, Kingsway, Gelco, Purolator, Dicom, Loomis, Brinks, Sky Cab, Burlington Northern, Canada Post, Air Canada, and CP Express. Of these, all except Federal Express and Airborne Express (which own and operate their own aircraft in Canada), use chartered and scheduled passenger and all-cargo aircraft.

(b) Air Courier Regulation

In the mid-1970's, in Canada there were no specific air courier regulations. Instead the industry was governed by three regulations: (1) the protective aircraft positioning charges; (2) the single entity charter rules; and (3) the standard route protection conditions governing the operation of charter flights over scheduled routes.[24]

During the 1970's, it became apparent that, in addition to their general freight services, some air carriers were chartering aircraft to courier companies. In doing so, they were offending these rules,

particularly the single entity charter rule which prohibited the chartering of aircraft to persons who were obtaining payment for traffic carried at a toll per unit. That is, as a consolidator on behalf of numerous shippers, the courier company was not just one entity but represented numerous shippers charging individual tolls to each.

A lobby for change, headed by the air courier companies was ultimately successful and, in May 1979, the Air Carrier Regulations were amended by the addition of subsection 112(12). This provision, an express exemption to the single entity charter rule, enabled the domestic charter of aircraft in groups A, B, or C (aircraft with a maximum authorized take-off weight not greater than 18,000 pounds) to persons operating courier services for the carriage of classified classes (a list) of material for overnight delivery and in packages not weighing over 50 kilograms. By February 1981, the aircraft size restriction was lifted.

In October 1981 carriers authorized to provide international charter services were allowed to charter aircraft for transborder flights to persons operating courier services. The provision was identical to that for

domestic charters, except on transborder flights, only aircraft in groups A, B, C, and D (aircraft with a maximum authorized take-off weight not greater than 35,000 pounds) could be used [s.112(12.1)]. Exclusion of larger aircraft ensured that the unit toll carriers would remain protected in respect of transborder services utilizing these aircraft.

By September 1983, concerns about the efficacy of these two regulations prompted the distribution of an Air Transport Committee working document entitled "Regulation of Courier Air Services". This paper requested comments on numerous outstanding issues including: the 50 kilogram package weight restriction; the list of allowed articles; split charters, and incidental traffic.

The following presents a brief overview of some of the arguments addressing these issues.

(c) Proposals for Change

Regarding the list of allowed goods, existing paragraph 112(12)(b) restricts the charterer to the carriage of: cash, precious metals, negotiable

instruments, bank documents, medical supplies and small machine parts. Concerns have been expressed that, apart from the fact that the carrier frequently does not know what commodity is in a parcel, the list of allowed goods is worded vaguely. For example, carriers can come up with varying interpretations of what is "small", what is a "machine" and what is a "part" and, an improper guess can open the carrier to a charge of contravening the regulations. As well, the list has been viewed as being artificial in that it often requires some unwieldy "line-drawing".

As an alternative, it has been urged that the list of permissible goods be removed, not only because of the interpretation difficulties and the artificial boundaries, but mainly because it should be the shipper's needs which determine the type of products carried. That is, the service provided by air couriers is door-to-door quick delivery of time sensitive material. It should be up to the shipper to determine if it wants to pay the premium for door-to-door overnight delivery.

Similar arguments have been presented in respect of the 50 kilogram weight restriction. That is, it is said that these rules mean that a shipper with a time

sensitive 49 kilogram article can utilize an air courier company which, in turn can consolidate shipments and charter an aircraft. On the other hand, while a 51 kilogram equally time sensitive parcel can still be given to a courier company (or a freight forwarder) the parcel can only be transported by licensed unit toll carriers because the single entity charter rule says that a consolidator cannot charter aircraft. In this latter situation, the time sensitivity requirement can be jeopardized.

It has been claimed that an expanded list of permissible goods and the removal of the weight limitation will allow air courier companies to become general freight forwarders (i.e. they will be able to transport courier material and general freight). In having the right to charter aircraft it is said that they will thereby change the nature of a charter operation to that of a toll per unit. It goes without saying that such a relaxation will introduce additional competition to the air cargo business of the licensed scheduled carriers. New competition, in turn, should promote better quality and cheaper service.

Presently, the air courier exemption stipulates, in part, that the charterer must be a "person" which

operates a courier service. Thus, the air carrier is allowed to charter aircraft to one courier at one time. But, this provision must be read in light of sections 21 and 37 of Schedule XIII to the regulations which allow split charters and incidental traffic on charter flights. Charter carriers have urged that these permissive rules be extended to their air courier operations in order to achieve increased operating efficiency. It is said that this increased efficiency will encourage lower rates and better quality service to shippers.

Again, it has been argued that to allow split charters and incidental traffic on courier charters will blur the distinctions between scheduled and chartered carrier services with the latter acquiring the status of a general unit toll service. Accordingly, it has been urged that both incidental traffic and split charters be prohibited when the charterer is engaged in courier service. It has also been said that if more than one courier charters an aircraft or, if incidental traffic is carried on a courier flight, the charter becomes a unit toll operation and, therefore, the carrier should be required to obtain a unit toll licence.

To attempt to rectify these problems the Air Transport Committee has presented several recommendations for changes. These recommendations include: (1) split charters on domestic charter flights should be allowed but only as long as all charterers are "bona fide" courier companies; (2) incidental traffic on courier flights should be prohibited; (3) the 50 kilogram package weight restriction should remain; and (4) the list of permitted goods should be deleted in favour of an allowance for the carriage of "time sensitive consignments".

Proposed amendments flowing from these conclusions have been presented.[26] As no further formal action has been taken, they are apparently not a CTC priority.

Single Entity Charter Rule

As indicated above, the single entity charter rule (s.112(11)) prohibits the charter of an aircraft to a person who obtains payment for traffic carried at a toll per unit. One of the direct effects of this regulation is the inability of freight forwarders to charter aircraft. That is, they are a consolidator and charge shippers a toll per unit for cargo shipped. Because they cannot

charter aircraft, freight forwarders are forced into using the services of licensed unit toll carriers. It is of course this protection granted to the unit toll carriers which may explain why the rule exists in the first place.

On the face of it, this is not necessarily alarming. Problems may arise, however, when one recognizes that about 80% of international cargo and 50 to 60% of domestic cargo is routed through freight forwarders.[27] Since freight forwarders must use scheduled airlines and given the reliance of scheduled carriers on carrying their cargo (70-80%)[28] in the bellyholds of passenger aircraft, then the potential for inefficiency arises. This inefficiency is due to the varying economics of cargo and passenger services. As indicated above, passengers prefer to travel in the early morning and early evening, and they prefer direct and return flights. On the other hand, shippers prefer that their cargo moves at night for early morning delivery and they are not adverse to multiple stop or indirect flights as long as their cargo reaches the required destination on time. As well, cargo tends to be one way. Again, this is further evidence of the inability of the regulator to adapt to market requirements.

Because of the predominance of cargo being carried in passenger aircraft, arguments have been raised to the effect that the needs of freight forwarders (and therefore shippers) are not being met. It has been suggested that this anomaly can be avoided if the single entity charter rule was removed. Such a repeal would mean that the charter carriers would be able to compete with the unit toll carriers for cargo carriage. This would likely mean that the more freighters would be offered to coincide with the unique demands of air cargo. The increased supply of a cargo lift would lower prices but the increased competition would maintain quality. It has also been argued that the resulting enhanced service would stimulate use of air cargo services. In this respect, the entry of all-cargo carriers and improved service in the United States is cited as evidence of the benefits to be derived from a relaxation of this rule. One such benefit, for example, is the 24 hour freight service in the United States. The norm in Canada is 48 hours.

Another example which shows the operating inefficiency associated with the Canadian rules can be seen in the operations of Emery World Wide, particularly, between its Dayton, Ohio hub and Toronto. For general freight, Emery charters a Boeing 727 which flies full from

Dayton into Toronto. Southbound, however, and due to the Canadian single entity charter rule, the aircraft flies empty to Buffalo where it is loaded with Canadian freight which has been trucked to Buffalo from Toronto. Apart from the time delay associated with this surface "shuttle", there are further disadvantages. The operation of the trucks, the extra maintenance and fuel burn on the aircraft and the extra handling all add to the costs that the shipper must pay. The extra handling also increases the incidence of damage to freight.

While there has been no industry-wide quantification of these costs, the argument is that they are substantial enough to warrant a review of the single entity charter rule. No formal review action has yet been taken.

Tariff Filing Requirements

While changes to the courier rules and the single entity charter rule would arguably benefit the charter carrier, the freight forwarder and the shipper, there have been proposals to change the tariff filing rules for unit toll carriers. Such changes would benefit those carriers.

Tariff filing requirements in the regulations stipulate varying notice periods prior to introduction of new rates. These time periods can, in certain circumstances, be abrogated by the Air Transport Committee.

The stated purpose of these tariff filing requirements, as expressed in s.113(1) of the regulations is "to permit the Commission to examine amendments to air carrier's rates and charges prior to their effective date and to make a determination on whether the proposals are just and reasonable".[29] Thus, if a carrier wants to make a tariff change, for example, in response to changing demand conditions, the carrier must incur a delay period prior to implementing the change. In an era when reductions in regulations are being considered, other alternatives must be considered to ensure that shippers can be protected from "unjust" or "unreasonable" rates.

The scheduled carriers have argued that these requirements are unfair because they compete with unregulated freight forwarders and courier companies which have total pricing freedom. Most importantly, freight forwarders and courier companies are able to alter their rates to shipper demand instantly - a luxury not enjoyed

by the air carriers. Accordingly, the carriers have argued that the tariff regulations represent an artificial constraint which prohibits them from effectively competing with freight forwarders and air courier companies.

To address this inequity, there are several options. First, all tariff filing and compliance provisions could be repealed. Alternatively, the carriers could be allowed to charge the amended rate prior to mandatory filing or thirdly, the filing period could be shortened.

The third alternative, at least in respect of the air courier industry, has been proposed by the Air Transport Committee[30] which advocated a one day filing period. As yet, no changes have been forthcoming. Again, these changes do not appear to be priority items.

Air Cargo Diversion

The inability, due to the regulations, of the Canadian air carriers to effectively compete with freight forwarders and courier companies is also said to exist on another front. It has been said that the lowering of cargo rates in the United States, attributed to the

pricing freedom and the absence of filing requirements associated with deregulation[31] has enabled American carriers to attract a substantial amount of Canadian cargo. This diversion of cargo away from Canadian carriers is said to be particularly acute in respect of shippers who are situated within trucking distance of American airports. Thus, Toronto and Montreal airports have been identified as being seriously hurt by this diversion. It was of course a similar diversion in respect of passenger traffic which was discussed at the Air Fare Hearings in early 1984 and which was a motivating factor behind the May 1984 "New Canadian Air Policy".

To effectively combat this competitive inequity, it has therefore been urged, as above, that the tariff filing requirements be eliminated. Such a change, it is said, would grant the Canadian carriers the pricing flexibility necessary to compete with American carriers.

Conclusions

The above discussion of issues in the Canadian air cargo industry suggests that the consideration of changes to the regulations affecting that industry should be a high priority.

Firstly, it must be said that the present regulatory environment in Canada discourages applications for new cargo licences or changes to existing ones. This is done by placing the burden of proof upon applicants who must show that incumbent carriers will not be adversely affected by the proposed service. As well, they must establish that public convenience and necessity are served by the proposal. This is a difficult if not time-consuming hurdle. The result then, is the reliance of shippers on incumbent carriers and, since these carriers predominantly carry cargo in passenger aircraft, the shippers' needs are being met in a sub-optimal fashion. Entry requirements must be relaxed.

More particularly, changes such as amendments to the air courier rules could enhance service and price to shippers as could alterations to the single entity charter rules. That is, a relaxation of these rules would remove entry barriers, expand the market for charter aircraft, grant new operating efficiencies and introduce new competition to the unit toll carriers. In turn, cargo rates should go down and speed and quality of service up. The special needs of the shipper will be better met by an increased all-cargo lift which would also encourage the elimination of any existing subsidization of passenger

service by virtue of the carriage of cargo in passenger and combination aircraft.

At the same time, changes to the tariff filing rules affecting Canadian carriers would improve their competitive position vis-à-vis freight forwarders and American carriers and, with respect to American carriers, a more flexible pricing policy in Canada might reduce any diversion of Canadian cargo to American airports. Again, the Canadian shipper should benefit by virtue of a lowering of cargo rates.

As indicated at the outset, this paper has not addressed the overall issue as to whether the Canadian air cargo industry should follow a path similar to that taken in the United States. Certainly, there are strong indications that deregulation has benefitted American shippers and the same benefits might be enjoyed in Canada. Suffice it to say, that the above discussion shows that there are some problems in our present system that should be dealt with by an alteration to the regulations. Given the growing importance of air cargo, evidence the increasing acceptance of "just in time inventory" management, there is a pressing need that changes be made now.

Footnotes

1. Air Transport Association of Canada, State of the Air Cargo Industry, (October, 1979), p. 11.

2. Statistics Canada, Canadian Civil Aviation 1982, p. 16.

3. See, supra note 1, p. 2.

4. Globe and Mail, November 30, 1981, Air carriers alter marketing strategies to attract shipments to non-peak hours, p. B-29.

5. Globe and Mail, June 27, 1983, Cargo Traffic Down but Revenue Soars for Air Carriers, p. B-9.

6. Toronto Star, March 5, 1985, Express Air Canada to offer same-day delivery in Canada, U.S., p. D-3.

7. See, supra note 5.

8. See, supra note 6.

9. See, supra note 1, p. 10.

10. An address by Mr. Bernard Gillies, Vice President, Cargo, Air Canada, to the CITL 1984 Conference, Toronto (January 27, 1984).

11. Federal Aviation Act, 1958, s. 401.

12. Air Commerce Magazine, supplement to the Journal of Commerce, September 21, 1983, Deregulation, p. 36.

13. Caron, Transition to a Free Market: Deregulation of the Air Cargo Industry (The Brookings Institute, Washington D.C., 1981), p. 16.

14. Id, at p. 16.

15. Airline Deregulation Act of 1978, Pub. L. No. 95-504, 92 Stat. 1705, (1978).

16. The Cargo Deregulation Act, Pub. L. No. 95-165, 91 Stat. 1284, (1977).

17. U.S., Report to Senate Committee on Commerce, Science and Transportation, Domestic Air Cargo Deregulation: A Preliminary Review, June 15, 1979, p. 588.

18. See, supra note 13, at p. 33.

19. See, supra note 12 at p. 4.

20. See, supra note 17 at p. 593.

21. Journal of Commerce, November 20, 1984, Forwarder Lift Could Spark Reregulation, p. 2-A.

22. Khan, Small Shipment Transportation, Canadian Transport Commission, Research Branch. No. 1984-02E, May 1982, p. 30.

23. Canadian Transportation and Distribution Management, September 1984, Air Courier Deregulation - A Winning or Losing Proposition, p. 50.

24. Canadian Transport Commission, Air Transport Committee, Regulation of Courier Air Services, 1983, p. 1.

25. Canadian Transport Commission, Air Transport Committee, Report of the Hearing Panel, Regulation of Courier Air Services, April 1984.

26. Canada Gazette, Part I, June 2, 1984, pp. 4495-4499.

27. See, supra note 1, p. 18.

28. See, supra note 1, pp. 11, 31.

29. See, supra note 25, p. 13.

30. See, supra note 26.

31. Canadian Freight Transportation System Performance and Issues 1984 (Ottawa: Transport Canada, Policy Studies Branch, 1984) p. 111.

AT THE CROSSROADS - THE FINANCIAL HEALTH OF CANADA'S LEVEL I AIRLINES

by

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INTRODUCTION

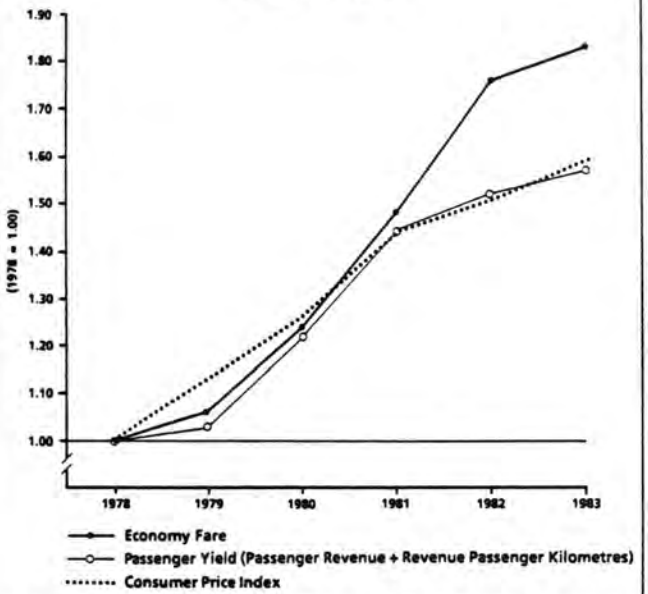
In 1981 the Air Transport Committee and the Research Branch of the Canadian Transport Commission on a joint basis, and in conjunction with the major Canadian airlines, (who formed a Task Force) undertook a programme of studies concerning airline pricing and financial performance. This paper is based on a CTC Working Paper[1] which presented current data on the topic, and interpreted them in the context of the financial and regulatory circumstances faced by the airlines as of July 1984.

ECONOMIC PERSPECTIVE

The trends illustrated in Figure 1 suggest that air transportation may have reached the stage of a mature industry with air travel/transport no longer accounting for an increasing proportion of economic activity. This milestone in the industry's life cycle, if in fact it has been reached, would suggest that an apparent fall in the income elasticity of demand for air travel between 1981 and 1983 could persist. As data reflecting the apparent demand resurgence of 1984 become available, the picture may change, but

Figure 2

AIR FARE INDICES



Sources: (1) Aviation Statistics Centre - Statement 3 - Unit Toll Services - Revenue Operating Statistics - 1983 Preliminary, and Statement 4 - Charter and Contract Flying Services - Revenue Operating Statistics - 1983 Preliminary

(2) Research Branch, CTC, "Inflation and the Canadian Airline Industry", December 1982, WP No. 40-82-10

(3) Statistics Canada Publications, Catalogue No.51-206, No.62-010

(4) Tariffs filed with the Air Transport Committee - 1983 Estimated

(5) Wardair International Annual Report 1983

Figure 1

AIR TRANSPORT REVENUE AS A PERCENT OF GROSS NATIONAL PRODUCT



Sources: (1) Aviation Statistics Centre - Statement 21 - Statement of Income - 1983 Preliminary

(2) Research Branch, CTC, "Equipment and Fleet Planning in the Canadian Airline Industry", August 1982, WP No. 10-82-05

(3) Statistics Canada Publications, Catalogue No. 11-003E, No. 13-004E

(4) Wardair International Annual Report 1983

historical growth rates are unlikely to persist over the longer term.

It is relevant to note the consistency of an achievement of industry maturity with the relaxed carrier protection features of current air policy. Also consistent are the general fall in passenger revenue yield relative to the economy fare, and the increase in the diversity and importance of discount fares as illustrated in Figure 2. The "six and five" programme would have been expected to affect price and revenue statistics, inasmuch as it limited economy fare increases. However, the observed increase in fare discounting during the "6 and 5" period suggests that economy fares may have been raised (the airlines took the maximum allowed, plus an allowance for fuel prices) beyond levels supportable by overall demand.

These pessimistic implications were drawn from data that could also be interpreted to support the thesis that prosperity will return as the business cycle progresses. The pessimistic perspective is, however, deemed appropriate as a background to this analysis; the Airline Task Force was originally motivated by the perceived poor financial health of the airlines, and there has been further deterioration in the interim. The current regulatory climate of relaxed pricing and entry regulation provides both opportunities (even under the pessimistic scenario outlined above) and pitfalls. The obvious opportunity for the industry as a whole is to exploit each market to the extent of its individual potential, employing value of service pricing to get the maximum out of the

market demand; this (all else equal) should lead to an increase in volume. On the other hand, opportunities for individual carriers are likely to involve exit from certain routings where they are at a disadvantage, while their competitors will exit from certain of their remaining routes (if not from the industry). The general fare increases, that the Level I airlines in their 1982 report concluded were necessary to the industry's financial survival, are most unlikely in the short run.

SUPPLY

Anticipation of strong and continuing growth in demand for air travel, as well as the need to replace older equipment, prompted the airlines to enter into a phase of planned aircraft acquisitions starting in 1978. In terms of available seats, capacity was expected to increase by approximately 20% over the 1980-85 period. These projected increases ranged from replacements of capacity, associated with a modest growth in available seats (zero for Nordair and 10% for Air Canada), to very substantial increases in available seats (49% for Wardair and 55% for EPA). The associated capital expenditure plans amounted to some $4.5 billion, spread rather evenly over the 1980-85 period.[2]

Changes to the airlines' plans since 1981 involved both modifications to planned acquisitions and the retirement/sales of older aircraft. The major changes to previously planned aircraft procurements are:

- Air Canada's 1982 Annual Report refers to 18 B767s (including an option for procurement of six aircraft in 1985) and three additional L1011s. The 1983 Annual Report does not refer to the option or the L1011s.

- CP Air in its 1983 Annual Report declared cancellation of the order for the four B767s; instead, CP Air intended to acquire 10 B737-300 aircraft, over the period 1985-88.

- PWA in its 1982 Annual Report indicated the intention to spread the planned procurement of four B767s over time; two to be delivered in 1983, with the procurement of the remaining two postponed until 1986-87.

- Wardair first noted, and then confirmed, the indefinite postponement of the six A310s it planned to acquire.

In summary, current forecasts indicate a total of 14 B767 aircraft and no A310s in operation during 1985, compared with earlier plans for 26 and 6 respectively. Parallel developments have taken place in the areas of accelerated retirements of obsolete airplanes, sales of older B737 models, and the acquisition of updated versions of this airplane as well as a scaling down in the size of certain types of equipment. The major changes in this field are:

- Air Canada has retired all DC8s from passenger service, (15 in total) and stored three older B747 models (two of these planes have since been sold).

- CP Air has sold five older B737s and its two B727s. It also cross-leased three of its eight long-range DC10-30s for three DC10-10 lighter and shorter range aircraft (plus $8 million annually).

- PWA and Nordair also disposed of their older B737 models (five and two respectively). In addition, Nordair disposed of two DC8 aircraft, while acquiring two additional turbo-prop FH227s. PWA reduced the number of L100s (Hercules) from two to one, and Quebecair disposed of three out of four B737s acquired in 1981, and leased four HS748 turbo-prop aircraft.[3]

Considerable changes also took place between 1981 and 1983 in the utilization of various aircraft types. Examples include:

- Air Canada withdrew its B747 aircraft from trans-continental routes in early 1982, increasing the use of L1011s and B727s.

- Both Air Canada and CP Air reserved the use of B747s for high-density international routes; even on these markets, increased use of the smaller long range L1011s and DC10s was noticeable. This applied also to Wardair's fleet utilization, especially in 1983.

- There appears to be a growing tendency to interface "hub and spoke" type networks with other Level I and local airlines (e.g., CP Air/EPA, PWA/Time Air, CP Air/Air BC).

Given the number of aircraft by type and carrier, and their associated payloads, resulting changes in capacity were developed. Capital expenditure estimates associated with the revised capacity forecast are shown in Table 1. Actual capital expenditures through 1983 based on information contained in the airlines' annual reports over this period amounted to $2.14 billion. An estimate for capital expenditures for 1984-85, consistent with information available (including capital commitments specified and reported by some of the airlines) amounts to about $1.0 billion, providing a total of $3.1 billion for the period 1981-85, with some $450 million committed in the 1986-88 time frame.

Table 1
CAPITAL EXPENDITURES
($ millions)

	1981	1982	1983	Forecast 1984	Forecast 1985	Sub-Total 81-85
Air Canada	472	304	344	480	160	1 760
CP Air	242	230	57	51	110	690
Wardair	84	11	7	12	20	134
PWA	100	71	120	24	35	350
Eastern Regionals	60	35	7	47	27	176
TOTAL	958	651	535	614	352	3 110

Source: Airlines' Annual Reports, 1981-1983.

DEMAND

One of the factors which influenced the Canadian airlines to enter into a phase of planned aircraft acquisitions in 1978, was the anticipation of strong and continuing demand for air travel, but with the exception of 1979, this anticipation did not materialize for the industry as a whole. To stimulate demand and fill otherwise empty seats the airlines embarked on extensive fare discounting. This was illustrated in Figure 2, where the fall in passenger revenue yield relative to the economy fare was presented, with the divergence being especially noticeable after 1981. A dual strategy of the airlines, capacity adjustments and attempts to stimulate demand, resulted in three out of the four major airlines having passenger load factors in 1983 (in spite of a sharp drop in industry demand) exceeding those in 1978 (see Table 2). In financial terms, however, the results were less than a real success and led to heavy losses in the industry.

Table 2
PASSENGER SERVICES: 4 MAJOR AIRLINES

	1978	1979	1980	1981	1982	1983
AVAILABLE SEAT KILOMETRES (BILLION)						
Air Canada	32.24	35.81	36.24	35.42	34.63	31.53
CP Air[1]	11.07	11.84	13.29	14.05	13.60	13.20
PWA[1]	2.12	2.57	2.78	3.09	2.83	2.75
Wardair[e]	4.86	7.07	7.77	7.82	8.51	7.74
PASSENGER LOAD FACTOR (%)						
Air Canada	62.7	65.8	67.4	65.2	63.1	65.0
CP Air[1]	68.9	70.6	70.1	68.7	65.5	70.0
PWA[1]	55.3	52.8	53.5	54.5	52.7	52.4
Wardair	78.1	77.2	78.7	72.4	72.6	80.0

[1]Scheduled services only. (e) Estimated

Source: Airlines' Annual Reports.

The success or failure of fare increases or discounting is partly a function of the responsiveness of demand to changes in fares, known as the demand price elasticity. The sensitivity of price elasticity estimates to various measures of demand, price and socio-economic activity was tested.[4] Also tested was the question of whether elasticities vary by market. The results suggest that the responsiveness of demand to price changes differs substantially between the various long-haul markets, and the estimates of elasticities were found to be sensitive to measures of demand. It can also be inferred that the quantity demanded within a specific fare class, would fall significantly as a result of fare increases, and that low-priced air fare travellers require price stimulation. The required level of stimulation also varies by market. The results indicate that overall fare increases are not likely to solve the industry's financial predicament but rather selective, market (route and service) specific action would be more logical.

Supply and demand are closely related, and neither should be considered in isolation. The implications of capacity increases, therefore, were examined in relation to traffic volumes. The approach followed in the analysis was to first infer an approximate level of output directly from the projections of fleet capacity. This level of output is referred to as the "capacity-constrained output". The second step was to contrast the capacity-constrained output for the total industry with expectations for market growth. For the purposes of the studies the capacity-constrained level of output expressed in revenue passenger kilometres (RPK) was calculated from the projections of fleet capacity, expressed in average payload tonnes (APT), by applying an output:capacity ratio. This output:capacity ratio is defined as the ratio of output (RPK) to average fleet capacity (APT).

Average payload is projected at 5000 tonnes and capacity constrained output at 47.6 billion revenue passenger kilometres by 1985 and to achieve zero excess capacity, 6% and 6.9% annual increases in traffic are required for 1984 and 1985 respectively (see Table 3). These aggregate increases do not appear unrealistic for the industry as a whole -- all else remaining equal. However, with increased competition and realignment of market shares among the Level I airlines, as well as the indicated expansion of Level II and III carriers into some short haul routes, the appropriateness of individual carriers' fleets to the demand circumstances they will face is questionable.

TABLE 3
LEVEL I AIRLINES: CAPACITY CONSTRAINED OUTPUT

Year	Average Payload Tonnes (APT)	Capacity Constrained Output (RPK) (BILL)	Traffic (RPK) (BILL)	Traffic Excess (Shortfall) (%)
Base Years				
1978	4260	39.7	38.1	(4.0)
1979	4510	42.6	44.0	3.4
1980	4820	45.7	46.0	.6
Average 1978-80	4530	42.7	42.7	0
Actuals				
1981	5110	48.6	45.1	(7.2)
1982	5110	48.6	43.0	(11.4)
1983	4800	45.7	42.0	(8.1)
Forecast				
1984	4770	45.4	44.6	(1.8)
1985	5000	47.6	47.6	0

Sources: (1) Airlines' Annual Reports, 1981-1983.
(2) Aviation Statistics Centre, Statements 3 and 4.
(3) Research Branch, CTC, "Equipment and Fleet Planning in the Canadian Airline Industry", August 1982, WP No. 10-82-05.
(4) Research Branch, CTC, "Fleet Capacity and Financial Health, Canadian Level I Airlines", August 1984, WP 60-84-13.

FINANCIAL ANALYSIS

The Level I airlines in their report Importance of Return on Investment presented historical rates of return to 1980 and compared them to similarly calculated averages for other industries, and concluded to the effect that airline rates of return were inadequate. The analyses presented here explored this premise and the companion issue of airline financial viability, both in greater detail and with the benefit of an additional three years of data.

The Level I airlines as corporate entities are far from homogeneous, and the extent to which financial and operating data

are available differs. The intent of this study was to capture the airline operations, as distinct from all commercial activities of the companies, and to do so in as comparable a manner as possible. As shown in Table 4, return on investment may have been low in the years to 1980, but it has deteriorated markedly since then. It is certainly far from the 19% the airlines argued as necessary to meet their cost of capital.

Table 4
RETURN ON INVESTMENT* (percent)

	1978	1979	1980	1981	1982	1983
Air Canada	9.4	9.7	9.2	8.0	2.3	5.7
CP Air	17.8	11.8	7.7	4.1	3.3	3.4
Wardair	8.1	5.3	13.6	5.6	5.6	9.0
PWA	7.0	10.5	10.0	13.2	8.5	7.8
Nordair	22.5	9.2	11.5	12.0	1.6	14.5
EPA	19.6	11.4	10.3	21.2	10.9	1.3
Quebecair	10.7	8.0	4.7	.7	(11.3)	(26.4)
Industry Total	10.3	9.6	9.5	7.8	3.4	5.2

*Defined as (net income + interest on long term debt) ÷ average total invested capital.

Sources: (1) Airline Annual Reports for Air Canada, CP Air, PWA, Nordair, and Wardair.
(2) Statistics Canada Publication, Catalogue No. 51-206 and Aviation Statistics Centre - Statement 21 - for EPA and Quebecair.

The airlines financial performance over the 1978-1983 period is shown in absolute terms in Table 5; and from this it is clear that, with the possible exceptions of PWA and Nordair, industry margins are thin; just how thin is illustrated in Table 6. The table also indicates the sensitivity of airline fortunes to revenue, either in terms of passenger yield (average fare level) or load factor, all else equal. As an order of magnitude, a 1% improvement in either would have doubled 1983's

industry net income. Cost savings without loss of revenue would have a similar effect. It can be concluded, therefore, that the industry is sensitive to economic fluctuations and this is reflected by the return on equity data.

Also partly responsible for the instability in the return on equity data is the capital structure, and its shift over time as illustrated again in Table 6. Several features are worthy of particular note. First, Air Canada's equity, restored through a 1978 conversion of $324 million in debt to equity under the Air Canada Act of 1977, fell markedly over the last two years. This deterioration in debt:equity ratio, while not grave in itself, when combined with the obvious cash squeeze indicated by the working capital trends (a loss of $350 million over 5 years) suggests approaching capital difficulties. CP Air's fall (a $140 million working capital deterioration, and increase in long term debt to virtually 90% when arrested by what amounts to a debt to equity conversion by its parent) must be viewed seriously, but in the perspective of CP Ltd.'s financial strength. Wardair's situation, to the end of 1983 with a negative and deteriorating working capital combined with negative and deteriorating equity, speaks for itself.[5]

Table 5
OPERATING INCOME*, INTEREST ON LONG TERM DEBT (LTD), NET INCOME
($ millions)

	1978	1979	1980	1981	1982	1983
Air Canada						
Operating Income	84	101	90	73[3]	(26)	28
Interest on LTD	46	46	44	55	63	80
Net Income	47	55	57	40	(33)	4
CP Air						
Operating Income	44	33	22	(3)[3]	(26)	(2)
Interest on LTD	11	15	22	38	57	39
Net Income	21	16	7	(17)	(35)	(13)
Wardair						
Operating Income	5	12	50	29	7	27
Interest on LTD	11	22	22	24	26	21
Net Income	-	(10)	8	(11)	(13)	(3)
PWA						
Operating Income	12	14	19	26	25	27
Interest on LTD[1]	7	21	22	28	23	21
Net Income	8	13	12	18	6	11
Nordair						
Operating Income	5.6	4.4	7.6	6.8	(1.6)	4.1
Interest on LTD	.5	1.3	3.6	4.3	3.2	2.6
Net Income	4.6	2.1	2.7	2.5	(2.4)	5.0
EPA						
Operating Income	2.0	.9	.5	7.6	3.3	(6.8)
Interest on LTD[2]	2.5	2.1	1.9	3.5	3.9	3.4[e]
Net Income	3.3	1.0	.9	4.4	.9	(2.9)[e]
Quebecair						
Operating Income	1.6	(2.0)	.9	(2.4)	(7.4)	(8.2)
Interest on LTD[2]	2.2	2.6	3.0	7.2	9.4	3.8
Net Income	(.2)	(1.0)	(1.4)	(6.8)	(16.6)	(16.6)
TOTAL						
Operating Income	154	163	190	137	(26)	69
Interest on LTD	80	110	119	160	185	171
Net Income	84	76	86	30	(93)	(16)

*Operating Income - Profit (loss) from operations based on total operating revenues less total operating expenses.

Notes:
1. Includes dividends on preferred shares.
2. For 1978-1982, total interest expense.
3. Transportation Fuel Compensation Recovery Charge (TFCRC) levied in 1981 rescinded in 1982 Air Canada $26M, CP Air $10M.
(e) Estimated

Sources:
(1) Airline Annual Reports for Air Canada, CP Air, PWA, Nordair and Wardair.
(2) Statistics Canada Publication, Catalogue No. 51-206 and Aviation Statistics Centre -Statement 21 - for EPA and Quebecair.

TABLE 6
4 MAJOR AIRLINES: SELECTED INDICATORS OF FINANCIAL PERFORMANCE

	1978	1979	1980	1981	1982	1983
OPERATING INCOME MARGIN* (%)						
Air Canada	6.4	6.3	4.7	3.2	(1.1)	1.2
CP Air	9.4	6.1	3.2	(.4)	(3.1)	(.2)
PWA	6.7	6.9	7.8	8.3	7.8	8.2
Wardair	3.2	5.6	16.7	9.2	2.0	7.4
NET INCOME MARGIN** (%)						
Air Canada	3.6	3.4	3.0	1.8	(1.4)	.2
CP Air	4.5	2.9	1.0	(2.1)	(4.1)	(1.5)
PWA	4.3	6.4	4.9	5.8	1.9	3.4
Wardair	-	(4.7)	2.7	(3.5)	(3.8)	(.8)
RETURN ON EQUITY*** (%)						
Air Canada	20.4	12.6	11.9	7.8	(6.5)	0.8
CP Air	52.5	19.8	7.0	(17.0)	(39.3)	(6.3)[2]
PWA	25.0	31.0	21.8	25.7	7.3	7.9[3]
Wardair	0	-4	400	-4	-4	-4
LTD/INVESTED CAPITAL**** (%)						
Air Canada	59	57	56	57	65	69
CP Air	67	70	76	84	89	59
PWA	89	85	83	77	75	60
Wardair	96	100	97	102	109	112
WORKING CAPITAL***** ($Mill)						
Air Canada	299	269	205	12	(35)	(49)
CP Air	4	(17)	(35)	(58)	(110)	(136)
PWA	175	152	137	59	44	77[1]
Wardair	6	-	2	(15)	(30)	(19)

* Operating Income (loss) divided by Operating Revenue.
** Net Income (loss) divided by Operating Revenue.
*** Net Income divided by average of yearly opening and closing equity.
**** Long Term Debt: includes current portion; does not include deferred taxes.
***** Current Assets less Current Liabilities (excluding current portion of LTD).

Notes:
(1) The 1983 figure for PWA should be viewed in the light of the major financing and accounting restatements that occurred during that year.
(2) Reflects substantial conversion of debt into equity by CP Ltd. parent.
(3) Reflects substantial equity injection.
(4) Wardair's negative equity in these years leads to meaningless results.

Source: Airlines' Annual Reports.

The Canadian airlines, with annual asset turnover of the order of 150%, are not a highly capital intensive industry. Further, the airline industry is characterized by fungible assets (approximately 80% of the total) for which an active market exists. Servicing their debt is certainly a problem for the airlines, but to view the situation in perspective one must recognize that 1983 interest on its long term debt only accounts for 3.5% of Air Canada's operating revenue; even for Wardair, with its 112% debt capital structure, this figure is less than 6%. Individually, the airlines have no problems that, all else equal, a 5% improvement in load factor would not solve. Indeed, as the airlines claim, return on investment is below cost of capital; however, there is also excess capacity.

Freedom to increase fares, as suggested by the airlines, would not fully resolve the problem; with relaxed entry regulation its impact would be limited. Relaxed entry regulation would encourage aggressiveness and efficiency, and more active competition could achieve what regulation and a high degree of direct government (federal and provincial) involvement has been unable to do -- reduce the number of active competitors on a given routing by discouraging the relatively inefficient carriers from remaining in that market; it could also reduce "cost-push" pricing tendencies. The analysis reported here suggests the presence of operating and expanding Canadian airlines, persisting under circumstances where a businessman, who was interested solely in maximum return on his investment, would contract or close down his airline operations and redeploy his

resources in more lucrative ventures. Thus, it is possible that the industry will persist at a less than economically efficient level indefinitely, but the financial circumstances of the airlines give a clear indication of the direction industry attrition could take.

When one views the Level I airlines as they enter a period of more active competition, it is relevant to focus on the differences. In 1983, both CP Air and PWA received substantial infusions of equity, the former over $200 million from its CP Ltd. parent, and the latter $100 million from a market issue. The trend in Air Canada's financial state is towards a point, perhaps in 1985 or 1986, where the government is obligated to contribute further equity. Air Canada's debt burden gives it financial security regardless of any intentions of a government of the day; the government ownership and debt: equity covenants of its United States Export-Import Development Bank loans preclude it ever falling into financial circumstances approaching those Wardair is facing. Nordair enjoys certain benefits associated with northern routings that are protected from competition, and EPA is effectively now part of CP Air. This leaves Quebecair and Wardair. Quebecair is expected to survive or disappear, in part, on the basis of non-economic government objectives.

The future for Wardair could be interesting. Its working capital deficit is serious, and with negative equity, further debt issue (except conceivably tied to equipment purchase) is most unlikely. Wardair needs equity, but with its debt burden and a

fleet of wide-bodied aircraft, neither suited to active competition on low density Canadian routings; nor currently in demand on the resale market, substantial new equity on favourable terms is unlikely.[6] As such, Wardair is in a vulnerable position.

IMPLICATIONS

Although the recent shift in the commercial and regulatory context, under which Canadian airlines operate, makes prediction distinctly speculative, certain implications (if not conclusions) can be drawn. Competitive success is expected to depend on two factors. Marketing, and thus the degree of acceptance of an airline by the travelling public, is likely to be a major consideration, but one whose success or failure can not be gauged at this time. The other major factor is the airline's financial strength and the suitability of its fleet under the competitive circumstances with which it is faced. In this aspect, new entrants are also a consideration.

The 1984 domestic air policy was designed to encourage increased airline competition. As intended, change has been gradual but steady, with no evidence of market instability. There already is some limited evidence of the direction in which the carriers are moving since the introduction of the new policy. However, because the policy, to a large extent, formalized a trend towards increased competition that has been encouraged for some years, there is a substantial further body of carrier reaction evidence available. Two trends, with equipment implications, should be highlighted.

The first is an accentuation of competition on the high density transcontinental long-haul routes that were the traditional source of surplus. Evidence of this competitive focus is found in the shifting trend of discounts. Discount fares as originally introduced in the late 1970s -- Advance Booking Charters (ABCs), Charter Class Canada, Courier Jet, Nighthawk, Skybus and off season Seat Sales -- focused on inducing travel demand that would not fly at full fare, and persuading travellers to patronize off-peak flights. These programmes were aimed at overall cost effectiveness and industry revenue expansion, but recently there has been a shift of focus towards inter-carrier competition.

The second trend with equipment implications for the Level I carriers is the expansion of Level II carriers into their short-haul markets. Examples include City Express' expansion in the Ottawa-Toronto market with its acquisition of DHC7 aircraft, Air BC's expansion in Vancouver-Victoria-Seattle, Time Air on the Prairies, and Air Ontario. If trends towards this sometimes competitive sometimes cooperative shift continue, they would have the result of forcing small jet aircraft (DC9 and B737) out of the short haul segment. The extent to which this will occur is not yet clear, but it could contribute to availability of these aircraft for longer hauls.

The projected overall shorter term effect on equipment is a squeeze on the B747, L1011 and DC10 aircraft in long-haul trans-continental service. Traffic densities are such that, with more

carriers operating and the need to maintain departure frequency to avoid the loss of full-fare paying passengers, it will be increasingly difficult to maintain satisfactory load factors with large aircraft. On the other hand, smaller turbojet aircraft will be released from short-haul to fill the gap. The overall efficiency effects of this will be mixed. On the short-haul side, expansion of the turboprop carriers in this market could be expected to improve economy for origin-destination passengers, but there will be some losses where the short-haul is but one leg of a larger trip. The retirement of wide-bodied aircraft in favour of less comfortable and higher seat-kilometre cost smaller ones will, of itself, have a negative effect. Competition, however, is a stimulus to efficiency, and should lead to cost reduction.

Some of the negative effects above may be only short term, but the effects of a changed competitive environment on the carriers will be permanent. In any industry where competitors are of unequal strength, one of the longer term effects of less regulated competition may be a reduction in the number of active competitors, due to the withdrawal of relatively less efficient participants. This is made more likely when there are "spoils" of economies of density to accrue to the survivor(s). Viewing the carriers as they enter a phase of increased competition, Air Canada, with its (still regulated) overseas operations utilizing many of its large aircraft, and a fleet of new B767s that offer appropriate size, operating economy and wide body comfort, is in a strong position. Wardair's equipment circumstances represent the opposite extreme, while

CP Air, PWA and Nordair have fleets of sufficiently efficient and small sized aircraft to offer them flexibility as the less regulated environment unfolds.

FOOTNOTES

[1]Fleet capacity and Financial Health, Canadian Level I Airlines. Research Branch, CTC, August 10, 1984, WP N°. 60-84-13.

[2]Airline Financial Performance: Importance of Return on Investment to Financial Viability, Industry Task Force Report, March 1982.

[3]FH227 and HS748 have approximately 40% to 50% of the seating capacity of a B737.

[4]The Demand for Long Haul Air Travel in Canada, Research Branch, CTC, April 1982, WP N° 10-82-04.

[5]At the time of revision of this paper, the recapitalization indicated by these facts is underway.

[6]Although details are not yet known, it seems that Wardair has reorganized its capital structure.

THE EASTERN PROVINCIAL AIRWAYS DISPUTE - SOME REFLECTIONS AND IMPLICATIONS FOR THE FUTURE

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ABSTRACT

One of the most controversial and bitter labour conflicts in the early 1980's was the 1983 contract dispute between the Canadian Airline Pilots Association (CALPA) and Eastern Provincial Airways (EPA). The objective of this paper is to examine the major areas of dispute which precipitated the strike, and the subsequent rulings by the Canada Labour Relations Board (CLRB) and the Federal Court of Appeal. The decisions of these two bodies will be assessed as to their implications for future labour relations in the airline industry. Finally the paper discusses the potential effects of deregulation on collective bargaining, particularly during the transitional period towards a more liberal regulatory regime.

Background to the 1983 Strike

Eastern Provincial Airways (EPA) is a regional airline based in Atlantic Canada, which at the time of the dispute was a wholly owned subsidiary of Newfoundland Capital Corporation. It serves the major centres of the

Maritimes as well as Montreal and Toronto. Although there is substantial competition with surface transport due to short haul distances, its only existing intra-modal competition is Air Canada. EPA operates a fleet of six Boeing 737 and five Hawker-Siddley 748 aircraft.

The Canadian Airline Pilots Association (CALPA) is a national organization representing the pilots of seven major airlines, one of which is EPA. The pilots of EPA joined CALPA in June, 1975. Prior to this, they were organized into their own union, the Maritime Air Line Pilots Association (MALPA).

As EPA grew in the mid 1970's, employee groups sought affiliation with larger, national labour organizations. The first group to leave the company union was the flight attendants, followed shortly thereafter by the pilots. It should be noted that the executive officers of MALPA were opposed to the merger with CALPA. These individuals, formerly tough union negotiators joined management when CALPA was certified as the legal bargaining agent for EPA pilots.

In 1976, Mr. Harry Steele, a retired navy officer, joined EPA as Vice President of Marketing. That same year, flight attendants went on strike. Steele used management and office workers as temporary replacements for the flight attendants and effectively broke the strike by maintaining the airline's operation. According to CALPA officials, there has been a progressive

deterioration of labour relations within the company from that point onward.

In 1982, EPA decided that is should rationalize the costs of its HS-748 operations. Management felt that the economics of turbo-prop aircraft were entirely different from those of jet aircraft, yet, the labour costs and schedules of the HS-748 reflected those of the B-737. The result of this reorganization of turbo-prop service was the creation of a new subsidiary named Air Maritime. Newfoundland Capital Corporation intended to separate turbo-prop and jet operations into Air Maritime and EPA respectively.

The Air Maritime dispute was brought before the Canadian Transport Commission (CTC) in 1982. At the conclusion of the hearings, Judge Green ruled that different conditions should apply for turbo-prop operations. The maximum number of monthly credited hours for pilots was increased to 85 for HS-748 aircraft. The CALPA pilots were disappointed by this decision.

The 1983 Dispute:

On September 30, 1982 the pilots' contract expired thus leaving the CALPA pilots in a legal strike position. Letters had been exchanged throughout the summer expressing interest in reopening negotiations but the parties did not meet until October 15, 1982.

The structure of Air Maritime remained a contentious issue. CALPA did not want the two airlines to be

organized separately since it would involve separate contracts and pilot seniority lists. More importantly, in the event of a strike, the other airline could fly the striking airlines' routes. Thus the threat of a strike would be removed as an effective bargaining tool for the union. Furthermore, with two seniority lists, career advancement for pilots would be seriously inhibited. The union also desired wage increases: 12% and 10% per year for B-737 and HS-748 pilots respectively. They also wanted to increase the pension cap from $40 000 to $60 000 per year.

EPA had different demands. In particular they wanted increased productivity from their pilots: monthly credited flying hours would increase from an average of 77½ to 85 for B-737 pilots. An incentive-based wage schedule would involve a minimum annual increase of 8% with an average increase of 17% per year.

Management argued that they could not afford a wage increase for turbo-prop pilots since labour costs had to be rationalized: a HS-748 had labour costs which were 75% of those of a B-737, yet only 35% of the revenue generating potential. In keeping with its strategy of improving productivity, EPA demanded that turbo-prop pilots increase their monthly credited hours from 85 to 90 hours.

The company offered to increase the pension cap for all pilots to $50 000 per year. All existing pilots of

EPA and Air Maritime would be on one seniority list. They could therefore exercise "bumping rights" and access any equipment in either airline. However, any new pilots hired by Air Maritime or EPA would be on separate seniority lists. This latter proposal would result in what is known in labour-relations as a "two-tier" contract.

On October 29, 1982, CALPA President R.E. Cook wrote to the Federal Minister of Labour, Charles Caccia requesting that a conciliator not be appointed and that the "parties be left to their own devices". CALPA felt that a conciliator would have little or no beneficial effect because on earlier occasions, EPA had ignored the recommendations of conciliators.

Management, on the other hand, perceived this action as an attempt by the union to position themselves for a strike during the Christmas season. EPA wrote the Minister of Labour in November urging him to appoint a conciliator to the negotiations. The Minister replied on January 4, 1983 that he would not appoint a conciliator to the talks therefore acceding to CALPA's wishes while preventing a disruption of Christmas travel. Under the Canada Labour Code the two parties had to reopen negotiations within seven days or else a strike or lockout could occur.

The EPA negotiating team met with senior management to discuss their current bargaining position. As a result of some informal discussions with CALPA negotiators they

believed that if they addressed the Air Maritime issue, CALPA would reconsider EPA's request for productivity increases.

Subsequently, EPA decided to restructure Air Maritime so that it would be a division of EPA rather than a separate subsidiary of Newfoundland Capital Corporation. This decision effectively made the EPA proposal compatible with CALPA's demand for a single seniority list for all pilots (EPA and Air Maritime).

On January 6, 1983 the EPA negotiating team outlined their new job security/seniority position in a meeting with CALPA. In return for this concession, airline management asked the union to address EPA's productivity demands: CALPA refused citing that EPA's Air Maritime proposal was not a concession, merely a compliance with the wishes of the Ministry of Labour.

At this point management withdrew their wage offer of October 22, 1982 claiming that the financial condition of the airline had deteriorated to the extent that it could no longer afford such a package. Indeed, the economic environment of the airline industry was the worst experienced in its history. Most major national and regional airlines suffered from lower load factors due to the recession.

During this period, EPA was also involved in collective bargaining with its clerical and maintenance employees. The International Association of Machinists

and Aerospace Workers (IAMAW) voted to strike on January 5, 1983. In response, EPA management locked out the 350 IAMAW members on January 6, 1983.

By mid-January, EPA had cut 65% of its services in an effort to retrench during the IAMAW strike. On January 16, the EPA team called CALPA back to the bargaining table to discuss less contentious issues. CALPA felt that the major areas of dispute (productivity, wages) should be negotiated first and in the event of an impasse, strike action would be taken. At this time, CALPA had taken a strike vote among EPA pilots but did not tabulate the results until negotiations failed on January 26, 1983. On that date EPA submitted a complete package including a new wage offer, which was unacceptable to the union negotiating team. The next day the pilots went on strike.

The strike continued for the next month without meetings between the two parties. On February 25, 1983, CALPA and EPA met to discuss the strike. The airline was operating only 35% of its schedule and revenue was declining dramatically. Similarly, the strike had taken its financial toll on the pilots. Both groups were willing to make some concessions but conflicted when a return to work agreement was also discussed. The highlights of the proposed agreement were as follows:

1) EPA was not in a position to resume full schedules immediately since it had been operating only 35% of its flights for nearly two months. It would take

1½ to 2 weeks to return to its pre-strike schedules. Consequently pilots would be recalled according to seniority as work became available. It should be noted that some pilots required retraining as their competency had lapsed during the strike.

2) The pilots who remained at work or were promoted during the strike would continue to fly in those positions.

3) There would be no recrimination for any legal acts committed during the strike by either pilots or management. In other words the union could not take any penal action against the two CALPA pilots or any management pilots who flew during the strike.

CALPA viewed the return to work agreement as yet another manifestation of EPA's "receding horizon" strategy. Whenever negotiations came close to a settlement, EPA would add terms and conditions to the collective agreement. In essence, they were trying to force as many concessions as possible. One of the terms added was that there would be no reprisals against pilots that flew during the strike, and that promotions made during that period would remain intact. This was unacceptable to CALPA since it would result in the demotion of some striking pilots. If the pilots were not penalized then it would weaken the collective discipline

of the union.

EPA then sent letters to the striking pilots, warning them that if they did not return to work by March 1, 1983 replacement pilots would be hired. Management argued that this action was necessary to meet its interlining commitments with CPAir and to ensure the long term viability of the airline. At the end of the strike, the striking pilots would be recalled according to seniority and the availability of work. In other words, some of the striking pilots would be laid off indefinitely until passenger demand increased but none would be fired. However, once recalled to active duty, a CALPA pilot would resume his seniority over the new pilots; if there were subsequent layoffs, the new pilots would be the first to be affected.

The IAMAW strike ended on March 10, 1983. Clerical and maintenance workers agreed to increase productivity and returned to work under the same "return to work" agreement offered to the pilots. It should be noted that this strike did not involve strikebreakers, the promotion of nonstriking workers, or replacements. Since CALPA was still on strike, many of the IAMAW workers would not be recalled for some time.

On March 28, 1983, the Canada Labour Relations Board (CLRB) began hearings into charges of unfair labour practices by both union and management. The hearings were suspended the following day when the two parties agreed to

resume negotiations.

During these discussions CALPA and EPA decided on a job security/seniority system for Air Maritime. More importantly, the union agreed to EPA's demands for productivity gains. Furthermore, CALPA accepted the Company's wage package and extended the contract length to three years. The union announced publicly that it had capitulated to EPA management.

The pilots complained that as part of EPA's strategy of receding horizons, the 18 replacement pilots (or "scabs" in the union's words) would be retained. Of the 90 pilots that went on strike only 54 were requested to return to work. The remainder of the striking pilots would be laid off indefinitely. The union negotiators argued that they could not bargain away the jobs of some CALPA members and wage increases for others as it contravened the union's duty to represent all members fairly and equitably.

With the continuation of the strike into April, EPA hired more replacement pilots to ensure the airline's operation. The CLRB hearings resumed on April 18. CALPA was allowed three days of testimony while the airline had less than one day before the panel ended the proceedings. The CLRB panel rendered its decision on May 27, 1983 and ruled in favour of CALPA (8).

The board ordered EPA to negotiate a return to work agreement without the "availability of work" stipulation.

Furthermore, the airline would have to rehire all striking pilots immediately under the terms of the April 4 tentative agreement. Striking pilots would return to their pre-strike seniority status thus displacing the replacements. Although the CLRB allowed the airline to retain the new pilots, there was insufficient work to keep them on active duty.

A return to work agreement was signed on June 10, 1983. The airline filed an appeal with the Federal Court of Appeal complaining that the CLRB panel conducted the hearings in a biased manner and had exceeded its jurisdiction. EPA claimed that it did not have an opportunity to present all of its witnesses before the conclusion of the hearings. Furthermore, they felt that the panel had attempted to impose a collective agreement rather than merely interpret the Canada Labour Code.

On October 6, 1983 the Federal Court of Appeal ruled in favour of EPA and ordered a new panel to investigate the complaints of unfair labour practices. This action nullified both the collective and return to work agreements of June 10, 1983.

At this point, EPA notified the CALPA pilots that the airline considered the union still on strike. As a result, forty pilots were laid off and replacements were hired to fill their positions. CALPA requested an injunction until the second CLRB panel reached a decision. The court refused because a collective agreement did not

legally exist.

By the time the second CLRB panel convened, the union was better prepared than it had been in April and believed it had a much stronger case. The panel took six weeks to hear from all the witnesses and participants. The panel reached its decision on December 20, 1983 (9). It ruled that EPA had bargained in bad faith on two accounts:

1) ignoring the bargaining unit by writing directly to individual pilots; and

2) EPA's firm position as to the irremovability of the replacement pilots.

CALPA was also found guilty of bargaining in bad faith with respect to the contradictions between their public and private postures. The panel ruled that all pilot positions at EPA and Air Maritime were vacant and ordered the airline to recall pilots according to their pre-strike seniority and the availability of work. The decision recognized both the seniority of the CALPA pilots over the replacement pilots, and the economic necessity of recalling pilots only as passenger demand allowed.

EPA announced it would appeal the ruling and requested a stay of execution pending the Court's decision. On January 9, 1984 the Federal Court of Appeal refused the stay of execution. One week later the pilots ratified a new labour contract. The terms were similar to those offered by management in April 1983 and were essentially the same as the contract imposed by the first

CLRB panel.

Although a tentative collective agreement had been signed, the return to work terms were still under dispute. During this period the airline continued its operations using both CALPA and replacement pilots in cockpit crews.

In the fall of 1983 the Canadian Air Transportation Administration of Transport Canada received complaints of tension between cockpit crews and allegations about poor aircraft maintenance. Transport Canada began monitoring EPA flights on a more frequent basis but its inspectors reported that operations were satisfactory.

By mid January 1984, Transport Canada received more complaints about poor flight safety. At this point Transport Canada increased its monitoring of EPA flights to the extent that almost every cockpit crew included an inspector. Soon thereafter, flight inspectors reported that cockpit hostility was intense and might pose a threat to passenger safety. In response, Transport Canada amended the airline's operating certificate, preventing them from mixing union and non-union pilots. The task force of flight inspectors continued for one week to ten days after the order to ensure compliance, and, monitor cockpit tension.

Presently, most of the replacement pilots are laid off from active duty. Some of EPA's market share was lost on a long term basis due to the negative publicity surrounding the dispute. The conflict changed the

complexion of labour relations in the company; it was evident from interviews that much bitterness and resentment still exists between pilots and management. However, CALPA officials express optimism for the future as they will be dealing with former CPAir management rather than those individuals who were involved in the conflict.

Conclusions and Implications for the Future:

The relationship between labour and management varies between firms and industries. It can range from cooperation and cordiality to hostile conflict. Labour-management relations are dynamic in nature so that over a period of time the relationship may shift along the continuum (7).

On this spectrum of labour-management relations, the 1983 EPA/CALPA dispute clearly represents that of open conflict between the two parties. This situation is usually characterized by distrust and contempt for the other group's interests and motivations. Long and bitter work stoppages often result. From the late 1970's to 1983, the relationship between EPA and its pilots gradually deteriorated to the extremely adverserial posture exhibited during the dispute.

This begs the question: "Why did the situation deteriorate between management and labour?" In addressing this question it is important to recognize the vital part

that both internal and external environmental factors play in labor-relations. Quinn Mills, in his book entitled "Labour - Management Relations", states:

> "Labour relations have a better chance of being peaceful and equitable when the product market is strong and the company is profitable, so that employees can be paid well; when employees have skills and status in the community; and when the broader organizations such as the corporation headquarters and the national union, are of responsible and responsive character." (7, p.117)

These conditions existed in the airline industry during the 1960s and 1970s. Generally the industry and most airlines were profitable and their pilots were respected and extremely well paid. Both the company and CALPA were growing so they could "afford" a cooperative relationship.

In the 1980's, however, each of Quinn Mills'(7) factors were reversed. The severe economic recession dramatically reduced demand for air travel. The industry as a whole was not profitable and most airlines were incurring substantial losses. Just as profitability and expanding markets fostered integrative bargaining in the 1970's where increases to labour costs could be passed onto the consumers through regulatory mechanisms, the 1982 recession forced distributive bargaining in contract negotiations. In essence, the once ever expanding pie had

reached its limit and indeed was shrinking.

Although EPA had realized a small profit in 1982, it became a source of contention in the conflict. Management wanted a higher return on its investment, particularly in the light of much needed fleet replacement. CALPA on the other hand, believed that the profit was a sign of EPA's financial health and the Company could therefore afford to accede to their demands.

Perhaps the most important of Quinn Mills' (7) factors that had been reversed had been labour and management's perception of one another. Their poor relationship was built upon successive conflicts, many of which had been inadequately settled. Thus, there was the cumulative effect of strain in the dispute. Finally, personality conflicts and misunderstandings tended to exacerbate the situation.

A number of conclusions can be drawn from this dispute. The rulings of the two CLRB panels serve to reinforce current regulations preventing "unfair labour practices" by either management or labour. If there was a time when these regulations would be relaxed, it would occur during a severe recession as was experienced during the strike. In the United States a combination of deregulation and recession caused the alleged near bankruptcies of some major airlines. The consequence was the reorganization of the company's operations, a rationalization of labour costs and a rollback of employee

rights. It is significant that in Canada, a similar attempt was only partially successful : EPA received major contract concessions from its pilots but it failed to disenfranchise its pilots from the national union.

The job security of striking employees has also been protected. Replacements may be hired for striking employees as it is within management's rights to maintain its schedules and operations to the best of its ability. However, the replacements, or "scabs" in union terminology, may not permanently replace any employees who are on a legal strike.

In the short-term, the negotiating position of CALPA has probably been strengthened by this dispute for three reasons. First, the availability of replacement pilots may be more limited in the future since CALPA members realize that there can be no longterm benefits to those who fly as replacements during a strike. In other words, there will be less tendancy for CALPA members to break with their union to become replacement pilots. Indeed, the CALPA membership contract outlines that pilots who fly during a strike are subject to penalties and prosecution. Secondly, union solidarity was maintained for the most part since few of the replacement pilots were CALPA members. CALPA pilots employed by other airlines contributed to the EPA pilot strike fund, and attempted to pressure the airline through other means. Thirdly, both CLRB panels found that EPA management was at fault for

contacting individual pilots directly, thus bypassing their legal bargaining representative (CALPA). Therefore, the union's authority is reinforced for future collective bargaining.

This dispute can be considered as a landmark case for Canadian airline labour relations. It raises and suggests answers to a number of questions about the effects of deregulation on labour management relations, particularly during the transitional period. Some of these questions include:

1) What will be the effect of increased competition on labour markets?
2) What changes in demands can be expected in contract negotiations?
3) What are the implications for national unions and their membership?
4) Will deregulation promote a shift toward conflict or cooperation on the spectrum of labour management relations?
5) How will the structure of collective bargaining be adapted in deregulation?

As the Canadian airline industry moves towards less regulation, there will be competitive pressures on carriers to lower fares in many markets. In addition, new entrants to the industry or specific routes will attempt to attract passengers at the expense of established airlines.

In an effort to lower fares while maintaining profitability, airlines will have to maintain a competitive cost structure. When you examine the major components of airline operating costs, it becomes apparent that labour is the only one over which management has significant leverage.

Another problem for existing carriers could be the emergence of non-unionized low cost carriers. In the United States it has been found that although the average salary of a new entrant employee is 50% of that in major airlines, he is 40% more productive (2).

Oppenheimer (2) identifies three methods to reduce labour costs:

1) Wage and productivity concessions.
2) Reorganization due to bankruptcy.
3) Promotion of two tier contracts.

Financially troubled airlines will demand wage and productivity concessions from their unions on the basis that it is in the interests of employees to ensure the viability of the company. Improvements to productivity and hence profitability not only affect the troubled airline but also its competitors. Even profitable competitors will be pressured to reduce labour costs so as to prevent an erosion of market share. Thus, like fare wars, contract concessions can have a snowball effect (2).

A number of airlines in the United States filed for bankruptcy and reorganized as low cost carriers. This has

been the experience with Continental which reemerged as a non-union carrier, and Braniff which exacted major productivity, wage, and operating concessions from its unions. Similarly Eastern airlines has used the spectre of bankruptcy to lower its labour costs. In Canada, due to more restrictive labour laws and the knowledge of the U.S. experience, it is questionable whether such reorganizations would take place.

Two tier contracts will also probably become popular as a means to reduce labour costs on a longer term basis. Under these agreements, new employees are hired at lower wage rates and benefits than existing employees whose job security remains intact. Thus within contracts there is a differentiation between old and new employees. Labour costs are reduced over the long term through attrition. It also encourages companies to expand and thus lower their average unit wage. In this manner it also benefits the union as membership grows.

It can be argued that EPA attempted to create a two tier structure for its pilots with the separation of EPA and Air Maritime. Under the proposal, existing pilots would be included on the same seniority list while new pilots would be entered on separate lists and have different contracts.

Even though this attempt was unsuccessful, it is likely that there will be increased pressures for two tier contracts in a deregulated environment. Indeed, Wardair

has negotiated a two-tier contract with its flight attendants and is approaching pilot contract negotiations with a similar strategy. Donald J. Carty, President and CEO of CPAir is a former senior Vice President and Controller of American Airlines where its new recruits are paid 50% below the pay scale of current employees (2). In fact, through expansion 47% of its employees will be paid at the lower wage scale by 1997. It is probable that he will rely on this experience in collective bargaining at CPAir.

Although unions in the United States are often willing to accept two tier contracts over the short run, they often demand a sunset clause to such a contact. Under the agreement, new hires would be paid at a lower rate but would reach parity with existing employees after a specified period of time. The period ranges from five years at Eastern Airlines to 13 years at Delta (2).

Airlines will also attempt to establish double breasted operations. By this it is meant that an unionized airline would create a non-union counterpart which would act as a low cost carrier. This has been the experience in both trucking (1) and airline industries under U. S. deregulation. Lefer (5) observes that Texas International Airlines and Frontier Airlines have both formed low cost non-union carriers.

Unions fear these non-union subsidiaries for two reasons. First, that the holding company could transfer

routes and markets from the unionized carrier to the non-union carriers. The result would be higher net revenues for the holding company and fewer jobs in the unionized carrier. Another fear, is that the non-union carrier would fly the unionized carrier's routes in the event of a strike. This would reduce or remove the effectiveness of a union's major bargaining weapon: the strike. The issue of double breasting operations has relevance to the EPA/ CALPA dispute in that EPA planned to separate turbo-prop and jet services into two independent, albeit unionized, carriers.

Wages and benefits were not the critical issues in the EPA dispute. Although wages and benefits will always be important, it is likely that more emphasis will be placed on productivity and operational flexibility, as was the case with this conflict. In the long run productivity increases which will allow carriers to reduce unit labour costs and the size of their labour force either through layoffs or attrition will be critical bargaining issues.

In a deregulated environment management will have to be more responsive to market forces. This demands greater operational flexibility to change routes, crews, scheduling and equipment. Therefore, coupled with productivity increases, there will probably be an erosion of costly and restrictive work rules. For example, this will undoubtedly have implications for the ratio between pilots' block hours and pay hours. Indeed, it should be

recalled that these two issues (productivity and operational flexibility) were managements' major concerns in the strike.

The demands of employees may also change under deregulation, particularly during the turbulent transitional period. The effect of the recent recession, experiences in the United States, and fears about Canadian deregulation may cause unions to give a greater priority to job security and stability in bargaining. Airline retrenchement programs and competitive reorganizations may cause a surplus in the labour market which would add to the insecurity of employees. This would tend to give management greater power in collective bargaining, as happened during the EPA strike.

Attempts to organize new entrants will also be more difficult. Surplus labour markets and a change to conservative public views have reduced collective solidarity among employees. Feldman (4) reports that in the United States, ALPA lost 55-60% of its organizing attempts in 1983.

The relationship between management and unions in the airline industry varies among carriers, union representatives, and over time. However, the general trend will probably be toward greater conflict in labour management relations. This will be an outgrowth of a highly competitive environment and a deterioration of Quinn Mills' (7) environmental factors which were

mentioned earlier in this section. Both organizations will have to take concerted efforts to improve relations and become more cooperative with one another. USAir and Delta are two examples which provide proof that relations need not be adversial in a deregulated industry (4).

As Dunlop (3) observed with the U.S. airline industry, collective bargaining will have to adapt to deregulation. The most dramatic problems will occur during the transitional period when both carriers and their unions are trying to adjust to competitive market forces. Perhaps the most important adaptation will be a possible shift to more decentralized collective bargaining. Presently there is a strong national pattern to airline union negotiations. This is particularly true with CALPA where an agreement with one airline becomes a precedent for bargaining with other carriers. There will be less national bargaining as airlines became more competitive; contracts will be differentiated between airlines and will depend upon such factors as the carriers' economics, financial status, route network and markets. Thus there will be a breakdown in the national pattern of collective bargaining as individual airlines attempt to create competitive advantages for themselves.

EPA's demands for higher productivity, greater operational flexibility and the separation of turbo-prop and jet services were all attempts to customize their contract with CALPA. Fragmentation of national unions has

occurred with the deregulation of both the United States trucking (1) and airline (3) industries. This raises the question of the future role of national unions within deregulated business environments.

In conclusion, deregulation will cause many important changes to labour-management relations in the airline industry. The combined effect of these changes will be to make labour costs more variable in nature so that they become responsive components of an airlines' competitive strategy. The EPA labour dispute in 1983 provided the first major evidence of these emerging trends.

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TRANSPORTATION PROFESSIONALS AND RESEARCH IN CANADA: THE NATURE OF DEMAND

by R.I. Logan, J.L. Courtney, M.A. Parnes[0]

ABSTRACT

An examination is presented in this paper of the characteristics of demand for transportation professionals and research in Canada as they influence the administration of the Transport University Programs (TUP) of Transport Canada. Working hypotheses are tested using the results of a survey involving 81 government and industry organizations. The resultant conclusions provide a basis for adjustment to TUP that would enhance the level and nature of collaboration between government, industry and the universities in the transportation field, and further the achievement of TUP objectives.

PURPOSE

Our purpose in this paper is twofold. The first is to examine the size and nature of demand for

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transportation professionals in Canada during the 1980s. The second is to attempt a preliminary assessment of the level, adequacy, and relevance of university transportation research in Canada. The results of these exercises are intended to provide feedback for improving TUP. To achieve our aims, a survey was carried out involving public and private sector organizations that have employed TUP-supported students in the past and/or that have made use of research carried out at Canadian universities funded, at least in part, by TUP. This "client" group was polled to obtain perspective on the following working hypotheses:

1) contrary to the situation when TUP was launched, the overall domestic supply of transportation professionals is now considered to be adequate relative to demand;

2) some important wishes of existing research users or beneficiaries are not being met by the current TUP process, suggesting a need for some form of remedial action; and,

3) TUP-funded or assisted transport research is not as well-marketed or known by government and industry as it could and should be.

Through the testing of these hypotheses, it was expected that a need for improved collaboration between government, universities and industry would become evident. The need for such collaboration has been a theme of widespread concern[1] for two reasons: "to help close the gap between information needs and resources in transportation research"[2] and to help ensure that the most appropriate research is carried out. The present climate of fiscal restraint requires a more effective use of resources wherever possible.

The present paper includes a priorization of current research requirements of TUP clients, carrying forward general themes outlined earlier by Haritos.[3] In addition, it extends recent work by Sheffield[4] through adding the demand for research by manufacturers, carriers, governments and consultants; the previous paper was confined to shippers.

BACKGROUND

TUP was initiated by the Canadian Transport Commission in the late 1960s to alleviate a situation whereby the CTC was being forced to import transportation professionals from abroad because of a serious lack of available expertise in Canada. When first

instituted, the Programs had as their main objectives the building up of research capability and increasing the domestic supply of knowledgeable people. In 1972, TUP was transferred to the Department of Transport where it has resided ever since.

TUP has three program components:

a) annual infrastructure grants to transportation centres of excellence at one or more universities in each of the major regions of Canada;

b) negotiated contributions for selected university transportation research projects judged to be of importance to the Canadian transportation sector; and,

c) fellowships to encourage promising graduate students to undertake transportation studies and research (master's and doctoral awards), fellowships to assist rising professionals wishing to return to university to upgrade their skills through post-graduate studies (industrial fellowships) and fellowships to allow established government and industry professionals, as well as visiting academics, to spend time at Canadian

universities doing research and teaching (senior fellowships).

Through these means, it has been the aim of TUP over the years to support academically-orientated transportation research, thus helping to build a reservoir of transportation expertise across Canada, while also filling any research void in the general systems and policy areas that might otherwise not receive attention. Advisory committees judge all TUP research proposals and fellowship applicants. Thus, the process of making awards is neither entirely self-governed nor entirely ungoverned, but rather subject to guidance that seeks "the necessary agenda".[5] Much of this guidance is obtained by ensuring that the advisory committees include university peer group representation.

Research agendas will vary over time. To maintain TUP relevance, periodic evaluations have been conducted. As well, the level of demand for transportation professionals has been assessed from time to time in light of the downward shift of science student enrollment in Canada over the 1970s.[6]

Has the nature of demand for transportational professionals changed since the inception of TUP? Thomson[7]

observed in 1978, with respect to Europe, a shift in university and industry transport research from engineering to the social sciences owing to the fact that "the incentives for engineering research have been greatly diminished". This same trend would appear to be evident in Canada.

This paper presents the findings of the most recent TUP evaluation. It is based on the survey mentioned earlier of the users (TUP clients) of program outputs, outputs being defined as transportation professionals and research. The user survey also provides information on current funding levels for university research complementing information derived from other sources.

TUP-supported "transportation research" focuses on the social science and operations research disciplines, rather than technological or "hard" enginering or applied science research. In Canada, both "hard" and "soft" research co-exist in the university research environment with TUP supporting mainly the latter. As shown in Table 1 below, technological research predominates in the case of industry and the provincial governments. "Soft" academic research appears to be funded almost entirely by federal

government sources, with TUP accounting for over 2/3s of this amount.

TABLE 1

Sources of Academic Funding for Transportation Research in Canada, 1983/84 ($ Millions)

FUNDING SOURCE	ENGINEERING AND APPLIED SCIENCE	SOCIAL SCIENCES AND OPERATIONS RESEARCH
Industry	$ .20	-
Provincial Governments	.80	-
Federal Government		
- Natural Sciences and Engineering Research Council (NSERC)**	.20	.30
- Social Sciences and Humanities Research Council (SSHRC)**	-	.04
- Transport Canada	1.35	.99
- Canadian Transport Commission	-	.10
TOTAL	$2.55	$1.43

Sources: 1985 TUP survey except where noted.

** Special tabulation by the Granting Councils of research undertaken by 30 of the most prominent Canadian university researchers.

The "universe" for transportation research conducted at Canadian universities is small. Based on the estimates shown here, such research accounts for only about 1% of total Canadian transportation R&D expenditures[8]. Although these estimates could be on the low side, they embody the best available information, and, even more importantly, they appear to portray accurately the ratio between "hard" and "soft" research in Canada.

METHODOLOGY

The research methodology involved distribution of two mail-back questionnaires to 18 government and 63 industry organizations. For purposes of this study, "government" was defined to include Transport Canada, the Canada Transport Commission, 12 provincial and territorial governments, and 4 transit authorities.

The "industry" component included 7 transport equipment manufacturers, 22 carriers, 2 forwarders, 24 consultants and 8 shippers.

The mailing list was largely derived from a review of organizations which have employed TUP-supported graduates in the past or have been involved in past TUP-supported research projects. The sample was purposely biased towards those most familiar with TUP, even though the replies would be expected to be sympathetic. It was thought that such a biased sample would indicate how best to ensure appropriate future employment levels for TUP graduates and usage of TUP-supported research. The replies being sought then were expected to be positive. Had they been negative, it would have been clear that changes were indeed required in TUP.

Looking at actual returns, the response rate was 83% for the government group, and 44% for industry. Only one government respondent failed to complete both questionnaires; this was the case for 12 industry respondents.

As indicated above, the three working hypotheses were tested through two questionnaires - an employment one and a research one. A lie score[9] was built in and answers were cross-checked between the two questionnaires, thus probing the perceptions of the respondents.

In the case of the employment questionnaire, an attempt was made to determine whether the supply of suitable transportation candidates was adequate relative to need over the past five years. Hiring levels for transportation professionals with one or more graduate degrees were also examined for both past and future five-year periods.

Regarding research, comments on current adequacy and any barriers to improvement were requested, along with an assessment of the present level of effort at universities. The relevance of research was gauged by asking for the research priorities of respondents and then determining if they were being met. Special

attention was paid to the dissemination of research findings: are they being used and what are the types of problem being experienced by research clients, if any?

Equally important as the numerical results are the comments of respondents, both those returned along with the completed or incomplete questionnaires, and those made during a selective telephone follow-up of those surveyed. Collectively, these comments provide a good indication of how TUP is perceived by the transportation community in Canada, both in the private and public sectors.

SURVEY RESULTS

1) EMPLOYMENT OF TRANSPORTATION PROFESSIONALS

An analysis of survey results leads to the general conclusion that the supply of suitable transportation candidates is sufficient to meet the current needs of government (see Table 2). There may continue to be shortages in particular areas - e.g., forecasting and operations research, aeronautics and marine engineering, and remote transport systems. These conclusions cannot be considered to be definitive, however, as a large proportion of industry returns (43%) contained

no comment or "don't know" answers, possibly indicating a minimal requirement for transportation professionals, or no differentiation in hiring practices on the basis of background in the transportation field or little knowledge of the company's future transportation needs.

An important result, obtained through a telephone follow-up with several transport carriers, was that functional specialists (in computers, marketing, etc.) are being sought, rather than transportation specialists. Several respondents noted that substantial training was required after a candidate was hired, indicating a need for an understanding of transportration issues, practices, etc. on the part of new employees. Industry does not identify a distinctive transportation professional category. Consequently, the role perceived by industry for TUP in the production of transportation professionals would not appear to be substantial.

Overall, the demand for professionals does not appear to be high, as measured by questions on the number of professionals with graduate studies hired over the past five years and those that might be hired in the next five. Table 3 shows that most respondents, both government and industry, have hired or will hire

TABLE 2

Extent of Problems in Finding Suitable Transportation Candidates for Job Openings (Past Five Years)

RESPONSE	Government	Industry
Yes - in most cases	11%	7%
- in a few cases	22%	11%
No - always enough	50%	39%
Don't know/no reply	17%	43%
TOTALS	100%	100%

Source: 1985 TUP Survey

TABLE 3

Demand for "Transportation Professionals" with Graduate Studies: Requirements by Respondent

Number Hired/ Required	Past Five Years		Next Five Years	
	Government	Industry	Government	Industry
None	22%	39%	22%	25%
1-5	50%	21%	44%	39%
6-10	6%	7%	19%	7%
More than 10	6%	4%	0%	0%
No Response	17%	29%	17%	29%

Does not necessarily add to 100% due to rounding

Source: 1985 TUP Survey

either none or only 1 to 5 such professionals per year. In aggregate, this sum could be significant for IUP; in any case, it would appear to be more than the 20-30 students supported annually by IUP through the fellowship program. There seems to be only a mild trend to increased hiring in the future with a shift in need from the government to the industry sector. In the 1-5 category, industry shows a shift from 21% to 39% while government shows a shift from 50% to 44%. This would tend to indicate a need to attune IUP graduates to industry rather than government demand to some extent in future. However, government will still require more transportation professionals overall than industry.

Respondents were given an opportunity to propose their own definition of "transportation professional"; 40% of the government and 30% of the industry respondents replied specifying "experience" and/or education at less than the graduate level as important criteria. The importance placed on this mix of experience and academic training was well-expressed in the following response by one manager:

> ...(IUP) professionals are usually very well qualified from the academic point of view. Not infrequently, however, they

> need more practical experience and training to enable them to function productively in the government (or industry) environment...

All this would suggest a need for a heightened emphasis on the industry and senior fellowships.

2) TRANSPORTATION RESEARCH

The government response rate to the research questionnaire was high. For industry, only 16 out of 28 respondents completed a questionnaire, in whole or in part. Various reasons were cited for this low completion rate. The most important factor was that only three industry respondents had been involved with transportation research projects undertaken at Canadian universities. The other 13 had not, but did provide varying degrees of opinion on the research results they had observed. Thus, while 75% of government respondents did in fact fund university research, this was the case for only some 10% of industry respondents.

While most government respondents appeared to be satisfied with the contract work done for them, many felt that a greater level of research effort by the

universities was required (see Table 4). Industry, on the other hand, was not clear as to the best level of effort.

The major barriers to improvement appear to be lack of funding and a perceived need for improved co-ordination of projects rather than the number or quality of trained professionals. The low ranking of this latter factor further reinforces the conclusion that the supply of trained professionals is sufficient for current needs. According to survey returns, access to transportation information is not an important barrier.

The relevance of the university research effort, when measured against client research priorities, shows that TUP is generally on track. Table 5 sets out these priorities. They range from surface freight (i.e., highways, trucking and rail) to urban and automobile studies. They generally compare favourably when matched with those identified by Sheffield (1984) in measuring shipper requirements (compare Table 5 with column #2 of Table 6). These results also tend to confirm satiation in the area of urban studies[10] and the need for emphasis on freight matters. The current level of effort perceived by shippers for various transport topics (see column #1

TABLE 4

Level of Effort - University Transportation Research

Response	Government	Industry
Just Right	17%	17%
More Than Enough	6%	-
Not Enough	39%	23%
Don't Know	39%	60%

Source: 1985 TUP Survey

TABLE 5

Ranking of TUP Client Research Priorities (By General Topic)

Topic	Rank	
Highways and Trucking (Freight)	1	HIGH
Rail (Freight)	1	
Intermodal (Freight)	2	
Marine (Freight)	3	
Air (Passenger)	4	LOW
Auto (Urban/Passenger)	5	

Source: 1985 TUP Survey

TABLE 6

Comparison of Levels of Research Effort - Shippers and TUP

Topic	Current Level of Effort Perceived by Shippers*	Level of Effort Proposed by Shippers*	Level of Effort Actually Supported by TUP**
Urban	1	3	4
Intercity Passenger	2	2	3
Freight	3	1	1
Multi-Sectoral	N/A	N/A	2

Sources: *Sheffield, 1984; **TUP records: number of completed Negotiated Research Contributions, 1976-84

of Table 6) does not, however, correspond with the actual output of TUP negotiated research contributions over the 1976-1984 period. In contrast, TUP generally achieved a reasonable match between the research which it actually funded and its clients' research priorities (compare Table 5 with column #3 of Table 6).

Half the government respondents and 60% of the industry respondents did not believe that present university research activities adequately covered off their areas of prime interest. The reasons given included the lack of a process for identifying the interests and needs of research users, and a problem in retaining the active participation of academics in the transport field.

3) DISSEMINATION OF RESEARCH RESULTS

Problems in the dissemination of research results were manifest in the low levels of client usage of university research, especially by industry (see Table 7). A number of solutions were suggested to the difficulties cited in learning about research findings, e.g., publication of project lists and summaries of results. While some of these solutions have already been adopted by TUP, such comments

indicate that a greater level of effort would appear to be required. One provincial official observed:

> I am not as aware as I should be...more PR is needed, and the universities should be more outgoing...

TABLE 7

Client Usage of University Research

Response	Government	Industry
Regularly	33%	7%
Sometimes	39%	29%
Never	-	14%
No Reply	28%	50%
	100%	100%

Source: 1985 IUP Survey

In sum, while IUP appears to cover the general priority areas identified by its clients, IUP output is not as well-used or well-known as it could be.

CONCLUSIONS AND PROSPECTS FOR IUP

Client perceptions of the utility of IUP output indicate some need for change in program direction. Even among sympathetic clients, criticism is not lacking, especially from industry. While the level

of collaboration between the universities and government in IUP appears to be at least acceptable, such is not the case on the part of the industrial community.

It would appear that the supply of transport professionals from Canadian sources has been generally more than adequate in recent years and that this situation will likely prevail at least until the end of the 1980s. However, some employers are still experiencing shortages. Also, a number of employers appear to favour on-the-job training to a significant degree. Overall, our initial hypothesis proved to be correct. It follows that the need for a IUP program at the Master's and Ph.D. levels would appear to be less today than previously. Clearly, the IUP fellowship component needs further review.

It would be helpful to differentiate the IUP fellowship program more clearly from the complementary (albeit, much more massive) SSHRC and NSERC programs.

Perhaps the quantity of more "junior" fellowships should be cut back, at least for a period. The quantity of senior and industrial fellowships could

be increased, assuming sufficient demand. Alternatively, the total amount of fellowship aid could be reduced.

While TUP appears to meet the general research requirements of its various clienteles, further action is required in the dissemination of research results, especially to industry.

FOOTNOTES

1 Judith Maxwell and Stephanie Currie, Partnership For Growth: Corporate - University Co-operation in Canada, The Corporate-Higher Education Forum, Montreal 1984.

2 Rolf R. Schmitt and Alan E. Pisarski, "Diverging Information Needs and Resources in Transportation Research", Proceedings, Twenty-Fourth Annual Meeting of Transportation Research Forum, Arlington, VA 1983.

3 Z.J. Haritos, "Transportation Research In Canada: Quo Vadis?", Proceedings, Twenty-Third Annual Meeting of Transportation Research Forum, New Orleans 1982.

4 W.H. Sheffield, "Canadian Transportation Research: A Shipper's Perspective", Proceedings, Twenty-Fifth Annual Meeting of Transportation Research Forum, Boston 1984.

5 G. Paquet and J. Taylor, On Marksmanship: A Preliminary Look at the Evaluability and Evaluation of a Research Grants Program, Ottawa 1983.

6 I.C. Clark, "Federal Governments and University Science Research: A Comparison of Practices in the United States and Canada, 1970-1979", Canadian Public Policy, Spring 1980. Figure 6 depicts a 20% drop in enrollment between the early and the late seventies for full time graduate students.

7 J. Michael Thomson, "Some Reflections on Transport Research in Europe", Canadian Transport Commission Seminar Series, Spring 1978.

8 Transport Canada, Transportation Research and Development in Canada: Situation Report, 1983, Ottawa 1983. Section 6 gives the total at $398.6 million.

9 To test overall validity, the same question was asked in both questionnaires in a slightly different fashion.

10 James F. Hickling Ltd., Urban Transportation Research and Development Plan, Ottawa 1984. This report concludes that the level of current research in Canada is reasonable and compares favourably with that for other countries.

CANADIAN TRANSPORTATION INFORMATION FRAMEWORKS

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ABSTRACT

Statistics Canada, Transport Canada, the Canadian Transport Commission and provincial governments all issue a variety of data series covering portions of Canadian freight and passenger transportation activity. Varying definitions and jurisdictions, coupled with the paucity, or lack, of respectable data on some significant components, have inhibited the production of a comprehensive quantitative picture. The paper describes the work in progress at the Canadian Marine Transportation Centre to remedy this deficiency. The objective of the work has been to produce a series of consistent, interrelated information frameworks that incorporate both hard and soft data and that are capable of being continuously updated and extended using fragmentary intelligence as it becomes available.

INTRODUCTION

In a country where transportation plays a crucial role -- both economically and socially, the average Canadian might think that there would be an abundance of statistical information covering all aspects of transportation in Canada. However, the opposite is true; the present state of statistical information describing transportation in Canada leaves much to be desired. No adequate, comprehensive quantitative information package exists that portrays the dimensions of Canadian transportation. Various agencies produce a great deal of data covering many segments of transportation. Some of this data is very precise, while some of it is extremely inaccurate. In addition, significant gaps in the coverage exist in many areas, especially those areas in which there are no statutory reporting requirements (e.g., private carriage). Furthermore, the lack of consistency among these agencies in the collection and defition of statistical information means that much of the available information has limited use.

OBJECTIVES

The primary objective of the project is to produce a comprehensive, quantitative, dynamic information system which describes the totality of Canadian transportation.

There are five sub-objectives:

1. To establish a set of definitions to be applied consistently across all modes of transport.

2. To identify the relationships inherent in transportation data.

3. To develop a structure which enables future refinement and extension of these relationships.

4. To quantify this structure.

5. To develop an interactive transportation information system.

INFORMATION COVERAGE

The Transportation Information Frameworks (T.I.F.) provide a wide variety of statistical information on transportation in Canada. Two categories of transport are recognized, namely, passenger and freight. Passenger transport is subdivided according to the following modes: air, rail, water, and highway. Freight transport is subdivided according to the following modes: air, rail, water, highway, and pipeline.

Each mode of transport is described in terms of the following types of statistics: activity, financial, and structural.

(a) Activity Statistics

Activity statistics describe the physical movements within each mode of transport.

A movement is considered to be a one-way trip.

Three types of movements are defined; they are as follows: domestic, transborder, and international.

A domestic movement is defined as one having both its origin and destination within Canada.

A transborder movement is defined as one having its origin in Canada and its destination in the United States or its origin in the United States and its destination in Canada.

An international movement is defined as one having its origin in Canada and its destination in any other part of the world except the United States or its origin in any other part of the world except the United States and its destination in Canada.

In the case of transborder and international movements, a distinction is made between the Canadian portion of the movement and the total movement.

The Canadian portion of a movement refers to the portion which actually occurs in Canada; whereas, the total movement refers to the entire movement from origin to destination.

Domestic passenger transport is partitioned into urban, intercity, and extraurban components.

Urban travel consists of movements up to 80 km in

length within an urban area.

Intercity travel consists of movements between urban areas separated by at least 80 km.

Extraurban travel consists of all movements which are not classified as either urban or intercity travel.

Six major commodity groups of the Standard Commodity Classification (SCC) system are used to describe freight movements. The categories are as follows:

I - Live Animals
II - Food, Feed, Beverages and Tobacco
III - Crude Materials, inedible
IV - Fabricated Materials, inedible
V - End Products, inedible
VI - General or Unclassified

The basic units of measure for passenger movements are 1) number of passengers carried and 2) number of passenger-kilometres. Similar units (i.e., number of tonnes carried, number of tonne-kilometres) are used to describe freight activity.

(b) Financial Statistics

Financial statistics provide information on operating revenues, operating expenses, and investment.

Operating revenues include revenues directly obtained through the operation of a mode.

Operating expenses include expenses directly

incurred in the operation of a mode.

Investment represents expenditures on capital assets.

(c) Structural Statistics

Structural statistics provide coverage on such items as ownership, employment, infrastructure, equipment, safety, etc.

SYSTEM OVERVIEW

The T.I.F. system may be described in terms of the following: information structure; maintenance, support, and development; and outputs. A graphical representation of the system is shown in Exhibit A.

(A) INFORMATION STRUCTURE

There are three classifications of statistical information in the T.I.F. system -- namely, base data, relational data, and derived data.

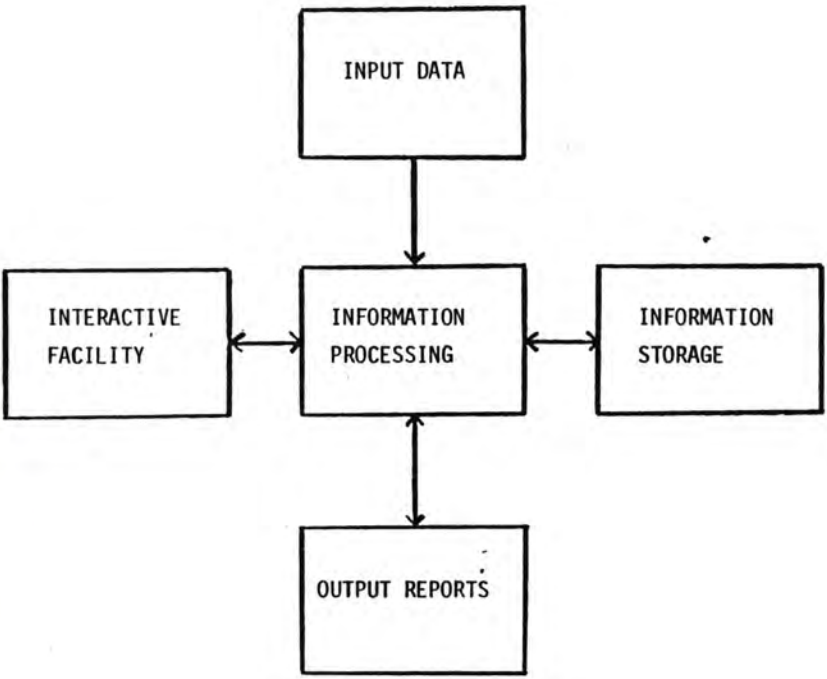
Base data refers to data which is determined outside of the system.

Relational data refers to data which is used to quantify relationships between various data elements.

Derived data refers to data which has been derived from base data and relational data.

There is a large variety of interrelationships and linkages among the various elements of transportation

EXHIBIT A


INPUT DATA
INTERACTIVE FACILITY
INFORMATION PROCESSING
INFORMATION STORAGE
OUTPUT REPORTS

data. While many of them are of interest and value in their own right, they provide the means of linking frameworks. This allows data enhancement both in terms of accuracy and in further disaggregation. It also makes it possible to incorporate ad hoc, fragmentary data on a continuing basis, to confirm, extend or update the basic frameworks. Specialised, detailed data, and regional or issue-related information may then be linked to them.

A series of diagrams has been designed to display the information in a useful manner. There are three types of charts: summary, linkage, and detail.

A summary chart shows the disaggregation of a particular quantity by several categories.

A linkage chart shows the relationship between two or more different quantities. It also acts as an interface between summary charts.

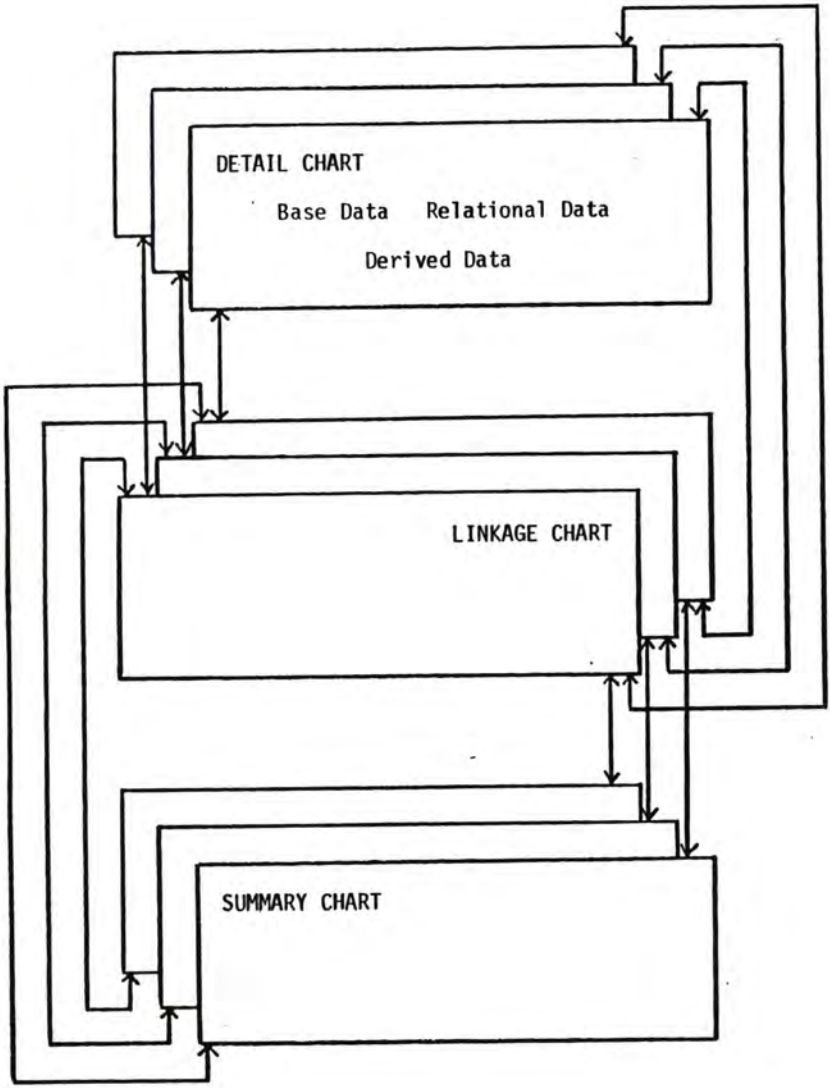
A detail chart indicates the derivation of a quantity or quantities used in one of the other two types of charts.

Exhibit B depicts the relationship between the various components of the information structure.

(B) MAINTENANCE, SUPPORT, AND DEVELOPMENT

The T.I.F. system involves several continuing functions.

EXHIBIT B


DETAIL CHART
Base Data
Relational Data
Derived Data
LINKAGE CHART
SUMMARY CHART

1. Updating.

The frameworks are being designed to be updated whenever fresh information becomes available. Using a set of decision rules, the impact of new information on the existing system is assessed. As a result, new information is "edited" before it is allowed to modify the system. This is necessary to ensure stability in the system. Three main categories of information are used for updating:

a) Regular, formal statistical reports (primarily statistics Canada, Transport Canada, provincial governments).

b) Regular, sectoral and corporate reports (e.g., Canada Ports Corporation, Dominion Marine Association, corporate annual reports, etc.).

c) Spot data and fragmentary items of variable quality. Most of the linking indices used in the T.I.F. are changed and updated on the basis of studies and surveys. These are carried out for a variety of purposes for many different agencies, including governments, inquiry commissions, regulatory bodies, carriers, users or suppliers. It is not intended that support of the T.I.F. will include any direct data collection.

2. Extension.

Additions to the T.I.F. primarily consist of further disaggregations. These will be triggered either by demand or by the availability of new information. The scope of T.I.F. should not be allowed to go beyond the point of broad fairly general interest, nor should one specific mode or transportation activity be disaggregated merely because data happens to be available.

3. Upgrading.

Structural and design changes will be made to improve quality and accuracy, or to simplify the linkage models and acceptance of updates.

(C) OUTPUTS

To meet the range of identified uses of the T.I.F., three types of output are presently envisaged:

1) A brief, largely diagrammatic booklet (approximately 15 pages) that summarises the broad size and shape of Canadian transportation. The emphasis is on clarity and comprehensibility. This publication could be made available on a stand-alone basis; it could also be published as an insert in periodicals (Transpo; Transport and Distribution Management, etc).

2) A more comprehensive, probably annual, publication

(approximately 50 to 75 pages) largely in tabular form, to consistent levels of disaggregation.

3) A computerised data bank which would be accessible either as an independent base, or as part of one of the existing institutional or commercial systems. This whole field is developing and changing so rapidly that it is not appropriate to make specific or long term plans. Commercial services would clearly market it in a similar manner to their current offerings. One of the functions of the T.I.F. is to direct users to the more specific, specialised data bases that are available.

USERS

The T.I.F. are intended to contribute a background of quantitative information to discussion and debate on policy and public interest issues in transportation. The customers for it will probably be among the following:

Transport Canada

Federal government departments

Members of Parliament (individuals and committees)

Provincial governments

Media

Schools and universities

Transportation industry and associations

Transportation user associations

Public interest groups

APPLICATIONS

1) The majority of transportation research studies, policy papers and consultant reports attempt to provide the transportation context for their particular topic, generally in quantitative terms. Those that do not probably should. One use of the Transportation Information Frameworks is to assist in providing that context.

2) News media and other reports and publications covering transportation activities and events often attempt to provide the numeric background to the item, particularly when the item itself contains data (e.g., annual grain movements through a particular port; average subsidy per VIA passenger; traffic growth or decline through the Seaway; derailments). An easily accessible source of consistent, approximately correct information would be of help. Much misinformation and many gross errors are promulgated almost on a daily basis. Even those closely involved with some sector of transportation often promulgate the occasional myth or misconception about the size or shape of transportation. Public discussion and debate on transportation issues often suffers as a result. By providing a comprehensive range of statistical

information on transportation, the T.I.F. would encourage informed debate on transport developments and policies.

3) There is, at present, no comprehensive, quantitative description of Canadian transportation available that is suitable for teaching purposes. Parts of the crude and somewhat fuzzy material that was initially developed at the TDA in 1970 and has never been properly updated, still turn up with embarrassing regularity. This current T.I.F. project was started, in part, to eliminate that embarrassment.

PROBLEM AREAS

Since the purpose of this project is to provide a complete view of transportation in Canada, it has been necessary to estimate certain segments of transport where little or no information exists. The most notable areas for which this has been done are private trucking and private automobile usage. Since both of these areas are significant, it is important that the estimation procedures be well developed.

However, there are some aspects of transport for which no estimates have been made. Included in this category are courier services, recreational transport, sewage disposal, water distribution, etc.

CONCLUSION

It must be accepted that complete transportation data will never be available on a regular, formal basis to adequately cover all facets of transportation across all modes. However, the Transportation Information Frameworks will rectify this situation to the greatest extent possible.

Anyone who would like to contribute to any aspect of this project should contact the authors.

ON SOLVING AN UNBALANCED TRANSPORTATION PROBLEM

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ABSTRACT

In this paper a modification is suggested for formulating an unbalanced transportation problem. An example has been presented and solved to illustrate the drawback of the conventional formulation and the advantage of using the suggested modification in the formulation of an unbalanced transportation problem.

INTRODUCTION

The problem of transporting a product from several factories (supply origins) to a number of warehouses (demand destinations) is generally considered as a very good application area for linear programming technique. The standard formulation of a single product transportation problem is as follows:

Let m = number of supply origins;

n = number of demand destinations;

a_i = amount available at supply origin 'i' (i=1, 2, ..., m);

b_j = amount required at demand destination 'j' (j=1, 2, ..., n);

C_{ij} = cost of transporting one item from supply origin 'i' to demand destination 'j';

X_{ij} = number of units transported from supply origin 'i' to demand destination 'j' and

Z = total cost of transporting the item.

The objective is to

$$\text{Minimize } Z = \sum_{i=1}^{m} \sum_{j=1}^{n} C_{ij} \; X_{ij} \tag{1}$$

Subject to the following conditions

$$\left.\begin{array}{ll} \text{all } X_{ij} \geq 0 & \text{for } i = 1, 2, \ldots, m \\ & \quad j = 1, 2, \ldots, n \end{array}\right] \tag{2}$$

and

$$\left.\begin{array}{ll} \sum_{i=1}^{m} X_{ij} \geq b_j & \text{for } j = 1, 2, \ldots, n \\ \sum_{j=1}^{n} X_{ij} \leq a_i & \text{for } i = 1, 2, \ldots, m \end{array}\right] \tag{3}$$

Three situations may arise depending on the total number of units available for transport and the total number of units required at the demand destinations.

Case I: $\sum_{i=1}^{m} a_i = \sum_{j=1}^{n} b_j$

This is the case when the total number of units available at the supply origins is equal to the total number of items available at the demand destinations. A transportation problem pertaining to this is termed as the

balanced transportation problem. In a balanced transportation the set of conditions represented by (3) are set in the form of equations.

Standard methods are available for solving the balanced transportation problem.

Case II: $\sum_{i=1}^{m} a_i > \sum_{j=1}^{n} b_j$

This case represents an unbalanced transportation problem. We obtain a balanced transportation problem by introducing a dummy demand destination (n+1) with requirement of

$$b_{n+1} = \sum_{i=1}^{m} a_i - \sum_{j=1}^{n} b_j$$

and $C_{i(n+1)} = 0$ for all 'i'.

We now have a balanced transportation problem involving m supply origins and (n+1) demand destinations.

Case III: $\sum_{i=1}^{m} a_i < \sum_{j=1}^{n} b_j$

This also represents an unbalanced transportation problem. In order to obtain the optimal solution and to be able to apply the techniques available for solving the balanced transportation problem, we create a dummy supply origin (m+1) with availability equal to

$$a_{m+1} = \sum_{j=1}^{n} b_j - \sum_{i=1}^{m} a_i$$

and the cost of transporting one item from i = m+1 to the jth demand destination is assumed to be

$$C_{(m+1)j} = 0 \text{ for } j = 1, 2, \ldots, n.$$

The implication of this assumption is that there is no penalty cost associated with unfulfilled demand at a destination, see Budnick et al.[2] This mathematical formulation of the unbalanced transportation problem, in the case of the total demand exceeding the total supply, is the most common available in the Management Science literature, see Davis et al.,[3] Lee et al.,[4] Taha[6] and Anderson et al.[1] However, in practical situations the problem may have to be reformulated specifying from where the extra demand is to come and at what cost or alternatively what penalty costs will be incurred for not meeting the demand.

SOLUTION OF THE TRANSPORTATION PROBLEMS

Before a solution of the transportation problem is attempted, the first step is to make sure that we have a balanced transportation problem. If the problem is unbalanced, then it must be balanced by creating a dummy supply original or demand destination.

The optimal solution of a balanced transportation problem is achieved in two stages. At first a good initial solution is obtained and then the initial solution is improved till the optimal solution is achieved. The number of iterations required to obtain the optimal solu-

tion from the initial solution very often depends on the initial solution. If it is possible to obtain a very good initial solution then the optimal solution is obtained in very few iterations.

There are two standard methods for obtaining a good initial solution of the transportation problem. These are:

1. Least Cost Method (LCM)

2. Vogel's Approximation Method (VAM)

According to LCM, we allocate maximum number of units to the cell having the least transport cost. On the other hand in VAM, see Reinfeld & Vogel,[5] maximum number of units are allocated to the least cost cell in the row or column for which the highest unit penalty cost is obtained.

We will concentrate our attention to the problem of determining good initial solution of the unbalanced transportation problem. We will illustrate the technique with the help of an example. At first the example will be solved using the existing techniques. The drawback of the current technique for solving the unbalanced transportation problem will be highlighted and a suggestion will be made to overcome the drawback. The example will be solved with the suggested approach for solving the unbalanced transportation problem. Finally computational results are given to illustrate the advantage of using the suggested approach.

EXAMPLE

The following data is available for an unbalanced transportation problem involving three supply origins and three demand destinations.

Supply Origin 'i'	Demand Destination 'j' 1	2	3	Available a_i
	6	19	15	40
	12	10	21	50
	15	14	17	50

C_{ij} Table

Required b_j	30	40	50

SOLUTION

The resulting balanced transportation problem after introducing a dummy demand destination is as follows:

'i'	'j' 1	2	3	4 (Dummy)	a_i
1	6	19	15	0	40
2	12	10	21	0	50
3	15	14	17	0	50
b_j	30	40	50	20	

Stage I: The initial solution is obtained using LCM and VAM. As there is a choice of allocating among the three zeros in the dummy column, so there are three possible initial solutions to the transportation problem using LCM. The solutions and the total cost associated with each solution are given below:

Solution by LCM			Solution by VAM
Solution I	Solution II	Solution III	
$X_{11} = 20$	$X_{11} = 30$	$X_{11} = 30$	$X_{11} = 30$
$X_{14} = 20^*$	$X_{13} = 10$	$X_{13} = 10$	$X_{13} = 10$
$X_{21} = 10$	$X_{22} = 30$	$X_{22} = 40$	$X_{22} = 40$
$X_{22} = 40$	$X_{24} = 20^*$	$X_{23} = 10$	$X_{23} = 10$
$X_{33} = 50$	$X_{32} = 10$	$X_{33} = 30$	$X_{33} = 30$
$Z = 1490$	$X_{33} = 40$	$X_{34} = 20^*$	$X_{34} = 20^*$
	$Z = 1450$	$Z = 1450$	$Z = 1450$

* Allocation in the dummy column.

Stage II: The optimal solution was then obtained and the minimum cost for this problem is found to be 1410.

DRAWBACKS OF THE CURRENT METHOD FOR SOLVING UNBALANCED PROBLEMS

The generally accepted formulation of the unbalanced transportation problems assumes zero as the cost of transporting one item from a supply origin to the dummy demand destination (or from the dummy supply origin

to any demand destination). Due to this reason when we apply LCM or VAM for obtaining the initial solution of the transportation problem, the allocation is first made to the zero value cells in the dummy supply origin or demand destination.

As a matter of fact no transport to or from the dummy actually takes place. Therefore, the allocation of items to the dummy column or row should be made last. In order to achieve this, the unit cost of transportation to a cell in the dummy row/column is taken to be larger than the largest C_{ij} value.

A SUGGESTED METHOD FOR UNBALANCED PROBLEMS

In order to ensure that the allocation of units to the cells in the dummy row/column is made last, the unit of cost of transportation to a cell in a the dummy row/column is assumed as

$$C_{i,dummy} \text{ or } C_{dummy,j} = 1 + \text{Max } (C_{ij})$$

As a result of this modification in the C_{ij} value in the dummy row/column, the units to the cells in the dummy row/column are allocated last.

An initial solution is obtained in Stage I and then the optimal solution is derived in Stage II.

As no actual transport of items takes place to or from the dummy, so in determining the actual transport cost, we ignore the cost of transporting to or from dummy.

SOLUTION OF THE EXAMPLE USING THE SUGGESTED METHOD

The largest C_{ij} is 21, so all C_{i4} values (cost of transporting for a supply origin to the dummy destination (j=4) will be assumed to be 22.

The format of the table for stage I is as follows:

		'j' 1	2	3	4	a_i
	1	6	19	15	22	40
'i'	2	12	10	21	22	50
	3	15	14	17	22	50
b_j		30	40	50	20	

The initial solution obtained on applying LCM or VAM is as follows:

$$X_{11} = 30$$

$$X_{13} = 10$$

$$X_{22} = 40$$

$$X_{24} = 10^*$$

$$X_{33} = 40$$

$$X_{34} = 10^*$$

* Allocation in the dummy column.

The total cost of this solution is 1410. Note that the cost of transporting to cells in the dummy column is ignored in determining the total transport cost.

Incidentally this is the optimal solution as revealed in our earlier attempt to solve the problem by the conventional methods.

The following table gives the results of computations on 80 imbalanced transportation problems.

Problem Size mxn	No. of Problems	*Percentage reduction in cost of the initial solution = y
3 x 4	20	2.69
6 x 8	20	3.42
9 x 12	20	2.95
12 x 15	20	1.87

$$* \; y = 100 \times \frac{(Z' - Z)}{Z'}$$

Where Z' = Total transportation cost of the lowest cost initial solution using the conventional formulation (C_{ij} involving a dummy = 0).

Z = Total transportation cost of the initial solution using the formulation suggested in this paper.

CONCLUDING REMARKS

The author of this paper has solved a large number of unbalanced transportation problems using the suggested modification in defininining the unit cost of transport involving the dummy either as a supply origin or the demand destination. The initial solutions obtained as a

result of using the suggested modification had equal or very often lower total cost. Due to this the optimal solutions were frequently obtained in Stage I or required only a few iterations in Stage II.

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U.S. DEREGULATION AND THE ESSENTIAL AIR SERVICE SUBSIDY: DISCRIMINANT ANALYSIS OF GEOGRAPHIC, DEMOGRAPHIC AND ECONOMIC CHARACTERISTICS

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INTRODUCTION

The passage of the Airline Deregulation Act (ADA) on 24 October, 1978 signaled the end of forty years of airline regulation in the United States. Fearing that freedom of entry and exit might lead to a reduction or loss of air service to small communities, an Essential Air Service (EAS) program was established under Section 419 of the Federal Aviation Act (FAA), as amended by the ADA. Section 419 was designed to guarantee the continuation of air service to small communities. It limits the right of incumbent carriers to exit from small communities in cases where no replacement carriers can be found and also provides federal financial support to these communities for a ten-year period terminating on 24 October, 1988. The notes which follow are intended to provide a summary of the EAS program and to examine its affects on small communities and commuter carriers.

DESCRIPTION OF THE EAS PROGRAM

The EAS program replaced the former Section 406 subsidy program, which was originally established to strengthen the (then) infant air industry. The Section 419 service guarantee only applies to communities with EAS designation. According to the ADA, a community may become eligible for such designation either under Section 419(a) or 419(b) of the Act:

- Under Section 419(a), those communities that were served by not more than one certificated carrier on or subsequent to October 24, 1978 are eligible; and
- Under Section 419(b), those communities deleted from a carrier's certificate between July 1, 1968 and October 24, 1978, and any other communities in Alaska and Hawaii which the Civil Aeronautics Board (CAB) designated as eligible could receive EAS designation.

The service guarantee was not extended to those communities for which air service between 1 July, 1968 and 24 October, 1978 was not at any time provided by a certificated carrier, but rather by an air taxi operator, a non-certificated third level carrier or a commuter carrier. This restriction was due to the fact that non-certificated carriers have virtually been deregulated since the early 1950's[1], and the points served by these carriers have been and are totally

dependent upon the market-place. At the time the ADA was passed, there were approximately 200 such points, by 1983 about half of them had lost all their air service. In contrast, none of the eligible points have lost all their air service.

Under the EAS program, guaranteed levels of service were established under Section 419(f). In States other than Alaska, the minimum level of service was set at the lesser of two round trips per day, five days a week, or the service level that prevailed in 1977. If necessary, subsidies were to be provided to maintain this service level to at least one air service focal point or hub[2]. In Alaska, the EAS level was established at the greater of two round trips per week, or the service level that existed for such points in 1976. Provisions were also made to change the guaranteed level of service as long as agreement on such was reached by all the parties involved (i.e., the CAB, the appropriate state agencies and the affected communities).[3]

In addition to the service levels, the CAB was also required to specify for each EAS point, the number and designation of hub(s), the maximum capacity guaranteed, the time of flights and the maximum number of stops. This was accomplished in accordance with the "Guidelines for Individual Determinations of Essential

Air Transportation" set out in Part 398 of the Policy Statement issued by the Board.

PERFORMANCE OF THE EAS PROGRAM

The change from the Section 406 to Section 419 subsidy program has had far-reaching affects on the growth of commuter operations and the development of small community air services. Under Section 406, subsidies were based on the carriers' overall financial requirements, while under Section 419 compensation is calculated on a specified minimum level of service. This change resulted in service levels to small communities which are more closely matched to actual demand. Under Section 419 any capacity in excess of the minimum required level of service is no longer eligible for any federal financial support. This, combined with the removal of market entry barriers, resulted in the establishment of commuter aircraft oriented operations in low density short-haul markets. As a consequence, 61 non-hub airports lost jet service between June 1, 1978 and June 1, 1984, and many small community air services have since become self-sufficient. At the same time, the change in the basis for allowing the subsidy has led to a significant increase in the market share of commuter carriers in the carriage of small community air passenger traffic. The market share of commuter carriers, as measured by

annual revenue passenger kilometres, increased from 0.4% in 1975 to 11% in 1983.

Under Section 406 of the FAA, subsidies for small community air services were limited to a few certificated carriers and the subsidy concentration rate (measuring the extent to which subsidy payments were controlled by a limited number of large carriers) was very high. Each controlling carrier was in a position to operate the small community air services so as to best serve their own corporate objectives and hence the effectiveness of competition was likely lessened leading to bigger subsidies and a higher rate of return earned by the carriers. As a result of the change-over from Section 406 to Section 419, as illustrated in Table 1, the number of carriers receiving Federal subsidies increased from 11 in Fiscal Year (FY) 1978 to 53 in FY 1984,while the average subsidies per carrier declined from $6.9 million to about $0.7 million. At the same time, the aggregate level of control on federal air service subsidies by the top four carriers dropped from 88.59% in FY 1978 to 30.48% in FY 1984.

The change of method in deriving the subsidy payments has deterred most of the local service carriers from serving the small community markets and has provided commuter carriers the opportunity to expand their operations in short-haul low density markets. As a result, many small communities no longer require any

federal financial support (as a general rule, when the enplanements exceed 30 passengers per day in the lower 48 states or 5 passengers per week in Alaska, a point can become subsidy free).

Table 1: Subsidies and Subsidy Concentration

	Section 406 in FY 1978	Section 419 in FY 1984 (Estimated)
Total subsidy payments	$75,363,000	$38,000,000
No. of carriers subsidized	11	53
Average subsidies per carrier	$6,851,000	$717,000.00
Amount of subsidies received by the top 4 subsidized carriers	$66,763,000	$11,583,520
The rate of subsidy concentration for the top 4 carriers	88.59%	30.48%
No. of subsidized points	392	134

Sources:

1) CAB Form 470, Fiscal year 1978.
2) CAB Form 470-A, Fiscal year 1984.
3) CAB report to Congress - "Implementation of the provisions of the Airline Deregulation Act of 1978" - Jan. 31, 1984.
4) Information provided by the CAB.

Therefore, a transition from the Section 406 program to the Section 419 program resulted in reductions in both the number of subsidized points and total subsidy payments. In fact, the number of subsidized

communities declined from 392 in Fy 1978 to approximately 134 in Fy 1984, while subsidy payments decreased from about $75 million to approximately $38 million over the same period.

Despite the program's success, it is felt that the Section 419 program could be further improved by incorporating the concept of isolation into the definition of eligible points. In 1983, an additional requirement on specifying EAS points in terms of isolation from hubs was recommended by the General Accounting Office to Congress. Should the recommendation be accepted, approximately 20 points presently included under the EAS program, which are located within 100 miles from the nearest hub would be eliminated from the Section 419 subsidy program. This suggestion has yet to be acted upon by Congress.

ANALYSIS OF THE MARKET CHARACTERISTICS OF SUBSIDIZED COMMUNITIES

Under a deregulated environment, the carriers are relatively free to restructure their network configuration so as to maximize profits. The economic viability of a route is determined by its demographic, geographic and economic characteristics. For instance, a community which is disadvantaged according to these characteristics would, in the absence of an effective subsidy program, probably have to face substantial increases in fares and/or reductions in the level of

service. To explain why financial support is required at some small communities one has to examine the market characteristics of the said communities. As the Communities with a less favourable market environment are best represented by non-hub airports, only such points were included in the study. Data availability, allowed to look at 295 communities in the lower 48 states, of which 100 are still benefitting from subsidized air service. In order to characterize the market of these communities the following variables were used:

1. Subsidy status:

   Since the purpose of the analysis is to discriminate a subsidized community from a non-subsidized one, the subsidy status had to be established. The transition to a system-wide Section 419 funding did not occur until the last quarter of 1983, and hence the subsidy status as of March 1, 1984 was selected.

2. Size of Population:

   The number of inhabitants for the Standard Metropolitan Statistical Areas (SMSAS) in 1980 were used to measure the size of population.

3. Distance to Nearest Air Service Centre:

   In accordance with the ADA, the Board was required to assign one or more hub(s) to an eligible point from which access to the national transportation

network can be attained. To arrive at the most appropriate airlink between a community and a hub(s), the Board had to consider the commercial, geographic and political ties of the candidate hub(s) to an eligible point and also the historical traffic levels to various hubs from that community. Once the CAB selected a list of designated hubs , the distance between the nearest air services centre and the small community were derived.

4. Level of Service:

To represent the level of service, the weekly aircraft departures and corresponding seat capacity for the first week of June, 1983 were selected.

5. Market Demand:

The 1982 annual enplanements were chosen to represent the passenger demand for each community.

6. Competitive Pressure:

The number of carriers operating in the community was selected to represent the degree of competition in providing air service.

7. Unit Fare:

Despite the fact that it was impossible to obtain the data showing the number of passengers travelling on each fare class, a fare variable was constructed. It was based on either the lowest

possible economy fare per kilometre or the lowest possible discount fare per kilometre, as offered in the first week of June 1983. From the eligible list of hubs compiled by the CAB, an average fare structure was derived for the city pairs specified for each EAS point. The difference between the average economy fare and the discount fare was also included in the analysis.

In order to establish the extent to which a subsidized community can be distinguished from a non-subsidized one, a discriminant analysis was conducted. Table 2 provides a comparison of the group means of the descriptive variables and it is apparent that substantial differences between the two groups exist. Differences are observed in passenger demand, in the number of carriers operating in the community, in the difference between the unit economy fare and the discount fare, in the weekly available seat capacity, and in the weekly departures. On the other hand, there is virtually no difference in group means of the unit economy fares. (i.e., 32.15¢ per kilometre for the subsidized communities as opposed to 32.21¢ per kilometre for the non-subsidized ones.) It is possible to conclude therefore that within a relatively competitive market environment, the EAS points have benefitted from the program inasmuch as the unit economy fares for the EAS points are comparable with those

observed in the non-subsidized non-hub communities. However, such benefits have not been extended to the discount fares, as the unit discount fares at the subsidized points are higher than those at the non-subsidized points (an average of 28.98¢ per kilometre at the subsidized versus an average of 25.56¢ per kilometre at the non-subsidized non-hub airports.)

Table 2: Group Means of the Descriptive Variables

Variables	Group: Subsidized Points	Group: Non-Subsidized Points
Population	19149	46630
Distance to the Nearest Air Service Centre (kilometre)	93.35	86.82
Weekly Available Seat	407	2231
Weekly Departures	26	73
Annual Enplanements	2201	24686
No. of Carriers Operating in the Point	1.23	2.17
Economy Fare per Kilometre	32.15¢	32.21¢
Discount Fare per Kilometre	28.98¢	25.56¢
Differences in Fares	3.1¢	6.8¢

Table 3 provides the results of the multivariate discriminant analysis in which the coefficients of the first canonical variate and the group means are summarized. The direction of the relationship

(positively or negatively related) between the subsidy status and the other variables is determined by the sign of the coefficients. That is, a positive coefficient indicates that the greater the measurement the greater is the chance of becoming self-sufficient. Conversely, a negative coefficient indicates that the greater the measurement the greater is the chance of being subsidized. Since the signs of the coefficients applicable to the economy fares and the population are contrary to the ones expected, these two variables were excluded from the discriminant function.

Furthermore, the relative importance of the variables can be determined through reviewing the size of the standardized canonical coefficients. Clearly, the most important factor in establishing a discriminant function is passenger demand, as it contributes most in determining whether subsidized service is required for a non-hub airport. The least important factors are the differences in fares, the distance to the nearest air service center, the weekly departures, and the number of carriers operating in the communities, and perhaps the discount fares. Therefore, these variables were further discarded from the discriminant function.

Table 3: Linear Discriminant Function Standardized Coefficients Based on the First Canonical Variate[4]

	Subsidized	Non-subsidized
Ln (population)	-0.1235	
Distance to the nearest air service center	0.0253	
Ln (available seats)	0.1747	
Ln (weekly departures)	-0.0229	
Ln (passenger demand)	1.5856	
No. of carriers	-0.0892	
Lowest possible economy fare per kilometre	0.2869	
Lowest possible discount fare per kilometre	-0.1196	
Difference in fares (per kilometre basis)	0.0000	
Group means	-1.8223	0.9351

The results of the linear discriminant function based on the passenger demand and seat capacity are shown in Table 4 and 5, the former describes the linear discriminant equations and latter provides the test statistics. Based on the size of the coefficients, passenger demand is still far more important than seat capacity in establishing a discriminant func-

tion and as the Wilk's Lambda is relatively small, only a small amount of information is left to be explained.

Table 4: Linear Discriminant Functions

	Standardized Canonical Coefficients (1st variate)	Fisher's Linear Discriminant Function
Constant	N.A.	-25.985
Ln (enplanements)	1.5734	2.9013
Ln (seat capacity)	0.0516	0.01189

Table 5: Test Statistics for Linear Discriminant Function

Statistics	Value
Adjusted canonical correlation	0.7835
Wilk's Lambda	0.3805
F Statistics	237.7
Probabilty greater than F	0.54E-62
Mahalanobis distances between groups	2.6863

In addition, a quadratic discriminant function (QDF) was also developed and was found to be an improvement on the linear one. The result is:

$$QDF = 0.269762\ (Pax)^2 - 1.81086\ (Seat)^2 + .694417\ (Pax)\ (Seat) - 14.8693\ (Pax) + 17.2176\ (Seat) + 34.7138$$

Where: Pax = Ln (Passenger demand)

Seat = Ln (Seat capacity)

Figure 1 displays the original data with logarithmic transformation, along with the linear and quadratic discriminant functions. A community (X) is classified into the subsidized group, if the calculated value of the quadratic function for a community (Q(X)) is less than or equal zero. Conversely, the community is classified into the non-subsidized group, if the calculated value of the quadratic function of a community is greater than zero. Based on such a classification rule, it was possible to derive the communities which should have been receiving or which should have had their subsidy removed. Among a sample of 295 non-hubs, only 23 were found to be misclassified.

FINDINGS OF THE ANALYSIS

When comparing the market characteristics of subsidized communities with those of the non-subsidized ones, the differences can be best explained through the measures of annual enplanements and weekly available seat capacity. For example, the average enplanements at the subsidized communities are only about 9% and average seat capacity 18% of the corresponding figures at the non-subsidized communities. At a subsidized community (facing both a low capacity and an even lower level of enplanements), it is reasonable to expect that higher revenue requirements, and hence higher fares

would be required in order to assure air services in the absence of subsidies. However, when comparing the unit economy fare between the subsidized and non-subsidized communities, there is virtually no difference. The reason for this is that the economy fares at the subsidized communities were kept in line with the corresponding fares at the non-subsidized points through the financial assistance provided under Section 419 of the FAA. In reviewing the orders issued by the CAB from 1979 onwards, the total annual EAS subsidies accounted for approximately 40% of the carriers' estimated annual revenue requirements. Therefore, it is reasonable to postulate that without the EAS provisions the ADA might have resulted in substantial increases in economy fares and/or reductions, or the elimination of services at the currently subsidized communities.

SUMMARY AND CONCLUSIONS

Without the EAS program, airline deregulation would have had a detrimental affect on about 100 small subsidized communities; both in terms of service levels and fares. In general, the lessons from the US experience suggest, that should a subsidy program be required during a transition period, it should be ensured that the subsidy payments be maintained at the minimum level. To do so, the right of existing

carriers to exit from a small community must be conditional upon the availability of suitable replacement carriers. In addition, the subsidy payments should be calculated on a specified minimum required level of service. Moreover, the presence of a well-developed commuter airline industry is essential for a successful implementation of a small community air service program.

From the results derived from the discriminant analysis, it is possible to conclude that subsidized communities have benefitted from the EAS program. To arrive at the net social benefits of the program, the net of the consumers' and producers' surplus should be quantified. In the absence of an accurately measured demand curve for air service at the subsidized communities, the net social benefits were not included in the study.

Footnotes

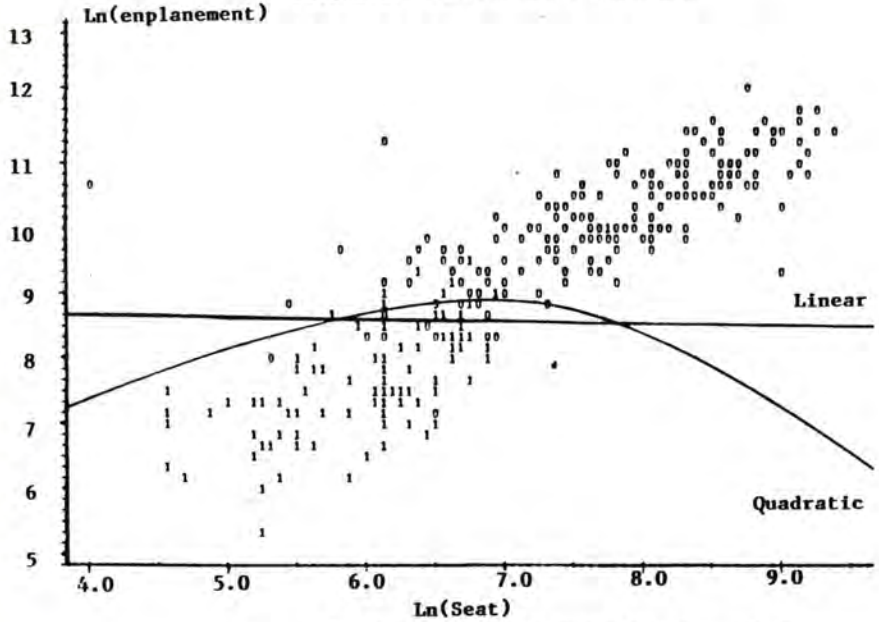
[1] Before the passage of the ADA, regulation of these carriers was limited to compliance with the limitations on aircraft size, payments of licence fees, and report-filing on a quarterly or semi-annually basis.

[2] A hub is defined as a point which enplanes more than 0.05% of total revenue-passenger miles in all services in the U.S.

[3] This provision was used by the CAB on occasions where a weekend service was added to the guaranteed minimum level of service at a number of points in the lower 48 states.

[4] The first canonical variate is the linear combination of a set of variables which maximizes the proportion of variance explained by the groups.

FIGURE 1: Discriminant Functions



0 denotes a non-subsidized community
1 denotes a subsidized community

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AN INDEX OF CONVENIENCE IN THE AIR TRANSPORT INDUSTRY

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The demand for travel is a derived demand. Travelling is not desirable in itself but as a means of being at certain locations at certain times. The desire to be at a given location at a given point in time is derived from the need to undertake certain patterns of activities at that location. It is therefore easy to assume that an individual will want to minimize not only his travel cost, measured in dollars, but also his cost of travel, measured in actual time spent travelling.

Many attributes can affect the demand for travel. If travel demand attributes had to be summarized, in broad categories, such categories would have to encompass: the time required to travel; the cost to the user; and qualitative categories such as safety, comfort and convenience. If certain attributes can be applied to all modes of transportation, others are specific to air travel.

The intent of this study is to define an appropriate measure for a very specific attribute of air travel, the actual convenience of air services.

But the convenience of air services refers to a particularity of the service which is not easily measured quantitatively. Convenience is measured here as the cost in time to go from one point to another. The total trip time can be divided into several components: time spent flying, time spent at transfer points, time spent waiting for the flight or time lost due to a non-optimal arriving time. The total trip time is then largely explained by the convenience of the frequency and schedule of the service offered to the user.

The methodology chosen to evaluate the convenience of air travel in Canada, is an index approach. The index of convenience takes into account two main characteristics of air travel: the flight duration and the schedule delay. The flight duration is defined as the difference between the final arrival time and the (first) departing time. Therefore it includes the time spent connecting or waiting for a connection when a direct flight is not available. The schedule delay is defined as the difference between the scheduled arrival time and the ideal time at which the traveller would like to arrive.

An actual measure of the convenience of air services offered quantifies an important qualitative attribute of air transport demand. Such a measure can be useful in estimating or forecasting a demand

function. It can also be helpful for other reasons. In the context of the reduction of the air transport industry regulations in Canada, an index of convenience can be used to monitor the effects of the policy changes on the convenience of air services as the services offered change. For the sake of comparison, the convenience of air services is measured from 1976 onward.

The index presented here was inspired by a CAB study[1]. The main assumptions are, however, adapted to the Canadian situation and some new methodological features are added.

Section I describes the sample used to measure the convenience of air travel in Canada. Section II explains the methodology used to compute the index of convenience as well as two other indices that are arrived at when distance and load factor are taken into account.

Sample

In Canada, a person can occupy a seat on an aircraft that can fly from various airports. The Canadian airport universe is limited, for the sake of this study, to airports receiving Class I and II services in 1978 and/or in 1983. The said airports are then divided into three groups: big airports, medium airports and small airports. There are eight big, six medium and 66 small airports. The sample

includes all the big and medium airports and nine small ones. The selection of small airports followed the following process: two of them were randomly chosen in Ontario, two in Quebec and one in each of the following Provinces: British Columbia, Alberta, Saskatchewan, Manitoba, and Maritimes. From the sample of twenty-three airports (cities), various combinations of city pairs exist. From all the possible city-pair combinations, a sample of 54 is used. The sample includes 14 randomly chosen pairs which implies a link between a big airport and a big airport, 24 pairs involving a big airport and a medium airport, 7 pairs involving a medium airport and a medium airport and 9 pairs where a small airport is linked to a big airport. Table 1 presents a list of all 54 city pairs used in the sample.

Table 1

SAMPLE

1. Calgary-Montreal
2. Calgary-Ottawa
3. Calgary-Vancouver
4. Calgary-Winnipeg
5. Edmonton-Halifax
6. Edmonton-Montreal
7. Edmonton-Ottawa
8. Halifax-Ottawa
9. Halifax-Toronto
10. Halifax-Winnipeg
11. Montreal-Ottawa
12. Montreal-Toronto
13. Ottawa-Toronto
14. Toronto-Vancouver
15. Prince George-Quebec
16. Prince George-Kelowna
17. Regina-Saskatoon
18. Saskatoon-Quebec
19. Quebec-Sept Iles
20. Quebec-Kelowna
21. Sept Iles-Kelowna
22. Calgary-Saskatoon
23. Calgary-Sept Iles
24. Calgary-Kelowna
25. Edmonton-Prince George
26. Edmonton-Quebec
27. Edmonton-Sept Iles
28. Halifax-Quebec
29. Halifax-Sept Iles
30. Halifax-Kelowna
31. Montreal-Regina
32. Ottawa-Prince George
33. Ottawa-Quebec
34. Ottawa-Sept Iles
35. Ottawa-Kelowna
36. Toronto-Regina
37. Toronto-Saskatoon
38. Toronto-Kelowna
39. Vancouver-Quebec
40. Vancouver-Sept Iles
41. Vancouver-Kelowna
42. Winnipeg-Saskatoon
43. Winnipeg-Quebec
44. Winnipeg-Sept Iles
45. Winnipeg-Kelowna
46. Gander-Montreal
47. Iles de la Madeleine-Montreal
48. Matagami-Montreal
49. Sudbury-Toronto
50. Sault Ste Marie-Toronto
51. Churchill-Toronto
52. Prince Albert-Vancouver
53. Fort McMurray-Vancouver
54. Quesnel-Vancouver

Index of Convenience

The first index of convenience computed is based on the methodology developed by the CAB. The schedule delay and the flight duration are computed for hypothetical travellers on the 54 routes. These hypothetical travellers are assumed to have desired arrival times spread every fifteen minutes during the peak hours of the day.[2] For each of these travellers, an ideal flight is chosen from all the flights listed in the Official Airline Guide (OAG).[3]

The ideal flight is the one for which the weighted sum of the flight duration and the schedule delay is minimized. The weights are such that a traveller is willing to incur an hour of schedule delay for 45 minutes saved on flight duration.[4]

The index for one route is then calculated as the average for all passengers on that route and the total index is the weighted sum of the route's indices. The weights for the total index are the relative share of each route's origin-destination passenger[5] traffic.

Indexes of convenience can also be computed for sub-samples. For instance, the sample accounts for the size of the two airports from which a city pair is derived; also, for each city pair in the sample, a given length of haul separates the two cities. Table 2 presents the results of the index of convenience for the whole sample and disaggregated by city size and length of haul (route kilometres).

Table 2

INDEX OF CONVENIENCE

1976=100

	1976	1978	1980	1983*
TOTAL SAMPLE	100.0	106.7	110.1	106.0
Big-Big	100.0	105.2	108.5	104.9
Medium-Medium	100.0	106.5	120.3	125.0
Big-Medium	100.0	108.4	103.1	99.4
Small-Big	100.0	141.1	145.1	140.3
less than 600km	100.0	102.6	87.2	104.7
601-1200km	100.0	126.3	113.5	112.1
1201-2400km	100.0	105.5	118.2	105.2
more than 2400km	100.0	95.6	91.8	85.5

*O-D data for the first three quarters of 1983 only.

The index has to be interpreted as a time cost index. In other words, when the absolute value of the index increases (decreases) from one year to another, it means that the cost, in time, to travel has increased or that the convenience has decreased (increased).

The index shows more variations in the convenience of the sub-samples of the Canadian routes than in the total sample. Between 1976 and 1984, the routes linking a medium city to another medium city face the highest decrease in the convenience of air travel. This is not surprising since people living in medium cities who intend to fly to another medium city often must go to a big city from which it then becomes possible to reach the actual medium city destination. For example, the travellers who want to go from Quebec

City to Kelowna have to go through the following travelling itinerary: Quebec City-Montreal-Vancouver-Kelowna. The measured decrease in convenience has happened mostly since 1982 and it coincides with the decrease in the volume of passengers carried by the air transport industry in Canada. Under the then difficult economic situation, carriers, in order to maintain their financial viability, were forced to rationalize their operations. The market of small to big cities stands as being the one with consistently the lowest convenience over the years. For small cities, the evidence indicates that the convenience of air services has neither improved nor deteriorated.

Index of Convenience Adjusted For Distance

As previously mentioned, the index of convenience takes into account the flight duration and the schedule delay. The flight duration is a function of three things: the speed of the aircraft, the time spent waiting for a connection and the distance between the origin and the destination. The last two are the most important aspects of the flight duration. However, if one compares two direct flights using the same aircraft type on two routes of different lengths, the flight duration is going to be higher for the longest route and the index of convenience, as defined, reflects it. To try to correct for such a bias, an index of convenience incorporating the length

of each route in the sample is calculated. This index is computed in an effort to "deflate" the index of convenience for the different stage length of each route. Without such a deflator, it is believed that the index "penalizes" the routes with important lengths of haul. However, not all of the possible bias is removed since the directionality of the route in the context of the different time zones between the different parts of the country remains a source of concern in the defined measure of convenience. To go from Montreal to Vancouver doesn't take as much time as to come back.

Everything else taken into account, the inclusion of the distance factor is a valid way to aim at a standardization of routes but it cannot be done in a straightforward manner.

Table 3 presents the results of the index of convenience adjusted for distance.

The index adjusted for distance follows the same trend as the simple index in the sub-samples aggregated by length of haul. This may indicate that the adjustment for distance is not affected that much by the different time zones. In the total sample, the index adjusted for distance indicates a higher level of travel convenience in Canada than the level indicated by the simple index, especially between 1978 and 1979 and between 1980 and 1981. The measure of

convenience has to take into account the fact that travelling from Quebec City to Kelowna has to take some time even in the best conditions possible because of the length of haul. Consequently, the index adjusted for distance indicates a better performance than the simple index.

Table 3

INDEX OF CONVENIENCE ADJUSTED FOR DISTANCE

1976 = 100

	1976	1978	1980	1983*
TOTAL SAMPLE	100.0	105.5	106.9	101.2
Big-Big	100.0	101.4	97.5	94.6
Medium-Medium	100.0	112.5	124.7	129.7
Big-Medium	100.0	98.1	114.0	104.0
Small-Big	100.0	134.6	145.5	139.2
less than 600km	100.0	104.2	90.8	108.0
601-1200km	100.0	128.6	118.0	113.3
1201-2400km	100.0	104.3	116.6	104.5
more than 2400km	100.0	96.8	91.7	84.7

*weighted by first three quarters of 1983 O-D data only.

Index of Convenience Adjusted for Seat Availability

According to Douglas-Miller, travel time includes actual time in the aircraft plus two sorts of delay: frequency delay and stochastic delay. Frequency delay is the equivalent to what was called earlier schedule delay. Stochastic delay is the time lost due to the nearest offered departure time being unavailable. To take into account the stochastic delay, an index of convenience incorporating the load factor of each flight is calculated. If the load factor for a

certain flight is very high, the probability that a traveller be denied a seat on that flight is very high. Therefore a high load factor for a flight reduces the possibility for that flight to be the one that minimizes the cost in time of the trip.

The load factors are unfortunately unavailable on a true O-D basis. Load factors are only available between every two stops the aircraft makes. Suppose one is interested in the load factor of a Montreal to Calgary flight. If the plane stops over in Toronto, two load factors are available: one for the Montreal to Toronto portion and one for the Toronto to Calgary portion. In cases where a flight with a stopover is involved, the highest load factor of all the flight's segments is the load factor used in the calculation of the index.

Load factors are not reported by all carriers. For smaller carriers like Great Lakes or Norcanair load factors are not available. Recently, however, small carriers have entered into markets which traditionally were served by bigger carriers. It is therefore important to take them into account in a study measuring the evolution of the level of convenience of air services. The sensitivity of the index was tested by allowing different load factors for flights with no reported load factors. Probably because of the small number of flights without

reported load factors in relation to the total number of flights in the whole sample, the index was found insensitive to variations around a 60% load factor.

Because load factors are not yet available for the year 1984, the index has not been computed for 1984 with the load factor adjustment. The load factor adjusted index has also been calculated on different sub-samples disaggregated by city size and length of haul. Table 4 presents the results.

Table 4

INDEX OF CONVENIENCE ADJUSTED BY LOAD FACTOR

1976 = 100

	1976	1978	1980	1983*
TOTAL SAMPLE	100.0	123.2	127.4	105.1
Big-Big	100.0	121.5	127.5	101.3
Medium-Medium	100.0	109.3	136.1	101.7
Big-Medium	100.0	129.3	113.7	117.1
Small-Big	100.0	170.0	177.7	140.3
less than 600km	100.0	113.6	108.9	74.6
601-1200km	100.0	137.3	126.8	118.0
1201-2400km	100.0	115.1	129.4	128.2
more than 2400km	100.0	118.8	121.3	97.9

*1983 weighted by first three quarters O-D data only.

The index of convenience adjusted with load factors follows more or less the same pattern as the other indexes but the peak and the through are a lot more pronounced.

It is interesting to note that the index adjusted for the load factor in the category big city to big city follows exactly the trend of the total sample.

Even if it is not the largest category in terms of the number of routes included, it is the category with the largest relative share of all origin-destination passenger and therefore it is the one that affects the average the most. However it may also be the one affected the most by the addition of the load factor since they are usually higher for the high density routes. This explains the big difference between the indexes with and without the adjustment by the load factor.

On the total sample, the year with the highest cost in time to travel or the lower convenience is 1980 and the year with the best convenience is 1976, except for the index adjusted by distance which shows 1981 to be the best year.

The CAB study from which the sample index of convenience is based shows results for the years 1978, 1980 and 1981 in the U.S. For the total sample, the Canadian indexes have the same behaviour which is a slight decrease in the convenience between 1978 and 1980 and then an increase between 1980 and 1981.

To summarize, the index adjusted by the load factor to take into account the stochastic delay is a step in the right direction even if the load factor is not the ideal measure of non-availability of a seat.

The indexes are now tested for sample sensitivity of medium-small cities. They will also be computed in

the future as some effects of the liberalization of the air transport industry are expected.

FOOTNOTES

(1) CAB, Competition and the Airlines, An Evaluation of Deregulation, (December, 1982)

(2) Peak hours are from 9:00 to 11:00 and from 16:00 to 20:00 based on frequency of both eastbound and westbound flights.

(3) Flights for the first Monday of June in each year were taken for consistency throughout the period.

(4) The CAB tried several assumptions for the trade off and their year-to-year comparisons were not sensitive to the value of the trade off assumed.

(5) Statistics Canada, #51-204, Annual.

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THE FARE BASIS SURVEY AND DISCOUNT AIR FARE UTILIZATION IN THE DOMESTIC MARKET

John A. Greig and Emile Di Sanza*

The late seventies witnessed a fundamental change in the pricing strategies of the domestic air carriers. Challenged by the development of the seat management concept[1], the authorization of charter competition on domestic routes and the impact of airline deregulation in the United States, the Canadian airlines responded with a proliferation of new fares reflecting a greater degree of market segmentation.

During this period, the Research Branch of the Canadian Transport Commission reported[2] on the changing mix of full fare and discount fare products available in the domestic market using air fare data received from the air carriers as special filings to the Commission. In

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response to the identified limitations in the special filings approach, particularly those related to the lack of uniformity in concepts and the discontinuous time series which was developing, the "Fare Basis Survey" was established in order to meet ongoing fare monitoring requirements. The survey was developed by the interdepartmental Aviation Statistics Requirement Committee[3] in consultation with the airline industry and reporting began in January 1983.

Purpose

This paper has two objectives: first, to introduce the "Fare Basis Survey" which has replaced the special filings and ad hoc surveys of the period 1978-1982; and second, to report on one application of the survey related to discount fare utilization in Canada.

The first section of this paper includes a discussion of the concepts underlying the survey, the survey design, the type of data reported, and the question of data reliability.

The second section reports on the proportion of Canadian air travellers using discount fares, the variability amongst different markets, and the

comparability between the Canadian experience with discount fares and that in the United States.

PART I

THE "FARE BASIS SURVEY" AN INTRODUCTION TO THE STATISTICAL FRAMEWORK

The "Fare Basis Survey" provides estimates of fare type utilization (and a respective measure of each estimate's reliability) in terms of traffic volume, fare revenue, and such derived indices as yield for the scheduled services of Canadian Level I carriers[4]. The carriers participating in the survey are: Air Canada, CP Air, Pacific Western Airlines (PWA), Nordair, Eastern Provincial Airways (EPA), Quebecair[5] and, effective with the initiation of its international scheduled service, Wardair.

Sample Design

The survey is designed to be conducted recurrently in accordance with a stratified random sample of 56 days per calendar year. The sample is based on a stratification by quarter and by day of the week which provides 28 strata; two days are chosen per stratum via a modified systematic selection.

Stratification by quarter facilitates the production of estimates at a quarterly level, an important requirement given pronounced seasonal variations in air travel. Stratification by day of the week is consistent with heterogeneity among days of the week in regards to traffic volume and fare composition.

The selection of a new set of sample days for each year is based on the following method[6]. One ordered pair of initial days (n_1, n_2) is selected as the random start from 65 possible combinations in the set:

$\{(n_1, n_2) | n_1, n_2 \varepsilon (1, 2, \ldots, 13), n_1 < n_2, n_2 - n_1 \neq 6, 7\}$

Every 13th day from these initial sample days is then selected, resulting in a quarterly sample of 14 days divided between two replicates as illustrated in Chart 1.

CHART 1: SAMPLE SELECTION

Random Start $(n_1, n_2) = (3, 8)$

			n_1					n_2					
APRIL	1	2	3	4	5	6	7	8	9	10	11	12	13
	14	15	16	17	18	19	20	21	22	23	24	25	26
APRIL/MAY	27	28	29	30	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18	19	20	21	22
MAY/JUNE	23	24	25	26	27	28	29	30	31	1	2	3	4
	5	6	7	8	9	10	11	12	13	14	15	16	17
	18	19	20	21	22	23	24	25	26	27	28	29	30

This sample design ensures dispersion of the sample days throughout the quarter in order to capture, as much as possible, changes in fare type utilization.

Survey Concepts and Methods

The universe consists of all "lifted" flight coupons (i.e., those used for travel) in a carrier's system applicable to scheduled services; reportable coupons are those which are lifted on one of the designated sample days.

Data selected from the reportable coupons are as follows:

1) Fare basis code
2) Coupon Origin & Destination (O&D)
3) Number of passengers
4) Revenue

The fare basis code is an alphanumeric code denoting the applicable service, discount and restrictions on travel. For the participating carriers, there are approximately 1 800 such codes or tariffs in effect. Since some of these codes are essentially identical, certain carriers regroup them into fare type codes resulting in approximately 700 carrier-specific fare codes being reported in the survey.

The coupon O&D identifies the two locations between which the coupon was used for passage. Data are reported for approximately 600 domestic and international coupon O&D city-pairs. The incidence of fare codes by city-pair will vary according to size and type of market, number of competing carriers and season. Some of the larger city-pairs have upwards of 100 fare codes reported in a quarter.

The revenue reported is the allocated portion of the revenue from the ticket associated with a particular coupon. Where the coupon comes from a one coupon ticket, all the ticket revenue is allocated to that coupon; where the coupon comes from a multi-coupon ticket, the ticket revenue is prorated. Although procedures for revenue proration vary considerably (contingent upon the nature of the itinerary, the type of fare, etc.), the basic method used is the "Straight Rate Proration Principle" whereby ticket revenue is prorated in proportion to the applicable prorate factors (usually the local regular economy fares) associated with the city-pairs of the coupons comprising the ticket.

Carriers report passenger volume and revenue aggregated by fare code and coupon O&D for each sample

day; approximately 70 000 such records are reported per quarter.

Population estimates are produced by applying the respective sampling weight of each stratum to the passenger volume and revenue values for each record in that stratum. The sampling weight is based on the number of occurrences of each day of the week in a particular quarter divided by the number of sample days selected for each stratum; thus the sampling weight will be either 6, 6.5 or 7.

Direct estimates (passenger volume, revenue) and derived indices (revenue passenger kilometres, yield) are produced for specified domains. A domain is defined in terms of carrier choice, fare designation, reference period and geographical entity. The criteria and parameters for defining the domain according to these components are summarized below.

Fare can be defined as (i) the reported fare code, either a discrete fare basis code (e.g., YHXE27) or the equivalent carrier code, (ii) an aggregate fare type (e.g., Advance Purchase Excursion) or (iii) a generalized fare group or category (e.g., Discount fare). Fare can be further differentiated according to the level of discount relative to the regular economy fare.

Because of sample design, the shortest reference period for which estimates may be produced is the quarter; from these basic estimates, year-to-date and annual estimates may be derived.

Geographical entity is based on the reported coupon O&D. It can be specified as a directional/combined ccupon, market, hub, zone, sub-sector, sector or system. Analytical criteria, such as city-pair distance and passenger density can be applied to further refine the definition of the domain.

In evaluating the results of the "Fare Basis Survey" it is important to consider that it is based on flight coupon data. This compares, for example, to the "Passenger Origin and Destination Survey" which is based on ticket origin and destination and the "Airport Activity Survey" based on flight segment data[7]. A coupon-based reporting format allows a linkage between market based data and airport activity data; its limitation, however, is that in itself, it does not allow for differentiation of local and through traffic.

Data Quality and Reliability

The collection of fare basis data within the framework of a survey dedicated specifically to fares

tends to minimize data deficiencies resulting from non-sampling error. In addition, because the flight coupon is a basic source for the carriers' own revenue accounting systems, data capture of coupon data by the carriers is a centralized computer-assisted operation and subject to internal verification resulting in relatively accurate and timely reporting at marginal cost and response burden to the carrier.

Reported data are computer-edited by the Aviation Statistics Centre to ensure proper sample selection, valid entries and logical inter-field dependencies. Using the respective regular economy fare of a coupon city-pair as a benchmark, intra- and inter-carrier analyses are performed to detect inconsistencies between fare code and average fare values.

Sampling error for estimates of totals (passenger volume, revenue, etc.) is derived from the standard formula used in a stratified replicated sample design while the Balanced Repeated Replication technique is used for estimates of ratios and proportions[8].

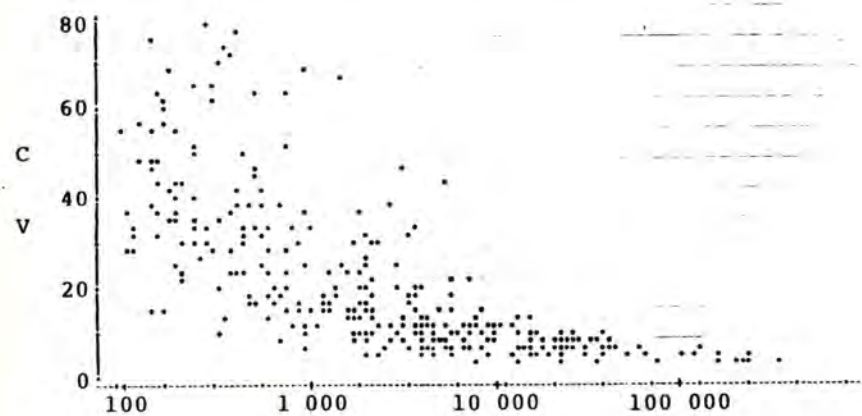
A measure of the estimate's reliability is provided by its associated coefficient of variation (c.v.), defined as the ratio of the estimate's standard

error to the estimate itself, expressed as a percentage. Estimates with a coefficient of less than 10 can be generally considered to be reliable from a sampling point of view.

As an indication of the reliability of the estimates for a characteristic of primary interest (i.e., discount passengers), the c.v. of the passenger volume estimate was plotted against the quarterly coupon city-pair passenger volume; the results are illustrated in Chart 2 below.

Chart 2

SCATTERPLOT: COEFFICIENT OF VARIATION OF DISCOUNT PASSENGER VOLUME AGAINST COUPON O&D ESTIMATE OF TOTAL PASSENGER VOLUME - THIRD QUARTER 1983



Passenger Volume Estimate (logarithmic scale).

Very poor reliability is apparent for markets below 1 000 passengers; however, as the market size approaches 10 000 passengers the reliability of discount passenger estimates increases markedly. Above 10 000 virtually all estimates fall within the normally acceptable range.

Finally, where appropriate, supplementary measures of reliability may also be derived. The reliability of passenger volume estimates may, for example, be established by means of confidence intervals. In evaluating estimates (e.g., discount passengers as a proportion of total passengers) over a period of time, the significance of the difference between the estimates may be determined by testing for the null hypothesis for a predetermined level of significance of the test statistic.

PART II

SOME PRELIMINARY RESULTS FROM THE FARE BASIS SURVEY

The first section of this paper has outlined the statistical framework within which fare data are collected in Canada. By virtue of its conceptual basis and relatively broad coverage, the survey accommodates considerable analytical scope. This section reports on one application of the "Fare Basis Survey", in particular, that related to the utilization of discount fares within the domestic market.

The Utilization of Discount Fares, 1978-1983

Until 1977 the range of air fares available in the domestic marketplace was rather limited. There were scheduled First Class fares, Economy Class fares and a small number of excursion fares available only during off-peak periods. Since 1977 there has been a proliferation of more generally available discounted air fares to complement the provision of the regular First Class and Economy Class fares.

This trend towards a more complex tariff structure in Canada, and indeed towards the increased marketing of discount air fares can be traced to three

events during the late seventies: (i) the development of the surplus seat concept which, in 1977, led to the first offering of a discount excursion fare program on domestic secheduled services during the summer peak travel period; (ii) the authorization of domestic Advance Booking Charters in 1977 to compete with the scheduled services in developing the market for lower priced travel in Canada; and (iii) the Airline Deregulation Act of 1978 which brought rapid changes to the U.S. domestic market in terms of price levels and the range of fare types offered. The proximity of U.S. airports to Canada's largest population centres has meant that the Canadian industry could not be far behind that in the United States without risking traffic diversion to U.S. carriers.

Understanding the impact of these events on both the travelling public and the domestic air carrier industry has required the extensive review of many inter-related issues; among them, how many travellers are flying on discount fares, at what price levels and under what conditions of sale. It is the measurement of the number of travellers using discount fares which is the focus of this section of the paper.

Data sources available in the period 1978 through 1982 had the effect of subdividing this issue into two components: that related to the utilization of deep discount fares[9] on Air Canada and CP Air and that related to the volume of passenger carriage on domestic charter air services.

Table 1 indicates that in this period (1978-1982) there was a major increase in the carriage of passengers on deep discount fares. In 1978, 14.5% of Air Canada and CP Air's output, as measured by revenue passenger kilometres, was accounted for by the carriage of passengers on such fares. This increased to 37% in 1982. In addition, by 1982, for every ten revenue passenger kilometres produced in discounted scheduled services, one was produced in domestic advance booking charter services[10].

Table 1 also endeavours to provide a link between the old (1978-1982) and the new (1983) data series. Thus the carriage of deep discount traffic as a proportion of total carriage on Air Canada, CP Air, EPA, Nordair and PWA in the southern domestic sector[11] amounted to 48% in 1983. This compares with 56% representing the proportion of total carriage accounted for by <u>all</u> discount fares on the same carriers in 1983 (see

Table 1

DISCOUNT TRAFFIC AS A PERCENTAGE OF TOTAL DISCOUNT AND FULL FARE TRAFFIC SOUTHERN DOMESTIC SECTOR

(Measured in Revenue Passenger Kilometres)

	Deep Discount Traffic	All Discounts
1978	14.5	N.A.
1980	25.3	N.A.
1982	37.3	N.A.
1983	48.1	55.5

Notes:

1. Deep discount traffic is that discounted by 25% or more off the full economy fare.

2. Revenue passenger kilometre data for 1978, 1980 and 1982 are tabulated from flight segment data of Air Canada and CP Air. Not included in these data is deep discount traffic carried on CP Air's western route, nor domestic portions of international flights.

3. Revenue passenger kilometre data for 1983 are tabulated from flight coupon data of Air Canada, CP Air, EPA, Nordair and PWA. Southern domestic services including domestic portions of international flights are included in these data.

Sources:

1978, 1980, 1982 Special Filings to the Air Transport Committee.
1983, Air Carrier Fare Basis Statistics reported to the Air Transport Committee, Scheduled Services, Preliminary Estimates.

Table 1) and 61% representing again the same proportion but for domestic scheduled and charter services (see Table 4).

A More Detailed Review of the Utilization of Discount Fares in 1983

A more detailed review of the mix of full and discount fares available in 1983 is important from a number of perspectives. First, 1983 is the year preceding the increased liberalization of domestic pricing as envisaged in the New Canadian (1984) Air Policy. As such the 1983 results become a benchmark against which to measure change as the air transport industry moves into a less regulated environment.

As well, 1983 is the first year for which data are available from the "Fare Basis Survey". In itself this has facilitated the implementation of two changes relative to the monitoring of domestic pricing. The monitoring now encompasses the domestic scheduled services of Level I carriers, not just those of Air Canada and CP Air. In addition, the interest is no longer focused exclusively on deep discount fares, (where the major product initiatives took place in the years 1978 through 1982), but rather the emphasis is on

discount fares in general, recognizing that the New Canadian (1984) Air Policy calls for the deregulation of pricing on discount fares by May 1986.

Table 2 reports on the distribution of passengers and revenue passenger kilometres by fare type within the southern and northern domestic sectors in 1983.

The fare basis codes reported by the participating carriers have been classified by general fare groups. The fare groups presented in the tables are as follows:

1) Premium Fare comprising First Class;
2) Full Fare comprising full fare Regular Economy;
3) Discount Fare comprising the various discount fares such as Charter Class, Seat Sales, Advance Purchase Excursion, Group, Senior Citizen, Youth, Family Plan Dependents, etc; and
4) Other comprising Industry and Agency Discount fares and Military as well as unknown fare codes.

The table indicates that in terms of passengers carried on domestic scheduled services 46% travelled on some form of discount ticket in 1983. In fact the actual number is likely somewhat higher insofar as some proportion of tickets with 'unknown' fare codes will be discount tickets. In terms of the carriage of discount traffic there is an identifiable third quarter peak.

Table 2

DISTRIBUTION OF PASSENGERS AND REVENUE PASSENGER KILOMETRES BY FARE TYPE WITHIN THE SOUTHERN AND NORTHERN DOMESTIC SECTORS, PRELIMINARY ESTIMATES, 1983

% Distribution by Fare Type

	Premium Fare	Full Fare	Discount Fare	Other and Unknown
SOUTHERN SECTOR				
Passengers				
1st Quarter	0.7	55.6	37.3	6.3*
2nd Quarter	0.8	49.1	45.3	4.9
3rd Quarter	0.7	42.0	50.7	6.6
4th Quarter	0.8	47.4	48.8	3.1
Annual	0.8	48.1	45.9	5.2
Revenue Passenger Kilometres				
Annual	1.4	37.3	55.5	5.8
NORTHERN SECTOR				
Revenue Passenger Kilometres				
Annual	--	65.1	33.6	1.4

Note: The asterisk indicates a coefficient of variation between 10 and 25%.

Source: Air Carrier Fare Basis Statistics reported to the Air Transport Committee, Scheduled Services, Level I Carriers, based on Flight Coupon Origin and Destination.

When the distribution is expressed in terms of revenue passenger kilometres, the annual proportion of output corresponding to travel by discount passengers increases to 56%. The relationship between the passenger and the revenue passenger kilometre proportions indicates a greater carriage of discount passengers on the longer haul services, a supposition corroborated by Table 3.

Finally, the table indicates that in northern services, a smaller proportion of output is accounted for by the carriage of discount passengers.

Table 3 reports the percentage carriage of discount fares by volume and distance categories. The table shows an increased proportion of discount traffic carried as the length of haul increases. No such simple pattern is evident in regards to the volume categories although there are differences amongst the cells suggesting market specific influences. The range of variation in the volume categories is considerably less than that in the distance categories.

Table 4 provides a comparison of Canadian and U.S. statistics relative to the carriage of discount traffic. The U.S. data are that reported by the Air

Table 3

PERCENTAGE CARRIAGE OF DISCOUNT FARES BY VOLUME AND LENGTH OF HAUL WITHIN THE SOUTHERN DOMESTIC SECTOR PRELIMINARY ESTIMATES, 1983

Volume (Psgrs/Day*)	LENGTH OF HAUL (KILOMETRES) 0-600	601-1200	1201-2400	2401+
10 - 50	39.5	42.1	56.9	66.0
51 - 200	34.9	50.8	52.6	54.1
201 - 500	34.5	41.1	58.1	60.4
501 +	28.7	54.3	57.2	64.6

Note:

*As defined by 1983 passenger traffic reported in the "Fare Basis Survey".

Source:

Air Carrier Fare Basis Statistics reported to the Air Transport Committee, Scheduled Services, Level I Carriers, based on Flight Coupon Origin and Destination.

Table 4

DISCOUNT TRAFFIC
A CANADA - U.S.A. COMPARISON
1983

	Canada	U.S.A.
Discount Traffic as a Percentage of Total Revenue Passenger Kilometres (RPK's)	61%	82%
Discount Yield as a Percentage of Full and Premium Fare Yield	47%	52%

Notes:

1. Carrier coverage:

   Canada - Level I Air Carriers, scheduled and charter for the computation of discount traffic, scheduled only for the computation of discount yield, domestic southern operations.

   U.S.A. - Majors, domestic and transborder operations.

2. Discount traffic:

   Canada - does not include first class discounts.

   U.S.A. - includes first class discount.

3. Total Traffic (RPK's):

   Canada - discount, full and premium fares as measured by flight coupons.

   U.S.A. - as measured by flight segment data.

4. Yield Comparison: Fare type yield is the total revenue by fare type divided by the RPK output by fare type.

Source:

Canada - Air Carrier Reports to the Air Transport Committee. Canadian data are preliminary.
U.S.A. - Air Transport Association of America survey of major American airlines.

Transport Association of America on: (i) discount traffic as a proportion of total revenue passenger kilometres and (ii) discount yield as a proportion of full and premium fare yields. Comparable Canadian data have been generated using the information available from the "Fare Basis Survey" supplemented by charter data.

In Canada, in 1983, 61% of the revenue passenger kilometres were accounted for by persons travelling on discount fares on the scheduled and charter services offered by Level I carriers. This compares to 82% in the United States on major carriers. The discount yield on scheduled services, in Canada, was 47% of the full and premium fare yield compared to 52% in the United States.

It is cautioned that as a measure of average discount the above proportion is an overestimate as it is influenced by the relative mixes of traffic at the different lengths of haul.

Conclusion

The issue of air fare type utilization in the domestic market is expected to assume even greater relevance in the years ahead as the Canadian air carriers respond to the increased pricing freedoms afforded in the

New Canadian (1984) Air Policy and as the debate on the direction and extent of further deregulation continues.

This paper has introduced the "Fare Basis Survey" including a review of the concepts underlying the survey, the survey methodology and the reliability of the estimates. In addition, the paper has reported on one application of the survey, in particular, the mix of full and discount fares available in the domestic market. It is hoped that this two-pronged approach, that is, a review of methodology and a preliminary interpretation of some pertinent results, will prove to be of assistance to industry observers as they endeavour to assess the progress of the domestic airline industry as it moves into a period of less regulation.

FOOTNOTES:

1. Application of the concept enables a carrier to define, based on historical traffic patterns, capacity (seats) supplemental to that required to meet the needs of the full fare traveller.

2. Canadian Transport Commission, A Review of Domestic Low-Priced Air fares: January-August 1978, Ottawa, December 1978.

   Canadian Transport Commission, A Review of Low-Priced Air Fares: 1979, Ottawa, November 1980.

   Canadian Transport Commission, The Low-Priced Air Fare Review: A Three-Year Perspective, Ottawa, March 1982.

Canadian Transport Commission, The Low-Priced Air Fare Review: The First Five Years, Ottawa, November 1983.

3. This Committee has respresentation from Statistics Canada, the Canadian Transport Commission and Transport Canada.

4. As established by criteria specified in the Air Carrier Regulations Part VIII, Section 146(1)a (revised 1981).

5. Quebecair began reporting in January 1984 on a limited basis.

6. The method described applies to quarters which have 91 days; the procedure is modified slightly to adjust for quarters which have 90 or 92 days and to avoid clustering the sample.

7. Concepts and methods relating to these surveys are described in the following Statistics Canada publications: Air Passenger Origin and Destination - Domestic Report (Catalogue 51-204), Air Carrier Traffic at Canadian Airports (Catalogue 51-005).

8. A technical description of the methodology for variance estimation, as developed by R. Carpenter of the Business Methods Survey Division (Statistics Canada), is available from the Aviation Statistics Centre.

9. Deep discount fares are those discounted by 25% or more off the full economy fares.

10. Canadian Transport Commission, The Low-Priced Air Fare Review: The First Five Years, Ottawa, November 1983, page 43.

11. The dividing line separating the southern and northern domestic sectors is defined by: the 50th parallel from the Atlantic Ocean to the Ontario-Manitoba boundary, the diagonal joining the 50th parallel at the Ontario-Manitoba boundary to the 55th parallel at the Manitoba-Saskatchewan boundary and the 55th parallel from the Manitoba-Saskatchewan boundary.

Measuring and Identifying the Causes of the Productivity Performance of the Canadian Class I Railroads 1956 - 1981*

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I. Introduction

The objective of this paper is to communicate the results of our measurement and analysis of the Total Factor Productivity[1] (hereafter TFP) of the Canadian National and the Canadian Pacific Railways from 1956 through 1981. This paper is a part of the larger study[2] which we have conducted with a negotiated research grant of the Transportation University Program (TUP). This paper is organized as follows: Section II is a brief description of the data base and the variables. In Section III we discuss the methodology for measuring and comparing (between the two firms and over time) TFP as well as present the empirical results. Section IV investigates the causes of the TFP differentials by utilizing several alternative TFP regression models. These allow us to measure the unexplained TFP levels as a means to evaluate the economic efficiency of the two carriers. In Section V, we summarize and interpret the empirical findings of this paper.

II. The Data

A detailed description of the sources and methods used to develop our data base is contained in Freeman, Oum, Tretheway and Waters (1985). We have relied heavily on the annual reports of the CN and CP filed with the Canadian Transport Commission (CTC). Construction of the data base was aided by access to the Wisconsin group's rail data. The annual reports follow the Uniform System of Accounts instituted in 1956. Accounting procedures and reporting practices before 1956 were significantly different from those instituted in 1956. Thus, our study is limited to the period from 1956 to 1981, the most recent year for which all data was available.

Freight service output is measured as revenue ton-miles and passenger service output is measured in revenue passenger-miles. As of 1978, VIA Rail assumed responsibility for passenger services in Canada. The resulting change in reporting to the CTC shows nearly all non-commuter passenger services being provided by VIA even though the CN and CP produce these services under contract to VIA. We assign VIA output to the appropriate carrier through analysis of passenger train fuel expenditures. For both freight and passenger services, multilateral output indices were formed and rescaled so that the 1956 values of Canadian Pacific were unity. A multilateral aggregate output index was constructed using freight and passenger revenue shares as the weighting components for the respective sub-indices.

On the input side our study identifies five input categories: labour, fuel, way and structures, equipment, and other purchased inputs (which we refer to as materials). The aggregate quantity of labour input is measured as a multilateral index of four component labour sub-indices. Labour price is measured via the dual price index. It is rebased to unity in 1956 for CP. Fuel consumption is measured by

converting consumption by fuel types (coal, diesel, crude oil, etc.) to their British Thermal Unit equivalents. The fuel price index is simply the total cost of fuel divided by the aggregate BTU consumption. This is also rebased to unity in 1956 for CP.

Construction of the capital stock and price series required a considerable amount of work. Way and structures investment is essentially total road additions (excluding land) with minor corrections for various plant and machinery accounts. Equipment capital is adjusted to include federal and provincial grain hopper car purchases which are allocated to the two Class I carriers. Both investment series cover the period 1890-1981 and are deflated by the railway industry input price deflators available from Statistics Canada (SC 13-568). Real capital stocks are constructed following the perpetual inventory method. The depreciation rates used for this calculation are 3 percent for way and structures and 6 percent for equipment. These are the figures used in earlier studies. The capital service price of each type of capital is computed following the approach suggested by Christensen and Jorgenson (1969).

Other purchased inputs (or "materials" as we refer to it) includes all inputs not elsewhere classified. Material cost is computed as total carrier expenditures less expenditures on all other identified inputs, less tax accruals, less joint facility and equipment rents. It is deflated by the Canadian Gross National Expenditure price index to yield a real quantity of materials.

Total factor input is calculated as the multilateral index of the five individual input indices. Once again CP 1956 is used as the base. Total factor productivity is the ratio of the multilateral output to multilateral input indices.

A large number of network and technological conditions were considered although only a few were actually used in the final stages. Route miles owned is included to measure scale effects.

III. Total Factor Productivity for Class I Canadian Railroads

A. Methodology

Christensen and Jorgenson (1970) proposed the following index of total factor productivity:

$$\ln (TFP_k/TFP_l) = \sum_i \left(\frac{R_{ik} + R_{il}}{2}\right) \ln \left(Y_{ik}/Y_{il}\right) \qquad (1)$$

$$- \sum_i \left(\frac{S_{ik} + S_{il}}{2}\right) \ln \left(X_{ik}/X_{il}\right),$$

where k and l are adjacent time periods, the Y's are output indexes, the X's are input indexes, the R's are output revenue shares, the S's are input cost shares, and the i subscripts denote the individual outputs or inputs. Diewert (1976) has shown equation 1 to be the exact index procedure that corresponds to a homogeneous translog production or transformation function. Caves, Christensen, and Diewert (1982) have further shown that no restrictions of separability or neutral technological change are implicit in equation 1.

As pointed out by Jorgenson and Nishimizu (1978) [henceforth JN], formulas such as equation 1 can be used to make both time-series and cross-sectional comparisons of TFP. In the case of cross-sectional comparisons, the indexes k and l are interpreted as different firms rather than different time periods. One could follow the approach of JN and choose a base year to carry out a comparison of the levels of CN and CP productivity. The individual growth rates of CN and CP productivity can then be used to extend the level comparison to earlier and later years. This is the approach used by Caves, Christensen, Swanson and Tretheway (1982). Recently, Caves, Christensen and Diewert (1982) [henceforth CCD] have criticized this method as lacking characteristicity, as defined by Dreschler (1973). Thus, in comparing two observations, perhaps CN 1956 and CP 1956, the two points being compared only have 50% of the weight in the comparison; the other 50% is coming from CN and CP in the reference year.

In their article, CCD proposed the following alternative procedure for making such time series cross-section comparisons:

$$\ln (TFP_k/TFP_l) = \frac{1}{2}\sum (R_i^k + \bar{R}_i)(\ln Y_i^k - \overline{\ln Y_i}) \qquad (2)$$

$$- \frac{1}{2}\sum (R_i^l + \bar{R}_i)(\ln Y_i^l - \overline{\ln Y_i})$$

$$- \frac{1}{2}\sum (S_n^k + \bar{S}_n)(\ln X_n^k - \overline{\ln X_n})$$

$$+ \frac{1}{2}\sum (S_n^l + \bar{S}_n)(\ln X_n^k - \overline{\ln X_n})$$

where $\bar{R}$ is the revenue share for output i averaged over all firms and time periods, $\bar{S}_n$ is the average cost share for input n, $\overline{\ln Y_i}$ is the average of the log of output i, and $\overline{\ln X_n}$ is the average of the log of input n. All bilateral comparisons based on equation 3 are both base-firm and base-year invariant. They are also transitive and have a higher degree of characteristicity than the JN procedure.

Equation (2) can be derived directly from a translog transformation structure by taking the difference between each firm's transformation function and the function resulting from averaging arithmetically the transformation functions across all observations. This procedure, in effect, uses the geometric average level of productivity as the norm.

We use the multilateral TFP index of equation (2) to measure and make comparisons of TFP for the CN and CP railroads for 1956 - 1981.

B. Differences with Wisconsin Studies

In a series of articles Caves, Christensen, Swanson and Tretheway of the University of Wisconsin explored TFP and costs of the Canadian railroads.[3] Their data was used as a starting point for this study. Nevertheless, this study differs from the Wisconsin studies in a number of respects. First, in this study we made several important corrections and refinements of the Wisconsin data. These changes are described in an appendix to our 1985 report. Second, we have updated the numbers to 1981. A third difference of this study from the Wisconsin studies arises from the treatment of outputs in the multilateral TFP index. Caves, Christensen and Swanson (1980) noted that if firms do not engage in marginal cost pricing or if production technology does not exhibit constant returns to scale, then use of revenue shares in (1) or (2) is inappropriate. The proper procedure is to use cost elasticities. Accordingly, they estimate a cost function, using U.S. data, and infer elasticities for each year for CN and CP. By using cost elasticities rather than revenue shares, changes in TFP over time (or among firms) represent shifts in the cost function.[4]

We have adopted a different approach here. We define growth in TFP as the total increase in outputs made possible by an increase in inputs. This will include the pure cost function shift effect of the Wisconsin studies, as well as output increases due to exploitation of economies of scale and from deviation from marginal cost pricing principles. This is the concept of TFP employed by Denny, Fuss and Waverman (1981). The latter authors decompose changes in this concept of TFP into the three components: pure shifts, scale effects and pricing effects. In order to perform such decompositions, one must obtain output cost elasticities, just as the Wisconsin approach did.

In our approach to TFP measurement, we did not want to presuppose cost elasticities. Thus we have measured TFP using revenue shares; i.e. using the Denny, Fuss and Waverman concept of TFP. At a later stage we intend to obtain cost elasticities using a cost function estimated with Canadian data. This would then allow us to decompose total TFP into its components, including pure cost function shifts.

We wish to emphasize that since the TFP concept used in this study differs from that used in the Wisconsin study, the results cannot be

compared. The Wisconsin TFP series reflect cost function shifts. Our series additionally includes productivity gains due to exploitation of scale economies and due to changes in deviations from marginal cost pricing. We leave a breakdown of TFP into components, including a cost shift component to a later stage of this research.

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C. Results

In this section we describe the results of our measurement of Total Factor Productivity (TFP) for the CN and CP. We use the multilateral index procedure developed in section A, and apply it to the data described in section C. As described in section B, revenue shares were used to weight the output components.

In Table 1 we show TFP levels and annual growth rates for the CN and CP, 1956 - 1981. The levels are plotted in Figure 1. We normalized our series so that TFP is unity for CP in 1956. We see that CN had a TFP level that was 89.1% of CP's in 1956.[5] This dominance of CP's over CN's TFP level continues throughout the 1956 - 1981 time period. In 1981, CN's level was 81.5% that of CP. Table 2 gives the year to year ratio of CN to CP TFP. Both carriers achieved strong growth rates of TFP over the entire time period; 3.1% per year for CN and 3.5% for CP. The finding that CP's level of TFP is higher than CN's does not imply that CP is more efficient. As described in section B, TFP does not necessarily translate into an efficiency shift of the cost or production functions.

Our methodology for computing TFP does not require the assumption that inputs and outputs are separable or that productivity growth (or firm differences) is neutral. Caves, Christensen and Diewert (1982) have shown that no such restrictions are implicit in equations 1 or 2. However under these assumptions we can interpret the terms on the right hand side of 1 and 2 as indexes of aggregate output and aggregate input. Our measurement of TFP is unchanged.

In Tables 3 and 4 we present these aggregate output and input indices. Again these are scaled so that CP in 1956 has the value of unity. In Table 5 we show the ratio of CN to CP for both output and input. In Figures 2 and 3 we show CP and CN levels of TFP, output and input. Both railroads had strong output growth, an annual rate of 2.8% for CN and 2.4% for CP. At the same time both carriers contracted

inputs so that TFP growth for the period exceeded output growth. Figures 4 and 5 show that both TFP and output growth exhibited cyclical behavior. This is true of both carriers.

We can also look at some of the individual outputs and inputs. Table 6 and Figure 6 show freight share in total output. In 1956 CN had a 91% share while CP had an 89% share. CP increased this share to 96% in 1981, while CN decreased it to 87%.

Table 7 gives CN and CP's labour cost shares. The significant decline of labour share, especially for CP can be seen. Tables 8 through 11 give cost shares for the remaining inputs; equipment, way and structures, fuel, and materials, (or other inputs). Fuel costs fell from roughly 8% of costs to 3% in 1964 reflecting dieselization and falling real prices of fuel. In the 1970's fuel share increased to 9% for each carrier.

IV. Total Factor Productivity Regressions

A. Analysis of Differences in TFP - Methodology

As described in section B, we use a "total" concept for TFP measurement. That is, our measure of TFP includes the "efficiency" shift in the cost function, as well as components due to economies of scale and density, network differences, and deviations of prices from marginal costs. Denny, Fuss and Waverman have proposed a decomposition of TFP into components due to effidiency, scale and deviations from marginal cost pricing. Their methodology, however, requires prior knowledge of cost elasticities, information which we do not have as yet. In addition, their methodology has not yet been generalized both to the multilateral case, and to include TFP effects for other factors such as density economies and network effects.

Caves, Christensen and Tretheway (1981), adopted a different approach to TFP decomposition. They regressed TFP on a number of factors, including output and network variables to decompose TFP differences into a number of sources. In fact, a Cobb-Douglas TFP function is dual to a Cobb-Douglas neoclassical total cost function. Thus, using TFP regressions they were able to obtain estimates of cost elasticities from a (very) restricted cost function.

Since TFP regressions reveal cost elasticities, one might ask why not proceed directly to cost estimation. The answer is that TFP estimation is less costly to perform. Cost functions are usually estimated jointly with input demand equations. Further, TFP regressions have greater degrees of freedom since input prices do not appear. We have found TFP regressions to be a cost effective method for performing preliminary analysis on the data.

FIGURE 1

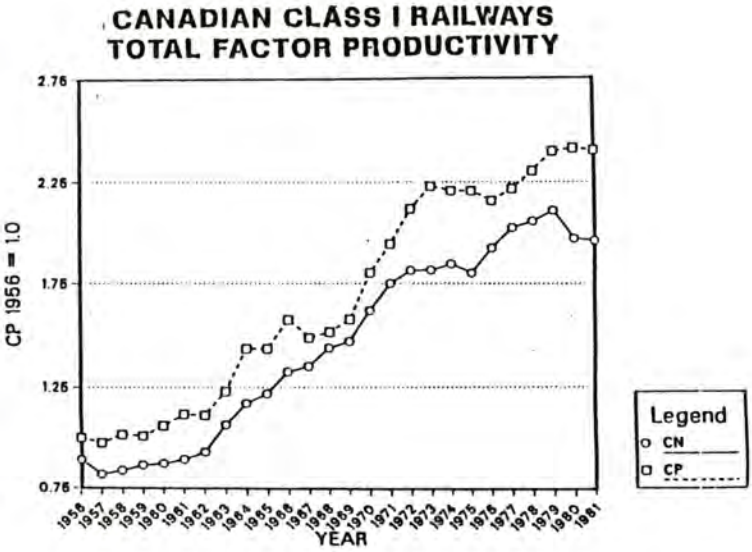


TABLE 1

Total Factor Productivity

(CP(1956)=1)

	Index		Growth	
	CNR	CPR	CNR	CPR
1956	0.892	1.000		
1957	0.819	0.976	-8.544	-2.426
1958	0.838	1.017	2.299	4.073
1959	0.865	1.009	3.168	-0.711
1960	0.873	1.061	0.984	4.979
1961	0.894	1.117	2.333	5.188
1962	0.930	1.112	3.935	-0.486
1963	1.064	1.230	13.485	10.124
1964	1.172	1.435	9.619	15.345
1965	1.219	1.434	3.994	-0.051
1966	1.325	1.574	8.333	9.328
1967	1.351	1.487	1.908	-5.667
1968	1.439	1.516	6.311	1.881
1969	1.470	1.577	2.154	3.945
1970	1.619	1.803	9.648	13.440
1971	1.749	1.943	7.748	7.459
1972	1.814	2.117	3.641	8.573
1973	1.815	2.228	0.047	5.120
1974	1.845	2.205	1.632	-1.056
1975	1.801	2.205	-2.436	0.004
1976	1.921	2.156	6.472	-2.258
1977	2.022	2.216	5.106	2.757
1978	2.054	2.303	1.571	3.845
1979	2.106	2.397	2.524	4.025
1980	1.967	2.412	-6.816	0.630
1981	1.957	2.402	-0.545	-0.421

TABLE 2

Relative TFP

(CN/CP)

	ratio	growth
1956	0.892	
1957	0.839	-6.118
1958	0.824	-1.774
1959	0.857	3.879
1960	0.823	-3.996
1961	0.800	-2.855
1962	0.836	4.422
1963	0.865	3.361
1964	0.817	-5.727
1965	0.850	4.045
1966	0.842	-0.996
1967	0.908	7.575
1968	0.949	4.430
1969	0.933	-1.791
1970	0.898	-3.792
1971	0.900	0.289
1972	0.857	-4.932
1973	0.815	-5.074
1974	0.837	2.688
1975	0.817	-2.439
1976	0.891	8.730
1977	0.912	2.349
1978	0.892	-2.273
1979	0.879	-1.501
1980	0.816	-7.447
1981	0.815	-0.125

TABLE 3

MULTILATERAL OUTPUT

(CP(1956)=1)

	index		growth	
	CNR	CPR	CNR	CPR
1956	1.209	1.000		
1957	1.076	0.909	-11.638	-9.546
1958	1.026	0.882	-4.746	-2.967
1959	1.034	0.850	0.752	-3.779
1960	0.992	0.835	-4.159	-1.730
1961	1.006	0.840	1.348	0.605
1962	1.028	0.830	2.188	-1.235
1963	1.160	0.918	12.140	10.116
1964	1.313	1.072	12.389	15.522
1965	1.363	1.055	3.719	-1.608
1966	1.480	1.144	8.245	8.112
1967	1.505	1.077	1.649	-6.062
1968	1.486	1.041	-1.250	-3.387
1969	1.529	1.086	2.842	4.181
1970	1.653	1.244	7.782	13.619
1971	1.803	1.340	8.687	7.409
1972	1.924	1.434	6.490	6.796
1973	1.876	1.477	-2.524	2.947
1974	2.072	1.533	9.964	3.745
1975	2.031	1.485	-2.001	-3.229
1976	2.107	1.441	3.671	-2.943
1977	2.185	1.529	3.630	5.884
1978	2.282	1.628	4.346	6.271
1979	2.356	1.721	3.181	5.559
1980	2.447	1.712	3.789	-0.490
1981	2.441	1.762	-0.247	2.837

TABLE 4

MULTILATERAL INPUT

(CP(1956)=1)

	index		growth	
	CNR	CPR	CNR	CPR
1956	1.356	1.000		
1957	1.314	0.931	-3.094	-7.119
1958	1.225	0.868	-7.045	-7.041
1959	1.196	0.842	-2.416	-3.068
1960	1.136	0.787	-5.143	-6.709
1961	1.125	0.752	-0.984	-4.583
1962	1.105	0.746	-1.748	-0.749
1963	1.090	0.746	-1.345	-0.008
1964	1.121	0.748	2.770	0.177
1965	1.118	0.736	-0.275	-1.557
1966	1.117	0.727	-0.088	-1.217
1967	1.114	0.724	-0.259	-0.396
1968	1.033	0.687	-7.561	-5.268
1969	1.040	0.689	0.688	0.236
1970	1.021	0.690	-1.867	0.179
1971	1.031	0.690	0.939	-0.050
1972	1.060	0.677	2.849	-1.778
1973	1.033	0.663	-2.571	-2.173
1974	1.123	0.695	8.332	4.801
1975	1.128	0.673	0.435	-3.232
1976	1.097	0.669	-2.801	-0.685
1977	1.081	0.690	-1.476	3.127
1978	1.111	0.707	2.775	2.427
1979	1.119	0.718	0.657	1.534
1980	1.244	0.710	10.606	-1.121
1981	1.247	0.733	0.298	3.257

Table 5

RATIO OF INDICES

(CN/CP)

	Output	Input	TFP	
			index	growth
1956	1.209	1.356	0.892	
1957	1.184	1.411	0.839	-6.118
1958	1.163	1.411	0.824	-1.774
1959	1.217	1.421	0.857	3.879
1960	1.188	1.443	0.823	-3.996
1961	1.197	1.496	0.800	-2.855
1962	1.238	1.481	0.836	4.422
1963	1.264	1.461	0.865	3.361
1964	1.225	1.500	0.817	-5.727
1965	1.292	1.519	0.850	4.045
1966	1.294	1.536	0.842	-0.996
1967	1.397	1.538	0.908	7.575
1968	1.427	1.504	0.949	4.430
1969	1.408	1.510	0.933	-1.791
1970	1.329	1.480	0.898	-3.792
1971	1.346	1.495	0.900	0.289
1972	1.342	1.565	0.857	-4.932
1973	1.270	1.559	0.815	-5.074
1974	1.352	1.615	0.837	2.688
1975	1.368	1.675	0.817	-2.439
1976	1.462	1.640	0.891	8.730
1977	1.429	1.567	0.912	2.349
1978	1.402	1.572	0.892	-2.273
1979	1.369	1.558	0.879	-1.501
1980	1.429	1.752	0.816	-7.447
1981	1.386	1.701	0.815	-0.125

FIGURE 2
CANADIAN PACIFIC RAILWAYS
MULTILATERAL TFP,
OUTPUT, AND INPUT INDICES

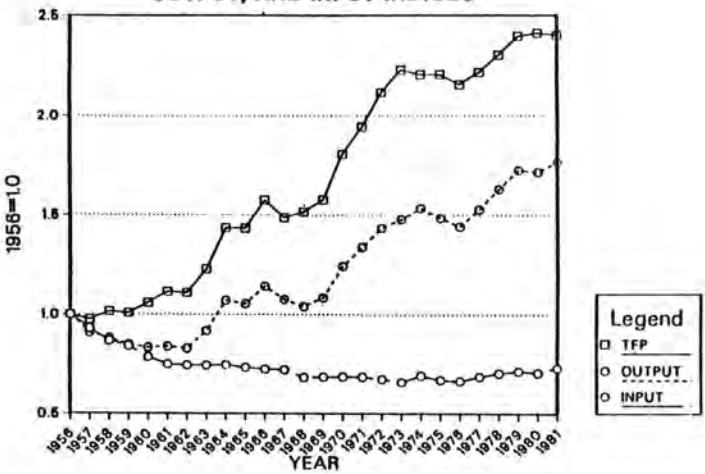


FIGURE 3
CANADIAN NATIONAL RAILWAYS
MULTILATERAL TFP,
OUTPUT, AND INPUT INDICES

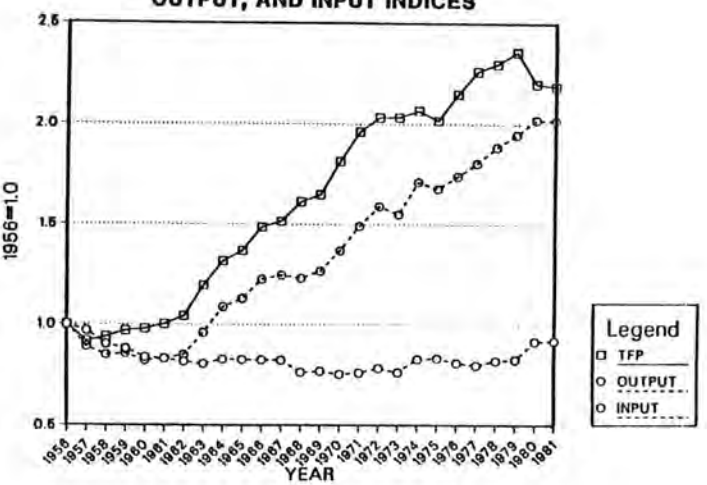


FIGURE 4
CANADIAN PACIFIC RAILWAYS
TFP and OUTPUT
ANNUAL GROWTH RATES

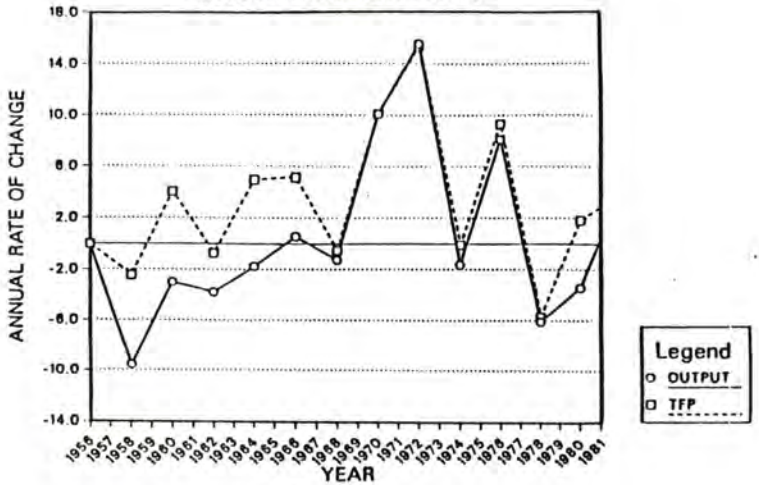


FIGURE 5
CANADIAN NATIONAL RAILWAYS
TFP and OUTPUT
ANNUAL GROWTH RATES

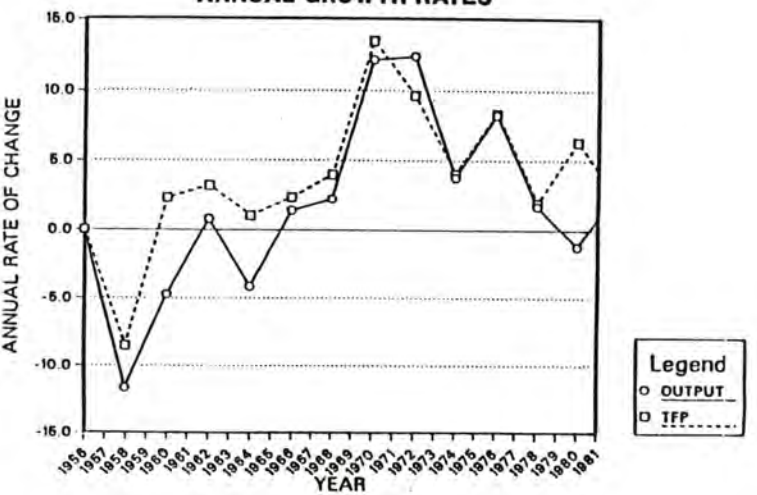


TABLE 6

Freight Revenue Share

	Percent		Growth	
	CNR	CPR	CNR	CPR
1956	91.299	88.978		
1957	90.691	88.503	-0.668	-0.536
1958	91.317	89.033	0.688	0.597
1959	91.809	89.857	0.538	0.921
1960	91.433	90.213	-0.411	0.396
1961	92.505	91.802	1.165	1.746
1962	92.591	91.488	0.094	-0.343
1963	92.776	92.208	0.199	0.784
1964	92.254	92.431	-0.565	0.241
1965	91.637	93.025	-0.671	0.641
1966	91.210	95.707	-0.467	2.843
1967	88.248	94.462	-3.301	-1.310
1968	90.338	95.694	2.340	1.297
1969	91.170	95.862	0.917	0.175
1970	91.845	96.516	0.738	0.680
1971	92.598	96.985	0.817	0.485
1972	92.839	97.266	0.260	0.289
1973	94.416	98.062	1.684	0.815
1974	93.542	97.395	-0.930	-0.683
1975	93.678	97.674	0.146	0.286
1976	94.342	97.921	0.707	0.253
1977	94.380	98.109	0.040	0.191
1978	93.957	97.725	-0.449	-0.392
1979	90.067	95.766	-4.229	-2.025
1980	88.441	95.784	-1.821	0.020
1981	87.479	96.043	-1.094	0.270

TABLE 7

Labour Cost Share

	Percent		Growth	
	CNR	CPR	CNR	CPR
1956	57.962	54.078		
1957	55.765	50.958	-3.863	-5.943
1958	53.781	49.402	-3.623	-3.101
1959	52.712	47.939	-2.007	-3.005
1960	49.837	46.205	-5.609	-3.684
1961	48.868	44.908	-1.965	-2.848
1962	47.810	43.206	-2.188	-3.864
1963	48.092	44.314	0.589	2.533
1964	49.448	45.898	2.779	3.512
1965	51.585	47.103	4.232	2.590
1966	49.922	45.410	-3.278	-3.661
1967	50.963	44.499	2.064	-2.025
1968	50.942	43.011	-0.042	-3.402
1969	51.501	43.370	1.091	0.832
1970	49.891	39.659	-3.175	-8.945
1971	51.342	42.338	2.866	6.536
1972	52.457	43.206	2.148	2.030
1973	53.473	45.793	1.920	5.816
1974	53.876	44.035	0.751	-3.916
1975	55.208	45.323	2.442	2.883
1976	56.966	48.362	3.134	6.490
1977	59.181	51.191	3.815	5.685
1978	57.099	49.842	-3.581	-2.670
1979	53.420	44.405	-6.660	-11.551
1980	46.488	36.847	-13.898	-18.659
1981	41.164	32.384	-12.163	-12.909

FIGURE 6
CANADIAN CLASS I RAILWAYS
FREIGHT REVENUE SHARE

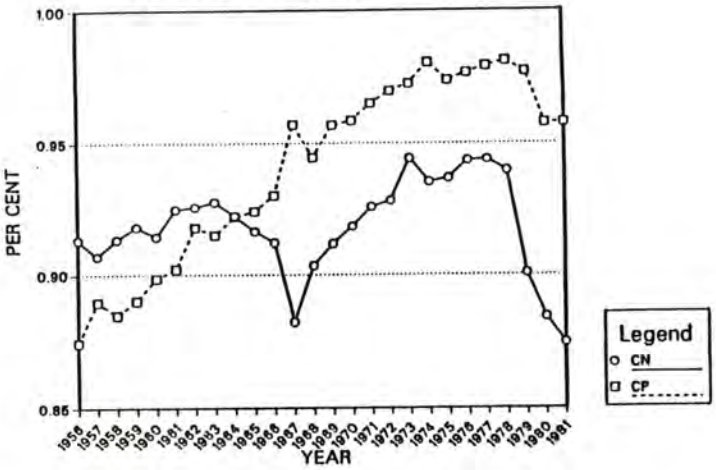


FIGURE 7
CANADIAN CLASS I RAILWAYS
RESIDUAL TFP

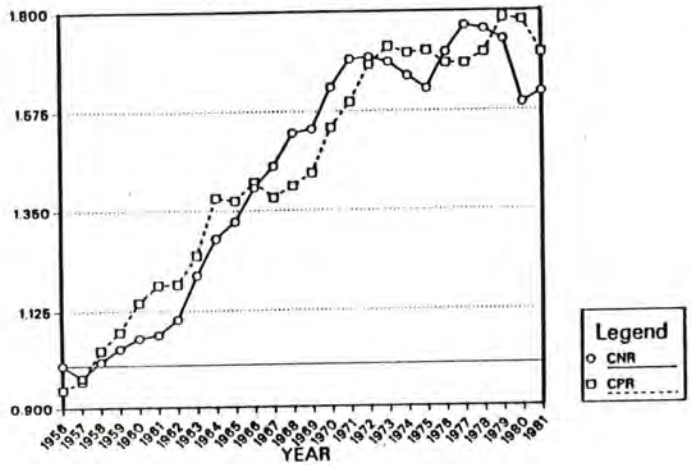


TABLE 8

Equipment Cost Share

	Percent		Growth	
	CNR	CPR	CNR	CPR
1956	9.012	13.190		
1957	8.088	13.284	-10.819	0.706
1958	8.978	14.675	10.441	9.963
1959	10.462	15.640	15.303	6.364
1960	11.565	16.694	10.021	6.524
1961	11.653	17.033	0.752	2.009
1962	12.151	17.975	4.185	5.384
1963	12.242	17.441	0.749	-3.016
1964	11.140	15.843	-9.430	-9.608
1965	10.795	14.810	-3.151	-6.747
1966	11.523	16.550	6.526	11.112
1967	12.165	17.976	5.425	8.264
1968	13.289	19.939	8.838	10.366
1969	13.126	19.280	-1.235	-3.362
1970	13.447	19.993	2.414	3.633
1971	13.005	18.507	-3.343	-7.724
1972	13.394	16.420	2.949	-11.965
1973	12.346	14.676	-8.151	-11.227
1974	10.246	14.118	-18.641	-3.878
1975	9.612	13.134	-6.382	-7.227
1976	8.809	11.548	-8.726	-12.864
1977	6.151	7.329	-35.913	-45.464
1978	3.952	4.699	-44.245	-44.453
1979	6.972	7.985	56.761	53.020
1980	11.128	12.265	46.761	42.914
1981	9.506	11.092	-15.758	-10.048

TABLE 9

Structures Cost Share

	Percent		Growth	
	CNR	CPR	CNR	CPR
1956	7.704	10.293		
1957	11.056	14.914	36.119	37.089
1958	13.004	17.614	16.228	16.635
1959	15.175	18.677	15.437	5.859
1960	17.305	20.489	13.137	9.261
1961	19.874	22.693	13.843	10.218
1962	20.699	23.153	4.065	2.005
1963	19.929	21.601	-3.787	-6.938
1964	19.725	21.309	-1.033	-1.362
1965	18.546	20.049	-6.164	-6.094
1966	17.777	20.127	-4.234	0.390
1967	17.113	20.077	-3.805	-0.251
1968	17.952	21.328	4.785	6.046
1969	16.700	20.562	-7.228	-3.660
1970	20.402	23.977	20.024	15.366
1971	17.878	20.952	-13.206	-13.486
1972	16.262	19.322	-9.473	-8.097
1973	15.391	17.012	-5.511	-12.736
1974	13.457	19.097	-13.426	11.563
1975	10.264	16.957	-27.083	-11.885
1976	7.729	14.024	-28.365	-18.989
1977	5.536	9.849	-33.382	-35.339
1978	7.825	13.253	34.615	29.683
1979	11.139	17.614	35.306	28.443
1980	15.992	24.373	36.166	32.478
1981	20.295	27.860	23.831	13.372

TABLE 10

Fuel Cost Share

	Percent		Growth	
	CNR	CPR	CNR	CPR
1956	8.761	7.823		
1957	6.986	5.966	-22.643	-27.105
1958	5.183	4.613	-29.847	-25.723
1959	4.415	4.012	-16.045	-13.950
1960	3.875	3.409	-13.040	-16.288
1961	3.629	3.157	-6.550	-7.676
1962	3.610	3.069	-0.530	-2.824
1963	3.736	3.281	3.436	6.678
1964	3.839	3.621	2.708	9.859
1965	3.871	3.762	0.838	3.822
1966	3.731	3.636	-3.681	-3.403
1967	3.618	3.412	-3.079	-6.357
1968	3.524	3.263	-2.641	-4.466
1969	3.416	3.239	-3.097	-0.764
1970	3.217	3.129	-6.028	-3.433
1971	3.479	3.530	7.846	12.056
1972	3.686	4.271	5.790	19.043
1973	3.884	4.720	5.230	9.993
1974	5.552	5.859	35.711	21.631
1975	5.877	6.315	5.691	7.494
1976	6.539	6.567	10.683	3.911
1977	7.553	7.759	14.408	16.671
1978	8.079	8.211	6.732	5.672
1979	7.733	7.927	-4.378	-3.520
1980	7.901	7.953	2.158	0.325
1981	9.013	9.484	13.164	17.606

TABLE 11

Materials Cost Share

	Percent		Growth	
	CNR	CPR	CNR	CPR
1956	16.561	14.616		
1957	18.105	14.878	8.914	1.781
1958	19.054	13.697	5.107	-8.275
1959	17.236	13.732	-10.028	0.261
1960	17.418	13.203	1.050	-3.932
1961	15.976	12.209	-8.638	-7.827
1962	15.731	12.597	-1.550	3.131
1963	16.000	13.363	1.696	5.899
1964	15.848	13.329	-0.950	-0.255
1965	15.203	14.277	-4.158	6.871
1966	17.047	14.277	11.449	0.000
1967	16.140	14.036	-5.465	-1.703
1968	14.293	12.458	-12.154	-11.922
1969	15.257	13.549	6.524	8.396
1970	13.043	13.241	-15.676	-2.300
1971	14.296	14.673	9.171	10.266
1972	14.200	16.780	-0.670	13.422
1973	14.906	17.799	4.850	5.892
1974	16.869	16.891	12.372	-5.237
1975	19.038	18.271	12.097	7.856
1976	19.957	19.498	4.709	6.499
1977	21.580	23.872	7.820	20.237
1978	23.045	23.994	6.571	0.511
1979	20.738	22.069	-10.551	-8.363
1980	18.491	18.563	-11.468	-17.299
1981	20.022	19.180	7.955	3.268

B. Analysis of Differences in TFP - Results

In Table 12 we present results of several simple TFP regressions using aggregate output. If constant returns to scale prevailed then one would expect the coefficient on aggregate output to be zero; i.e., productivity is unaffected by the level of output. In column 1 we find that output has a significantly positive coefficient; productivity rises when output rises. This suggests some kind of returns to scale.

Since output growth may be correlated with a constant rate of technical change, we include a time trend in the regression in column 2. Here we find a smaller but negative coefficient on output, suggesting some diseconomies of scale. The time coefficient indicates productivity not explained by output growth rising at a rate of 5.3% per year, on average.

To distinguish between economies of density and economies of scale we add route miles to the regression in column 3. The output coefficient now reflects economies of density, as network size (measured by route miles) is held constant. Significant returns to density are indicated. Returns to scale are obtained by adding the output and route miles coefficients together. This sum indicates very mild diseconomies of scale.

In Table 13 we investigate the effect of disaggregating output into freight and passenger components. The freight coefficient in column one has almost the same value as that on aggregate output in column one of Table 3.1. Passenger output has a negative sign in Table 3.2. There is no exact duality between TFP regression coefficients and cost function coefficients when we disaggregate outputs. We believe, however, that the results suggest a negative product complimentarity between freight and passenger output. That is, increases in passenger output cause costs to rise for existing freight output, resulting in an overall fall in system productivity.

In Column 2 we add a time trend. The freight coefficient is insignificantly different from zero, while passenger is again negative. We believe these results suggest constant or mild diseconomies of scale with negative interproduct complimentarity. Route miles is added in Column 3. Again negative product complimentarity, significant returns to density and roughly constant returns to scale.

From these regressions, we conclude the following: (a) inclusion of a time trend is critical, (b) inclusion of route miles indicates roughly constant returns to scale with significant economies of density, and (c) there may be negative interproduct complimentarity between freight and passenger outputs.

Table 12
TFP Regressions

Aggregate Output as Regressor
(Standard Errors in Parenthesis)

	(1)	(2)	(3)
Constant	.15 (.05)	-.22 (.03)	3.13 (.51)
Output	.82 (.10)	-.29 (.10)	.30 (.11)
Time Trend		.053 (.004)	.032 (.004)
Route Miles			-.34 (.05)
R-Squared	.55	.91	.95
Durbin Watson	.02	.69	.32

Table 13
TFP Regressions

Freight and Passenger as Separate Outputs
(Standard Errors in Parenthesis)

	(1)	(2)	(3)
Constant	-13.73 (1.36)	.44 (2.61)	2.82 (0.53)
Freight	.80 (.05)	.09 (.13)	.40 (.12)
Passenger	-.27 (.03)	-.13 (.03)	-.04 (.03)
Time Trend		.036 (.006)	.025 (.005)
Route Miles			-.30 (.05)
R-Squared	.88	.93	.95
Durbin Watson	.20	.51	.28

Utilizing the TFP regression model (3) in Table 13, we computed the unexplained TFP levels for both CN and CP. The unexplained TFP levels include the shift in production function over time (time effect) and the TFP residual.[6] The unexplained TFPs are plotted in Figure 7. From these we conclude that, after controlling for output levels and route-mileage, productivity performances have improved dramatically over the period. From 1957 to 1966 CP's unexplained TFP growth exceeds that of the CN. The reverse holds true for 1967 to 1972 and no clear pattern emerges for the 1973-1981 sub-period. However, in all instances the differences are not significant.

Durbin Watson statistics for the TFP regression models reported in Tables 12 and 13 are very low, indicating the existence of auto-correlation within the time-series data for a given firm. Although the parameter estimates are still unbiased, standard errors of the parameter estimates are biased. This may have obscured our conclusions concerning the statistical significance of various parameters. We intend to conduct a further investigation on the TFP regressions by correcting for the autocorrelations.

V. Summary of the Empirical Results

The empirical results of this paper may be summarized as follows:

(1) Because of the inability of the railways to adjust input levels to reflect changing traffic conditions (i.e., economic condition of the largely resource-based economy), at least in the short run, the yearly growth rates of TFP for both railways have been almost perfectly correlated with the growth rates of their outputs. This is particularly true since 1968. The implied rigidity of input use cannot be explained by fixed capital costs; the capital cost for ways and structures has been only about 14% and 19% of the total cost for CNR and CPR, respectively. Other inputs are also rigid. Whatever the cause, an increased ability to manage inputs more flexibly would improve efficiency of railway operations.

(2) The average annual growth rates of TFP during the entire study period (1956-81) were 3.1% and 3.5% respectively for CN and CP. CN had higher growth rates than CP during the 1960s. This situation was reversed in the 1970s. Both railroads had higher growth rates in the 1960s than the 1970s due to "diezilization" and other technological improvements.

(3) Comparison of the gross TFP levels indicates that the CN's productivity levels are about 15% lower than those of CP for all subperiods. This does not necessarily mean that CN is less efficient than CP. The gross TFP measures do not take into account the effects on productivity of changes in network, attributes of outputs or government-imposed regulations and restrictions.

(4) It is reasonably clear that the volume of passenger transportation impacts negatively on railway efficiency. There is no cost complementarity between freight and passenger services on a system-wide basis.

(5) The significant negative coefficient for route-miles in the TFP regressions indicates that there are significant efficiency losses due to maintaining light-density branch lines.

(6) We found significant economies of traffic density and constant returns to scale (changes in both output levels and network size).

(7) After controlling for the effects of changes in outputs and route-miles, the average annual growth rate of TFP during the study period (1956-81) became about 2.5% for both railways.

(8) Analysis of residual TFP indicates a dramatic increase in time-adjusted residual TFP from 1956 to 1981. Despite differing rates of increase in the various sub-periods under study, there appears to be no significant variation in residual TFP growth rates for the two railroads.

NOTES

1 Total Factor Productivity is the number of units of aggregate output produced from one unit of aggregate input. It represents overall efficiency of the firm far better than partial factor productivities such as labour and fuel productivities. Partial factor productivities are not able to control for the effects of other input levels on the productivity of an input.

2 See Freeman, Oum, Tretheway and Waters II (1985) for details.

3 Caves and Christensen (1978) (1980); Caves, Christensen and Swanson (1981a); and Caves, Christensen, Swanson and Tretheway (1982).

4 Note that TFP shifts using cost elasticities to weight outputs correspond to cost function rather than production function shifts. The two are related through returns to scale: Production function shift equals cost function shift times returns to scale. See Caves, Christensen and Swanson (1981b), and Ohta (1974).

5 This finding of CP TFP level above that of CN differs from the Wisconsin results where the opposite was found. There are two reasons for this difference. First, the Wisconsin study used a cost-shift concept of TFP while our study used a "total" TFP concept. Using the cost elasticities from the Wisconsin study we found CN TFP to still be below that of CP. The second reason is correction of errors in the Wisconsin data. Of particular importance was an understatement of CN electricity usage by a factor of 1000.

6 Unexplained TFP is computed by $\exp(.025 \times TIME_t + V_{it})$ where V_{it} is the residual of the log-linear TFP regression.

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AN EMPIRICAL INVESTIGATION FOR CANADIAN CLASS I RAILWAYS OF BOTH PERFORMANCE AND INDUSTRY COST STRUCTURE[1]

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Introduction

The objective of the paper is twofold. First it quantifies the recent productivity performance of Canadian National Railways' (CN) and Canadian Pacific Limited's (CP) rail operations. Indirectly, it compares the performance of a publicly owned firm to that of a privately owned one and allows one to see which of the two performed better over the 1956 to 1981 period. Initially, the intent was to simply update an earlier study carried out by Caves and Christensen[2] on the performance of Canadian railways. As it turned out, there was a need to measure the variability of empirical results to specific built-in methodological assumptions. Caves and Christensen assumed that it was appropriate to use cost elasticities, derived from a cost function estimated for U.S. railroads, to weight Canadian railways' output. These U.S. cost elasticities are replaced here by Canadian ones derived from an estimated cost function. The estimated cost function allows one to

address the second objective of the paper, i.e., the analysis of the cost structure of Canadian railways.

Data

The present analysis is limited to CN and CP operations and covers the period 1956 to 1981. While failure to consider all railways prevents generalizing the results to the whole railway transport industry in Canada, the analysis does nevertheless concentrate on the two most important railways in Canada. The last statement can be substantiated by a few key indicators. Looking at statistics for the year 1981, it is possible to note that CN and CP accounted in that year for 83.3% of railways' operating revenues in Canada, 91.6% of freight operating revenues, 82.1% of operating expenses, 90.6% of rail investments, 87.5% of railway employees, and 90.5% of tracks.

TABLE 1. RELATIVE IMPORTANCE OF CN AND CP IN THE CANADIAN RAILWAY SYSTEM, 1981

	CN and CP	Total All Railways
Operating Revenues(million of $)	5,119	6,145
Freight Revenues(million of $)	4,247	4,635
Operating Expenses(million of $)	4,712	5,742
Investments-rail(million of $)	86	94
No. of Employees	12,227	14,157
Track(route kilometres)	83,651	92,415

Source: Statistics Canada, Catalogue Nos. 52-205, 52-208 52,209, 52-212, 52-214

To study productivity growth, the production process of railway services is viewed as a two output and five input process. On the output side, passenger and freight services are the two types of railway services considered. The basic measure of passenger service used is aggregate passenger-kilometres while aggregate tonne-kilometres is the actual measure of rail freight output. The inputs used to produce the two outputs are: way and structure, equipment, labour, fuel and materials.

Way and structure and equipment constitute what could be called the capital input required to produce railway services. Massive amounts of capital are required by railways. Capital inputs are a significant component of total railway costs. Therefore careful attention must be given to measure accurately their contribution to productivity growth. Unfortunately, the measuring of capital, irrespective of the approach used, remains usually a subject for debate. The study employs physical units of measurement for the two types of capital. For way and structure, total kilometres operated of first main track is the measurement unit. For equipment, a distinction is made between freight and passenger services. On the freight side, nominal capacity of the freight equipment, measured in tonnes, is used, while on the passenger side, the number of passenger

equipment as of the end of the year, is used. The two are weighted according to the relative importance of the revenues generated by each type of traffic.

For labour, quantities of hours worked for four classes of labour are used for the computation of translog labour index, wage payments serving as weights. Actual quantities of each type of fuel utilized by railways are converted to their British thermal units (BTU) equivalents and then added. Material is also an input difficult to measure in the sense that numerous types of materials enter in the production of rail services. For these different types of materials, it is not possible to have a common physical unit of measurement. Expenditures on materials become the alternative measurement unit to adopt. Material expenditures are computed as a residual from total expenditures. From total railway expenses, the following are subtracted to arrive at material expenditures: railway tax accruals, joint facility rents, equipment rents, pensions, road property depreciation, other equipment and machinery depreciation, rolling stock and vessels depreciation, cost of fuel and net labour costs. The expenditures are then deflated by the Industry Selling Price Index.

For the multiproduct cost characterization of railway operations, a production process with two outputs and three inputs is used. The two outputs

defined for the productivity assessment serve also in the cost analysis. On the input side, the three inputs used in the cost function are labour, fuel, and capital and material. The average hourly salary deflated by the CPI is the labour price measure. Fuel is measured in terms of constant dollar expenditures on the said input. For capital and material, the net stock of equipment and structure is added to the material expenditures, both being measured in constant dollars.

Methodology and Concepts: An Outline

Productivity refers to the efficiency with which inputs are transformed within the production process into output. Productivity advancement contributes to economic growth. A measure of productivity identifies changes in the level of production that cannot be explained by changes in usage of the associated inputs and by the characteristics of the original production process.

Total factor productivity (TFP) measures are among the more accurate measures of productivity advancement. TFP measures relate changes in all outputs to changes in all inputs. A production process with several inputs and outputs requires specifying a method of aggregation where the weighting system for the construction of aggregate input and output measures determine the underlying production

function. The approach used for measuring the relative growth rates of outputs and inputs is the Divisia index.

The conventional Divisia index is defined as the ratio of aggregate output to aggregate input, aggregate output (input) being an index of disaggregated outputs (inputs). The Divisia indices for aggregate output and input are defined in terms of proportional rates of growth. Because yearly data is used, the Tornqvist approximation to the continuous Divisia index enters into play:

$$\ln(TFP_t/TFP_{t-1}) = \frac{1}{2} \sum_j (r_{jt} + r_{j,t-1}) \ln(Y_{jt}/Y_{j,t-1}) - \frac{1}{2} \sum_i (s_{it} + s_{i,t-1}) \ln(X_{it}/X_{i,t-1})$$

where r_{jt} is the revenue share of output Y_j in total revenues of period t, and s_{it} the cost share of input X_i in total costs of period t. Using revenue shares as weights for outputs implies constant returns to scale for the structure of production and output prices proportional to their marginal costs. By assuming constant returns to scale, scale effects are assumed not to contribute to the railways' productivity performance. This explains why these measures are referred to as being "unadjusted" measures of productivity.

It is widely accepted that prices for rail services do not reflect marginal costs of production. Instead of using revenue shares to weight outputs, the alternative is to do what Caves and Christensen did and use estimated output cost elasticities:

$$\ln(TFP_t/TFP_{t-1}) = \sum_j \left[\left(\frac{1}{2} \frac{\partial \ln C}{\partial \ln Y_j} \right)_t + \left(\frac{1}{2} \frac{\partial \ln C}{\partial \ln Y_j} \right)_{t-1} \right] \ln(Y_{jt}/Y_{j,t-1}) - \frac{1}{2} \sum_i (s_{it} + s_{i,t-1}) \ln(X_{it}/X_{i,t-1})$$

The elasticity of cost with respect to output can be interpreted as a measure of static or scale economies. It isolates the change in cost that is independent of technical change and changes in input prices. Output cost elasticities, by accounting for scale effects, allows for a more accurate measurement of productivity growth. This explains why this second TFP measure is referred to as the "adjusted" measure.

Caves and Christensen computed their freight and passenger cost elasticities for CN and CP from a multiproduct cost function estimated for U.S. railroads for the years 1955, 1963 and 1974. They justified their approach by saying that "the largest U.S. railroads have cost and output levels similar to the CN and the CP". From their estimated multiproduct cost function, they came to the conclusion that "in

the region of freight and passenger output levels produced by the CN and the CP, the hypothesis of constant returns to scale (could not) be rejected". They then normalized the estimated cost elasticities to sum to unity and interpreted them between the years for which the cost function was estimated.

Output cost elasticities estimates, specific to CN and CP are derived, in this study, from the generalized translog functional form used to represent the cost function:

$$\ln C = \alpha_0 + \sum_i \alpha_i \ln P_i + \sum\sum_{ij} \ln P_i \ln P_j + \sum_m \alpha_m \left[\frac{Y_m^{\lambda_m}-1}{\lambda_m}\right] + \sum\sum_{mn} \gamma_{mn} \left[\frac{Y_m^{\lambda_m}-1}{\lambda_m}\right]\left[\frac{Y_n^{\lambda_n}-1}{\lambda_n}\right] + \sum\sum_{mi} \gamma_{mi} \left[\frac{Y_m^{\lambda_m}-1}{\lambda_m}\right] \ln P_i + \theta_T \ln T$$

where the Y_m are outputs and the P_i input prices. The Box-Cox transformation (λ) is used for the outputs. The minimization of the SSE serves as the criteria to arrive at the appropriate value for λ_s. The Y_m and P_i are normalized such that their mean values are equal to unity. The mean value of each variable is derived from the pooled series of observations of CN and CP. The cost function is estimated over the period 1956 to 1978 and the period 1956 to 1981 with CN and CP data pooled together. The cost function and the cost share

equations of the factor inputs (one of which is deleted to avoid singularity) are treated as a multivariate regression system and the parameters are estimated using the two stage Zellner technique, which produces asymptotically maximum likelihood estimates. The cost function is not used to infer productivity growth but to infer the railways' structure of production.

Railways are viewed as highly integrated vertically. The integration of railway system activities within large companies increases the need for an evaluation of the efficiency of railway market structures, the industry being dominated in Canada by two railways operating in various markets. A conventional concept of structure such as economies of scale comes to mind. But railways are multiproduct firms and economies of scale cannot capture the complexity of market relationships. Besides, the concept for railway operations lead to definitional confusion. It is important to distinguish between economies of traffic density, economies of size and economies of scale. Economies of scale resulting from increased traffic volume when the network configuration is held fixed, is referred to as economies of density. Since route kilometres or track kilometres are not explicitly introduced into the equation, it is not possible to estimate the minimum

efficient traffic density from the model. According to Braeutigam, Daughety and Turnqvist[3], economies resulting from an increase in output, when the size of the network can also change to adjust optimally to traffic volume along each arc of the network, should be referred to as economies of size, being a broader notion of economies of scale.

In a multiproduct context, new cost concepts are needed to gain insight into the behaviour of a multiproduct firm and industry. To the old concept of economies of scale, the new concept of economies of scope, which measures cost advantages of having firms providing large numbers of diversified products as against specialization in production, has been introduced. But empirical study of multiproduct firms is in its infancy and the empirical results arrived at are presented in the hope that they will generate further econometric analysis of Canadian railway costs. It is important to emphasize that the empirical evidence is based exclusively on a pooled cross section and time series analysis of CN and CP over the period 1956-1981, a period which saw the creation of VIA Rail, the intercity rail passenger service operator in Canada. The evidence on multiproduct cost concepts is obtained with the generalized translog cost function. The measures of the multiproduct cost concepts are both functions of

the data and the estimated parameters. Formal definitions of the concepts follow.[4]

A comparison of the cost of producing passenger and freight rail services separately with the actual joint cost allows one to determine whether it is less costly for a single railway to produce jointly or separately the services:

$$SC = \sum_{j=1}^{2} C_j (Y_j) - C(Y_1, Y_2)$$

When overall economies of scope exists, SC is greater than zero. The translog cost function shows economies of scope when cost complementarity can be observed (i.e., when $\partial^2 C / \partial Y_1 Y_2 < 0$). In a multiproduct context, the identification of the proportion of economies of scale attributable to each output is important. Product specific economies of scale are equivalent to the ratio of the incremental cost for that output over its marginal cost. If economies are achieved in the production of a given output, the measure of economies of scale specific to that output will be greater than one. For a multiproduct production process, the degree of economies of scale, i.e., the evidence on scale effects for the overall production process, accounts for both the economies of scale specific to each output and the economies of scope. The global measure of economies of scale will

indicate the presence of economies of scale if the measure is greater than one.

Empirical Results

Average annual changes in outputs, inputs and productivity are reported in Table 2. Over the 1956 to 1975 period, the two Canadian railways were increasing their outputs but reducing their utilization of inputs. On average, CN's productivity improved over that period at an annual rate of 3.9% while a rate of 4.0% was attained by CP. From 1975 to 1981, the situation changed somewhat. CN's output was growing at a slower rate than the one observed over the 1956 to 1975 period, while CP was achieving a higher rate of growth for its output. On the input side, CN and CP were unable to maintain between 1975 and 1981, a declining rate of input utilization, CP having the worst record. As a result, a decline in productivity growth is observed. For the period 1956 to 1981 as a whole, CN seems to have attained a slightly higher level of efficiency, its average yearly productivity growth reaching 3.25% compared to 3.1% for CP.

TABLE 2. AVERAGE ANNUAL CHANGES IN PRODUCTIVITY UNADJUSTED MEASURE

	CN	CP
	Aggregate Output	
1956-1975	2.03	1.73
1975-1981	1.83	2.51
1956-1981	1.98	1.91
	Aggregate Input	
1956-1975	-1.86	-2.27
1975-1981	0.60	2.28
1956-1981	-1.27	-1.18
	Productivity	
1956-1975	3.89	3.99
1975-1981	1.23	0.23
1956-1981	3.25	3.09

Caves and Christensen's productivity measures indicated also that CN had achieved better results over the 1956 to 1975 period. For various reasons such as outputs' weights, measurement unit for some of the inputs, Caves and Christensen's measures of productivity changes differed from ours. The approach used in this study shows a more important reduction in input utilization by the two railways, especially for CN, than the one measured by Caves and Christensen.

TABLE 3. AVERAGE ANNUAL CHANGE IN PRODUCTIVITY(%), ADJUSTED MEASURE

	CN	CP
	Aggregate Output	
1956-1975	6.08	1.63
1956-1975*	2.30	0.80
1956-1981	8.54	2.60
	Aggregate Input	
1956-1975	-1.86	-2.27
1956-1975*	-0.80	-1.80
1956-1981	-1.27	-1.18
	Productivity	
1956-1975	7.94	3.90
1956-1975*	3.10	2.70
1956-1981	9.81	3.77

*Caves & Christensen estimates.

When Canadian cost elasticities are introduced to weight the outputs, the calculated productivity indicators give quite a different picture than the one obtained when adjustments for scale effects are neglected (Tables 2 and 3). Prior to making such an adjustment, productivity measurements indicated an average annual growth rate of respectively 3.25% and 3.1% for CN and CP between 1956 and 1981. After adjusting for scale effects, their productivity growth are respectively 9.8% and 3.8%.

This, normally, would imply that the two railways are facing diseconomies of scale, diseconomies which are more important in CN's operations than in CP's. But before jumping to such a conclusion, it is

important to emphasize that the output cost elasticities are derived from the estimated cost function, that the function is estimated with pooled data of CN and CP from 1956 to 1981, and that the specification of the function did not allow for differences among the years in the structure of production. The integer measure of time (T) used here does not really allow for the accounting of the yearly differences in the production structure. It is also important to note that regularity conditions (e.g., negative semidefinite Hessian matrix) from the theory of cost and production are not satisfied over the entire period for the two railroads.

Because Caves and Christensen believed that there were not enough Canadian railroads to provide data for the estimation of a multiproduct cost function, they used a cross section of U.S. railroads to infer Canadian cost elasticities. The variation in costs and output levels of CN and CP result from changes in their production structure which have occurred between 1956 and 1981. Not being able to account properly for such variations, the cost elasticities obtained are not only reflecting scale effects but also an evolving production process of rail services. Therefore, the derived cost elasticities cannot pretend to adjust the productivity measurement for scale effects. The adjusted productivity measures reported in Table 3, to

the exception of those quoted from Caves and Christensen's study, are biased by an adjustment which mixes together scale effects and changes in production structure.

The cost function can nevertheless be used to analyze, at the observed level of output and factor prices, (i.e., the normalization point), the production structure of CN and CP rail services. Already, a reference to decreasing returns to scale has been made. But such a reference has to be placed in a multiproduct context. Looking at Table 4, it is possible to note that product specific diseconomies of scale are observed. But these diseconomies are compensated for by important economies of scope which outweigh the product specific diseconomies and indicate marginal overall increasing returns to scale for rail operations of CN and CP. But, basically, the assumption of constant returns to scale behind the Divisia approach cannot be rejected by the evidence gathered from the estimated cost function.

TABLE 4. ESTIMATES OF MULTIPRODUCT COST CONCEPTS

Concepts	1956-1978	1956-1981
Economies of Scale		
- passenger specific	0.26	-61.50
- freight specific	0.17	-6.08
- total economies of scale	1.17	3.35
Cost Complementarity	-0.34	-0.63
Overall Economies of Scope	0.86	4.36

Coming back to CN and CP production structure of rail services, the evidence indicates that the two railways averaged over the 1956 to 1981 period, cost advantages in the joint supply of passenger and freight services. Such a finding implies that the joint production of the two outputs generate cost savings which, to some extent, questions the decision to create VIA Rail. Outputs are measured unequivocally at a fairly aggregate level, a level too aggregated to let the estimated cost function reflect all the characteristics of rail service production. For instance, looking at the freight side of railway operations, one has to recognize that railroads provide service for a wide range of commodities. Having found that the separation of passenger and freight services increase the cost of rail operations, it is then of interest to inquire into the presence of economies of scope between the various rail commodity movements. The aggregate unit of output measurement used prevents the analyzing of such an important aspect of rail operations and therefore to assess whether commodity rates are or are not compensatory.

Conclusion

CN and CP have faced a decline in their productivity gains since 1975. Most sectors of the economy, though, have been experiencing lagging productivity growth. Productivity differences between

the two railways are not significant and such differences cannot be confidently attributed to differences in the type of ownership. The study has allowed one to question the appropriateness of using Canadian railway cost elasticities to weight the outputs. The evidence indicates that a measure of productivity assuming constant returns to scale is an appropriate measure of railway productivity experience.

The scope of rail operations affects the overall level of railroad's costs more than the actual scale of the operations. The level of aggregation at which the study is carried out, does not allow one to achieve complete evidence on the natural monopoly issue behind any market structure analysis. Due to data limitations imposed by the highly concentrated nature of rail operations in Canada, only a simple cost model can be used which does not allow one to measure at which density of traffic, increasing returns are achieved. The evidence presented suggests that economies of scope are likely to play an important role in the market behaviour of the railroad industry.

FOOTNOTES

1. The opinions and interpretations expressed are the authors' and do not necessarily reflect those of the Canadian Transport Commission.

2. Caves, D.W. and Christensen, Productivity in Canadian Railroads, 1956-1975, CTC, Report No. 10-78-16.

3. Braeutigam, R.R., Daughety, A.F. and Turnquist, M.A., A firm specific analysis of economies of density in the U.S. Railroad industry, The Journal of Industrial Economics, Vol. XXXIII, No. 1, Sept. 1984, p. 3-20.

4. The algebra behind the said definitions and further details on the cost concepts playing a crucial role in the analysis of multiproduct industries can be found in: Baumol, W.J., Panzar, J.C. and Willig, R.D., Contestable Markets and the Theory of Industry Structure, Harcourt, New York, 1982.

THE RAIL COST ADJUSTMENT FACTOR: INFLATIONARY COST RECOVERY MECHANISM

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ABSTRACT

This paper discusses the rail cost adjustment factor (RCAF)--a factor by which rail carriers may adjust their rates to recoup inflationary cost increases. It explains the rationale for the RCAF and the methodology for constructing the forecast of the Association of American Railroads' (AAR) price index, which is the basis for the Interstate Commerce Commission's (ICC or Commission) determination of the RCAF. It illustrates the results of the last four and one-half years of experience with the RCAF, and discusses outstanding issues, such as whether there should be a productivity adjustment to the index.

BACKGROUND

Prior to the Staggers Rail Act of 1980, general rate increases were the predominant mechanism by which the

strictly regulated railroads were allowed to seek recovery of inflationary costs. These lengthy, expensive, and burdensome proceedings before the Commission prevented the railroads from fully recovering their increased costs, due to the requirement for submission of extensive historical cost evidence and the prolonged procedural periods for planning, submission, replies, and implementation of rate increase actions. During the decade of the 1970's, the railroads experienced low rates of return, deferred maintenance, poor service, declining traffic, and extensive financial failures.

By 1980, both the Congress and the ICC recognized the need to assure that rail rates could be responsive to market conditions and could keep pace with inflationary pressures. While Congress was debating the bill which was the forerunner of the Staggers Act, the ICC, in an Advance Notice of Proposed Rulemaking (ANPR) in Ex Parte No. 290 (Sub-No. 2), served April 28, 1980, announced its intention to replace existing procedures for the filing of railroad general rate increases. The ICC anticipated that the amount of the allowable increases would be determined through the use of an index of railroad costs, and that carriers would be permitted to file for rate increases commensurate with changes in the index to re-

cover their increased costs automatically without regulatory intervention.

In response to the ANPR, the AAR proposed that an expanded and refined version of the price index produced since the 1930's be used for this purpose. The most comprehensive index published by the AAR at that time included wages and supplements, fuel, and other materials and supplies, which together accounted for about 70 percent of total operating expenses. The AAR proposed to add the remaining operating expenses plus interest to the index in order to cover total costs.

Section 203 of the Staggers Rail Act, which was passed in October 1980, directed the Commission to publish a rail cost adjustment factor (RCAF) which was to be used to adjust base rates in effect as of a certain date.[1/] This RCAF was to be a fraction, the numerator of which was the latest railroad cost index, and the

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1/ Section 203 states, "For the 24-month period beginning October 1, 1980 the base rate is the rate in effect on October 1, 1980; for the 24-month period beginning October 1, 1982, the rate in effect on October 1, 1982; and for the 5-year period beginning on October 1, 1984, and for each subsequent 5-year period, the rate in effect on the first day of the applicable 5-year period. (Section 203, codified at 40 U.S.C. §10707a (a)(1)(A).)

denominator of which was the same index in the base period. The cost index was to be compiled or verified by the Commission, and to be adjusted to account for the changing composition of railroad costs.[1/]

The ICC issued a decision regarding its implementation of Section 203 on April 19, 1981. For the required "Index of Railroad Costs" it decided to use an interim version of the AAR price index until such time as the AAR's all-inclusive index would be available for analysis. The AAR's first submission of the interim mid-quarter index (IMI), as it was called, was retroactive to the fourth quarter of 1980, the required starting date. The AAR submitted the details of its proposed all-inclusive index on January 29, 1982, but it was not until June 23, 1983 that the ICC issued a Notice of Proposed Rule-

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1/ Section 203 states, "Commencing with the fourth quarter of 1980, the Commission shall, as often as practicable but in no event less often than quarterly, publish a rail cost adjustment factor which shall be a fraction, the numerator of which is the latest published Index of Railroad Costs (which index shall be compiled or verified by the Commission, with appropriate adjustments to reflect the changing composition of railroad costs, including the quality and mix of material and labor), and the denominator of which is the same index for the fourth quarter of 1980, or for the fourth quarter of 1982 or for the fourth quarter of every fifth year thereafter, as appropriate." (Section 203, codified at 40 U.S.C. §10707a(a)(2)(B).)

making (NPR) on the subject. The ICC took exception to some aspects of the AAR's proposed methodology in the NPR, and the AAR modified its original proposal in response to the ICC's concerns. Finally, on January 2, 1985, the ICC issued its decision directing the AAR to submit a further-modified version of the all-inclusive index as the basis for the ICC's determination of the RCAF.

METHODOLOGY

When the AAR first proposed that the Commission use the index which it had been calculating for decades--Railroad Material Prices, Wage Rates and Supplements Combined, Including Fuel--it also proposed to enlarge the scope of the index to become an "all-inclusive" index by including all other railroad expenses, such as depreciation, purchased services, equipment rents, interest, taxes other than income and payroll, and miscellaneous other expenses. However, the methodology for these six components had not been solidified at that time.

When the Commission issued its decision in April 1981 to utilize the AAR price index, it modified the index until such time as the AAR's all-inclusive index would be

available. The ICC's modification consisted of using the Producer Price Index (PPI) for All Commodities, calculated and published by the U.S. Bureau of Labor Statistics, as a surrogate measure of inflation in the "other expenses" component of the index. This index was called the interim midquarter index (IMI), and it was to be a forecast of the next quarter's prices. It was to be filed 20 days before the end of each quarter, and in order to meet the requirement that it reflect the changing composition of railroad costs, the weights of the index components were to be updated annually.

Thus, until the March 5, 1985 (or second quarter 1985) filing, the AAR submitted the IMI on a quarterly basis. This index had four components--labor, which was 48.5 percent of the total index in 1983; fuel, 10.3 percent; materials and supplies, 7.2 percent; and other expenses, 34.0 percent. The same methodology is used in both the IMI and the all-inclusive index for the first three of these components.

The labor index measures the change in the price of labor per straight time hour, and is a composite of a wage index and a supplements (or fringes) index. The total price of labor consists of two components for the wage

index--straight time pay and pay for time not worked (vacations, holidays, etc.), plus four components for the supplements index--railroad contributions for health and welfare, railroad retirement and medicare taxes, supplemental annuities, and unemployment insurance. To compute the labor index, the wages index and supplements index are weighted together using the respective amounts of wages and supplements charged to operating expense in the weighting year. In 1983, the weights were 77.2 percent wages and 22.8 percent supplements.

The fuel index is calculated by weighting together average mid-month fuel prices supplied by each of the Class I railroads. The weighting factors are the total number of gallons consumed by locomotives on each of the roads in the weighting year.

The materials and supplies index is based on price changes in a market basket of 38 items which make up the preponderance of railroads' purchases. Mid-quarter prices for these items are collected from the nine largest railroads in the U.S., which together account for over 85 percent of all Class I railroads' purchases. The weighting for the market basket items consists of the dollar amounts purchased in the weighting year.

The "other expenses" component was indexed in the IMI using the PPI for All Commodities as a surrogate for specific indices. This interim procedure has been replaced in the Commission's new all-inclusive index.

The AAR's March 5, 1985 quarterly index submission to the ICC utilized the newly-required all-inclusive index for the first time. This index differs from the interim mid-quarter index in several ways:

1. The interest component (four percent of the index) has been deleted from the index;

2. As a result of deleting interest, the weights of the other components have shifted as shown:

1983 INDEX WEIGHTS

Interim Midquarter Index		All-Inclusive Index	
Labor	48.5%	Labor	50.4%
Fuel	10.3	Fuel	10.8
Materials and Supplies	7.2	Materials and Supplies	7.5
Other Expenses	34.0	Equipment Rents	9.6
		Depreciation	7.7
		Other Expenses	14.0
TOTAL	100.0%		100.0%

3. The methodology for each of the components of "other expenses" is different in the all-inclusive index than it was in the IMI. In the interim midquarter index the other expenses were indexed as a group using the PPI for All Commodities as a surrogate. In the all-inclusive index the PPI for Railroad Equipment (PPI-RE) is used for the depreciation index, and the PPI for Industrial Commodities less Fuel and Related Products and Power (PPI-LF) is used for other expenses, which consist of purchased services, taxes (other than payroll and income), casualties and insurance, loss and damage, and general and administrative expenses. The equipment rents index consists of two components--car hire and lease rentals. The car hire component measures the change in the average rate for cars registered on the Universal Machine Language Equipment Register, while the lease rentals index will use actual lease rentals data from the roads, deflated by the amount of locomotive horsepower leased or the amount of freight car capacity leased, as appropriate. This index has not yet been developed, although it may be in place in time for the June 5, 1985 filing.

The RCAF is developed by the ICC from a forecast of the index for the upcoming quarter. Forecasting in the usual sense of the word is not necessary for labor, materials and supplies, and car hire, since what will happen to these components in the future is known in advance. For example, increases in labor are based largely on union contract provisions and payroll tax increases, which are known in time to be incorporated in the "forecast".[1/]

In the case of materials and supplies, a three-month lag is observed between the time of purchase and the time an item is charged to operating expense.[2/] Since it is the latter that is measured in the index, the current quarter's spot prices are used to represent the forecast quarter's charge-out prices.

The other component which does not require a true forecast is car hire, since car hire rate increases are known in advance and can be factored into the calculation. In this case, however, the actual index for the

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1/ The only labor component which requires estimation is health and welfare, since not all the following year's contribution rates are known in December when the first quarter forecast is filed with the ICC.

2/ This three-month lag factor is based upon a survey of railroad purchasing officers.

quarter could be different from the forecast because the number of cars and their various rates are constantly changing.

On the other hand, fuel, lease rentals, the PPI-RE, and the PPI-LF must be forecast. The fuel forecast is made on a consensus basis, i.e., the projections of the fuel purchasing officers of the largest railroads, past and current prices of fuel, and the projections found in both specialized and general business publications are all taken into account. The lease rentals forecast will probably use an ARIMA method, the same method that is used to forecast the PPI's. ARIMA methods use historical data for the same variable to develop a forecasting model.

The "forecasts" of all the components of the index are multiplied by their respective weights and the results are added together to obtain the composite index. The final steps involve a linking process and a rebasing to the currently required base level for the ICC. The linking is necessitated by changing weights periodically, and also, in second quarter 1985, by changing the composition of the index. Linking is accomplished by determining the relative change between the forecasts for the upcoming quarter and the current quarter and then multi-

plying that change times the previous level of the index, which was calculated with different weights.

FOUR AND ONE-HALF YEARS OF RESULTS

In the 4 1/2 years since passage of the Staggers Act, the index which has been the basis for the RCAF increased to a level of 127.9 (1980=100) in third quarter, 1984, but has since fallen to a level of 126.0. The following table shows the history of the AAR index and of the RCAF. The index (the IMI until the second quarter of 1985, and the all-inclusive index in the second quarter, 1985) is shown on a 1980 base in the first column.1/

The RCAF, in column 2, is shown on two bases-- October 1, 1980 and October 1, 1982. The reason for the changeover to October 1, 1982, beginning with first quarter, 1983, was the requirement, as quoted previously, that at that time the denominator of the RCAF should be the index for the fourth quarter of 1982. Furthermore, the base rate for the 24-month period beginning on October 1, 1982 was to be the rates in effect on that date. At the pre-

1/ During the first year the index was 1979-based, and since that time has been a 1980-based index.

AAR INDEX AND RCAF

	AAR Index Used to Determine RCAF (1980=100) (1)	Rail Cost Adjustment Factor (2)	Allowable Quarterly Increase (3)
10/1/80	102.7	1.000	
4Q,80	103.4	1.007	0.7%
1Q,81	108.6	1.057	5.0
2Q,81	110.7	1.078	2.0
3Q,81	113.8	1.108	2.8
4Q,81	115.4	1.124	1.4
1Q,82	120.9	1.177	4.7
2Q,82	118.4	1.153	-
3Q,82	119.0	1.159	-
4Q,82	119.0	1.159	-
10/1/82		1.000	
1Q,83	122.1	1.010	1.0
2Q,83	118.4	0.979	-
3Q,83	120.8	0.999	-
4Q,83	122.4	1.012	0.2
1Q,84	127.3	1.053[1/]	4.1
2Q,84	127.3	1.053	-
3Q,84	127.9	1.058	0.4[2/]
4Q,84	127.3	1.053	-
1Q,85	126.7	1.048	-
2Q,85	126.0	1.042	-

1/ The ICC in 2Q,84 determined that the 1Q,84 RCAF should have been 1.052, but no retroactive rate actions were ordered.

2/ The index increase of 0.5% was reduced to a 0.4% allowable increase to adjust for the 0.1% overstatement in first quarter 1984.

sent time, the denominator of the RCAF is the first quarter 1982 index of 120.9 rather than the lower fourth quarter 1982 index of 119.0. This adjustment was necessary because base rates in effect on October 1, 1982 reflected the level of the index in first quarter 1982. Failure to recognize this adjustment would have led to excessive cost recovery.

The last column of the table shows the rate increases allowed by the Commission as a result of the increases in the RCAF. There have been no increases since third quarter 1984, because the index has declined in each subsequent quarter.

ISSUES REMAINING

The most significant RCAF issue outstanding (which is docketed by the ICC as Ex Parte No. 290 (Sub-No.4)) concerns mainly whether the index used as the basis for the RCAF should be adjusted for productivity. Shippers argue that since the AAR index is an input price index, it should be adjusted for productivity increases to convert it to an output index which would measure the increase in cost per unit of output. Shortly after the ICC implemented Section 203 of the Staggers Act, shippers

petitioned for judicial review of the Commission's final decision, which did not require a productivity adjustment. On May 4, 1982 the United States Court of Appeals for the D.C. Circuit upheld the Commission's decision not to adopt any productivity or other input-output adjustments other than those reflected in the changing composition of rail inputs. The court also stated that it expected the Commission to review the index and revise it if circumstances warranted.1/

In accordance with this Court decision, the ICC questioned whether a productivity adjustment should be adopted in an Advance Notice of Proposed Rulemaking on July 23, 1982. Several productivity adjustment methodologies were proposed by respondents, including one by Douglas W. Caves and Laurits R. Christensen, which was the object of several questions included in the ICC's September 27, 1984 Notice of Proposed Rulemaking. Public comments were filed February 11, 1985 in response to the Commission's NPR, and reply comments were due March 29, 1985.

1/ Western Coal Traffic League v. United States, 677 F. 2d 915 (D.C. Cir. 1982).

The AAR argues in this case that the Commission should not adopt the Caves-Christensen or any other methodology for adjusting the index for productivity. The principal bases for this conclusion are:

1. Productivity adjustments to the index would prevent the railroad industry from fully recovering its cost increases, since competition already forces railroads to transfer a share of productivity growth to shippers through lower rates and "flagouts" or "holddowns" from rate increases. Adjustment of the index would mean a double pass-through of the gains.

2. Productivity adjustments to the index would reduce the railroads' incentive to increase productivity.

3. Accurate, timely, and reliable measures of railroad productivity do not exist.

4. Because the industry is revenue-inadequate, even a small overestimate of productivity gains could have serious adverse consequences.

Another RCAF issue which remains outstanding is the methodology of the all-inclusive index. Even though the Commission's January 2, 1985 decision has adopted a modified version of the all-inclusive index, as mentioned previously, the methodology still appears to be "interim" in many cases. For several components the Commission has left room for change by adopting a methodology (usually one of the Producer Price Indexes) "for use at this time," or by asking that further proposals be made. Purchased services is a component for which the Commission adopted a Producer Price Index, but suggested that the AAR develop an index which would make use of actual railroad data. Depreciation is another component which utilizes a Producer Price Index "at this time." The Commission stated that if it adopts replacement cost accounting in Ex Parte No. 393 (Sub-No. 1), the depreciation component of the index would need to be modified accordingly.[1/]

Certain other issues continue to recur. In February, 1985 a petition was filed by certain shippers to reopen the Ex Parte No. 290 (Sub-No. 2) proceeding on the grounds

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1/ January 2, 1985 decision, p. 15.

that it contains material error.[1/] At issue are the methodologies for equipment rents, depreciation, and purchased services, the use of the three-month Treasury Bill rate to calculate the opportunity cost of capital when railroads collect funds for the payment of retroactive wages in advance of their disbursement,[2/] and whether or not there should be allowed an additional audit of the index. These questions, especially the last, have been raised many times before. The Commission has consistently turned down this request, stating that, "we are still convinced that the integrity of the index and the confidential nature of the data which underlie it are protected by both the CPA's audit, our review of the CPA's procedures and workpapers, and our own independent review and audit of the index."[3/]

1/ The due date for comments was extended to April 1, 1985.

2/ This happens during contract negotiations. If management makes an offer, that amount is reflected in the STHR, and hence in the index. The opportunity cost of those funds is later to be subtracted from the index, so that, in effect, shippers receive payment for the railroads' use of those funds prior to their disbursement by the carriers.

3/ Ex Parte No. 290 (Sub-No. 2) decision, January 2, 1985, p. 4.

In its response to the petition, the AAR supported the ICC decision in all respects. In regard to the shipper audit question, in addition to reiterating its position that the public interest is adequately protected by the Commission's audit procedures, it stated that the railroads have no reason to willfully supply data which would bias the index. The industry is well aware that to call the integrity of the index into question by the use of incorrect data or procedures would be both counter-productive and short-sighted. The railroads have no desire to return to the lengthy and expensive rate proceedings under prior regulation that cost the industry so much in lost revenues.[1/]

1/ AAR April 1, 1985 Response to Petition to Reopen Ex Parte No. 290 (Sub-No. 2) filed by Carolina Power and Light Company, et al.

CONCLUSION

The RCAF is a mechanism for recovering inflationary cost increases which the railroad industry considers essential to its financial health, since it allows them to obtain prompt cost-recovery rate increases with minimal regulatory delay. Over time, the index methodology underlying the RCAF may continue to be refined, but the RCAF itself will remain an important Staggers Act reform.

RESOURCE DEVELOPMENT AND TRANSPORTATION: THE CASE OF GEOGRAPHICALLY ISOLATED NORTHERN RESOURCES

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INTRODUCTION

Resource development in geographically isolated areas is extremely dependent on the economics of transportation. In this paper we are interested in investigating the theoretical aspects of this relationship and in briefly applying the theoretical propositions to northern resource development.

Transportation in remote regions is generally thought to be more complex and more expensive. Often, particularly as it relates to natural resource activities, the economics of transport determine to a great extent whether, how and when the resource will be developed.

The emphasis here will be on northern environs because these areas generally lack extensive surface transport systems. As an example, the discovery and development of a coal deposit in Montana may be made more feasible relative to other locations since the transportation system beyond the mine site already exists. Generally this is not the case in Alaska, the Yukon Territory, the Northwest Territories, or even the northern part of most Canadian provinces. Utilizing the economic concepts of demand and supply for transportation can provide insight into the regional differences relative to the viability of resource development projects, and this understanding is the thesis of this discussion.

THEORETICAL CONSIDERATIONS

The economics of transportation depend to a large measure on consideration of demand and supply relationships. Transportation demand is the classic derived demand, arising from the demand for final goods. Supply of transportation is primarily a function of current available technology and present cost/price relationships. Emphasis here is on the shifters of demand and supply and the concept of elasticity as it relates to economic viability of resource development.

DEMAND

By demand shifters we refer to those items which, in traditional demand theory, cause the demand curve to shift either to the right (an increase) or to the left (a decrease). Specifically these are conventionally defined as income, population, tastes and preferences, and price and availability of substitute goods.

Income of the purchaser of transportation services can be thought of as level of feasibility of the developmental project. The greater the feasibility the higher is the expected income stream and vise versa. Transportation demand is shifted to the right if potential internalized net revenues are large. Internalization means that the resource developer could retain a large share of the net revenues. Another way of saying this is that the resource developer has captured a substantial portion of the benefit stream. Thus the transportation demand curve is forced to the right when the benefit stream can be captured by the developer. If the benefits are low or some form of intervention prevents the private firm from capturing them, then the private demand curve would tend towards the left. As will be discussed later in this paper, the difference between private and social benefits and costs are extremely important in the economics of transportation in northern resource development.

Population, as a determinant of demand for transportation, deals with the number and size of the development

projects. The transportation demand curve will shift to the right if there are numerous viable smaller projects within reasonable proximity of each other, or one project of substantial size. Another way of looking at population is by the number of users of transportation. In an agricultural development project there would be many farmers and this alone would tend to shift the transportation demand curve to the right.

Tastes and preference refers to the desires of the direct user group or the people affected by the transportation activity. If greater economic development is viewed as an important attribute, and the resource project is seen as a major contributor, then this preference will shift the transportation demand curve to the right. When environmental concerns are deemed important and transportation system development has a negative effect, then the demand of transport can be lessened (shifted to the left). As an example, the development of a mine can create economic activity in terms of employment. If greater employment is desired for the region in which the mine is located, the demand for transportation would be enhanced. However, when concern for environmental damage also affects the same project, including the transportation system, there would be pressure on the demand curve to shift to the left. In other words, there can be countervailing forces pulling and tugging on the

demand curve for any shifter category. The actual shift depends on the overall strength of each.

The final demand shifter, price and availability of substitute goods, has special meaning to development of resources in northern areas. Prior to development of a project several substitutes and costs are possible, e.g., railline development, maritime transportation with associated port development, haul road construction, pipeline development, etc. However, the economies of scale and size suggest that, once a decision has been made as to what type of transportation mode to use, little further effect from availability of substitute goods will be felt on the demand for transportation, at least in the near term. In the longer time frame, as level of development in a region increases, alternative modes may appear, such as roads replacing air transportation in northern communities.

The effect of all of these demand determinants is reflected in the price elasticity of demand which measures the responsiveness of quantity demanded to a change in price. High value resource activity may not be responsive to large changes in the price of transport; therefore the transportation demand curve is more inelastic. If the resource project is marginal, then it tends to be sensitive to price changes because the price of transportation relative to income (net returns) is high. Thus, the demand curve for transportation for a marginal

resource is more elastic. This topic will be developed again a little later in this paper.

SUPPLY

In comparing northern transportation to more temperate areas important differences can be ascertained by reviewing the shifters of the supply curve. Three items seem very relevant to this discussion: the production function, price of inputs, and front end investment or the ratio of fixed to variable costs.

The production function denotes the physical efficiency of the relationship between inputs and outputs. As it pertains to transportation supply, the production function in northern environs would tend to be at a lower level, less physically efficient, than more southernly locations. This can be related to greater inefficiencies caused by harsh climate coupled with geographic isolation from the main North American surface transport routes and effect on planning process. Such a circumstance implies that the transport supply curve is shifted to the left to reflect the duality of a lower production function.

The price of inputs is determined by the need to transport the inputs to the geographically isolated area or, in the case of labor, the harsh climate requires a higher pay scale. In effect, the firm's average cost curve is raised because of the added transportation cost and geographical wage factor added to the price of

inputs. The marginal cost curve is shifted to the left and since this is the short run supply curve for the firm, it too is shifted to the left.

The third major factor is relationship between fixed and variable costs or the front end investment. An agricultural project may depend on the development of a port facility to transship grain to ocean going vessels. The front end investment for this transportation component is large. A limited production of grain from a few farms to this facility leads to a high cost operation for the terminal because of low volume. Thus the economic viability of the project is dependent on large volumes to spread the high fixed costs. The short run supply curve would not be affected by this necessary investment. One way to overcome this relationship is to subsidize the terminal facility, which in effect represents a greater volume or a lower average total cost curve. In such a case the terminal supply curve would be shifted to the right, as will be discussed later.

Another example of the fixed/variable factor is the highway system which is developed for a marginal resource. The users associated with the resource activity are not able to economically provide the front end investment for the needed road system. A government subsidy in the form of public highway construction represents a shift of the transportation supply curve to the right.

The differentiation of private versus social costs and benefits is the essence of the front end investment argument. If the resource is of high value, it tends to be volume insensitive and private costs are the key factor. The more marginal the resource the greater consideration must be given to social costs and benefits. To shift the transport supply curve to the right requires social investment supportive of the private investment.

Transport supply tends to be inelastic. In remote locations this is even more pronounced because the high front end investment usually limits the feasible options to one. This investment is also generally lumpy because the building of a 'small' transport system in a remote location may be nearly as expensive as a 'large' system. The short run elasticities of supply may be somewhat more elastic.

SUPPLY-DEMAND CONSIDERATIONS

The private-social cost argument for high value versus marginal resource activities can be examined by looking at a partial equilibrium market solution (Figure 1). The inelasticity of the demand curve for high value resources (and its transportation) means it is non-responsive to price changes brought about by a shift to the right of the supply curve. This shift is due to a subsidy represented by the addition of the social investment to the private supply curve. The high value

resource does not require a transportation subsidy to be developed.

MARKET SOLUTIONS

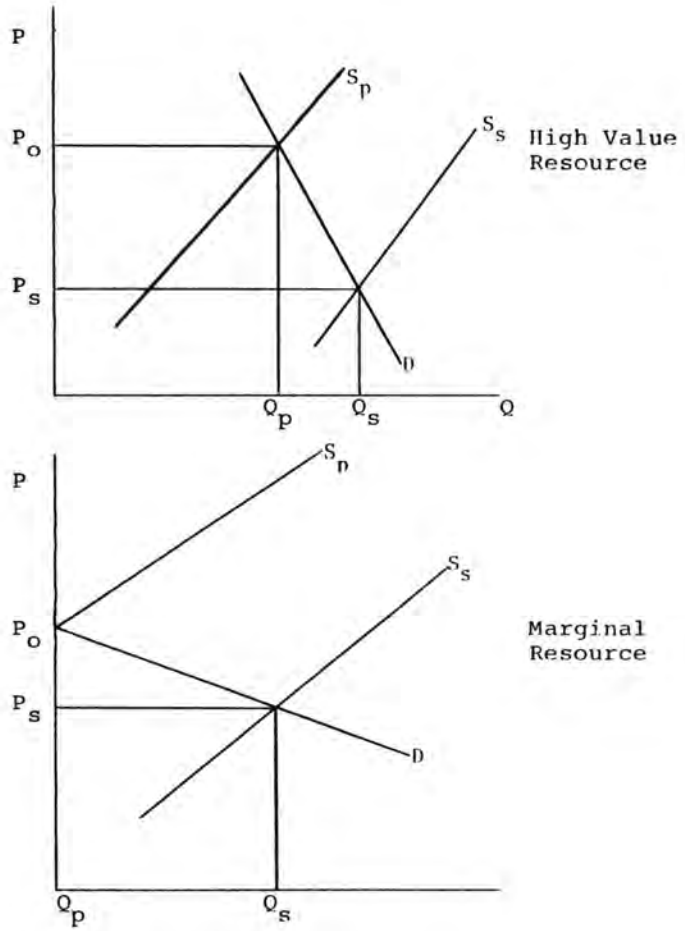


FIGURE 1

The marginal resource (and its transportation) has a more elastic demand curve. It is much more responsive to

changes in transport price. The private supply curve for transportation could be so far to the left (low production function, high price of inputs, and high front end investment) that the two curves do not intersect. Thus the resource project is not feasible.

The curve is shifted to the right with the addition of the social supply curve. Demand and supply now intersect, with the resultant transport price and level of production for the marginal resource.

AN APPLICATION

Examples supporting the previous propositions can be presented. The intent here is not to provide full documentation of each case but rather to highlight how a more thorough understanding of supply and demand for transportation can be helpful in explaining natural resource development activities in northern areas.

Some of the variables affecting both supply and demand are given in Table 1. The five major resource activities found in Alaska are also presented. (A similar table could be developed for northern Canada.) Beginning with demand, agriculture would tend to shift the demand curve for transportation moderately. Its income and economic development potential is low, but population (in terms of number of potential users) is high. Pressure to shift demand to the left (a decrease)

because of environmental concerns is limited in agriculture compared to the other resources.

Petroleum is generally a high income generator thus it places strong pressure toward shifting demand to the right. This likely would override any decreasing tendencies from environmental concerns.

Table 1. TRANSPORTATION DEMAND AND SUPPLY SHIFTERS FOR ALASKA RESOURCE DEVELOPMENT. (H=High, M=Medium, L=Low)

	Demand			
Shifters	Income	Population	Economic Development	Environmental Concerns
Agriculture	L	H	L	L-M
Petroleum	H	L	L	H
Fish	L-H	H	H	M
Mining	L-H	L-H	L	H
Forestry	L-H	L	H	H

	Supply		
Shifters	Production Function	Price Input	Front Investment
Agriculture	L	H	H
Petroleum	H	H	H
Fish	M	H	H
Mining	H-L	H	H
Forestry	H-L	H	H

Of the remaining three resources, fishing tends to be in the strongest position to shift demand to the right. Demand shifters for mining and forestry appear to nearly counterbalance one another.

Supply shifters tend to be consistent across resources except for the production function. Input prices and front end investment are all high and negative. They are then, shifters to the left.

Petroleum, particularly the Trans Alaska Oil Pipeline, strongly pressures the transportation supply curve to the right due to production function efficiencies. Extremes in northern conditions negatively impact the transportation production functions of the other resources mainly because of highway usage (excluding the fishing industry). Forestry is helped when it has near access to water transport. Agriculture and mining benefit from close proximity to a railroad.

Simultaneous consideration of transportation supply and demand for these five northern resources again makes Figure 1 useful. For a high value resource, like petroleum, supply and demand curves are inelastic. The demand curve tends to be pressured toward the right due to a substantial net benefit (income stream). Supply that is internal to the firm, the private supply curve, is also shifted to the right because of petroleum transport efficiencies.

For more marginal activities, such as agriculture, the transport demand curve tends to be pressured toward the left and is highly elastic (Figure 1). The private supply curve is so far to the left (caused by high costs and lower transport productivity) that it conceivably did not intercept the demand curve. Expenditure of public funds in front end investment, e.g., railroad, roads, and port grain terminal facilities, will shift this supply curve to the right making agricultural transportation more viable. The new curve represents social and private supply considerations.

There is a further means of addressing demand and supply for transportation that underlies the previous discussion. Demand generates benefits generally in terms of an income stream. Supply generates costs, e.g., construction, operation, and maintenance. An important issue is whether the benefits and/or costs are captured by the resource development firms or are dispersed throughout the society.

The five northern resources are presented in terms of benefits and costs, either captured or dispersed, in Table 2. For petroleum, the benefits of transportation are large (the resource has a high value) and can be captured by the resource firms because of specialization of the transport system (a single use pipeline) and ownership of the resource. The owners and users (same group) of the oil pipeline can also provide all of its

private costs. From a societal viewpoint, they have a large enough income stream from the resource activity to internalize quantifiable social costs.

Agriculture has both dispersed benefits and costs. Its income stream is low and dispersed over many non-farm as well as farm users. The costs of the transport system, including highways, railroads, and ports, are spread among farmers and many others in the society. This suggests that the dispersed nature of the benefits and costs requires societal intervention in the transport system in order to support northern agriculture development.

TABLE 2. BENEFITS AND COSTS OF TRANSPORT
(D=Dispersed, C=Captured)

Shifters	Benefits	Costs
Agriculture	D	D
Petroleum	C	C
Fish	C	C
Mining	C	D-C
Forestry	C	D-C

The remaining resources have many of the same characteristics as petroleum. Mining and forestry could have dispersed costs because of environmental damage potential. The fishing industry gains because it has

little need of ground or air transportation while fishing in northern waters adjacent to Alaska.

CONCLUSIONS

In general, transportation provides for the usefulness of a resource base in terms of utilization by society. It appears that the study of demand and supply relationships for transportation can provide insights into the connective lengths between the resource, societal use, and potential development.

The issue of social versus private costs is key in determing the economic viability of the transport system and the resource development. If transportation cost and benefits can be internalized within the resource activity, its development, even in an environmentally sensitive time period, is highly probable. When development is economically viable only with the expenditure of public funds to aid transportation, the resource activity is less assured. Development of marginal resource projects with dispersed benefits appears to be the future child of governments or public entities.

SMALL SHIPPERS' INTERESTS IN CHANGING TRANSPORT ENVIRONMENTS

EUGENE M. LUDWICK

1. INTRODUCTION

Most debates with respect to development of proposals for the creation of deregulated, or at least more competitive, modes or transport systems, raise the potential negative impact on the so-called small shipper as a concern. This is so in spite of the fact that the identity and interests of small shippers are generally unknown.

Simply stated and without regard to size, "the interests of shippers are that they should be able to have their goods transported from point of origin to point of market safely, expeditiously and as economically as possible, and that the facilities to do this should be available with the required frequency".[1] On the basis of this statement of shippers' interests, a small shipper may be defined as one who, in all cases or in a particular market or service lane, does not offer sufficient volumes of freight to interest one or more carriers in transporting the goods either safely, expeditiously, economically or regularly.

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[1] United Nations Conference on Trade and Development, Protection of Shipper Interests: What are Shipper Interests? (New York, 1975), p. 1

In other words, the application of the term small shipper goes beyond the firm which is obviously small in terms of economic activity (for example, sales of less than $1 million per year). It extends to any firm which, for whatever reason, does not have the power to influence rate or service levels through negotiation. An example could include a remote pulp and paper company with an annual total rail freight bill of over $5 million - an apparently large amount of money which may pale in comparison to that spent by competitors with annual rail traffic budgets approaching $100 million and who are the subject of intense competitive freight solicitation. Further, consider the case of two grain companies, one annually shipping 1,000 containers of specialty crops from the prairies to Western Europe using a single ocean line (or the lines of a single conference), the other also annually shipping 1,000 containers to every corner of the world using dozens of different lines in different conferences on a sporadic basis. The first of the two firms is clearly the more attractive target for competitive freight solicitation and rate negotiation by the few carriers which might be involved. To the many carriers operating in the many service lanes required by the second company, that company is considered small and therefore of little interest. Rates are offered on a "take it or leave it" basis.

Historically, regulatory bodies such as the Interstate Commerce Commission, the Canadian Transport Commission and provincial/state highway transport boards have been established to ensure a balance between the interests of shippers and carriers resulting in the provision of services to all requiring them at rates deemed to be fair and reasonable. Contrary to the fears expressed by opponents of transport deregulation in the United States, removal of rate and service regulation as well as the legal common carrier obligation to carry all freight offered by any shipper has not, in most cases, negatively affected "small shippers" or shippers in small communities. Services, routings, and equipment may have changed, but competition and the entrepreneurial desire to earn profits have generated a variety of new transport alternatives. In particular, the services of intermediaries such as freight forwarders, pool car operators and brokers have gained increased recognition as valuable options for the small shipper.

2. RAIL TRANSPORTATION

Current Canadian transportation policy and legislation declares ....

> "...that an economic efficient and adequate transportation system making the best use of all available modes of transportation at the lowest cost is essential to protect the interests of users of transportation and to maintain the economic well being and growth of Canada...."[2]

These objectives are considered most likely to be achieved when, among other things . . .

(d) each mode of transport, so far as practicable, carries traffic to or from any point in Canada under tolls and conditions that do not constitute:

i) an unfair disadvantage in respect of any such traffic beyond that disadvantage inherent in the location or volume of the traffic, the scale of the operation connected therewith or the type of traffic or service involved, or

ii) an undue obstacle to the interchange of commodities between points in Canada or unreasonable discouragement to the development of primary or secondary industries or to export trade in or from any region of Canada or to the movement of commodities through Canadian ports."[3]

Simply stated, Canada's orientation in transport policy and legislation has been to ensure that service is provided to all who require it at "reasonable" rates. The Canadian Transport Commission regulates railways in order to ensure the achievement of these objectives. Provincial motor transport boards do the same for trucking. Presumably, regulation of transportation in America had been instituted for similar reasons.

Developments in the United States providing for deregulation of the truck, rail and air transport modes, however, have given rise to discussion in Canada relative to whether Canadian transportation users might be better served by transport industries regulated by the marketplace rather than by governments. In particular, recent

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[2] National Transportation Act, 1966-67, C. 69, 5.2, section 3

[3] Ibid.

debate has focussed on the desirability of limiting railways' ability to set rates collectively. An important point that has been raised by opponents of change is that the small shipper would suffer higher rates and reduced or eliminated services.

In the fall of 1983, E. M. LUDWICK & ASSOCIATES INC. was commissioned to conduct a survey[4] of large and small Canadian shippers aimed at learning the views of firms using domestic and transborder railway transportation services on appropriate alternatives regarding collective versus competitive rate-making. While firms of all sizes are cognisant of some of the negative aspects of deregulation in the U.S., overall, most firms are in favour of limiting railways' collective rate-making practices and creating a more competitive rail transport environment.

Following are some quotes explaining small shippers' fears about a competitive rail rate-making environment:

> We are opposed to secret rate negotiation and strongly urge continuation of the status quo in the railway rate-making and publication process. The alternative is, in our view, the opening up of chaotic confusion in the transport market place to the great detriment of transportation in the country in general.

> The market in which we operate is very highly competitive so I have to know what my competitors are paying for rail services at all times.

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4 E. M. LUDWICK & ASSOCIATES INC., Competitive Versus Collective Railway Rate-Making: Survey of Rail Users' Views, Evidence Given on Behalf of the Director of Research and Investigation - Combines Investigation Act, Before the Railway Transport Committee of the Canadian Transportation Commission - "Inquiry Into the Effects of U.S. Rail Deregulation", Toronto, Ontario, October 1984.

> As a small Canadian shipper we believe in honest free competition and transport deregulation even though small shippers will become rate takers more than ever while large companies will be able to dictate to rail carriers.

These concerns notwithstanding, small shippers participating in the survey, who have involvements in transborder rail shipping, report positive experiences with U.S. deregulation especially as regards rate levels, railway innovation and responsiveness to individual shipper needs, and perceptions of railway efficiency and productivity. They expect similar positive effects would result from the introduction in Canada of legislation similar to the 4R and Staggers Acts.

Amongst all survey respondents, small shippers are strong proponents of the view that competition between railways acting independently is necessary to encourage innovation and efficiency leading to flexible and innovative service and pricing actions as well as research and development. They strongly disagree with the notion that competition between railways would affect their commercial viability by reducing railway earnings and endangering the provision of adequate and efficiently supplied railway services.

Two small shippers explain their viewpoints:

> In our experience with U.S. rail deregulation we have had better access to competitive rail rates and services. We expect that deregulation in Canada would benefit shippers similarly.

> Our Canadian railways are run very soundly and economically in the present regulated system. I believe

> that they will continue to do so in a free and open environment simply because there are only two railways and it would not be practical for them to get involved in suicidal price wars that would destroy their viability and ability to serve those that pay for the bill.

Overall, small shippers agree with their larger confreres that a more competitive rail transport system, limiting railway collective rate-making to movements requiring two railways (joint or interline rates) is much more desirable than the status quo. One small shipper goes as far as to say:

> Current laws concerning collective rate-making and rate publication are being broken now with no enforcement or penalties. We are therefore of the position that the only practical approach is to throw everything open to free enterprise.

Complete rail deregulation is an option favoured by a few survey respondents. However, the point of the matter is that the majority of small shippers whose interests are of such great concern report that they prefer more comptition over the current regulatory system that is supposed to protect or at least "balance" the interests of shippers and carriers.

3. OCEAN TRANSPORT

Unlike surface transportation, ocean liner services to and from Canada are not subject to service and rate regulation of any kind. Indeed, marine shipping companies operating within price and service-fixing liner conferences were completely unrestricted until the passage of the

first Shipping Conferences Exemption Act in 1970. Certain amendments to this act which exempts certain practices of shipping conferences from Canadian antitrust laws, are intended for the forthcoming legislative year which would somewhat lessen the monopolistic power of conference lines.

Although liner shipping markets are characterized by relatively few suppliers, with the occasional presence of independent non-conference outsiders, and very many buyers, ocean shipping to and from Canada is generally unregulated other than by market supply and demand. In these "competitive" circumstances, one would expect that the small shipper faces great difficulty in obtaining regular ocean transport services at reasonable rates.

In a survey of ocean transport users conducted in 1982[5], small shippers do express some difficulty in dealing with shipping lines against which they are able to exert little or no bargaining power. One small shipper from the Canadian Prairie region explains:

> The problem with conferences often is that if you don't like the rate they have to offer, you don't get to ship. Conferences have the power to make things very tough on shippers and can actually act to keep Canadian shippers out of foreign markets. There is therefore a trade-off; for a higher price and loyalty contracts with conferences you can ship anywhere in the world; and, for a lower price you can ship to the selected points that the outsiders call at.

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5 E. M. LUDWICK & ASSOCIATES INC. Shipping Conferences: Survey of Users' Views, Consumer and Corporate Affairs Canada, Ottawa, Ontario, 1983

Small and large shippers alike express a number of concerns about the conference system of ocean shipping. For example, they have not been able to negotiate loyalty (patronage) contracts which they consider fair and reasonable, and which require a commitment of less than their total cargo on routes served by a conference. The practice of imposing surcharges, the unilateral manner in which they are derived, and their levels are considered to be completely arbitrary and generally draw strong criticism from shippers. They view such surcharges simply as a means for conference lines to gain additional revenues and thereby escape the rate provisions in the loyalty contracts. The majority view of Canadian ocean transport users is that the extra costs of serving St. Lawrence River ports should be translated into higher rates for shippers in Central Canada, or lower rates for traffic originating from or destined for points in the Maritime provinces.

As regards their relationships with conferences in comparison with large ocean transport users, relatively few small shippers undertake to hold rate consultations with conferences because they are certain the outcome will be in favour of the conferences. Small shippers especially report difficulty in attempting to deal with joint Canada/U.S. conferences. If most small shippers avoid consultations with conferences, over two-thirds of small shippers who have bothered to negotiate directly, have

achieved results they consider satisfactory.

Further, in agreement with their larger confreres, small shippers consider that individual shippers themselves are best able to look after shippers interests with respect to conferences. As one small shipper states:

> We believe that individual shippers themselves are best able to look after their interests in relation to liner conferences. We are fairly small, and if we are able to do it, other shippers should be able to as well.

This kind of attitude helps explain why many small and large shippers alike agree that the best course of action for governing the behaviour of the liner conferences is to repeal the Shipping Conferences Exemption Act thereby making ocean transport services completely regulated by market supply and demand conditions.

Two large shippers from Ontario and Quebec make their positions clear:

> We believe in free enterprise. We want the right to have free and open competition. We do not wish for shippers to collude nor for conferences to collude, we just expect fair situations and free competition.

> We like conferences, but want marine shipping to be kept open in order to keep the conferences honest. We do not want to be in a take it or leave it position.

The views of these large shippers likely reflect the fact that they control enough freight to interest one or more carriers in transporting their goods regularly, safely, expeditiously and economically. The small shipper is not in this position and the protection of his interests, indeed his success in competing in foreign markets, may

depend on the availability of non-carrier shipping alternatives.

4. INTERMEDIARY ALTERNATIVES - THE FREIGHT FORWARDER

Though they generally maintain a much lower profile than carriers, transportation intermediaries are responsible for the movement of a substantial amount of domestic freight within Canada and the United States, transborder freight between our two nations and overseas traffic on behalf of shippers and consignees. Depending on the scope and orientation of their operations they are known as poolcar operators, consolidators, shippers' agents (piggyback forwarders) or simply freight forwarders. In the deregulated American transport environment, the "broker" is beginning to play an increasingly important role in providing cost-competitive shipping alternatives, particularly by finding full or part loads for motor carriers seeking backhauls. In many cases, the forwarder acts as a for-hire transportation department for a number of small and medium-sized shippers. "Many of the largest corporations ....use freight forwarders and have done so for many years....The size of the corporation, therefore, is not necessarily the deciding factor. Individual conditions determine individual decisions."[6] For example, small and

6 D.G. Gillespie, "Freight Forwarding and Brokerage", Export Trade and Shipper, vol. 76, no. 13 (28 October, 1957)

large shippers alike use freight forwarders when they wish to (among other things):[7]

- penetrate new international markets for the first time;
- serve peculiar or difficult markets such as politically unstable countries where trade rules and barriers can change very frequently;
- obtain a more competitive rate for a small shipment by having their freight consolidated with other shippers' goods.

As commissionable agents acting on behalf of shippers transport intermediaries book vessel, rail car, truck or airline space, prepare and present documents, arrange transportation to and from ports, airports, or intermodal loading/unloading points, and provide other complementary services without necessarily handling the goods themselves.

> The importance of their work must not be underrated. The documents required as a result of statutes, regulations, and commercial practices include ocean and inland bills of lading, customs declarations, consular documents, dock receipts, certificates of inspection and measurement, certificates and binders for insurance, banking documents, forwarders' receipts and others for the business uses of the carrier such as invoices and billing forms, manifests, tracers, and the like.[8]

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7 E. M. LUDWICK & ASSOCIATES INC., The Role of International Freight Forwarders in the Enhancement of Canadian Export Trade, Transport Canada, Ottawa, Ontario, 1984.

8 Canadian Institute of Traffic and Transportation, Canadian Traffic and Transportation, vol. I (Toronto, 1978) p.251

As an agent, the transport intermediary charges clients according to a prearranged schedule of fees for any or all services performed. The fee can take the form of a fixed charge, a percentage of the freight, a percentage of the value of the goods, etc. In this role, the intermediary also performs a service for the carrier (by regularly providing the carrier with traffic which is accompanied by correct and timely documentation) for which he is often, but not always, paid a commission on the freight he generates.

By pooling or consolidating the small (i.e., less than containerload) shipments of numerous shippers, some forwarders or brokers in effect act as carriers themselves transporting the goods and delivering them to the ultimate consignee at a single rate for the through door-to-door movement. This rate - usually an FAK (Freight, All Kinds) or "Mixed Freight" rate - is generally lower than that which would apply to the same small shipment if made by an individual shipper dealing directly with the carrier on a commodity-specific basis. The forwarder can offer this rate by chartering large volumes of space from carriers at "wholesale" prices and then selling portions of it to his clients at retail prices.

It can be argued that because entry, services, and rates are unrestricted, the forwarding/intermediary alternative is somewhat dubious, and that the shipper runs the risk of being improperly served by the unscrupulous and

incompetent. However, in the previously mentioned survey of ocean transport users, small shippers give freight forwarders highest ratings in terms of many aspects of service quality, including: customer service, low instances of claims, ability to conduct meaningful consultations, fast service, reasonable freight rates, regular reliable schedules, availability of space on demand and stability of freight rates.[9]

A recent study [10] undertaken by E. M. LUDWICK & ASSOCIATES INC. for a major Canadian retail chain demonstrates, at least in part, the value of the freight forwarding alternative to the small shipper. The firm in question was seeking to import between 100 and 200 containers of various retail goods in 1984-85 of which 50 per cent would be LCL and the rest, full container loads in 20' and 40' containers from several origins in the Far East to two destinations in Western Canada. Rates, terms and conditions were sought from five freight forwarders, three conference lines and three non-conference lines.

The three conference lines all refused to quote rates ostensibly because they considered that the origins and commodities were too many and the volumes too small to be of interest. Three of the freight forwarders declined the request for a variety of reasons. While one of the three

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9 op. cit., p.9

10 Unpublished confidential rate enquiry, 1984

non-conference lines offered a highly competitive rate, the least expensive and least complicated quote came from a major worldwide forwarder offering a single door-to-door rate covering all commodities and all origins differentiated only by the two Western Canadian destinations.

AVERAGE ALL-INCLUSIVE DOOR-TO-DOOR RATE QUOTES ($U.S.)

ORGANIZATION	20' CONTAINER	40' CONTAINER
Forwarder #1 - Eastern Ports	$2,657	$4,081
Non-Conference Line #1 - Western Ports	2,707	4,161
Forwarder #2 - Western Ports	2,725	5,777
Non-Conference Line #2 - Western Ports	2,860	6,064
Non-Conference Line #3 - Eastern Ports	-	6,822

While it appears anomalous that forwarder #1 using eastern ports can provide a better rate than both independent line #1 and forwarder #2 using western ports to service points in Western Canada, the rates reflect forwarder #1's very high traffic volumes on Far East/Canada routes resulting in his ability to pass on significant savings to all his Canadian clients.

The above illustration simply serves to demonstrate that a bit of research or "shopping" can result in the identification of cost and service-competitive alternatives for small users in an unregulated environment where shippers are left to fend for themselves. Certainly, most

small shippers can ill afford to hire a consultant to undertake such research. However, a better informed domestic or international shipper can take advantage of the services (including rate research) offered by transport intermediaries, who, driven by the entrepreneurial desire to earn profits, are anxious to provide small or any-sized shippers with economical alternatives that induce freight to move.

In conclusion, when considering the relative merits of introducing more competitive transport environments, perhaps our concerns should not particularly be directed to the protection of small shippers' interests. Small shippers can learn how to protect their own interests if efforts are made to educate them in the alternatives that are available and how to seek them out.

This paper is in no way meant to be taken as an endorsement of wholesale deregulation. Rather, it should serve to point out that effects on the shipping - user and carrier - community as a whole are what must be considered and not only the possible negative effects on the small shipper straw man.

NORTH AMERICAN TRADE DIVERSION: A NEW PERSPECTIVE

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The purpose of this paper is to discuss the routing of North American maritime trade, from the perspective of recently completed and ongoing transportation research on the hinterland of Canadian ports, cargo "diversion" in North America, and the supply of intermodal transport services for international trade. The topics covered in this paper are:

(1) an overview of developments which have affected Eastern Canadian ports since the introduction of containerization, including a discussion of the factors behind the shifts in activity among major North American ports;
(2) an assessment of the economic factors behind the growth of intermodalism in the movement of unitized cargo by liner shipping companies;
(3) an analysis of cargo movements in the context of the total distribution system.

The author particularly wants to thank Mr. J. Diamond from the Research Branch for his invaluable comments on earlier versions of this paper. I am also indebted to Mr. Burton F. Kelso, Director of Transport Industries Analysis, for his support in preparing this paper. However, I alone am responsible for the views expressed in this paper.

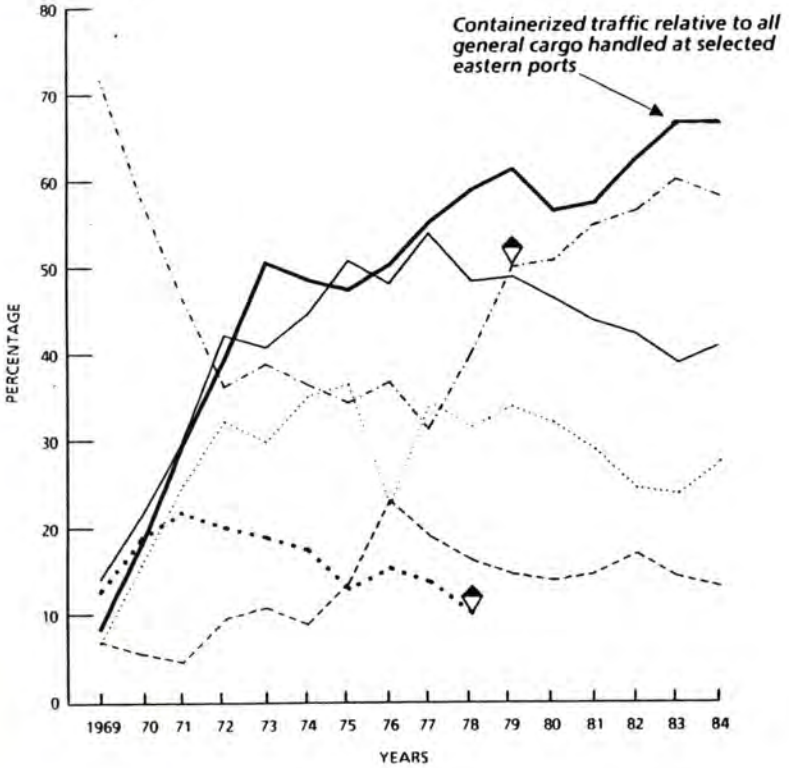
The main thrust of this paper is that in the intermodal era of transportation, the shifts in role among major North American ports and so-called "Cargo diversion", goes far beyond the issue of economic "losses" incurred by specific ports.

1. Trends in the Supply of Deep Sea Container Shipping Services in Canada

Containerization, which was first introduced into the Canadian deep sea trades during 1968 in the Port of Montréal, captured much of the general cargo trade by 1978. By 1984, nearly fifty per cent of all general cargo handled by the six major Canadian ports was containerized; this trend was even more pronounced for Eastern ports where almost 70 per cent of general cargo was containerized. The growth of containerization in the movement of general cargo in Eastern ports is illustrated in Figure 1. This figure also indicates the share of containerized traffic handled by the Atlantic ports relative to the St. Lawrence ports.

A close examination of Figure 1 shows the past and ongoing impacts of the containerization on the cargo handled by Eastern Canadian ports. First, during the 1969-1976 period, port activity in Halifax and Saint John significantly increased because containers allowed the quick and efficient intermodal transfer of

Figure 1
DISTRIBUTION OF CONTAINERIZED TRAFFIC BY SELECTED EASTERN PORTS 1969 - 1984 (tonnage figures)



Legend

- ..... *Port of Québec*
- ------ *Port of Saint John*
- ..... *Port of Halifax*
- -·-·- *Port of Montréal*
- ——— *Ports of Halifax and Saint John*
- ◇ *CP Navigations operations transferred from the port of Québec to the port of Montréal in 1978*

Source: Research Branch, Canadian Transport Commission.

cargo from ships to trucks or rail lines. These characteristics of the changing transport system significantly reduced the disadvantages of distance in the ports' hinterland which was common during the pre-container era. Despite the relatively small volume of container traffic in Canada, the use of many ports by liner companies was quite pervasive until about 1978. The strategy of liner companies to use many ports has been referred to as the "multi-port approach".

From the beginning of 1979 to the middle of 1981, container port traffic in Canada, became more concentrated, indicating many liner companies started to abandon the "multi-port approach". Very high volumes of cargo were required to attain the economies of scale associated with the large container ships and container transport facilities either at ports or at inland interchange points between modes. Therefore, ports which are connected to more extensive rail and road networks were in a much better position to capture container traffic. For example, the fact that Montréal was linked to very extensive inland transportation networks has meant that, since 1979, the port of Québec has not handled any containerized traffic. The main economic reason for this was that the inland costs of hauling container freight directly to Montréal was lower than the combined costs of the maritime and port sector costs of handling the cargo at the port of

Québec. In other words, a call at the Port of Québec involves the whole ship as an indivisible unit while the incremental cost of the overland hauling may relate to only a small percentage of the entire cargo.

The economics of port choice not only takes into account the concentration of cargo at certain ports, but also the relative advantage of port locations. A secondary (i.e. less important) port could, from an ocean carrier's perspective, be economically included in an existing itinerary which is already sustained by large volumes of cargo. The economic incentive which would convince a carrier to include a secondary port in its itinerary would occur when the additional revenues generated by calling on the secondary port exceed the incremental costs of serving that port. Cases in point are the ports of Halifax and Saint John which are generally included in North Atlantic and Trans-Pacific-North American container routes. The large volumes of American trade loaded and unloaded at ports from New York to Norfolk, combined with the well developed inland networks connecting the ports of Halifax and Saint John to major Canadian industrial markets, provide the economic justification for their inclusion in the itineraries of many American shipping routes.

From the late 1970's to 1981, which can be considered as the first phase in the rationalization of

Canadian port, liner companies were choosing to serve fewer ports, thereby increasing the concentration of traffic in certain ports.

The second phase, which covered the 1981-1984 period, was marked by major decisions of two liner companies. In mid-1981, Dart Container Line moved its operations from Halifax to Montréal and, late in 1982, ACL consolidated all of its operations in Halifax. These recent changes have highlited the comparative roles of the two ports. Montréal is the Canadian port served by ocean liners offering containerized services that usually do not include American ports in their itineraries while Halifax has emerged as the port used by maritime carriers offering container services to both American and Canadian ports; the latter are generally referred to as "continental routes".

2. Intermodalism and Competition between North American Ports

Although during the past ten years, the impact of containerization has mainly been viewed in terms of standardization of equipment, rationalization of port operations and shifts in activity among ports, the developing inland transport networks connected to ports have been the decisive factor in changing the traditional concept of a port's hinterland. Increasingly, liner shipping companies are playing a

greater role in the total distribution of cargo by implementing international intermodal through transport services. The above approach, where the shippers are offered a comprehensive door-to-door transport service, has enabled ocean carriers to reach farther into inland markets both in Canada and the United States. The two main consequences of this trend are:

(1) a port can no longer consider its traditional hinterland (any area within a reasonably close proximity) as a captive market;
(2) Canadian and United States' overseas trade are increasingly subject to routing through non-national ports.

The latter cargo movements are usually referred to as "diversion phenomena". Diversion is the process whereby carriers serving country A solicit cargo from shippers in country B, then transport it overland from country B to A for final shipment overseas to country C. Main statistics on cargo diversion in North America are presented in Tables 1 and 2.

Table 1 shows that East coast ports in Canada handled most of the American overseas trade moving through Canadian ports. In fact, between 1976 and 1984, U.S. cargo accounted for about 23 per cent of the containers traffic growth in these ports. However, table 2 (based on 1978 constant dollar) reveals that a substantial amount of Canadian overseas trade was also diverted through U.S. ports. In addition, what is much more relevant to observe is that the diversion of

Table 1
CONTAINERIZED INTERNATIONAL TRAFFIC GROWTH
IN CANADA
1976 - 1984

	East Coast		West Coast		Canada	
	1976	1984	1976	1984	1976	1984
Canadian traffic at Canadian ports:						
(1) (000, TEU)	305.1	468.6	71.2	114.1	376.3	582.7
average annual growth	5.5%		6.1%		5.6%	
American traffic through Canadian ports:						
(2) (000, TEU)	49.9	146.6	1.4	3.3	51.4	149.9
average annual growth	14.4%		11.3%		14.3%	
Total containers handled at Canadian ports						
(3) (000, TEU)	355.0	615.2	72.6	117.4	427.7	732.6
average annual growth	7.1%		6.2%		7.0%	

* Twenty Foot Equivalent Unit

Source: Canadian Transport Commission, Research Branch.

Table 2
CANADIAN AND AMERICAN DIVERTED TRADE
1978-1982
(000 000, $)
(in constant 1978 Canadian dollar)

	1978	1979	1980	1981	1982
Canadian Trade Through USA					
(1) Via US East Coast	922.2	959.3	973.6	1 132.3	1 055.7
(2) Via US West Coast	1 577.6	2 667.3	3 121.7	3 856.2	2 959.1
(3) Total	2 499.8	3 626.6	4 095.3	4 988.5	4 014.8
American Trade Through Canada					
(4) Via Canadian East Coast	N/A	2 686.2	2 823.2	3 123.2	2 520.4
(5) Via Canadian West Coast	N/A	189.4	229.9	208.4	224.8
(6) Total	2 675.0	2 875.6	3 053.1	3 331.6	2 745.2
Selected Breakdown					
Canadian Trade Through US West Coast					
(7) Export	192.9	165.1	240.8	312.1	407.0
(8) Import	1 384.7	2 502.2	2 880.9	3 544.1	2 552.1
American Trade Through Canada's East Coast					
(9) Export	N/A	1 018.9	1 451.4	1 574.3	1 233.5
(10) Import	N/A	1 667.3	1 371.8	1 548.9	1 286.9

Note: N/A not available

Source: Canadian Transport Commission, Research Branch

American and Canadian cargo takes on distinctive patterns. Liner shipping companies operating through U.S. west coast ports had a significant impact on the routing of Canadian trade, mainly with regard to our import trade. By contrast, liner companies serving Canadian east coast ports carried a substantial amount of trade originating from and destined for the United States.

The origins and destinations of this diverted overseas trade, as shown in Tables 3 and 4, emphasize this distinctive pattern. American trade diverted through Canada is essentially destinated for or originating from Western European countries, while the bulk of Canadian trade diverted through U.S.' ports is destinated for or originating from Asian countries. In addition, there is a certain amount of Canadian exports via American Atlantic ports, which are destinated for South America, Central America and Middle East.

Various reasons have been proposed as explanation for the diversion phenomena:

(1) "thin" Canadian trade on some maritime routes, resulting in less frequent calls at Canadian ports in comparison with American ports (such as for South and Central America);
(2) differences between Canadian and American labour costs, port charges, and union regulations (such as container destuffing and stuffing rules); and
(3) more efficient and better co-ordinated intermodal services in Canada due to the development of extensive inland transport networks.

Table 3

AMERICAN TRADE DIVERSION
COUNTRY GROUPS OF ORIGIN AND DESTINATION
(by percentage of value)
1982

COUNTRY GROUPS	EXPORTATION			IMPORTATION		
	Total	East Coast	West Coast	Total	East Coast	West Coast
Western Europe	79.4	93.5	6.5	81.0	96.6	3.4
Eastern Europe	13.2	81.0	19.0	2.4	98.6	1.4
Middle East	0.6	80.7	19.3	0.2	98.2	1.8
Africa	1.1	98.6	1.4	3.5	98.8	1.2
Asia	4.0	45.9	54.1	10.1	73.8	26.2
Oceania	1.1	54.7	45.3	1.2	90.8	9.2
South America	0.5	71.6	28.4	1.0	89.0	11.0
Central America	0.1	93.6	4.4	0.6	98.7	1.3
Total	100.0	89.3	10.7	100.0	94.3	5.7

Source: Canadian Transport Commission, Research Branch

Table 4

CANADIAN TRADE DIVERSION
COUNTRY GROUPS OF ORIGIN AND DESTINATION
(by percentage of value)
1982

COUNTRY GROUPS	EXPORTATION			IMPORTATION		
	Total	East Coast	West Coast	Total	East Coast	West Coast
Western Europe	12.8	83.4	16.6	9.8	52.8	47.2
Eastern Europe	..			..		
Middle East	11.4	96.7	3.3	0.1	93.8	6.2
Africa	3.0	97.7	2.3	6.6	30.9	69.1
Asia	49.6	38.7	61.3	79.0	2.0	98.0
Oceania	4.8	82.7	17.3	0.7	17.5	82.5
South America	10.9	98.9	1.1	2.4	87.1	12.9
Central America	7.5	96.5	3.5	1.3	78.2	21.8
Total	100.0	65.7	34.3	100.0	9.7	90.3

(..): less of 0.1 percent

Source: Canadian Transport Commission, Research Branch

The rest of this paper will develop the thesis that the implementation of intermodal services has had a significant impacts on the evolution of the structure of the North American trade diversion and that these services are going to have an increasing influence on the total distribution system.

3. Intermodalism and International Liner Shipping Companies

As it is apparent from the first two sections of this paper, by and large, containerization has made the implementation of cost efficient intermodal transport services technologically feasible. This evolution in transportation has altered the conventional notion of a sea port's hinterland because ocean carriers now can have greater access to new inland markets across the North American continent.

Until recent regulatory changes in the United States, multimodal transport has been more common in Canada than in the United States. However, recent U.S. deregulatory legislation are resulting in the development of U.S.-based multimodal transport enterprises. For example, the U.S. Shipping Act of 1984 now allows individual liner companies to offer time-volume rates and complete intermodal services (referred to as "service contracts" in the U.S.). Such intermodal services could include pick-up and delivery,

inland as well as maritime transport and freight forwarding services.

The above discussion leads us to the question of the economic and commercial reasons behind the liner shipping companies decision to become involved in these new integrated transport services. This raises the issue of scale economies associated with the utilization of containers and, concurrently, issues related to ships' size and transportation geography.

With the introduction of containers into deep-sea trade, ports have experienced a notable transformation in their operations due to improved cargo handling methods. Among other things, these improvements have meant higher productivity and faster turnaround time at the ports. In order to take advantage of the scale economies made possible by the use of containers, liner companies, during the mid-1970's, introduced a new generation of fully cellular containerships to replace conventional vessels converted to carry containers.

The introduction of specialized containerships, with their much larger carrying capacity, has resulted in two major organizational problems in the distribution of cargo. The first problem was the need for better integration with and coordination between land and maritime transport so as to achieve a rapid inland turnaround of containers and

to avoid port congestion. The second problem has been to establish a new equilibrium between route density (effective demand) and the expanded capacity provided by the new specialized fleet of large containerships (effective supply); the latter were made economically feasible by the greater handling speed of containerized cargo.

Liner companies have attempted to solve the first distributional problem by supplying coordinated services of more than one mode under their own control. This extension of ocean carriers' activities into surface transport sector has been achieved through cooperation and formal agreements with rail and truck carriers or, directly, through vertical integration by the acquisition of carriers in other transport modes. An example of a special arrangement by an ocean carrier is the American President Lines leasing its own railway equipment and having an agreement with a railway to operate this equipment. Typical examples of integrated firms are CP Enterprises Ltd. in Canada and Sea-Land Services in the U.S.

These recent initiatives by liner companies can be explained in large part by the fact that port container facilities and the new containerships are highly capital intensive and require high density traffic volumes to achieve the scale economies which would make the investment profitable. In order to have

control over the cost and quality (i.e. reliability) of service offered to shippers in inland markets, it is in the economic and business interest of the liner companies to offer intermodal transport services.

In regard to the second distributional problem, resulting from the faster turnaround time at ports and the larger, but fewer, containerships, there has been an integration of services and an expansion of geographical markets. Typical examples of integrated services are the consortium, Atlantic Container Lines (ACL) and, more recently, the new liner company, Canada Maritime, which was jointly created by CP Ships and Dart Container Line. The broader geographical markets are embodied in the new port itineraries and service patterns, which have resulted in greater traffic concentration in fewer ports.

In practice, market forces have concurrently imposed solutions to both distributional problems. Today, the available intermodal transport technology has been adapted and well integrated into the operations of inland carriers. Since its introduction into the transport system by liner shipping companies, the container has come to be considered as a unit of transport. After selecting the carrier, the shipper tends to let the carrier take complete responsibility for the transport of cargo, including routing and the choice of port. Within the context of oceanborne

containerized cargo, inland modes are playing an increasingly important role in the development of container transport networks, and, consequently, the maritime routes established by liner carriers. With the increasing use of larger specialized container ships, liner companies will be more and more selecting ports on the basis on the total cost of delivery to final destinations.

In summary, the strategies chosen by individual liner companies are, to a large extent, determined by the following five factors:

- actual and/or potential market size
- inland transport networks
- frequency of shippers' transport requirements
- length of maritime itineraries
- sizes of ships.

The economic impact of these factors have already been discussed, but the particular effects on Canadian transportation are worth noting and should be monitored; this monitoring should include such new developments as the inland container terminals.

4. New Cargo Routing and the Concept of Inland Terminals

"Round-the-world" services and inland terminal centers dominate the recent and ongoing developments in the supply of international liner shipping services. Both of these developments reflect the idea that intermodalism has reached a certain stage

of maturity and that liner shipping is entering the third phase of containerization. Round-the-world services has been already proposed or announced by American President Lines, Evergreen Container Lines, and the joint services of Neptune Orient Lines and Orient Overseas Container Lines. These new services can be viewed as an extension of continental services (joint American and Canadian port itineraries), which characterize many of the actual container routes calling on Halifax, Saint John and Vancouver.

The scale economies derived from the overall intermodal transport system always provides the economic rationale for the establishment of round-the-world services and continental routes. However, economies of traffic density have also encouraged liner companies to supply such services. These latter economies refer to the decrease in incremental costs associated with a particular segment or facility of the system. These economies of traffic density are a result of:

(1) to some extent, larger and more specialized vessels;
(2) savings resulting from the automation of port facilities;
(3) technological improvements in the inland transport modes; and
(4) savings achieved in the development of consolidation/marshalling inland centers.

It is likely that the co-existance of economies of scale and economies of traffic density in

the supply of international intermodal services are the major inducements for liner companies to operate round-the-world and continental services. The key requirements for the abovementioned economies is the concentration of cargo handling facilities. The actual growth of existing continental services are evidence that such concentration can be achieved.

On the other hand, geographic concentration (access to major cargo markets) is not always possible to achieve. This explains why both round-the-world services or continental routes include selected ports within well-defined and rational routes. The two remaining factors to consider are ship size and distances between major markets.

The North Atlantic route has two important features. First, it is by far the shortest of the deep-sea container routes. Second, after the North American-Far Eastern route, it is the second largest route for containerized cargo. Since this route is relatively short, fleets of relatively small ships can serve a small number of ports, provided the services are reasonably frequent.

Montréal's central location in North America and its relative proximity to Western European ports allow some liner companies to simultaneously serve the Canadian industrial heartland and the U.S. Mid-west markets (especially between Chicago and Detroit). The

ocean carriers decision to use the port of Montréal are based on a fast turnaround time at port, minimum transit time on the maritime portion through a simple route structure integrated with an inland transport network. Those three components allow competitive overall transit times and constitute an alternative to round-the-world and continental services to North American/Western European shippers.

The information contained in Tables 1 and 3 and the fact that Western Europe is the main market for Montréal support the contention of comparative economic advantages of liner companies operating out of Montréal on the North Atlantic route and the view that there is a great deal of American diverted trade handled by Montréal-based ocean carriers.

Nevertheless, continuing technological innovations and changes in the organization of cargo distribution systems, combined with recent regulatory reforms in the U.S. (i.e. the Shipping Act of 1984 and the Stagger's Act of 1980), indicate that the current situation is a dynamic rather than a static one.

Inland container terminals are a recent innovation which may in some markets become an integral part of the intermodal system. The inland terminal's philosophy is that "...large container vessels and speedy handling of containers at the port alone would not yield the ultimate advantage of large-scale

intermodal movements (linked with either round-the-world or continental services) if the cargo could not reach its inland destination at the same rapid pace." (Hayut, Y. (1980)) A typical inland container terminal might provide some or all of the following services:

(1) grouping and dispatching consignments to obtain dense traffic flows;
(2) consolidating shipments in order to minimize costs by either ensuring full containerloads or reducing pick-up and delivery charges;
(3) offering auxilliary services such as forwarding and packaging; and finally,
(4) providing temporary wharehousing and storage facilities.

Although this list is not exhaustive, it indicates the numerous functions, traditionally provided by sea ports which can potentially be provided by these inland container terminals.

There are a number of reasons for constructing inland container terminals. First, from the shipping companies' point of view, there are the combined advantages of quicker movement of containers and the wider access to inland points. Second, from the inland carriers' viewpoint, there would be better co-ordination between trucking firms and railways. Third, from mainly the raiways' perspective, there is the opportunity to achieve economies of traffic density. The distance of these terminals from ports may vary considerably and they do not necessarily have to be points of origin or destination. These terminals will, of necessity, require a high degree of

accessibility to major highways, rail lines and ports. This concept has already been introduced into North America with the co-operation of some railways and shipping lines.

In view of the above, there is a strong indication that a greater co-ordination and integration of the links in the intermodal transport chain are likely to emerge as inland container terminals become established. It is also likely that as market forces intensify this trend, international carriers will be thinking in terms of offering intermodal services as a complete package. The major question arising from these potential developments is: what will be the impact on the actual cargo distribution in North America, particularly with reference to Canadian ports?

The answer to this question is not obvious. The possible "continentalization" of container transport networks cannot be ignored. Trends in the development of international intermodal transport systems, including the emerging operational and organizational strategies of liner shipping carriers, will clearly have a major direct impact on the movements of Canadian and American trade as well as the viability of our ports.

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