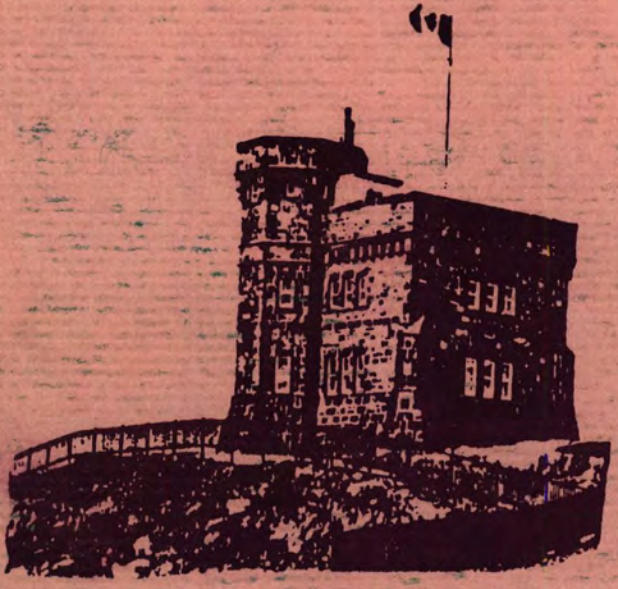
CANADIAN TRANSPORTATION RESEARCH FORUM
LE GROUPE DE RECHERCHES SUR LES TRANSPORTS AU CANADA

22nd ANNUAL MEETING

PROCEEDINGS



ST. JOHN'S, NEWFOUNDLAND
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PRESIDENT'S MESSAGE

Welcome to the 1987 Annual Conference of the Canadian Transportation Research Forum (CTRF).

This, our twenty-second conference, is a landmark in CTRF history. It is our first conference in Newfoundland and it completes a long standing objective of your Board of Directors. We have now held our annual gathering in every one of Canada's ten provinces. We believe that this accomplishment underlines the national scope of our organization and our dedication to transportation - one of our greatest national preoccupations, historically, economically and politically.

While the formal sessions and the papers in this volume will generate lively discussion, I am sure that emerging legislation and the accompanying, new regulatory institutions and regimes will themselves spark debate among you throughout the conference. Your conference organizers have strived to provide a mix of formal and informal opportunity to promote such interaction.

As CTRF veterans know, this is an organization supported entirely by the volunteer effort of its members and some welcome public and private sector sponsoring of annual conference events. As in previous years, the work of planning and organizing this meeting has been considerable. We are indebted to a long list of Newfoundlanders who have made this event possible.

On behalf of the Board of Directors, I invite you to participate and enjoy. I thank you for the opportunity to have served as your twenty-second President.

Rod B. Taylor
President
Canadian Transportation Research Forum

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DEREGULATION CONCEPTS AND AIR COMPETITION POLICY IN THE UNITED STATES AND CANADA

Alexander C. Phillips*

(i) The Promise of Deregulation

Deregulation as a competition policy for air transport advocates the promise of a more innovative, low-cost, adequate and efficient air transport system by placing greater reliance on market competition and by abolishing restrictive economic regulatory controls. Given this promise, the questions we should ask then are the following: (1) What is deregulation? (2) How is deregulation to be implemented? and (3) Will the consequences of this policy fulfill the promise that has been made?

To answer these questions, we must first look at the existing legislative framework governing air transport regulation in both the United States and Canada. Second, we must look at what deregulation provisions have been implemented in the United States and what the deregulation proposals are for Canada. Lastly, we should look at what the effects of the deregulation provisions in the United States have been as well as what the potential consequences of the Canadian deregulation proposals may be.

On June 26, 1986, when former Transport Minister, Don Mazankowski tabled Bill C-126 to amend the National Transportation Act and thereby implement his White Paper known as Freedom to Move which was released in the summer of 1985, we as Canadians took our first steps towards implementing deregulation in the air transportation industry. Moreover, even though this Bill died on the order paper with the end of the first session of the thirty-third Parliament in September 1986, it was reintroduced as Bill C-18 for first reading on November 4, 1986 and attained second reading just prior to the Christmas recess.

(ii) Deregulation - A Definition

Deregulation if one was to define it is not as simple as saying that it is the removal of Government red tape and bureaucratic inefficiency. Deregulation is more complex a concept and represents two things in my view. First, it represents a new policy concept for transportation competition and second, it is a term used to broadly describe a process of legislative change which has been employed to implement this new concept.

Specifically, deregulation as a competition policy for aviation

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advocates the removal of government regulation of entry, exit and pricing of air transport services and it allows market forces of supply and demand to operate freely to determine the number of competitors, the routes operated and the fares charged. This market oriented competitive policy is often coupled with a policy of strict application and enforcement of antitrust or competition laws in order to guard against greater industry concentration and monopoly power as well as potential anticompetitive practices such as predatory pricing in order to ensure fair market competition.

This new competition policy concept is to be contrasted with the policy rationale underlying a regulated system which was that control over entry, exit and prices by independent regulatory tribunals was required to protect consumers against excessive competition, market domination by large carriers, monopoly pricing and inadequate service. Such tribunals were staffed by experts in the industry and performed both an adjudication and a policy making function through the exercise of their discretion in licencing and price control matters.

To understand deregulation as a competition policy concept and as a process of regulatory change then, one must understand the relationship of legislated policy and its implementation through independent regulatory tribunals and the exercise by those tribunals of two primary functions. The first being a licencing or certification function to control entry and exit in the industry and second, a price control function. With this definition in mind, let us look at the U.S. regulatory framework prior to deregulation.

(iii) U.S. Regulatory Framework For Aviation Prior to Deregulation

Prior to the development of deregulation as a competition policy concept in the mid 1970's and the process of regulatory change which resulted in the passage of the Airline Deregulation Act of 1978[1], the regulation of domestic U.S. aviation was governed for forty years by the principles and regulatory framework established by the Civil Aeronautics Act of 1938.[2] Specifically, this Act set up the Civil Aeronautics Authority which ultimately became the Civil Aeronautics Board (more commonly known as the CAB) in 1940. The CAB was an independent regulatory tribunal which was primarily responsible for the economic regulation of domestic aviation in the United States. Being responsible for economic regulation, the CAB exercised first, a licencing or certification function to control the entry of new air carriers to the industry, the exit of existing carriers and the allocation of routes. Secondly, it exercised a price control function to regulate the air fares charged for air service on the routes so allocated.

With respect to the licencing function of the CAB, an applicant carrier had to establish that its proposed service met the statutory criteria of being "required by the public convenience and necessity" and that it was "fit, willing and able to perform such transportation properly"[3]. Moreover, a determination of public convenience and necessity by the CAB took into account the objectives and factors set

out as a declaration of aviation policy in Section 2 of the Civil Aeronautics Act of 1938. These included the following:

(1) The encouragement and development of an air transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States, of the postal service and the national defence.

(2) The regulation of air transportation in such a manner as to recognize and preserve the inherent advantage of, assure the highest degree of safety in, and foster sound economic conditions in such transportation and to improve the relations between and coordinate transportation by air carriers.

(3) The promotion of adequate, economical, and efficient service by air carriers at reasonable charges, without unjust discriminations, undue preferences, or unfair or destructive competitive practices.

(4) Competition to the extent necessary to assure the sound development of an air transportation system properly adapted to the needs of the foreign and domestic commerce of the United States, of the postal service, and of the National Defence.

(5) The promotion of safety in air commerce and

(6) The promotion, encouragement and development of civil aeronautics.

In effect, a new entrant seeking to begin a new or competing service had to prove that there was a need or demand for his service which would generate sufficient revenues and be profitable given his cost structure while at the same time not jeopardizing the profitability of any existing carrier.[4] If successful in meeting this test of "public convenience and necessity" and fitness to operate, an applicant carrier was issued a certificate authorizing the proposed service and route.

Similarly, the CAB controlled exit from the industry by prohibiting the abandonment of any route for which a certificate had been issued unless the CAB found the abandonment to be in the "public interest". The factors and considerations to be taken into account as being in the "public interest" were the same policy considerations outlined in Section 2 of the Civil Aeronautics Act as being in accordance with the "public convenience and necessity".[5]

With respect to the price or fare control function of the CAB, the Civil Aeronautics Act required that all carrier tariffs be filed[6] and that every carrier establish "just and reasonable" rates, fares and charges.[7] It prohibited rebating or charging fares different from the filed tariffs[8] and it prohibited carriers from charging fares which were "unjustly discriminatory" or "unduly preferential" in nature.[9]

Thus, we had a regulatory framework in the United States whereby licencing was based on a test of "public convenience and necessity", abandonment was based on a test of "public interest" and price or fare control was based on tests of "just and reasonable" rates which were not "unjustly discriminatory" or "unduly preferential" with no rebating. Moreover, this economic regulatory framework was repeated in the Federal Aviation Act of 1958[10] when the Federal Aviation Administration was created as a separate authority in charge of air safety.[11]

Under this regulatory framework, the discretionary policy of the CAB was protectionist in nature and one which did not promote market competition. The attitude of the CAB during the 1960's and early 1970's under this framework was to treat air transportation as a public utility requiring regulatory protection due to the large capital investment involved in equipping and operating an airline. In effect, Section 102(d) of the Federal Aviation Act which required the Board to consider "competition to the extent necessary to ensure the sound development of an air transport system" as a factor in determining whether the public convenience and necessity test was met in any given licencing application, was interpreted restrictively "to the extent necessary" from the regulator's point of view rather than focus on the "competition" aspect per se.

Let us now compare the pre-deregulation regulatory framework of the United States with the existing regulatory framework for air transportation in Canada.

(iv) Existing Regulatory Framework For Aviation in Canada

The existing regulatory system for air transportation in Canada is characterized by the policy set out in the National Transportation Act of 1967. Specifically, this Act set out a policy of intermodal competition which was to be applied to all modes of transportation and not just aviation. Moreover, all modes were seen to compete with each other in the hope that both an adequate and also an efficient and economic transportation system at the lowest total cost would be achieved. The key here is the balancing of both an adequate and an economic and efficient transport system. This balancing was to be accomplished by regulation and under the National Transportation Act, the Canadian Transport Commission and a number of modal committees were established to regulate the various modes of transport. For our purposes, this included the Air Transport Committee which was established to regulate aviation and control entry into the industry through the licencing of carriers and the designation of routes, to control exit or abandonment from particular routes and to control air fares.

With respect to the licencing function of the Air Transport Committee under a regulated system, the ATC is empowered under the Aeronautics Act to grant a licence for a commercial air service to an applicant where, in its opinion, such service is required by the "present and future public convenience and necessity".[12] The determination of the public convenience and necessity then, as in the

United States, represents a legislative or statutory test which an applicant has to meet in order to be granted a licence to operate on a proposed route. Moreover, a number of factors have to be shown in practice when applying to the Air Transport Committee to obtain a licence and these include the following:

1. establishing a need for the service between the points you wish to serve,
2. providing a forecast of traffic to meet unmet demand,
3. providing a convenient operating schedule,
4. ensuring your equipment is of the sufficient size and capacity to meet the forecasted traffic demand,
5. showing you intend to provide a unique and innovative service,
6. showing that the existing service is inadequate, and
7. showing that the revenues based on competitive rates would exceed your cost of providing and operating the new service.[13]

In effect, the Air Transport Committee is given the discretion subject to the overriding policy objectives of the government and the statutory goal of an economic, adequate and efficient transport system at the lowest total cost, to assess these factors and to determine whether an applicant's submission meets the legislative test of public convenience and necessity. With respect to exit or abandonment, the public convenience and necessity test is also applied whenever an applicant carrier proposes to discontinue service.[14] A carrier cannot merely stop service at will or upon short notice. A decision of the Air Transport Committee is required and that decision must be based on an opinion that the service is no longer required by the public convenience and necessity.

The main thing to remember is that the Aeronautics Act adopted this public convenience and necessity test in Canada. This test allows for the exercise of independent discretion by the ATC to carry out its licencing function to control both entry and exit in the air transport industry.

Air fares, in contrast, are regulated under the Air Carrier Regulations of the Aeronautics Act and these regulations require all airlines to file their tariffs with the Air Transport Committee for approval.[15] Such tariffs then are subject to the power of the ATC to suspend or disallow them whenever the ATC deems that the fares are not "just and reasonable" or are "unjustly discriminatory" or "unduly preferential".[16] The two tests employed here are identical to the U.S. regulatory framework which existed prior to deregulation. First, all fares must be "just and reasonable" and just and reasonable fares are fares that cover cost and pay as large a return on capital invested as other securities of a similar risk.[17] Second, fares must not be "unjustly discriminatory" or "unduly preferential" which means that all fares covering traffic of the same description moving under substantially similar circumstances and conditions must be charged equally to all persons at the same rate. Where the fares filed do not meet these tests, the Air Transport Committee has the power, not only

to suspend or disallow the fare, but it can also require an air carrier to substitute a new fare satisfactory to the Air Transport Committee or the ATC itself may prescribe another fare in lieu of the fare disallowed.[18] The Air Transport Committee then, has considerable control over the fares charged, including an interim power of suspension once a fare is filed prior to its effective date as well as the power to disallow a fare following a hearing. Moreover, the "just and reasonable" and the not "unjustly discriminatory" or "unduly preferential" tests for fares also give the Air Transport Committee discretion to set the level of air fares.

The factors and economic considerations however, that a carrier has to show to satisfy these statutory licencing and fare control tests so as to obtain a commercial air service licence and to have its fares approved are not specified in the legislation. They are factors and considerations which the Air Transport Committee itself has deemed are necessary to meet the statutory tests of "public convenience and necessity" or "just and reasonable" and not "unjustly discriminatory" fares. In this way, the specification of factors in its licencing and fare approval decisions has allowed the Air Transport Committee in effect to establish more specific regulatory policy governing the airline industry than actually exists under the legislation.

In Canada, the determination of "public convenience and necessity" in licencing or "just and reasonable" rates in fare control, is the formulation of an opinion within the discretion of the Air Transport Committee and is not a finding of fact.[19] The consequence of this is that the decisions of the ATC cannot be challenged on appeal to a superior court on the merits. Such decisions can only be challenged by so called "political appeals" to the Minister of Transport (i.e. s.64(1) of the National Transportation Act) or on a procedural basis pursuant to the rules of natural justice and judicial review of administrative tribunals by superior courts in administrative law.
In the United States in contrast, while the formulation of an opinion as to public convenience and necessity as required under the U.S. legislation is similar to the regulatory process and framework in Canada, the U.S. framework differs in that it tends to specify the objectives and factors of a specific aviation regulatory policy. While the objectives and factors of this aviation policy were relatively vague as in the Civil Aeronautics Act of 1938 and the Federal Aviation Act of 1958, the U.S. aviation regulatory policy objectives and factors would become much more specific with the passage of the Airline Deregulation Act of 1978. Canada, in contrast has always left the factors to be determined by the Air Transport Committee in its discretion as part of its licencing or fare control function.

Next, let us discuss the airline deregulation provisions of the U.S. Airline Deregulation Act of 1978 as well as the proposals in Canada for airline deregulation.

(v) Airline Deregulation Provisions in the United States

Unlike the Civil Aeronautics Act of 1938, the Airline Deregulation Act of 1978 was based on the deregulation policy concept that airlines

are not public utilities but businesses whose services can be supplied and priced through the interplay of free market forces and that this would lead to greater efficiency, lower fares and an optimum allocation of resources and level of service. To achieve this, the Act sought to implement complete freedom of entry, exit and pricing by carriers through a phased-in program of "sunset" provisions to give the industry time to adjust, with complete abolition of the Civil Aeronautics Board on January 1, 1985.

Specifically, domestic route regulation and the Board's licencing function to control entry was to terminate on January 1, 1982 and thereafter a regime of free entry would exist. The Board's fare control function was to terminate on January 1, 1983. The remaining functions such as the regulation of international air transport was transferred to the Department of Transportation and antitrust oversight was transferred to the Department of Justice by January 1, 1985. Moreover, while these sunset provisions were in effect, (i.e. while licencing still existed until January 1, 1982 and fare regulation existed until January 1, 1983), various sections of the Airline Deregulation Act set out a pro-competitive market competition policy in specific detail which the CAB was required to rely on in determining whether the public convenience and necessity and just and reasonable rate tests were met by an applicant carrier. So for example, we see in Section 102 of the Federal Aviation Act as amended now by the Airline Deregulation Act that in the exercise and performance of its powers and duties the CAB was required to consider the following among other things as being in the "public interest" and in accordance with the "public convenience and necessity":

(1) The assignment and maintenance of safety as the highest priority in air commerce.
(2) The prevention of any deterioration in established safety procedures.
(3) The availability of a variety of adequate, economic, efficient and low-priced services by air carriers without unjust discrimination, undue preference or advantage or unfair or deceptive practices.
(4) The placement of maximum reliance on competitive market forces and on actual and potential competition, (a) to provide the needed air transport system and (b) to encourage efficient and well managed carriers to earn adequate profits and to attract capital.
(5) The development and maintenance of a sound regulatory environment which is responsive to the needs of the public and in which decisions are reached promptly.
(6) The encouragement of air service at major urban areas through secondary or satellite airports.
(7) The prevention of unfair, deceptive, predatory, or anti-competitive practices in air transport and the avoidance of (a) unreasonable industry concentration, excessive market domination and monopoly power and (b) other conditions that would tend to allow one or more air carriers unreasonably to increase prices, reduce services, or exclude competition in air transportation.

(8) The maintenance of a comprehensive and convenient system of continuous scheduled airline service for small communities and for isolated areas, with direct federal assistance where appropriate.

(9) The encouragement, development and maintenance of an air transport system relying on actual and potential competition to provide efficiency, innovation and low prices and to determine the variety, quality and price of air transport services.

(10) The encouragement of entry into transport markets by new air carriers, the encouragement of entry into additional air transport markets by existing carriers, and the continued strengthening of small air carriers so as to ensure a more effective competitive airline industry.

These factors, in effect, outline the elements of the deregulation competition policy concept which was adopted in the United States. The main element to remember is that while the existing regulatory framework under the 1938 and 1958 Act had relied on "competition to the extent necessary" in establishing licencing and price controls to assist a fledgling air transport industry and to protect it from competitive market forces, the Airline Deregulation Act of 1978 has replaced the above section with the subsections in 102(a)(4) and 102(a)(9) which call for reliance on competitive market forces and on actual and potential competition by the CAB during the sunset periods. These sections, in effect, direct the CAB during the sunset periods to consider "competition" as the primary criteria in decision-making unlike past CAB practice under the existing regulatory framework in the hope that such market competition would provide efficiency, innovation and low prices as well as determine the variety, quality and price of air transport services.

While Section 102(a)(10) called for the encouragement of entry into new and existing air transport markets so as to assure a more effective, competitive airline industry, the licencing function of the CAB during the sunset period was liberalized in three ways. First, the licencing test that a proposed service be "required" by the public convenience and necessity was replaced with the provision whereby a proposed service need only be "consistent with" the public convenience and necessity.[20] The new Act by stipulating that proposed services need only be consistent with public convenience and necessity, thereby shifted the presumption from favouring the status quo to favouring the applicants seeking new authority.[21] Together with the new policy directive in Section 102(a)(10), the CAB was given clear authority to exercise its discretion in favour of competition and greater freedom of entry. As a result, this reform eliminated any possibility of the CAB repeating its past practice of having an informal route moratorium by refusing to consider applications for new authority by saying no new authority was required in a mature and stabilized route network.[22] Second, to encourage competition with respect to entry, the Act also established an automatic entry program whereby each carrier was entitled to add one new route each year for three years starting in 1979 without going through the route certification procedure and as well, they could protect a single route each year from new

competition.[23] Third, the CAB also introduced an expedited licencing process for new route applications through show cause proceedings without hearings.[24] In addition, those opposed to an application had the burden of showing that the proposed licence or grant of authority was not consistent with the public convenience and necessity.[25] Consequently, there were few objections to show cause and the certification process of new routes proceeded much more quickly than under the old regulatory framework.

As a result of the sunset provisions of the Airline Deregulation Act[26] with respect to the licencing function of the CAB, beginning on January 1, 1982, the CAB domestic route licensing authority based on public convenience and necessity expired and any existing carrier has since been allowed to enter any route of its choice and in practice certificates have been granted to any carrier able to show that it was fit willing and able to operate. The previous obligation to demonstrate public convenience and necessity for new services was no longer required.

Equally consistent with the policy of competition determined by market forces is freedom of exit from unprofitable markets and the freedom to shift resources from profitable markets to more profitable ones. The new Act did give air carriers greater freedom to exit markets. Specifically, in contrast to the existing regulatory framework which required an application for abandonment and the approval of the CAB after a hearing and a determination that the abandonment was in the public interest, the new Act in most cases allows an air carrier to terminate all service at a community simply by giving 90 days notice.[27] For small communities, where air service is deemed essential, the CAB and after 1985, the Department of Transportation can require the last carrier serving such communities not to terminate its service and in return, the Government has developed a subsidy system with compensation payments for carriers to maintain these essential air services.[28]

To achieve greater competition in the domestic aviation industry, the Airline Deregulation Act also sought to achieve greater pricing freedom for carriers, coupled with greater protection against anti-competitive pricing practices. This is evident in the policy directives set out in Section 102(a)(3) and 102(a)(7). Section 102(a)(3) changes the existing policy directive with respect to fare regulation under Section 102(2)(c) of the 1938/58 Act by adding the statutory criteria of low fare services to the existing criteria of adequate, economic and efficient services. This represents a major change from the existing regulatory framework in that fare levels were previously regarded as simply being a result of regulatory policy whereas now they are a statutory criteria in determining deregulation policy as it affects fares. Moreover, it reflects greater concern for the needs of the consumer of air services than in the past.[29] In addition, Section 102(a)(7) expands on the definition of unfair or destructive competitive practices to combat predatory pricing or other specific anti-competitive practices of carriers per se in an effort to prevent air carriers from unreasonably increasing prices, reducing services or excluding competition in air transportation.

With respect to the regulation of fares by the CAB prior to the termination of its fare control function on January 1, 1983, the Airline Deregulation Act modified the CAB powers of suspension and investigation to determine if rates were not "just and reasonable" by providing for "zones of reasonableness" within which a carrier could raise or lower fares without the CAB having authority to find the fare to be unjust or unreasonable on the basis that the fare was too high or too low.[30] Specifically, the CAB was required to accept as "just and reasonable" any fare that represented an increase up to 5% above the standard industry fare level or a decrease to as much as 50% from that level. The standard industry fare level or SIFL was the fare level in effect on January 1, 1977 for each route and was adjusted semi-annually by the percentage change in actual operating costs per available seat mile. The CAB still retained the power under this section however, to disallow fares above the SIFL which it found to be unduly preferential, unduly prejudicial or unjustly discriminatory or below the SIFL which it found to be predatory in nature even though such fare changes fell within this "zone of reasonableness". Moreover, the Airline Deregulation Act also set out some specific factors which the CAB was required to consider in determining whether a rate was "just and reasonable" and not "unduly prejudicial" and "unjustly discriminatory".[31] These factors included all the policy factors set out in Section 102, an adequate and efficient transport system at the lowest cost consistent with the furnishing of such services, the effect of prices upon the movement of traffic, the desirability of peak and off peak pricing to improve economic efficiency and provide low cost air service and lastly, the desirability of allowing an air carrier to determine prices in response to particular competitive market conditions on the basis of such air carrier's individual costs as opposed to an average industry cost basis.

It is important to note that the new factors are much more specific than those which existed under the existing regulatory framework prior to deregulation. Indeed the requirement to consider the policy directives in section 102 itself, requires one to go through a much more specific list of policy goals than existed under the 1938/58 Act. Secondly, specific references to individual price and service options like peak and off peak pricing and the desirability of price determination by carriers in response to competitive market conditions on the basis of individual carrier costs rather than the average cost to the industry as a whole signifies two major changes from the existing regulatory framework. First, the CAB was required to consider prices set by carriers on the basis of individual carrier costs, demands in individual markets and particular competitive market conditions in such markets in line with a policy objective of low fare service for consumers. This is in complete contrast to the factors stressed under the old regulatory framework of fares based on (1) average industry cost rather than the cost of providing a particular service (2) sufficient revenue requirements for an air carrier industry performing service obligations in a stabilized route network, and (3) a mature industry operating under a public utility doctrine. Secondly, it shows that Congress wanted to, and succeeded in further limiting the CAB's discretion by outlining much more specific factors that were required to be considered in any determination of whether a fare was

just and reasonable. No doubt this was done in response to the discretionary policy and vague factors which characterized the existing regulatory framework under the 1938/58 Act. Such freedom in pricing allowed air carriers then, to engage in differential and greater discount pricing which was designed to attract passengers who would not otherwise travel, to fill seats which would otherwise fly empty, to shift traffic from peak to off peak travel as well as promote and develop new markets. In addition, while the new Act provided for increased pricing freedom for carriers under the sunset provisions, absolute freedom to set prices came when the CAB fare regulation function officially ceased to exist on January 1, 1983.[32]

In comparing the legislative policy directives of the United States and Canada for air transport, one notices the similarity in that both call for a balancing in providing both an economic and efficient service with an adequate service. However, the policy approach is different in the United States now, in that the U.S. policy is one of open market competition with low prices as the stated policy objective and with maximum reliance on competitive market forces and on actual and potential competition as a further policy objective. Moreover, the U.S. has a separate policy objective for aviation competition alone. Canada has a broad policy objective for all modes with aviation being seen to compete with all other modes. Low prices is not a policy objective but the provision of service as part of a lowest total cost system is. In Canada, reliance is placed on regulatory control of entry and fares having due regard to national policy as a limitation to competition rather than reliance on competitive market forces. The Canadian regulatory policy objectives are similar to the 1938/58 regime of the U.S. prior to deregulation which called for the promotion of adequate, economical and efficient services by air carriers at reasonable charges. It differs in that the Canadian policy directives apply to multi-modal competition including aviation, but is not directed at aviation specifically as in the United States. Moreover, the Canadian regulatory structure depends to a large degree on paying due regard to national policy as outlined from time to time by the Minister of Transport as opposed to having specific policy objectives and factors outlined in the government legislation as the U.S. has done. With this in mind, let us turn to a discussion of the Canadian liberalization and deregulation proposals.

(vi) Canadian Liberalization and Deregulation Proposals

The process of reevaluation of domestic aviation competition policy in Canada involved many groups, government departments and agencies. Most notable of these were Transport Canada[33], the Economic Council of Canada[34], the House of Commons Standing Committee on Transport[35], Consumer and Corporate Affairs Canada[36], the Canadian Transport Commission[37] as well as the Minister of Transport. Though space does not permit me to outline the contribution of each of these respective groups, I would like to focus on the "liberalization" policy outlined in the New Canadian Air Policy which was announced on May 10, 1984 by then Transport Minister Lloyd Axworthy, and contrast it with the clear "deregulation" policy of the current Conservative Government which has been proposed for implementation by Bill C-18 as of November

4, 1986 as a consequence of the White Paper known as Freedom to Move, which was announced on July 15, 1985. Moreover, understanding the differences between liberalization versus deregulation requires an understanding of the regulatory frameworks of both the United States and Canada which we have just covered.

Liberalization as the new term was used in the New Canadian Air Policy, described the consensus reached by the cross country air fare hearings of the Air Transport Committee which were held in 1984. It was also a term used to describe a staged process of regulatory change. In effect, the Minister defined "liberalization" as policy directions which would allow for the implementation of competition through the existing legislation. Specifically, the Minister outlined to the Air Transport Committee his power to overturn any of its decisions on his own motion in line with the competition policy he felt was now appropriate for aviation in Canada. This so called power of "political appeal" which the Minister possessed pursuant to s.64(1) of the National Transportation Act was coupled with policy statements he made to the effect that the Air Transport Committee should consider "competition" as the primary criterion in its determination of the public convenience and necessity test in the exercise of its discretion in licencing. In effect, the Minister appears to have been putting pressure on the Air Transport Committee to exercise its discretion in a liberalized fashion based on greater competition or face the threat of unilateral policy implementation by the Minister himself through the political appeal process.

This liberalization policy was only to apply to mature services which were defined to exclude those services operating in the north. This liberalization policy also had a number of specific components in terms of entry, exit and fare regulation. First, describing the existing regional air carrier policy as obsolete, the Minister repealed all the existing policies defining air carrier roles.[38] This in effect freed regional air carriers like Nordair, Pacific Western, Eastern Provincial and Quebec Air to compete with mainline carriers such as Air Canada and CP Air. Second, the Minister proposed the removal of all restrictions prohibiting or limiting the frequency of non-stop and turn-around services and restrictions specifying the kind and maximum size of aircraft to be used on all domestic scheduled service licences of national, regional and local carriers serving markets in southern Canada. Third, with respect to licencing, the Minister called on the ATC to give much greater weight to the benefits of increased competition in judging the requirements of public convenience and necessity in relation to particular licence applications.[39] Moreover, the new policy favoured freer exit in line with freer entry and called on the CTC to grant freedom of exit to incumbent carriers faced with new entry on 60 days notice. Fourth, the Minister's policy called for greater pricing freedom within two years by giving the airlines unlimited freedom to reduce their fares while limiting increases to an objective measure such as a national weighted average of the rise in the price of the factors of production other than labour. In effect, neither increases nor decreases in discount fares or in premium fares for that matter would be subject to CTC control.[40] Subsequently, however, Axworthy agreed to a CTC proposal for zones of flexibility

within which the CTC would exercise its discretion to say that fares set by carriers within the zones would meet the "just and reasonable" rate test but only for a two year period after which all restrictions would be removed.[41] Fifth, the policy also called on the CTC to make procedural reforms to speed up and simplify the regulatory process. In particular, it was asked to consider changing the evidentiary requirement associated with public convenience and necessity in licencing by shifting the burden of proof from the applicant to the opposing intervenors.[42] This is similar to the procedural reform of the CAB prior to sunset under the Airline Deregulation Act of 1978. Lastly, the Minister reiterated his future approach and policy with respect to appeals from decisions of the Air Transport Committee by saying that the Minister of Transport would henceforth in responding to appeals against CTC decisions give much greater weight to the benefits of competition.[43]

It is interesting to note that while the former Minister's policy is described as a made-in-Canada approach, it bears striking similarities to the defacto deregulation or liberalization policy adopted by the Chairman of the Civil Aeronautics Board, Alfred Kahn, when he was appointed prior to the passage of the Airline Deregulation Act of 1978. In licencing, both policies depend on the regulatory agency to rely on competition as the primary factor in exercising its discretion in terms of public convenience and necessity. In fare control, Kahn had proposed zones of reasonableness which subsequently formed part of the sunset provisions of the Airline Deregulation Act of 1978 prior to complete freedom of pricing. Axworthy, being Minister of Transport, and (unlike Kahn) not Chairman of the Air Transport Committee however, had no power over the exercise of discretion by the ATC other than the threat of unilateral action through political appeal. In liberalizing rate regulation short of legislative action in the short term then, it was impossible for the Minister to establish his own zones of reasonableness and limit the discretion of the ATC so as to deem fares set within the zones to be just and reasonable even though he proposed to establish an objective standard and limit the subjective discretion of the ATC within two years. Consequently, he accepted a proposal by the ATC for zones of flexibility, wherein the ATC itself would exercise its discretion to deem fares within such zones to be just and reasonable.

Due to the lack of political consensus, Axworthy could not legislate deregulation U.S. style immediately and sought to liberalize the existing regulatory framework as best he could as a first step to legislated deregulation and complete freedom of entry and exit and freedom of pricing. The liberalization proposals in Canada unlike the Airline Deregulation Act of 1978 with respect to the CAB, did not abolish the ATC and its licensing and price control functions and transfer its remaining functions to the executive. By having to work through the existing legislated regulatory system, Axworthy ran into difficulty because the Canadian system has given much broader regulatory discretion to the Air Transport Committee by not legislating the specific policy factors that the ATC could be required to take into account in the exercise of its discretion in determining "just and reasonable" fares or "public convenience and necessity" in licencing.

This was done under the Airline Deregulation Act of 1978 for the sunset periods prior to the abolition of entry and pricing controls in order to limit the discretion of the CAB under deregulation prior to the CAB's abolition. Because there was no legislative policy statement defining the policy objectives and factors to be considered under a pro-competitive regime, not even low prices as in the U.S., only policy statements of the Minister and the threat of political appeal, the Minister was faced with trying to implement his policy in a manner acceptable to public consensus but unacceptable to the regulatory agency's view of its proper exercise of discretion. This impasse appeared to end with the defeat of the Liberal Government four months later in September, 1984. However, the debate over how far and how deregulation should be implemented in Canada remains an open question.

With this background, let us now look at the specific deregulation proposals of the Conservative Government as set out in Freedom To Move and Bill C-18, an Act to amend the National Transportation Act. In reviewing these proposals and provisions for new air transport legislation in Canada, one will quickly realize that Canada is embarking on a "deregulation" policy concept similar to that of the United States as opposed to a "liberalization" competition policy.

First, under the proposed deregulation legislation, the Canadian Transport Commission is to be abolished and is to be replaced by a new body called the National Transportation Agency. The National Transportation Agency will be required to take into account a newly amended national transportation policy which includes the following:

(1) Safety as a top priority,
(2) A transport system which exists to serve the needs of shippers and travellers,
(3) Competition and market forces are to be the prime agents providing economic, efficient and adequate transportation at the lowest total cost,
(4) Intra as well as intermodal competition is to be encouraged so that the economic regulation of carriers can be minimized,
(5) Carriers so far as practical are to bear a fair share of the cost of facilities and services provided at public expense and are to be compensated for publicly imposed duties, and
(6) Transportation is to continue to be key to regional development.

For air transportation specifically, the "public convenience and necessity" test is to be abolished and the control of entry will only be subject to a "fit, willing and able" test that focuses on the safety of carrier operations and adequate liability insurance. There will no longer be any route restrictions or equipment restrictions on the carriers themselves. Carriers wishing to discontinue or abandon service will be able to do so upon 60 days advance notice in most cases and they will no longer have to show that the abandonment is consistent with a public convenience and necessity test.

With respect to fares, carriers will be permitted to establish fare levels and to lower fares without regulatory approval though

increases in regular air passenger fares on so-called monopoly routes will be appealable. The Agency may upon complaint disallow such increases if it is determined that they are unreasonable. It is interesting to note here that the legislation does not provide any safe guard for excessive fare decreases and predatory pricing.

In all, it is hoped that the removal of restrictive economic regulatory controls will produce a more competitive market oriented industry which is more cost conscious, innovative and efficient. Moreover, these changes will only apply to the southern domestic routes in Canada. The northern and remote air service routes are to remain regulated. Moreover, for the north, it is proposed that the onus will no longer be on the applicants, it will be on those parties, i.e., a community or another carrier who feels that a granting of a new licence will jeopardize the continuation of an essential air service to object and such intervenors will have to satisfy the Agency that the new service which is proposed would lead to a significant decrease or instability in the level of domestic service. In effect, this appears to be a reverse onus test. For northern and remote regions there will also continue to be licence conditions imposed with respect to routes and equipment and fare levels will be appealable to the new agency. Abandonment, however will only require 60 days notice.

(vii) Effects of Deregulation in the U.S. and Potential Consequences of the Canadian Deregulation Proposals

Let us turn to our last question. What then are the potential consequences of these deregulation proposals given the existing regulatory structure for transportation in Canada?

For the Canadian aviation industry, it is important to look at the effects of deregulation in the United States. There we can see freedom of entry and exit led to many new carriers initiating service and to existing carriers adopting new routes and dropping others at will. Moreover, intrastate carriers expanded into larger interstate markets with commuter or regional air service growing where local interstate service had been cut back. Specifically, large interstate trunk carriers like United Airlines tended to withdraw from many thin, less profitable, low density and short distance routes and they concentrated on the longer, denser routes more suited to the aircraft types in their fleet. The interstate trunk carriers also rationalized their route networks by promoting one or more hub airports as switching points where passengers could make a number of on-line connections. While this reduces long haul non-stops, it is more efficient in terms of cost and number of passengers carried to more destinations as the hub system enhances a carrier's ability to provide feeder traffic for its longer haul services. Former local service carriers have also employed the hub airport principle to carry more passengers rather than transfer them to trunk carriers and have supplemented their route structure with longer haul routes to popular destinations, thereby increasing competition with trunk carriers. Regional air carriers, formerly classified as commuter carriers which largely used turboprop aircraft, have consequently expanded into many local service markets formerly served uneconomically by jet service.[44] Thus, in the United

States there have been many changes in service, particularly non-stop service, convenience of connections, frequency of service and type of equipment used depending on the nature of the market, its demand and the existence of competition. Indeed, it appears that many small communities have experienced the loss of jet service and connection convenience and while there has been more frequent service from commuter carriers, smaller aircraft, fewer seats, less comfort and questionable safety records have been causes for concern.[45]

Freedom of pricing in the United States has lead to lower fares on more competitive dense routes, higher fares on thin routes and overall, a more complex fare structure with price disparities not related to distance travelled. Specifically, the presence of competitors and the existence of excess capacity on wide body aircraft in dense long haul markets resulted in continual fare wars and low prices. This was in contrast with higher fares being charged on less travelled routes using different equipment. This has led to claims of price discrimination from those travellers paying higher fares for travelling relatively the same distance but from smaller centres or on thin routes. Deregulation policy would simply describe this as real price competition determined by market forces.[46] Typically, however, the primary effect seems to have been a diversion of traffic from competitors which in turn leads to a price war and discount prices becoming the norm with consumers wondering how higher prices existed before. If discount prices are set below cost, then cross subsidization through higher fares on less competitive routes may take place leading to price cost disparities and likely greater fare distance inconsistency. As a consequence, there have been calls by a number of major airlines to re-introduce the close relationship between fares and distance and to get the level of fares up as well as to discontinue low discount fares.[47]

Lastly the U.S. airline industry has suffered a decline in profitability, severe losses and some bankruptcies including Braniff in May 1982, Continental in September 1983 and Frontier Airlines most recently in 1986. The causes are not clear as inflationary rises in fuel costs, the recession and the 1981 air controllers' strike which affected the system's capacity also affected carriers in addition to competitive market forces under deregulation.[48] In 1985 and 1986 however, some argue that the poor financial performance and bankruptcies have led to increased merger activity and the industry tending to become more concentrated. Specifically five companies, American, Delta, Northwest, United and U.S. Air which together carried 48% of the traffic on America's 25 leading airlines in the first nine months of 1984, made 94% of the industry's net profit as against 55% in 1978 when airline deregulation was introduced. The five's net profit for the period also tripled to 790 million dollars over the same period in 1983.[49] In 1986, there has been considerable merger activity with Northwest acquiring Republic, TWA acquiring Ozark, Delta acquiring Western and Texas Air Corporation acquiring Eastern and Peoples Express as well as Peoples' bankrupt subsidiary, Frontier Airlines.

In Canada recently, we have also witnessed a host of merger activity, including the merger of Canadian Pacific Airlines with Pacific Western Airlines which was formally approved by the ATC on

February 26, 1987. This followed CPAir's acquisition of Nordair in 1986 and Eastern Provincial Airways in 1984. In 1986, Nordair Metro, a subsidiary of Nordair acquired Quebec Air to bring Quebec Air under the CPAir umbrella together with Eastern Provincial and Nordair, all of which were former regional air carriers. We are also witnessing a number of agreements being signed by smaller local commuter carriers with the major carriers to provide feeder service to the mainline network. Examples include the following commuter airlines signing feed or scheduling agreements with CPAir: Air Atlantic in the Atlantic region, Nordair Metro in Quebec, Time Air in Alberta, Norcanair out of Saskatoon serving Alberta, Saskatchewan and Minnesota, NorOntario serving North Western Ontario, Intercity Airways serving Southern Ontario and Quebec and Pem-Air serving Southern Ontario. For Air Canada we have feed or scheduling agreements with Pacific Western Airlines in western Canada until its merger with Canadian Pacific Airlines as well as Air B.C. on the west coast out of Vancouver and Firstair in the western provinces, Northwest Territorial Airways out of the Northwest Territories, Air Ontario and Austin Airways out of Ontario and Air Nova out of the Atlantic provinces.

As a consequence in my view, with the rise in the number of commuter airlines and feed agreements, it is quite possible that smaller communities served by jet service will lose it. Although they may acquire turboprop service, which may be more frequent, it may also be more inconvenient. There may be fewer direct flights, there will likely be more hub airports requiring on-line connections and safety may become a cause for concern. Moreover, it is questionable whether smaller airlines who do not sign feed agreements will be in a fair competitive position in terms of scheduling and connections with main line carriers. With respect to air fares, there will likely be lower air fares in the short term. However, unless there is some safeguard introduced to guard against excessive fare discounts and predatory pricing as well as anti-competitive merger and service pooling agreements, I expect there will be fewer airlines than we have had under a regulated system with a regional air carrier policy and they will likely charge higher prices in the long term.

(viii) Conclusion and Recommendations

In conclusion, if one looks at the air transport mode in the United States, the benefits of deregulation have been less than spectacular. There is still considerable controversy over the benefits to be achieved by adopting a deregulation competition policy for air transportation. Moreover, when one compares the deregulation policy concepts for transportation in the United States and Canada, it becomes apparent that U.S. deregulation initiatives have had a significant effect on the formulation of Canadian air transport policy.

In my view, the complete abolition of independent tribunal discretion and complete reliance on the forces of market competition is an improper policy choice for Canada. The former liberalization policy proposals in my view are to be preferred to complete deregulation because they would retain the exercise of regulatory discretion in licencing and pricing. This discretion could then be exercised within

the existing regulatory framework beneficially to promote direct real price competition for existing demand based on innovation and efficiency as well as greater pricing freedom and also provide predatory pricing protection in the first instance, before excessively low fares are implemented. (ie. when fares are clearly uneconomic, targeted at competitors and supported through market power not lower costs and greater efficiency). The exercise of discretion by an independent regulatory commission should not simply be seen as arbitrary, capricious, anti-competitive or protectionist. Coupled with greater expertise and knowledge of the industry and greater potential for conducting detailed staff investigations of carrier operations and costs, an independent regulatory commission should play a preliminary role to reduce the likelihood of anti-competitive behaviour and predatory pricing by exercising their regulatory discretion to ensure fair market competition. Complete deregulation, with the abolition of regulatory discretion and the whole independent regulatory tribunal framework coupled with reliance on strict anti-trust enforcement by the courts through competition laws of general applicability, in my view, ignores the expertise or the potential to establish an independent regulatory tribunal with the expertise to analyze carrier costs and operations and their ability to act in the first instance to review and disallow predatory fares or anticompetitive intercarrier agreements before the fares or agreements come into effect and substantial damage is caused.

Outlining more specific statutory policy objectives and factors to assist in the exercise of independent regulatory discretion and based on clearer governmental policy guidelines (not binding policy directives from the Minister) promoting market competition based on real price competition, innovation and efficiency, would allow for the implementation of a liberalization competition policy making best use of the potential in the existing regulatory structure in order to establish an adequate yet efficient and economic transport system based on effective but fair market competition.

In this way, in my view, the exercise of regulatory discretion could be consistent with deregulation policy promoting greater direct competition and greater pricing freedom for carriers and yet still avoid some of the deleterious affects of adopting the deregulation competition policy concept in its entirety.

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The Role of Churchill, Manitoba in the Resupply Operations to Arctic Communities*

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ABSTRACT

The following paper is a discussion of Churchill's role as a base for resupply of bulk fuel and dry cargo to communities in the Keewatin District of the Northwest Territories. In addition to describing the current resupply operations, this paper includes a brief history of the three modes of transportation which are utilized for resupply at Churchill: marine, air and rail. This paper also summarizes the study which the governments of Canada and Manitoba commissioned the IBI Group to undertake on the preservation and expansion of the Port of Churchill resupply operations. This discussion concludes with an outline of the activities which the Government of Manitoba has pursued which could lead to the expansion of resupply operations at Churchill.

INTRODUCTION

The town of Churchill, located on the southwest shores of Hudson Bay, is widely recognized as a grain exporting channel and as the "Polar Bear Capital of the World". However, this paper focuses upon another equally important role, that role being Churchill as a base for resupply of bulk fuel and dry cargo to communities in the Keewatin District of the Northwest Territories. In addition to describing the current operations, the paper includes a brief history of the three modes of transportation which are utilized for resupply at Churchill: marine, air and rail.

Under the Churchill Subsidiary Agreement, the governments of Canada and Manitoba commissioned the IBI Group to undertake an independent study on the preservation and expansion of the Port of

*The views expressed in this paper are those of the author and do not necessarily reflect those of Manitoba Highways and Transportation.

Churchill's resupply operation. This study was released in November 1986 as part of a package of studies focusing on the development potential of Churchill. Outlined in the study were opportunities for the expansion of both marine and air resupply. This paper will summarize the IBI study.

Resulting partially from the recommendations of the consultant and partially from the interest demonstrated by the Northern Transportation Company Ltd. (NTCL) and the Northwest Territorial government, the Government of Manitoba is pursuing the avenues which may lead to its objective of expanding the resupply operations at Churchill. This paper concludes with an outline of the activities which have been undertaken to attain this provincial objective.

HISTORY

Marine

Churchill has served as a marine resupply base since the early 1700's when the Hudson's Bay Company established Fort Prince of Wales at the mouth of the Churchill River. One of the Fort's main purposes was as an entrepot; an intermediate centre for trade and transshipment. Immigrants and supplies from Europe, en route to settlements in the south, arrived via Churchill and moved inland by York boats which travelled down the Churchill River.

The extensive use of Churchill as a resupply base for the prairies diminished in the late 1800s with the Red River cart brigades from St. Paul, Minnesota and the completion of the transcontinental railway. However, the Hudson's Bay Company (HBC) continued to utilize Churchill as one of the supply bases for its northern stores. The HBC supply vessel, the S.S. Nascopie called at Churchill many years prior to the opening of the port facilities in 1931. As well, small vessels had been carrying supplies from Churchill to other communities along the western shores of Hudson Bay long before the federal government initiated barge resupply service in 1975.

Prior to 1975, the three main supply routes to the Northwest Territories were:

- the MacKenzie Valley, served mainly from Edmonton;
- the west coast of Hudson Bay and the central Arctic, served mainly from Montreal, but also from Churchill and Winnipeg;
- the islands of the eastern Arctic, served by sea and air from Montreal and the east coast ports.

In 1971, the Northern Transportation Company Limited (NTCL), a crown corporation established in 1934, presented a proposal to the federal government to operate a tug and barge resupply service to the Keewatin from a base at Churchill. Since the tug and barges would winter in Churchill, the NTCL season could begin in

July, approximately one month before vessels from Montreal could enter the Hudson Strait. NTCL could accomplish this because, first, the Bay is ice free before the Strait and second, insurance regulations in effect at that time prohibited ships from sailing into Hudson Strait from the east before July 23. NTCL proposed that the service from Churchill would be available at lower rates than those of the Sealift. Also a more complete service would be provided since NTCL could beach the barges to facilitate unloading. The vessels of the Sealift only deliver cargoes to the high water mark. Therefore, NTCL offers a more complete service by delivering the goods to customers' warehouses whereas the Sealift requires a lighterage service to unload the vessels from off shore.

The federal government was reluctant at first to transfer the resupply function to Churchill from the eastern shippers who virtually undertook all of Keewatin resupply. However, at the Western Economic Opportunities Conference which was sponsored by the four Western provinces in 1973, the federal government finally responded favourably to the concept of Churchill resupply. Federal support was given to a resolution brought forward by the Government of Manitoba requesting federal authorization of NTCL to proceed with plans to establish a Churchill based service. Benefits of the proposed service were outlined in the resolution. People in the Keewatin would receive a more complete service and lower rates; employment opportunities would be available in Churchill (13 local people are employed seasonally); business would increase for western manufacturers as goods destined for the Keewatin would come from the west. In January 1974, the federal government signed a 15 year contract with NTCL, to serve six communities on the west side of Hudson Bay.

As a result of the Mulroney government's policy to privatize crown corporations, NTCL was sold in July 1985 to Nunasi Development Corporation.

Air

Churchill's air resupply role began in the early days of aviation history. In 1927 the first aircraft arrived in Churchill from Winnipeg. The pilots flew supplies into the Keewatin to support exploration and mining projects.

The construction of the United States Air Force base in 1942 provided an all weather airport which could accommodate large aircraft. With the availability of these modern facilities a number of commercial carriers have utilized Churchill as a base for operations. These carriers included Arctic Wings, Transair, Calm Air, Pacific Western Airlines, Lambair and Ontario Central Airways.

Arctic Wings, established in 1947, was the first commercial air carrier to be based in Churchill. The carrier obtained a Class 4 charter licence to serve the Keewatin. By 1951, Arctic Wings expanded to unit toll service enabling charges to be levied per pound or per person.

A merger between Arctic Wings and Central Northern Airways in 1955 resulted in the establishment of Transair Ltd. which took over the Churchill-based service. During 1961, Transair initiated a Class 2 Regular Specific Point Service between Churchill, Rankin Inlet, Baker Lake and Coral Harbour. Beginnning in 1968, Eskimo Point, Chesterfield Inlet, Whale Cove, Repulse Bay, Yellowknife and Hall Beach were served by Transair under a Class 3 Specific Point licence.

Calm Air began operating from a base at Churchill in 1977 when Transair relinquished a portion of its Class 4 charter authority to Calm Air. As well, Transair transferred operating authority to Calm Air to provide a Class 3 service from Rankin Inlet to Baker Lake, Coral Harbour, Repulse Bay, Chesterfield Inlet and Whale Cove. On March 1, 1980, Calm Air received permission to operate a Class 2 service to Rankin Inlet, Baker Lake, Eskimo Point and Coral Harbour from its Churchill base. Chesterfield Inlet, Whale Cove and Repulse Bay are served from Churchill under a Class 3 licence.

Pacific Western Airlines (PWA), who supported Calm Air's 1980 expansion, took control of Transair in August 1979 and by December 1979 had attained authority to provide air service to the Keewatin. PWA also provided six scheduled commercial flights a week to Churchill from Winnipeg during the summer and four flights a week in the winter.

Two other carriers, who shipped smaller volumes out of Churchill, were Lambair and Ontario Central Airways (OCA). Lambair served out of Churchill from 1960 until the carrier went bankrupt in 1980. OCA which was purchased by Nunasi Central Airlines in 1985 was licenced in 1982 to offer a Class 4 charter service from Churchill to any Canadian destination.

Although not directly involved with Churchill resupply, mention should be made of Northwest Territorial Airways Ltd. (NWTA) as this carrier has had an effect on Churchill resupply volumes. In October 1981, the Air Transport Committee granted NWTA the authority to provide a regular scheduled non-stop air service between Winnipeg and Rankin Inlet, a route which was previously only served from Churchill. The fares and cargo rates charged by NWTA from Winnipeg To Rankin Inlet were less expensive than those charged by the PWA-Calm Air connection. Therefore, the lower price and non-stop convenience offered by NWTA drew traffic from Churchill. This loss was a major contributor to the reduction of flights offered by both Calm Air and PWA.

Rail

In 1885 construction began on the rail line to Hudson Bay with Port Nelson (York Factory) planned as the terminus. The rail line would satisfy the demand of prairie grain producers for a shorter and more direct route to Europe than that provided by the eastern gateway. Because federal finances were dedicated to the construction of the east/west Canadian Pacific line, the federal government could not undertake the construction of the Hudson Bay line. However, land grants were offered to any party who would construct this railroad.

In 1910, Canadian Northern Railway completed the line from Hudson Bay, Saskatchewan to The Pas, Manitoba. The next phase of construction was continued by the federal government, but was halted in 1917 due to the diversion of finances to the World War I war effort. After the war, interest in the line was revived and Canadian National Railways resumed construction to Port Nelson in 1926. However, in 1927 the line was redirected as a result of a report prepared for the Ministry of Railways and Canals. This report favored a port at Churchill over Port Nelson. The line was completed in 1929 with the first grain being shipped in 1931.

The Hudson Bay line was incorporated into the CN system in 1951 and as of April 1979 VIA Rail began operating the passenger service on the line.

CURRENT OPERATIONS

Marine

Currently the communities of Canada's Arctic are served by three main resupply routes:

- the islands of the Eastern Arctic via Montreal and other eastern ports;
- the Western Arctic via the Mackenzie River;
- the Keewatin District via Churchill and Winnipeg.

The Eastern Arctic is served by the Eastern Arctic Sealift. The Canadian Coast Guard who coordinate the Sealift, call separate tenders for the delivery of fuel and dry cargo.

The Western Arctic is served by NTCL which is headquartered in Edmonton, Alberta. NTCL operates terminals in six communities in the Western Arctic and Alberta.

Since 1975 NTCL has also been serving the Keewatin from its base in Churchill. The six communites served by NTCL: Eskimo Point, Whale Cove, Rankin Inlet, Baker Lake, Chesterfield Inlet and Coral Harbour; have a total 1984 population of 4,300.[1]

Although Repulse Bay is administratively in the Keewatin, NTCL cannot serve the community due to dangerous ice conditions which exist in Foxe Basin. Repulse Bay might then be accessed via Roes Welcome Sound where ice conditions are not as severe. However, this route also poses some risk as adequate soundings (measurements of depth) are not available.

At the beginning of each year, NTCL publishes a tentative schedule of departure dates. Anyone wishing to ship goods to a given community must ensure NTCL receives the goods by a certain specified date, usually two to three weeks prior to the scheduled departure. The type of goods shipped are generally:

- bulk fuels;
- general cargo on pallets;
- cargo containerized or on trailers;
- heavy equipment and vehicles.

On average, July 17 marks the beginning of NTCL's shipping season. The actual opening is carefully planned based on ice conditions and forecasts. Ice conditions at the Keewatin communities usually determine the season opening since the harbour at the Port of Churchill is clear of ice at an earlier date. By August, ice conditions no longer pose any problem.

The length of the shipping season, ending on average around October 4, permits NTCL to average nine trips for a total of eleven stops. Sometimes two ports are supplied during one trip. Each trip averages nine days; one day to load, five days sailing, two and a half days to unload at the first port; one half day to unload at a second port (two of nine trips or 20 percent included two port stops - 2.5 x 20% = .5).[2]

NTCL utilizes one tug and four barges to perform its resupply operations. On each trip, the tug pulls two barges, one covered and one not, loaded with bulk fuel and dry cargo to the destined community. While the tug is at anchor, the bulk fuel is unloaded and then the barges are beached and crews, flown in from Churchill, unload the dry cargo. The goods are then delivered to a customer's warehouse or to another specified location. With the delivery complete, the tug returns with the two empty barges to Churchill where two loaded barges have been prepared for the next trip.

The facilities at the Port of Churchill which NTCL uses for resupply operations include:

1. Docking space located at the north end and east face of the wharf;

2. A covered steel transit shed of which NTCL leases 5,574 square metres of floor area or 75 percent of the total area. The shed is equipped with lights but is not heated or insulated;

3. An open storage area on the wharf north of the transit shed;

4. A berth on the east side of the wharf where the tug and four barges are wintered;

5. A pipeline originating from the Esso tank farm located east of the grain elevators and running to an underground header at the north end of the wharf.

Total annual volumes of resupply cargo have varied from 15,700 to 24,500 tonnes between 1978 to 1985. The average total volume shipped is 21,000 tonnes and the average shipped per port stop is 1,700 tonnes. However, shipments have been as high as 3,000 tonnes to communities such as Rankin Inlet, Baker Lake, and Coral Harbour.[3]

Bulk fuels account for 70 to 80 percent of the total volumes shipped, the average being 73 percent. Bulk fuels comprise a larger proportion, 78 to 80 percent of total volumes shipped to Eskimo Point, Whale Cove and Rankin Inlet. These three southern communities tend to use air resupply for dry cargo to a greater extent than the three northern communities where bulk fuel accounts for 70 to 75 percent of the volume. This trend towards an increasing use of the air mode is becoming more prevalent in the entire area. In 1979, shipments by barge comprised 66 percent of total cargo shipped. By 1985, this percentage decreased to 45 percent.[4]

The Canadian Transport Commission report on Churchill resupply provides a variety of reasons to explain this trend.[5] First, NTCL's uniform pricing structure can be partially attributed to the reduced proportion of marine shipments of dry cargo. Since NTCL's prices are not distance related as air rates are, the differential between barge and air rates for communities closer to Churchill is not as great as in communities located further north. When air rates are competitive with barge rates, more customers are likely to choose the faster service provided by air transport. Second, certain shippers have opted for the higher air transportation costs rather than the higher inventory costs incurred from storing the once or twice a year marine shipment. Third, air transport is being used to a greater extent to ship construction materials immediately prior to the start of a project. The risk of damage due to weather or pilferage is minimized since stockpiling a year's supply would not be neccessary. Finally, the volume of construction material shipped by barge is dwindling due to a reduction in construction activity related to the slower economy in the Arctic.

Traffic projections for marine cargoes in the Keewatin have been estimated at 27,000 tonnes in 1989 and 37,000 tonnes by 2004.[6] These projections were based on natural population growth rates and per capita tonnage estimates. Projections for the 1986 season estimated total volume at 25,000 tonnes. The actual tonnage

shipped in 1986, a record 30,000 tonnes, surpassed the projection by 5,000 tonnes. The increase was attributed to the construction of a housing project. Since the project has been completed, an official of the NWT government expects volumes to return to normal. However, it may be encouraging to note that even with a static population a backlog of housing demand still exists and more construction is anticipated.[7]

Air

Passengers and cargo are flown into the Northwest Territories via three air service corridors. The East corridor is served from Montreal/Ottawa; the West corridor is served from Edmonton/Yellowknife; and the South corridor from Winnipeg/Thompson/Churchill.

The market area served from the south consists mainly of the Keewatin District. Some small shipments are transferred at Rankin Inlet destined for communities further north.

The South corridor has a total freight cost advantage over the other corridors when serving the Keewatin. This advantage does not result from per tonne-km rates as rates are slightly higher from Winnipeg/Churchill. The advantage relates to shorter flying distances. The distance to Rankin Inlet from Winnipeg/Churchill is 859 air miles; from Montreal/Frobisher Bay it is 1822 air miles; and from Edmonton/Yellowknife it is 1265 air miles.

Most of the non-perishable and non-priority air shipments from Churchill are transported by rail from Winnipeg, or by road from Winnipeg to Thompson and then piggyback rail to Churchill. The use of the road/rail system takes advantage of the rail and trucking rates which are relatively lower than air rates and further reduces total shipping costs. This price advantage has been a major factor in the establishment of Churchill's dominant role in the resupply of the Keewatin.

Three airlines are licenced and have a base at Churchill; Pacific Western Airlines, Calm Air, and Nunasi Central Airlines.

Pacific Western Airlines (PWA) provides Class 1 (Scheduled commercial unit toll); Class 2 (Regular Specific Point commercial unit toll); and Class 4 (Charter commercial) service from Churchill. PWA offers four flights per week in the summer and three flights per week in the winter from Winnipeg to Churchill.

Calm Air, the primary operator in the Keewatin, provides Class 2, Class 3 (Specific Point commercial unit toll), and Class 4 service to the Keewatin. Six flights per week from Churchill, originating in Thompson, provide cargo and passenger service to the Keewatin. The communities served include the six served by NTCL, Repulse Bay and Cullaton Lake Mines which is approximately 250 kilometres west

of Eskimo Point. The 1984 population of this market was approximately 4,700[8].

Nunasi Central Airlines, which is the third airline based at Churchill, operates a Class 4 service.

Although originally constructed as a United States military base, the Churchill airport has some military facilities which the aforementioned commercial carriers still utilize.

There are two runways at this airport. The larger can easily accommodate large aircraft. It has an asphalt surface and is 9,200 feet long and 160 feet wide. The second runway is 6,081 feet long and 200 feet wide. Most of this runway, 4,600 feet, has a gravel surface and 1,481 feet is asphalted.

The largest hangar at the airport houses the passenger terminal and the aircraft which Calm Air has based in Churchill. Three small metal storage buildings serve as cargo terminals for Calm Air, PWA and Costa Cartage (a freight forwarding company). Nunasi Central recently began storing cargo in a hangar complex located at the intersection of the runways.

The airport is equipped with landing and en route navigational aids which exceed the requirements of resupply activities. Services available include fuel, oil, a power supply and de-icing.

As discussed in the previous section, during the 1980s a greater percentage of total cargo destined for the Keewatin area was transported by air rather than the marine mode. Due to the competitive nature of the air industry, an exact figure for air cargo and passenger volumes is not readily available.

Estimates for cargo shipped between 1979 and 1985 range from 5,300 tonnes in 1979 to 9,300 tonnes in 1984. These estimates exclude cargo shipped to Cullaton Lake Mines. In 1982, approximately 3,600 tonnes of freight was shipped to the mine for a total volume of 10,200 tonnes of air cargo shipped from Churchill to the Keewatin.[9]

Passenger traffic between Churchill and the Keewatin from 1979 to 1982 declined by an average 12 percent per year from 5,730 unit toll passengers to 3,800 unit toll passengers in 1982.[10] The Canadian Transport Commission has noted that the decline of traffic in Churchill coincided with a growth of traffic to Rankin Inlet from Yellowknife and Winnipeg. This increase from the south and west is partially attributed to the initiation of NWTA's non-stop service between Rankin Inlet and Yellowknife in 1980 and the non-stop service between Rankin Inlet and Winnipeg in 1982.

Rail

Being the northern terminus of the 1,600 km rail line from Winnipeg, Churchill is a major staging point for goods destined for the Keewatin. Although cargo is not shipped directly to the Keewatin by rail, this mode plays an important part in the resupply operations from Churchill. Both air and marine modes rely heavily on rail to transport goods to Churchill. Shipping by rail, which provides the only surface link to Churchill from the south, allows the shipper of non-perishable and non-priority goods to take advantage of the lower cost of shipping by rail as opposed to air.

The majority of dry cargo is shipped by the Hudson's Bay Company, Arctic Cooperatives Limited and the Northwest Territorial government. These organizations rely on freight forwarding companies such as Costa Cartage, Federated Co-operatives, and Route Canada (previously CN Route) to consolidate goods in Winnipeg and to ensure the goods are delivered to the Keewatin.

Surface transportation to Churchill is provided by CN Rail. A weekly freight train leaves Winnipeg on Fridays and arrives in Churchill on Monday evenings. In addition, Route Canada transports highway trailers from Winnipeg to Thompson by road for transshipment by a special piggyback service to Churchill. The piggyback service which is restricted to Route Canada is provided three times per week out of Thompson on specially equipped piggyback flat cars which are attached to the VIA passenger train. A variation of the piggyback service is offered by Costa Cartage directly from Winnipeg. Due to the shortage of piggyback cars, CN has adopted a policy to encourage piggyback service to major urban centres only. Therefore, Costa Cartage must use a time consuming and expensive method to fasten trailers to standard flat cars.

When goods arrive in Churchill deliveries can be made to the town station or to the wharf. The rail line runs through the transit shed and terminates almost at the north end of the wharf.

The area of the shed leased by NTCL can accommodate five boxcars for simultaneous unloading. The shed floor is at the door level of the rail cars to facilitate direct unloading. The goods are sorted by destination and stored. Some goods are repacked and palletized. A shrink wrap machine is used to protect delicate cargo and goods that are stored outside of the transit shed. Goods arriving by truck trailer are handled in a similar fashion. However, due to lack of a high level unloading dock for trailers, unloading is difficult.

A week prior to departure, the barges are docked and loaded on the east side of the wharf. Small lots and delicate goods are placed in the covered area of the barge. The covered barge is usually packed full from floor to ceiling. Large items and remaining

cargo are loaded on the open barge as well as unloading and transportation equipment necessary for deliveries.

Bulk fuel is shipped by pipeline from Edmonton to Regina and then by tank car to Churchill. A rail line runs directly to the Esso tank farm located east of the grain elevator. When the barges are loaded with the dry cargo, the barges are moved to the north end of the wharf where bulk fuel is loaded from the underground pipeline which runs from the tank farm.

The IBI Group Resupply Study

A number of reports have been written which deal with various aspects of the resupply operations at Churchill. The most recent, and one of the main references for this paper, was jointly commissioned by Transport Canada and the Manitoba Department of Highways and Transportation under the Canada/Manitoba Subsidiary Agreement on Churchill. The study is part of a package of four studies for the development of Churchill's potential. The studies were carried out by the IBI Group and its associate sub-consultants.

The main objective of "The Port of Churchill Resupply Operations" study was to evaluate options to preserve and expand rail, marine and air resupply operations at Churchill. The five major chapters presented in the report were:

- Present Services and Projections;
- Marine and Rail Resupply;
- Air Resupply;
- Operations and Infrastructures;
- Evaluations and Conclusions.

The study area for marine resupply included the current market area in the Keewatin region of the Northwest Territories plus an area extending north into Foxe Basin, northeast to the easterly entrance of Hudson Strait, east to the communities on the eastern coast of the Hudson Bay and James Bay and to the communities on the Ontario coastline of Hudson Bay. For air resupply, the study area included the Keewatin, the eastern communities of Kitikmeot, located in the District of Franklin, and much of Baffin Island.

The consultant identified the following problems with the existing resupply operation:

1. the high cost of bulk fuel at Churchill - $68 per tonne more expensive than at Montreal;

2. the cost of rail service from Winnipeg to Churchill at $123 per tonne;

3. the level of service of the rail haul from Winnipeg to Churchill;

4. the use of a flat rate for all NTCL cargoes regardless of distance leads to greater use of air service in the South Keewatin and under utilization of the NTCL service.

The consultant developed three opportunities for expansion of marine resupply and one for air resupply. A key component in the alternatives is a lower cost road/rail link and a higher level of service from Winnipeg to Churchill. This could be accomplished by the introduction of a piggyback trailer service which the consultant acknowledges is not in accordance with CN policy.

Two of the options analyzed to route more marine traffic out of Churchill were the expansion of NTCL territory, and the use of Churchill as a secondary port for the Eastern Arctic Sealift vessels or the vessel of Hudson's Bay Company. The first opportunity is preferred as it involves both dry cargo and bulk fuel whereas the second only brings dry shipments. The consultant noted that the shipments of bulk fuel generate 40 percent of NTCL's revenue. Therefore, NTCL's ability to continue operations with only dry cargo shipments is questionable. However, due to the unpredictable nature of world oil prices, in the long term, the first opportunity is a more vulnerable option.

The third opportunity for marine resupply was to allow NTCL to charge a sliding rate scale based on distance so the ratio of marine to air tariff in the south would approach that of the north. The new rate scale would divert an estimated 1,000 tonnes of cargo from air to marine.

The consultant identified an air corridor through the central Arctic where all points contained were closer in air miles to Winnipeg/Churchill than Montreal or Edmonton. However, this geographic advantage was not being captured by the existing air route structure. Therefore the consultant recommended that a Winnipeg - Churchill - Rankin Inlet - Hall Beach Corridor be established.

The success of this air option to retain and expand Churchill's role as an air resupply base requires the following conditions to be met:

1. Establishment of a lower cost road/rail link between Winnipeg and Churchill for dry goods, with lower rates based on the higher anticipated volumes identified in the IBI resupply study;

2. Improved co-ordination for intermodal transfer at Churchill to reduce loss and damage;

3. Granting of passenger and cargo pick up rights at Churchill to the present non-stop air service between Winnipeg and Rankin Inlet;

4. Improved institutional arrangements so that customers in northern communities can deal with one resupply entity in ordering goods via the surface/air link through Churchill.

Based on the conclusions and opportunities presented in the study the following action plan was proposed:

1. As the Government of the Northwest Territories has a broad interest and responsibility in the resupply operation, they should take the lead role in restructuring the resupply system with the support of the federal government.

2. Negotiations should be carried out with CN and appropriate trucking firms with the view to achieving increased service and lower rates for freight movement.

3. Negotiations should be entered into with the Canadian Coast Guard to have the Eastern Sealift operations make interim calls at Churchill to pick up new supplies for Arctic communities rather than returning directly to Montreal.

4. Discussions should continue with NTCL on the possibility of expanding the number of communities served in the Keewatin. In addition, guarantees of minimum annual volumes shipped by rail and/or truck should be obtained from shippers to encourage CN to reduce rates.

5. NTCL's operation is vulnerable to world oil prices. If prices continue to drop, fuel may be supplied from Montreal rather than Churchill. Therefore, assistance should be provided to NTCL in obtaining a less expensive source of fuel perhaps by tanker. Western Canadian refineries currently supply the fuel at Churchill.

6. The desirability of the Winnipeg/Churchill/Rankin Inlet/Hall Beach corridor should be confirmed or other mechanisms for increasing competition or improving the level of service should be formulated.

7. The feasibility of contracting the coordination of road/rail shipments to both the air and marine modes to a single operator should be examined.

8. Negotiations should be carried out between NTCL and Transport Canada to achieve a distance based resupply tariff.

If the recommended action plan is achieved, the consultant has calculated that bulk fuel and dry cargo volumes for Arctic resupply would total approximately 62,400 tonnes based on 1984 volumes.

INVOLVEMENT OF THE PROVINCE OF MANITOBA

The Province of Manitoba's involvement in enhancing the Port of Churchill's role as a deep-sea port began with the decision to relocate the port from Port Nelson in 1927. Over the past sixty years, the Province has been instrumental in the successful achievement of many initiatives.

In the past fifteen years, Manitoba can be credited with achieving the following initiatives related to strengthening Churchill's role in Arctic resupply:

- being the driving force behind the three Prairie Provinces founding the Port Churchill Development Board in 1973;

- playing a major part in encouraging the federal government to transfer the Keewatin resupply function from the Eastern Arctic Sealift to NTCL in 1975;

- being co-author of the $93 million Canada/Manitoba Subsidiary Agreement on Churchill. The IBI study which is analyzing means to preserve and expand resupply operations at Churchill is one of the initiatives under the Sub-Agreement;

- being the catalyst for initiating discussions between all parties who have some degree of interest in Churchill resupply.

The Province's efforts to increase the activity at Churchill are ongoing as provincial officials intend to base future actions on those recommended in the IBI resupply study.

Discussions have already been initiated with the major shippers such as the Hudson's Bay Company. The shippers are quite pleased with using Churchill from a technical point of view. However, they are reluctant to ship goods via this route due to the high rail costs incurred.

Discussions have also been initiated between the Government of NWT and NTCL. The purpose of these meetings is to determine methods to increase the resupply operations at Churchill. At present, neither party can visualize any immediate opportunity due to high land transportation costs.

As a result of opinions expressed during the discussions mentioned above, it is crucial that negotiations take place to persuade CN to provide developmental rates to encourage traffic on the Churchill line.

In addition to initiating discussions geared to the expansion of Churchill's role in Arctic resupply, the Province is actively pursuing means to ensure Churchill's role does not diminish. For

example, the Province recently came to the aid of NTCL in obtaining lower fuel costs for the 1986 shipping season. Esso Petroleum Canada is currently unable to handle dyed diesel which is eligible for a 2.2 cents per litre tax refund in the marine loading facilities at Churchill as the dye would contaminate the clear fuel which is ineligible for a tax exemption. Esso could solve this problem by installing a flushing system or a separate delivery line to the dock for colored fuel. Either solution would require the investment of capital which Esso was unwilling to commit in 1986. Esso's management agreement for the tank farm was up for renewal and some uncertainty surrounded Esso's resigning. NTCL approached the Province for assistance. As the situation was beyond NTCL's control which resulted in a financial burden, the Province granted a temporary tax exemption which would give NTCL a refund of 2.2 cents per litre on the clear diesel consumed during the 1986 shipping season. This positive development reduced tug operating costs for NTCL which in turn ensures the future success of the continued operation of Churchill resupply.

A new six year leasing agreement has been signed by Esso. Now that the management question surrounding the tank farm is answered, the Province will likely participate in discussions between NTCL and Esso to solve the logistics problem of supplying colored diesel at Churchill.

CONCLUSION

The residents of the Keewatin communities benefit from the more complete and less expensive marine service offered by NTCL as opposed to ships based in Montreal. As well, due to the short air distance from Churchill, the Keewatin communities also enjoy lower air transportation costs.

However, due to obstacles such as the high cost of the road/rail link, there are parties who believe that resupply operations based in Churchill cannot be expanded. The Province of Manitoba does not share this status quo attitude. As evident in the previous section, the Province of Manitoba has been and will be strongly committed to ensure this valued service is provided out of Churchill.

Endnotes

1. The IBI Group, Port of Churchill Resupply Operations Study - Study C, (Toronto: 1986), exhibit 2.3.

2. Ibid., p. 2-11.

3. Ibid., p. 2-12.

4. Ibid., exhibit 2-12.

5. Canadian Transport Commission, Research Branch, Passenger Transport Studies, The Role of Churchill in the Transportation System for Northern Canada, TT72-1983/03E (Canada: Supply and Services Canada, 1983), p. 62.

6. The IBI Group, op. cit., exhibit 2.15.

7. Ibid., p. 2-24.

8. Ibid., exhibit 2.3.

9. Ibid., exhibit 2.12; also CTC, op. cit., p. 65.

10. CTC, op. cit., p. 30.

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The Feasibility of Submarines for Transportation of Artic Resources

Over the years, there has been a growing interest in the transportation of mineral and hydrocarbon resources from mines and wells in the Artic circle to markets in more temperate areas. So far, this has only been done by pipeline or by ship. Neither of these methods is completely satisfactory, but they have the advantage of demonstrating that it is technically possbible to carry out such functions. Another potential solution to the problem is the cargo carrying submarine. This alternative has several attactive features, especially since it can sail beneath the ice. The speed losses caused by variations in ice thickness which inevitably affect the schedule of a surface ship, are therefore avoided.

However, since there are no cargo carrying submarines in existence, it is important to review the technical alternatives and evaluate their economics before proposing the submarine as a viable alternative to conventional methods. This paper reviews the various design proposals in the literature and considers the feasibility of the principal features of the transportation system such as cargo, hull structure, propulsion machinery and terminal operations. It also considers the various routes for which a submarine cargo vessel could be used.

The study concludes that a submarine cargo ship is technically feasible and economically comparable with surface ship systems under certain conditions. There remains, however, a tremendous amount of work to be done before such a system could become operational. The paper makes recommendations on features which are likely to make the submarine systems more competative.

THE FEASIBILITY OF SUBMARINE TRANSPORTATION OF ARTIC RESOURCES

1. INTRODUCTION

Since the discovery of oil and gas in Prudhoe Bay in the late sixties, and the opening of a mine at Nanisivik on Baffin Island, NWT, in 1974 there have been several attempts to demonstrate the feasibility of shipping resources from the Artic to markets in temperate climates. In 1969, the ice strengthened tanker 'Manhattan' negotiated the North-West passage. This was soon followed by the construction of the Trans-Alaska pipeline system (TAPS). In 1978 the 'Artic' shipped ore southwards during the summer season. All these systems were extensions of

conventional technology, but had some drawbacks when developed for Artic use. The TAPS was five times more expensive to build than its estimates. It also raised objections from native groups who were concerned over disruptions to the environment. In 1977 the Berger commission placed a 10 year moratorium on the development of new pipeline systems in the Canadian Artic. The pipeline also limits the market potential of Canadian crude oil, which is just as likely to end up in Europe or Japan rather than the lower 48 states of the USA.

If the pipeline is undesirable from economic and environmental considerations, the alternative must be some form of vessel system. Ships have operated in Artic waters for many years, but so far there has only been one (MV Artic) operating as a conventional transportation system in Canadian waters. There are several disadvantages to a surface ship system. Variations in ice features can cause speed fluctuations which can result in considerable disruption to a ship's schedule. There are also the environmental considerations of the broken channel left by the ship, which can disrupt traditional migration routes for animals and so effect the lifestyles of humans in the area.

One possible method of avoiding the surface ice is by travelling underneath it. Military submarines have operated, without any apparent difficulties, under the Artic ice cap for many years, but so far there have been no attempts to develop submarine cargo systems beyond the feasibility study stages. There are good reasons why the use of submarine cargo ships is not more widespread. The difficulty is a fundamental problem of hydrodynamics. The resistance of a ship may be assumed to be made up of two components, one due to the viscosity of the fluid in contact with the body, and the other due to the movement of the fluid around the body. For a surface ship, this component also includes the force due to wavemaking at the free surface. The potential advantage of a submarine is the elimination of the wavemaking component of the resistance.

The ratio of the two resistance components, as fractions of the total is not constant throughout the speed range, and only at high speeds does the wavemaking resistance become significant. These speeds are typically outside the range of those considered economical for bulk cargos. The low speed performance of a submarine will be worse than that of the equivalent surface ship, since its wetted area is higher. The submarine is uncompetitive if operation in open water alone is considered. However, if the submarine can operate in circumstances which the surface ship cannot, there is the possibility that it could be economically competitive. Such a situation could be the shipping of resources from the Artic. The purpose of this paper is to review the technical and economic considerations of this option when compared to the more conventional systems. In addition we must anticipate some of the regulations which may apply to submarine cargo ships, since they may have an effect on the operating economics.

2. PRINCIPLES OF SUBMARINE DESIGN

The design of a submarine is more complex than that of a surface ship. The principle of Archimedes states that a submarine must displace its own volume and mass of fluid in order to remain in equilibrium. The external volume of the submarine is constant, but the mass changes during a voyage as fuel and stores are consumed. The problem is further complicated by the thermal expansion or contraction of the cargo. To accommodate all these changes, the submarine must be capable of taking on and discharging ballast during the voyage.

Submarines operate at increased hydrostatic pressure relative to surface ships, due to the increased depth of water. The submarine structure must be designed to accommodate these extra loads, or it will collapse. the option taken by military submarines is to build a complete pressure hull, capable of withstanding the variation in hydrostatic loading over the operating range. This construction technique becomes very expensive as submarines increase in size since very thick high grade plates must be used.

If the pressure inside the submarine can be maintained at the same level as the external hydrostatic pressure, then the outer skin of the submarine simply becomes a membrane to contain the cargo. It can be built for a much lower cost than the pressure hull, since lower grade materials can be used. The type of cargo most suited to this approach is a liquid, since its internal pressure is naturally the same as the hydrostatic pressure, provided that the liquid fills the container. This concept can be modified slightly to provide pressure hulls inside the submarine for machinery and accommoation.

The other area which needs to be addressed is the design of a system to allow for a variable weight of the submarine or variable volume of the cargo. It is extremely unlikely that the submarine can make a round trip full of cargo in each direction. Therefore it must carry something, to maintain its neutral buoyance. Most surface bulk carriers use sea water as ballast, since it is easily available, cheap and easy to dispose of at the end of the journey. This would also be the obvious choice for submarines. However, unless the cargo and the ballast had exactly the same densities and thermal expansion properties, it is necessary to provide empty spaces in the submarine to allow for these features. These spaces must be pressure hulls in order that they may operate partly full. The problem is greatly simplified for the designer if the cargo spaces can be used for carrying ballast, and the density of the cargo is close to that of sea water. The most effective cargo then becomes a liquid cargo, such as refined petroleum products, crude oil or methanol derived from liquified natural gas (LNG). Solid cargo would be extremely difficult to carry, since it would not withstand the hydrostatic pressure. Coal and ore could be carried in the form of a slurry, but it would require extra processing before loading. For a

design to carry LNG there are additional problems, since ballast water cannot be carried in the cargo tanks. This means that the whole cargo and ballast system is built from pressure vessels, which would be expensive, or some other form of ballast must be used, which can be carried in the cargo tanks.

The most efficient hull structure for a submarine minimizes the use of expensive pressure vessel construction to those areas which are essential, and all other tanks are based on a membrane approach.

3. LITERATURE REVIEW

Work on the development of submarines began around the beginning of the 18th century. By the middle of the 19th century, the military submarine as we know it today had been born. Development of this type of ship has continued up to the present day and sizes have been greatly increased and propulsion units made more reliable. The largest submarines sailing belong to the USSR, and have a submerged displacement of approximately 25,000 tonnes. The role of the military submarine is well developed and the vessels are highly sophisticated in terms of control and navigation systems. They have also shown that nuclear power is a practical method of propelling submarines. However there has only been one submarine built with the intention of carrying cargo on a regular basis. The submarine, called 'Deuthschland', was built in 1916 for carrying strategic goods for the Kaiser's war effort. The deadweight of this ship was only 700 tonnes. There are accounts of submarines carrying fuel oil in ballast tanks during the second world war, but agan this was for strategic reasons, not commercial ones.

The earliest reference to cargo carrying nuclear powered submarines was given by Russo, Turner and Wood [1]. This paper presented a parametric study covering ship deadweights between 20,000 and 40,000 tonnes at operating speeds between 20 and 40 knots. This design was not developed for Artic operation, and as discussed above this is not likely to be competitive with surface ships. The concept was designed to carry refined petroleum products from gasoline to bunker. The general structural design was based on the concept of minimizing the amount of pressure vessel construction within the hull. The hull form was of a rectangular cross section with a beam approximately twice the depth. This was chosen, despite the degradation of resistance relative to a square section, to allow access to existing ports and terminals.

As the development of Artic resources became a realistic concept, the potential benefits of submarine transportation systems were realized, and the basic concept described above was modified to carry crude oil from Alaska to the Eastern Seaboard of the United States. This was described by Jacobsen [2], and the study looked at two basic sizes of submarines. The smaller

submarine studied had a deadweight of 170,999 tonnes, and was considered to be the largest which could be built at that time. The larger submarine had a deadweight of 250,000 tonnes, and was considered to be the largest vessel which could safely navigate the North-West Passage fully submerged. The total transportation concept included a submarine loading dock, so that the submarine would never have to surface through the ice.

The basic design was extended again in 1975 [3], to an increased deadweight of 280,000 tonnes. Since the deadweight had been increased, it was no longer possible to use the North-West Passage, and so the only practical route was under the polar ice cap. This study was used by several authors for comparisons with surface tankers and pipelines [4, 5, 6]. The basic concept of the design was still the same as the original proposal, with minimum pressure hull construction, a beam to depth ratio of two, and a submarine loading dock. However, since the deadweight had been increased, the idea of a trans-shipment terminal was introduced. The location proposed was one of the Norwegian fjords, which had sheltered deep water, relatively free of ice and was therefore ideal for the construction of such a terminal. This concept minimized the route of the expensive submarine to just the section covered by ice. The remainder of the journey could be completed by a conventional surface tanker.

The concept was modified by Court, Kumm and O'Callaghan [7] to carry methanol derived from Artic natural gas. The methanol was processed on a floating barge system towed north and installed near the production site for the gas. The propulsion unit was changed from a nuclear powered steam turbine to a fuel cell. The ship size was reduced to a deadweight of 160,000 tonnes, but the route chose remained under the polar ice cap, rather than using the North-West Passage. This gave the potential for diversifying into the European market as well as the United States.

Another version was given by Jacobsen and Murphy [8] where the design was modified for carrying liquified natural gas, with a non-nuclear power option. The propulsion system was fueled by methane or distilate fuel oil, but the final drive system was still a stream turbine. This reference also presented a design for a 180,000 tonne deadweight crude oil tanker, with the same propulsion unit option. The design had to be modified for the transportation of LNG since ballast water could no longer be carried in the cargo spaces. This meant the hull had to be fitted with extra pressurized ballast tanks, and was therefore less efficient than the crude oil carrier.

All the above references were derived from the initial work developed by Russo, Turner and Wood. The hull design was chosen to minimize the amount of pressure vessel construction, and hence capital costs. A midship section for this type of construction is shown in Figure 1 and a typical general arrangement in Figure 2. All of the references propose a submarine docking system for loading and unloading cargo, which is shown in Figure 3.

An alternative approach was taken by MacPhail [9] in his proposal for an LNG carrier. He suggested building the complete hull as a pressure vessel. This design left very little room for ballast tanks, and so he proposed using liquid nitrogen as ballast for the north-bound trip, which would be discharged at the northern terminal. The design was powered by a gas turbine modified to burn the boil-off from the LNG. In the paper, MacPhail presents two hull options. One is a conventional submarine and the other is a barge for cargo transportation, pushed by a removable propulsion unit, which could be transferred between barges.

The original work performed by Russ et al [1], included some model experiments to establish the basic propulsive performance of the design. Although the models used were small, the results should be useful in preliminary design. A range of hull form proportions were considered, with breadth to depth ratio varying from 1.0 to 2.5. This study showed that there was little change in form drag once the breadth to depth ratio was greater than 1.5. However, the ratio was constrained to be 2.0, so that the draught was not too great to enter conventional ports. These proportions were then used exclusively by all the other references, with the exception of MacPhail, who took the optimum solution for minimum resistance, which was a body of revolution. Spencer [10] removed the draught restriction on the form given by Russo et al, and found that the optimum resistance was always with a beam to draught ratio of 1.0. It appears that the penalty of a higher form resistance is more than compensated for by minimizing the wetted area for a given displacement. Table 1 shows a comparison of the principal dimensions of each of the submarine proposals, together with the largest military submarines currently sailing.

4. TECHNICAL EVALUATION

4.1 Hull Structure Design

Having reviewed the various proposals, we may now consider what options have the most chance of successful application, given these considerations, and potential legislation which may affect the concept. As we have discussed, the most probable application of a submarine cargo vessel will be for liquid cargos, such as crude oil or methanol. The hull structure is reasonably efficient provided that ballast water can be carried in the cargo tanks. This was the approach taken by Russo et al, and with one exception, has been generally adopted as the most feasible method. However, since that proposal was prepared, the IMO introduced legislation concerning the segregation of ballast from cargo tanks for all tankers with deadweights greater than 20,000 tonnes. It also requires the ships to have double skins, to minimize the risk of cargo spillage if the outer hull is damaged.

Although the IMO regulations do not apply specifically to submarines, it is reasonable to assume that submarine construction would not be allowed to go ahead without meeting at least the spirit of the regulations. The basic concept of the membrane hull could be extended to allow for a double skin, but it would of course have to be full of sea water for both load and ballast conditions. If the requirement for ballast segregation was taken literally, it would probably kill the submarine concept before it started. Since the densities of, say, crude oil and water are within a few percent of each other, the volume of the cargo tanks and ballast tanks would be similar. This means that the volume of the submarine with segregated ballast would be approximately twice that of the submarine with unsegregated ballast. This has the extra disadvantage that all these tanks must be pressurized, so that they can be run partly full to maintain neutral buoyancy in all conditions. The surface ship avoids this problem by running at a reduced draft in the ballast condition with virtually no degradation in performance.

The most likely solution to this dilemma is to convince the legislators that the submarine could be safely operated with a ballast water treatment plant at the northern terminal. The ballast water would be cleaned and oil residue removed, before clean water was disposed of. Several of the later authors [8, 9, 10] make allowance for the double skin in the general arrangements, but only Spencer makes any allowance for the treatment of the ballast.

The other regulation which apply to ships operating in the Canadian Artic are the Canadian Artic Pollution Prevention Regulations (CASPPR). These regulations cover such aspects of ship design as installed power, shell plating strength, and navigation and safety systems. Again these regulations are not formulated for submarines, and in this case most of the problems encountered by surface ships are avoided. It is likely that the legislation would be updated to cover hull strengths for emergency surfacing in ice covered water or grounding situations where the submarine acidentally sits on the bottom. Other areas are likely to be crew evacuation and safety systems, especially if the submarine was nuclear powered.

4.2 Main Machinery Arrangement

It is unlikely that existing fossil fuel burning systems could be adapted for use in large submarines. There are two problems with such systems. The first is the requirement for oxygen to support the combustion of the fuel, and the second is the disposal of the products of combustion. The first is solved by carrying quantities of liquid oxygen in addition to the fuel.

Although valuable cargo capacity is lost, it is technically feasible and relatively easy to implement. The second problem is potentially more difficult. Exhaust gases cannot be disposed of without compressing them to greater than the hydrostatic pressure. Since this pressure is very high the compression system is a large capital investment. One alternative to compression is cleaning systems, which would overcome combustion products and allow the exhaust gases to be recycled. Another option would be to dissolve the exhaust products in water which could then be discharged easily. Some work has been done on both these options, but again extra capital investment is required for the treatment equipment.

The one option of submarine propulsion which has demonstrated that it can operate completely submerged for extended periods is the nuclear powered steam turbine. This type of unit first came into opertion in the mid-fifties, and soon demonstrated that it could be used for under ice operation. The first submarine to sail under the Artic ice cap was the USS Nautilus in 1957. Such units could easily be supplied to provide the power requirements for large cargo carrying submarines, even allowing for the other demands on the system, such as accommodation, ballast handling pumps and other ship systems. Although most of the operational data for such ships is based on military applications, where there is considerable secrecy, there appears to be a reasonable safety record for such systems.

Although nuclear powered submarines have demonstrated that they can operate for long periods under water, there is a growing reaction against them from environmental considerations. The fuel cell is one system which shows potential for solving some of the problems of submarine propulsion without using nuclear power. The fuel cell is a device similar to the lead acid battery, but with the fundamental difference that it does not need recharging by electro-mechanical methods. Instead, the system is based on a chemical reaction. The reactants are hydrogen at the anode and oxygen at the cathode. The system is recharged by replacing the oxygen at the anode on a continuous basis, and the products of the reaction are DC electric power, water and heat. Phosphoric acid is used as an electrolyte and hydrogen is provided from a fuel source, either directly or from a hydrogen rich gas such as methane. The oxygen is provided directly. The dimensions of such a system are similar to those of the equivalent nuclear powered system, and therefore suitable for use in submarines. Although this system has only been developed on a small scale there are several potential advantages for submarine systems. The products of reaction are easy to dispose of, unlike fossil fuel burning systems. In addition the system lends itself to small scale experimentation more readily than nuclear power, and so would be more suitable for pilot projects. Possible disadvantages are the need to carry two potentially hazardous fuels, both of which are highly flammable. The development needed to realize such a system is described by Court et al.

5. TERMINAL DESIGN AND ROUTE SELECTION

There are two proven sources of oil in the Canadian Artic. Firstly there is the Beaufort Sea, and secondly there is the Sverdrup Basin, where natural gas has been the main find to date, but significasnt oil reserves have been identified. In addition, seismic surveys of Lancaster Sound and Baffin Bay look promising for future development. The indications are that the three fields of the Beaufort Sea are the most likely for initial development. There are three major markets for Canadian oil. The domestic North American market would most likely be served with an east coast terminal in Canada or the United States. The European market could be serviced from Rotterdam. The other likely market is Japan, who, with no natural resources of its own, is looking for politically stable sources of oil and gas. The Beaufort Sea is approximately the geographic centre of these three markets, with distances of approximately 3700 nautical miles to each one.

The North American ports have relatively shallow water, approximately 12m, and this would be too shallow for submarines and large surface ships. One option to solve this problem would be to use a single point mooring in deep water offshore. The vessel could tie up to the point, either a gravity based tower or a floating buoy, to discharge cargo. The European and Japanese ports have very deep water, and so access directly to the port would be possible but only in surface operation. If the route of the expensive submarine or icebreaker was to be limited to the northern section, and the journey completed in conventional surface tanker, the requirement to include a trans-shipment terminal would have to be considered.

The selection of the appropriate terminal type is important to the overall operability of the transportation system. Since the development of Artic resources is a very recent idea, there are no existing terminal facilities for surface ships or submarines. It would be necessary to construct the appropriate facility for either system. To maximize efficiency, as much construction as possible would probably be done in temperate regions and the prefabricated units would be towed to the final erection site. It is important to review the design alternatives for the various terminal options to see which would be the most feasible.

In order to avoid the complex control systems needed to maintain neutral buoyancy when loading or discharging cargo, it is preferable to design the submarine with positive or negative buoyancy for this condition. The options then become either a surface system or a submerged system. A submarine system for the Artic terminal has the advantage of never having to surface the submarine through the ice sheet. In addition, it maintains the local climate, which would be effected by the presence of quantities of open water. It also means that the amount the amount of reinforcing of the submarine hull is minimized, which is desirable when using the 'soft' hull option. However, there are

some considerations which work against the submarine docking system. Not least is the one of manoeuvring such a large submarine into a specific location underwater. The inertia of such a vessel is considerable, and docking procedures would have to be initiated up to 35 km away from the site. A sophisticated network of sonar sensors linked to the ships control system would be needed to direct the submarine onto its dock. Since any failure of this system could be catastrophic, there would have to be fail-safe back-up systems with high levels of redundancy.

The cost of the submarine and surface terminal options may not be greatly different. As discussed above the submarine tanker would not be effective unless it could carry cargo in ballast tanks. It would therefore need some facilities at the terminal for cleaning and storing dirty ballast water to meet IMO regulations for ballast discharge. The surface ship option would however, need to be equipped with larger storage tanks than the submarine system, since the probability of the tanker not being able to get to the dock would be higher. Similar considerations would have to be made for the unloading or trans-shipment port at the southern end. Since this is likely to be in ice-free water some of the above considerations are irrelevant. If conventional terminals could be adapted to submarine cargo ships there could be some potential cost savings. However, since these ports are usually very busy, it would be necessary to surface a long way from the terminal to avoid collisions. In addition, if a submarine loading system was used at the northern end, it would mean the added complication of having the ship negatively buoyant at the northern end, and positively buoyant at the southern end.

There are several factors which must be considered when selecting the route for the submarine. The submarine must have adquate water depth for safe navigation. It is important to consider both the clearance between the keel of the vessel and the ocean floor and the clearance between the top of the submarine and the bottom of the ice cover including pressure ridges. A reasonable clearance in each direction would be one hull depth, making the minimum hull water depth between the bottom of the ice and the ocean floor three hull depths. This may be too small to avoid the effects of the boundaries on the fluid, and so the preferred water depth would be up to seven hull depths, for the majority of the route.

If we take this depth of water, we find that two possible routes from the Artic are not feasible for submarines. There is insufficient water depth in the North-West Pasage and the Bering Strait for the safe operation of submarines. This leaves the only possible route to be under the polar ice cap. So the shipping of Artic oil to Japan by submarine is not likely to be economical, simply because of the geography. As already discussed it would not be easy to provide submarine access to conventional ports, and so a dedicated deep water trans-shipment terminal would have to be considered. There are two possible locations for such a terminal. One is in Trinity Bay, Newfoundland, and the other is Bodo,

Norway. Both ports have very deep water, are sheltered, and relatively ice free. The trans-shipment terminal could be surface or submerged depending on what option was chosen for the northern terminal.

Other considerations for the route can be related to social, environmental and economic factors. The route should create as little disturbance as possible to the delicate Artic environment, and especially breeding grounds for animals and fish. Busy shipping lanes and areas of offshore activity should be avoided, and so should areas of high iceberg concentration. All of these factors indicate that a route under the polar ice cap to Norway, or around Greenland to Newfoundland are the most suitable for submarines.

The discussion above relates entirely to the technical aspects of the design of a submarine transportation system. It appears that the system is feasible, allowing for a reasonable extrapolation of existing technology. However, there is only one practical route for a submarine tanker, and that is directly under the polar ice cap, as shown in Figure 4.

6. ECONOMIC EVALUATION

Having determined that a submarine transportation system is technically feasible, we must now review its operating economics in relation to the surface ship and pipeline options. The initial work by Russo et al [1] did not make any attempt at any economic evaluation. There was some discussion when the paper was presented, which indicated that the submarine option would be up to 4.5 times more expensive than the equivalent surface tanker. It is important to remember that this was not based on Artic operation, and so the surface tankers were only to normal specification. In addition, it was before the IMO legislatiion was introduced, and so the tanker construction costs would be lower than the equivalent IMO tanker today.

Jacobsen [2] compares his two submarine proposals with an icebreaking surface tanker, of 250,000 tonnes deadweight. Although there were only two submarines and one icbreaker, the study presented the required freight rates for a range of acquisition cost and ship speed for each case, In general the acquisition cost of the submarine option was more than twice the cost of the surface icebreaker. However, if the surface tanker could not average a speed of more than six knots, the submarine option should have a lower transportation cost. If the surface tanker can maintain an average speed of between 6 and 10 knots the two systems are comparable. It is difficult to establish absolute values, since no details of the economic evaluation are given. also, no allowance is made for the capital cost of the terminals at either end of the route.

The basic design prepared in [3] was used for three seperate comparisons with alternative transportation methods. Taylor and Montgomery [4] compare the submarine tanker, using either a direct route to the Eastern Seaboard or trans-shipment in Norway, with an icebreaking tanker and a pipeline. The icebreaking tanker uses either a direct route through the North-West Passage, or trans-shipping to conventional tankers in Greenland or Iceland. The pipeline options are either trans-Alaska with tankers to the eastern seaboard, or trans-Canada directly to the east coast. The results showed that even though the capital cost was approximately twice that of the surface ship, the required freight rate for the submarine system was comparable to the icebreaking tanker. If we use the icebreaker as the standard for both ships going direct, the submarine option was 17% higher than the surface ship. If trans-shipment was used, the submarine was 8% lower. The pipeline is considered to be up to 55% higher than the best surface ship option. The same information was presented by Montgomery and Jordan [5], but with the addition of a mobile trans-shipment terminal. This shortened the route of the submarine, and reduced the required freight rate of the submarine to 16% below the surface icebreaking tanker.

Several surface ship options were compared with the submarine system by German, Macpherarson, Meakin and Park [6], for carrying crude oil or methanol from the Beaufort Sea to the Eastern Seaboard. The surface ship options were divided into two basic categories. The first consists of Class 3 tankers loading in the Beaufort Sea, and travelling westward through the Bering Strait. These then had the option of trans-shipping at the Unimak Pass, lightering into vessels capable of going through the Panama Canal, or going around Cape Horn, to ports on the Eastern Seaboard. The second option was to use Class 8 tankers through the North-West Passage, directly to the Eastern Seaboard, or trans-shipping in Greenland. The submarine option was as described above in [4]. The surface ship sizes were varied form 60,000 to 400,000 tonnes deadweight for the crude oil option. The methanol option assumed that the ships would be the same size, but the deadweight range would be reduced to 54,000 to 360,999 tonnes. The results showed that the required freight rate for the submarine and the Class 3 icebreakers were comparable if the cargo was crude oil. The Class 8 tankers were slightly more expensive, by about 20%. If the cargo was methanol, the submarine was approximately 12% more expensive than the best Class 3 tanker but the submarine and the Class 8 tanker had similar required freight rates. Another option was considered for the surface tanker, and that was LNG carriers of the same classification on the same routes. This was not compared with the submarine since these authors did not consider it economical to ship LNG by submarine. The ship sizes for LNG varied between 75,000 and 175,000 cubic metres. The surface ship route options are shown in Figures 5 and 6.

The analysis of the methanol carrying tanker given by Court et al, using the polar route and trans-shipping in Norway, concludes that it is more economical to ship by submarine than by surface ship. It also considers it to be more economical to ship methanol from the Artic by submarine than by conventional tanker from the Persian Gulf. The rider to the study is that it is only economical to ship the methanol by submarine if it is used as an automobile fuel or additive, based on the cost of gasoline at the time of the study. There are, however, substantial reserves of natural gas in southern Canada and the United States, which could also be processed for automobile fuel. Although not covered by the study, intuitively one feels it would be cheaper to produce methanol from these sources rather than from Artic gas. In addition, it concludes that shipping LNG directly would not be cost effective.

The results of the economic analyses generally agree that shipping of Artic crude oil or methanol by submarine is comparable with the icebreaking tanker, but it shows no significant advasntage. It is also accepted that the acquisition cost of a submarine is much higher than a surface ship of equivalent deadweight. There is some contradictory evidence, for example the transportation of methanol, but even in that case neither system appeared to have a significant advantage over the other. Neither of the proposals for the shipping of LNG by submarine directly [8, 9] include an economic analysis, but other authors [6, 7] state that it would not be economically viable when compared to other technical options. It is difficult to make a full review of the economics, since very little data is given in the references, but it is hoped that the relative comparisons within a given reference are not biased in favour of one system or another. The one independant study available was given by Spencer, and this also indicated that the submarine system had a lower required freight rate for the transportation of crude oil than surface icebreaker.

7. THE FUTURE OF SUBMARINES FOR ARTIC TRANSPORTATION

It appears that the Artic submarine is technically feasible given the current state of the art of the major ship systems, and there is evidence to indicate that it could be at least as economical a transporation system as the surface icebreaker. The final question to ask is, will it be accepted by the industry as a reasonable alternative to existing systems? The transportation of natural resources from the Artic by submarine represents a new concept in transportation systems. It is also a complete departure from techniques which have evolved from the shipping industry, such as ice breaking bulk carriers or pipelines. These systems have demonstrated that they are able to operate in the Artic environment. The economic evaluation of the concept suggests that to be competitive with surface ships, the submarine must have a submerged volume at least ten times larger than the

largest submarine built to date. Since this step is so large, it would be more likely that an uneconomic pilot project would be built to develop the design, construction, and operating techniques on a smaller scale.

Even a pilot project could experience some difficulties. The reduced size may simplify hull construction, but the selection of propulsion unit may pose some problems. The only propulsion unit which has demonstrated that it can operate in a polar environment under water is the nuclear powered steam turbine. The disadvantage of such a unit is that it is not economical for small scale operation, since its capital cost per unit of power is much higher than the equivalent non-nuclear system. The fuel cell system may be preferred since the environmental risk is smaller, and it would be easier to produce a small scale unit, but more development work would have to be done in order to provide a functioning system of the powers required. An existing military system of nuclear power could be used, but this would not provide the required power output, unless the pilot project was for a very small design, or a substantial loss of speed was accepted.

The submarine is a very inflexible system. The requirement to maintain neutral buoyancy means that the hull structure, cargo type and ballast arrangement must be very carefully tuned. This means that it is difficult to change cargo type, even between different liquids such as crude oil and methanol. In addition there is only one practical route out of the Artic ocean which can be guaranteed to have sufficient water depths for all ice conditions, and that is directly under the polar ice cap. An icebreaking bulk carrier however, if built to the appropriate ice class, could navigate any of several routes out of the Artic ocean, and if necessary, it could also carry several cargos. The M.V. Artic was recently converted from a dry bulk carrier to a combined oil and bulk cargo carrier. The surface icebreaker could carry a wide variety of equipment on deck which would resupply northern social and industrial requirements. This would be extremely difficult to incorporate into a submarine design.

The economic evaluation of the submarine concept is based entirely on estimates. None of the studies published are beyond the feasibility stage, and so detail design work still has to be done. The TAPS when finally completed cost approximately five times the original estimates, but now there is expertise and experience in that field. Similarly for the icebreaking tanker, there is a certain amount of experience, based on supply boats, government icebreakers and one bulk carrier. There is no actual data for the construction costs of a submarine cargo ship together with the terminal and trans-shipment ports. It is likely that there will be unforeseen complications and costs, which could well make the submarine system less competitive than the surface ship.

Given all the above considerations, it is extremely unlikely that a submarine system would be used in the initial development of Artic resources. The system could be more efficient than a surface system, but it is unlikely that any company would take a risk with so much unproven technology until the development of the Artic is more established. Perhaps the best hope for the submarine lies with the legislators. The advantage of the submarine is that it can operate without disturbing the surface ice. Any disruptions to the surface ice conditions could permanently change factors such as breeding grounds for wildlife and hunting and transportation patterns for Inuit. If legislation was passed to prevent the disturbance of the Artic environment, then the submarine would be the system with the least disruption to the delicate Artic infra-structure.

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TABLE 1

PRINCIPAL DIMENSIONS OF SUBMARINE PROPOSALS

REFERENCE	CARGO CAPACITY	CARGO TYPE	LENGTH (m)	BEAM (m)	DEPTH (m)	SUBMERGED VOLUME (m_3)	INSTALLED POWER (kw)
Typhoon Class (USSR)	-	-	170.0	23.0	11.5	24,500	60,000
Ohio Class (USA)	-	-	170.7	12.8	10.8	18,200	45,000
[1]	20,000 DWT	P	170.0	24.0	12.2	46,000	14,000
[1]	40,000 DWT	P	216.4	36.6	12.2	79,000	53,300
[2]	170,000 DWT	C	274.0	42.7	26.8	248,000	101,000
[2]	250,000 DWT	C	310.0	52.0	28.5	361,000	101,000
[3]	278,000 DWT	C	304.8	54.9	29.0	414,000	84,000
[7]	160,000 DWT	M	260.0	46.6	24.7	260,000	160,000
[8]	180,000 DWT	C	311.0	51.8	24.7	368,000	74,500
[8]	140,000m^3	LNG	448.0	74.3	28.6	721,000	74,500
[9]	52,000m^3	LNG	213.4	24.4	24.4	83,000	15,000
[10]	440.000 DWT	C	335.0	50.0	50.0	714,000	112,000

CARGO TYPE - C: Crude Oil
LNG: Liquified Natural Gas
M: Methanol
P: Petroleum Products

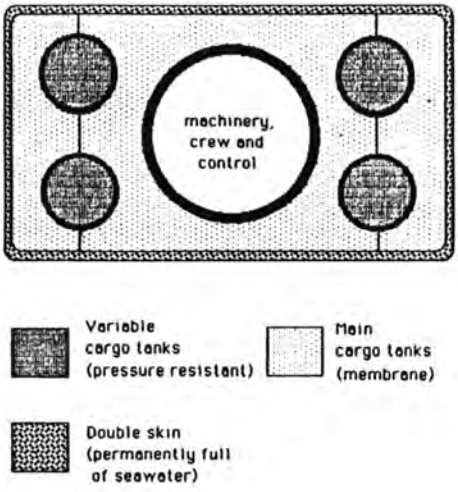


Figure 1

Midship Section Through Membrane Type Submarine

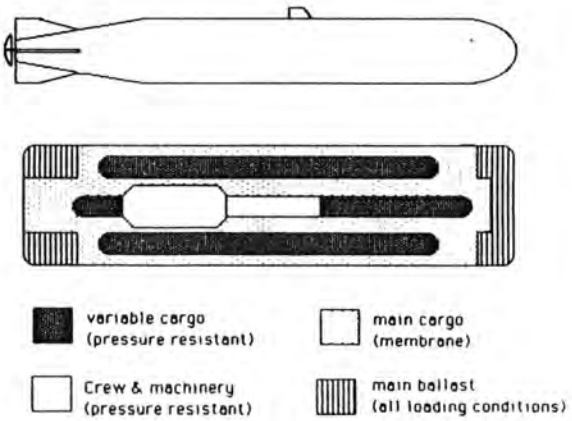


Figure 2

General Arrangement - Membrane Construction

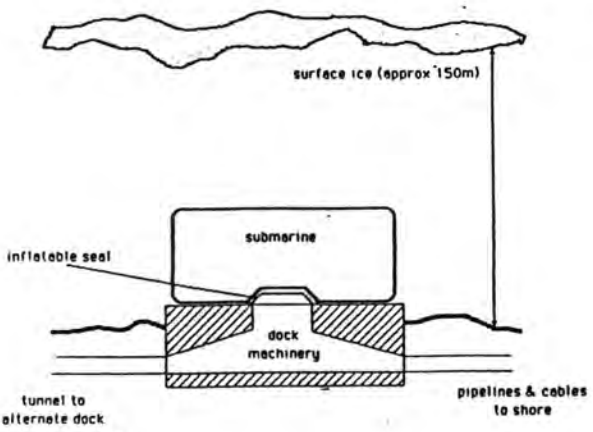


Figure 3

Submarine Docking Arrangement



Figure 4

Routes for submarine tankers



Figure 5

Routes for Class 3 tankers

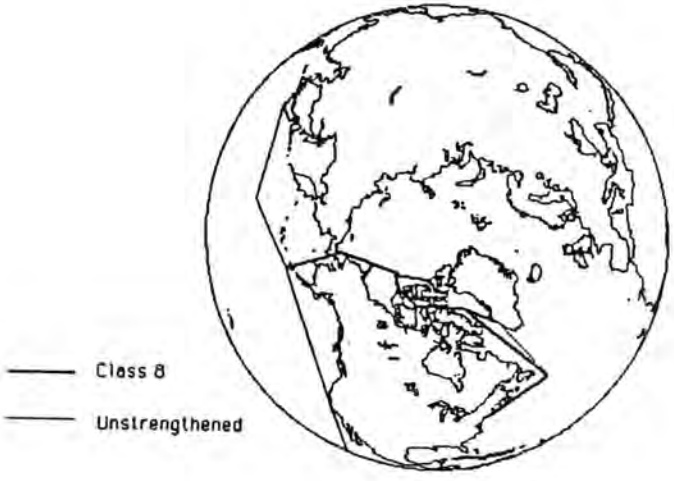


Figure 6

Routes for combination of
Class 8 and Unstrengthened
tankers

PRIVATIZATION OF THE KINGSTON METROPOLITAN REGION PUBLIC PASSENGER TRANSPORTATION SYSTEM

by
Dennis Wheatley and Amin Ebrahim*

ABSTRACT

The public passenger transportation system in Kingston, Jamaica used to be provided by a government owned and subsidized bus company, the Jamaica Omnibus Services Ltd. (JOS). However, because of the deterioration of JOS in the 1970's and the relative vigour of the private sector in operating minibus services, the Government of Jamaica decided to privatize public transport operations on 1st January, 1984. The paper presents background to this privatization and gives an assessment of the success and problems of the new system from 1984 to 1986, its first two years of operation.

INTRODUCTION

The provision of public passenger transportation in Kingston, Jamaica is essential. This service used to be provided by a Government owned and subsidized bus company, the Jamaica Omnibus Sevices Limited (JOS). However, because of the deterioration of JOS in the 1970's and the relative vigour of the private sector in operating minibus services, and in keeping with its policy of reducing the role of the public sector in the economy, the Government of Jamaica decided to privatize public passenger transport operations on 1st January, 1984. This was undertaken in the Kingston Metropolitan Region (KMR), population 650,000, and in the resort city of Montego Bay, population 60,000, where another Government owned bus company was experiencing similar difficulties.

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* Views expressed in this paper are those of the authors and are not necessarily those of the Government of Jamaica. Both authors were consultants to the Government of Jamaica. Dennis Wheatley is a British Government transport consultant on loan, until 1985, to the Transport Authority. Amin Ebrahim is a Canadian transport economist and was on leave from the Federal Government, until 1986, to work with the Jamaican Ministry of Construction (Works).

ERRATA SHEET

page 451. The first sentence of the fourth paragraph should read:

Of 57 single driver operations, 29 (Group A) completed the trip in an average of 18 hours, while **28** (Group B) averaged 27 hours.

page 607. The footnote should include:

The research from which this paper was drawn was funded by the Institute for Research on Public Policy which has been provided with a grant by the Government of Canada (Department of Regional Industrial Expansion) to support research in the area of the international trade aspects of the Canadian service sector.

This paper presents the background to the new system and gives an assessment of its successes and problems during its first two years of operation.

BACKGROUND

Jamaica Omnibus Services Limited (JOS) was established in 1953 by a private passenger transport company. It operated successfully in what was then a much smaller area. Latter, with the expansion of Kingston, JOS grew such that by 1975 it had a fleet of almost 400-44 seat buses. In that year, the company was taken over by the Government. The reasons given for the take-over were:

- poor and unreliable service due to downturn in fleet availability resulting from lack of vehicle maintenance.
- on going financial losses.
- crisis in staff morale with attendant industrial relations problems.

These problems were similar those which had in many other countries led to the collapse of private operators and to the public take-over of many of the municipal transit systems, namely:

- an obligation to operate longer routes to less densely populated areas.
- the denial of a profitable fare-structure.

In effect, in 1975 the Government took over a moribund operation. From 1975 to 1982, the Government purchased over 300 new buses including 160 largely untried sophisticated omnibuses designed especially for developing countries which were a complete failure. Furthermore, due to Jamaica's economic difficulties, there was a shortage of foreign exchange to purchase spare parts. The result was a deteriorating cash flow from reduced revenues and increased costs. At the same time, employment was maintained at previous levels, thereby imposing relatively more and more overhead costs.

Despite the deteriorating service, the demand for public transport had been steadily increasing so that in 1974 JOS was carrying 140 million passengers a year. While the demand was on the increase, the service continued to decline with a daily fleet availability figure dropping to an average of 220 by December 1980.

The decline in the JOS service was due to the massive influx of minibuses as a mode of public transport. To control the minibus operations, the Government introduced a franchise system, whereby the minibus operators paid JOS a fee to operate on designated routes, thereby leaving to JOS the remainder of the routes. However, the licenced as well as illegal minibus operators pirated on JOS's exclusive routes. To make matters worse, the minibus operators generally left JOS to carry school children at reduced fares. Because of these and other factors, the compromise arrangement with minibus operators was not successful.

Surveys undertaken in 1977 revealed that minibuse use had increased to account for one-third of passengers carried. JOS carried the other two-thirds. By 1982, JOS was operating only 140 buses a day and carrying only 20% of total passengers thus losing heavily because one-half of its passengers were school children and because it continued to employ relatively high number of personnel more appropriate for a much larger fleet.

In effect, by 1982, 80% of Kingston's transit system had been privatized. What remained was to restructure and improve the quality of the system, particularly to improve reliability, safety and comfort of the service.

THE PRIVATIZATION PROCESS

The decision to privatize reflected the Government's determination to improve the efficiency of the system and make it more sensitive to the demands of passengers. On December 31, 1983, the Government ordered JOS to cease operations and dispose of its assets, instituted a revised route structure to 61 routes by amalgamation from 70 routes, and handed over the service to sub-franchises.

Establishment of Sub-Franchises

Legislation was enacted to make JOS the sole franchise holder of the KMR public passenger transportation system until year 2005. JOS's function now is to sub-franchise routes to private operators, who for a fee, provide the service. Currently, JOS has a Government appointed Chairman and a board of directors.

The revised route structure was organised into 10 sub-franchise areas (packages), each of which was designed to encourage competition and to contain profitable and less profitable routes. Thus, packages

have no geographical exclusivity.

A local firm of consultants was hired to assist in carrying out the Government's decision to privatize. The firm compiled and advertised an information package which gave details of the new system and enticed interested parties to apply for a sub-franchise.

The interested parties could apply for one or more of the packages and were interviewed by the consultants. A shortlist was prepared. The Ministry of Public Utilities and Transport then reinterviewed the shortlisted applicants and eventually selected the successful candidates. The successful applicants were offered a sub-franchise in exchange for a fixed fee, payable annually, based on the number of passenger seats ascribed to the particular sub-franchise area. The fees are payable to JOS and are used to provide funding for the Transport Authority.

No subsidy of any kind is granted to sub-franchise holders, except that the importation of buses is allowed free of duty. The sub-franchise system offers to the holders the security of operational rights for six years.

Responsibilities of Sub-Franchisees

The responsibilities of the sub-franchise holders are outlined in the Sub-Franchise Agreement and generally require provision of an efficient and reliable public passenger transportation service 16 to 18 hours a day on the assigned routes. A route chart is required to be exhibited in a conspicuous place in the buses, schedules are to be observed, discrimination in picking up passengers by reason of their age or handicap is forbidden and fares as prescribed by the Ministry of Public Utilities and Transport are to be charged.

Furthermore, the sub-franchise holder is expected to provide proper maintenance to the buses, hold public liability insurance, and formulate and enforce rules for the guidance of drivers and conductors on discipline, public relations, personal appearance and safety of passengers.

Finally, the sub-franchisee is responsible for the operation of his package by using his own buses or allocating his routes to sub-sub-franchisees. To obtain road licences for his sub-sub-franchisees, he has to make recommendations to the Transport Authority. He also has to monitor the operation of his package(s) and report regularly to the Transport Authority.

THE TRANSPORT AUTHORITY

The Transport Authority is the Government's public transportation regulatory arm. When legislation is finally in place, probably in 1987, it will be a statutory body with the power to control and monitor the sub-franchises and sole responsibility for bus inspection and licencing. Currently, the Authority operates under the Ministry of Public Utilities and Transport but will eventually be administered by a board of directors and chairman appointed by the Minister of Public Utilities and Transport.

The Transport Authority is responsible to monitor the performance of sub-franchisees and sub-sub-franchisees. The Transport Authority grants road licences for buses, recommends to the Minister fares to be charged, keeps a national motor vehicle register and informs the sub-franchisees and the police of traffic violation. Route inspectors will play a key role in the Authority's monitoring activities and will be able to exercise considerable authority over the minibus operators under the new legislation.

The Authority has a Research and Planning Department responsible for creating an information data bank to plan for future requirements such as seat capacity, type of bus and frequency of service based on changes in demand.

It is under the guidance of the World Bank that the Government decided to privatize the public passenger transportation system. Accordingly, technical assistance provided by the World Bank to the Authority aims at constantly reviewing transit development and policy, developing a methodology for reviewing fares, developing a process for supervision of sub-franchises, and providing operator training and guidance.

THE IMPACT OF PRIVATIZATION

Whereas privatization has had some distinct benefits, the current system is still plagued with many original and some new problems.

Benefits of the New System

The changeover of the system on 1st January 1984 was largely successful. The major advantage of the new system is that the Government subsidy has been eliminated, except for the importation of buses free of duty. Another advantage is the stability of fares.

since both the Government and the package holders favour continuing the current level of bus fares as long as is practicable. The system is also tending towards a standard 29 passenger-type midi-bus in place of various sizes of small and big buses. People are being moved better and faster than before, complaints have fallen significantly, and public image of the Transport Authority has been enhanced.

Problems of the New System

The new system has a number of problems. The system has resulted in an improvement in service, safety and comfort, however, further improvements are necessary. For example, safety and comfort are being sacrificed by overloading. A midi-bus with a seating capacity of 29 and a standing capacity of 14 is often loaded with more than 70 passengers. School children are still being discriminated against, although less so than before, because they pay low fares, as are the passengers on longer routes where there is a tendency to short-circuit the route. Bad driving habits are a further shortcoming and many buses are not maintained properly.

Another problem is illegal buses or 'robots', as they are called in Jamaica, which still operate in the system and deprive legal operators of revenue. Still another problem relates to the issuing of tickets which is hardly ever done, thus conductors and drivers often overcharge passengers and it has been claimed pocket some of the days' takings instead of handing everything to the minibus owners.

Other problems are lack of cooperation between the 10 sub-franchise holders, and amongst their sub-sub-franchise holders, exasperated by fare anomalies (especially in the semi-rural areas), pirating on routes by robots and other sub-sub-franchise holders, and the risk of armed robbery on some routes, especially at night.

However, the greatest problem is the control and policing of the system. Both the Transport Authority and the traffic police have limited direct control over the franchise operators because of the hierarchical structure of the new system resulting in lack of accountability.

CONCLUSION

To date, some major benefits which have been achieved are: the minibus operators have been legalised; the Government subsidy has been eliminated; and passengers are being moved better and faster than before.

The public transportation system is far more efficient than prior to the privatization. In 1982, the system had 100 large buses and 1000 minibuses, all operated privately, assisted by 160 JOS buses. In March 1986, the system has 1000 midibuses and approximately 1000 minibuses. However, the goal is to achieve still higher standard of service, safety and comfort.

It seems clear that a centre of population as large as KMR, having such heavy demands on the public transportation system (240 million passenger journeys per year), requires better service than is now offered to the public.

The Transport Authority is directly responsible to control, monitor, inspect and enforce its regulations, however, it has not been able to effectively exert authority due to delays in legislation to give it "legal status" and the complications of the hierarchical nature of the franchise structure.

Other innovations which are planned include the introduction of a system of ticketing and time tabling/scheduling, and training and education of the operators and their employees by the Transport Authority to influence drivers, sub-franchise and sub-sub-franchise holders to improve their performance. Drivers need to be trained to improve their skills, conductors need to be trained for behaviour, and the operators to maintain their vehicles.

Finally, the new system has the potential for developing into a much better service if both Government and package holders assume the proper management, support and advisory roles. This implies that proper management, training and monitoring of the system be carried out continuously with periodic reviews to gauge the progress made. Targets should be set and be clearly enunciated, and these should be discussed and explained by the Transport Authority to the package holders. Furthermore, there is a need to create and promote harmony between package holders because almost all routes share a part of their journey with route(s) from neighbouring packages.

All in all, the move to privatization has been successful for the public passenger transportation system in KMR. With improvement in the franchising procedures, there is potential for further improvement of the system.

TRANSIT SERVICE DISTRIBUTION

EVALUATING LEVEL OF SERVICE

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1.0 Introduction

Municipal public services compete for scarce government funding at both the provincial and municipal levels. Government subsidization is prevalent in the financing of urban public transit systems and has prompted the need for a systematic framework to analyse transit level of service by geographic area and urban population segmentation. The results of such an analysis addresses some of the distributional equity questions such as "who receives the transit services" and "who pays for urban transit". Equity oriented data will provide an information base for decision-making when funding levels are being set and budgets being established.

A procedure to evaluate distributional equity of urban public transit was developed for the regional transit system (Metro Transit) in Halifax, Nova Scotia in 1985. The procedure is applicable to other Canadian transit systems and indeed can be adapted to analyze distributional issues for most 'measurable' urban public services. The two main data requirements for this analysis are transit operation statistics and demographic (Census) characteristics. The locations and frequencies for Metro Transit's 39 bus routes formed the basis for assessing the supply of transit service available to area residents. Geographic and socioeconomic segmentation was carried out using a combination of data sources: 1981 Statistics Canada Census, a 1981 Regional Transportation Travel Demand and Household Survey (1) and 1985 demographic statistics.

Metro Transit serves the four municipal units of Halifax, Dartmouth, Bedford and the urban portion of Halifax County. For analysis purposes, the region has been subdivided into 129 traffic zones. These zones are also aggregated into 19 residential areas for ease of presentation and comparing data results for this paper.

2.0 DEFINING THE POPULATION

Using various social and economical indicies, the urban population was defined both spatially and by socioeconomic status (SES). The Blishen Scale (2) was employed which assigns a numerical value to a population group based on reported occupation. The value represents each occupation's level of education, income and prestige. The 1981 Canada Census data set of 22 occupational groups by sex and by census tract is the information source used in the calculation of the Blishen Scale for the Metro Transit area. Figure 1 shows the data manipulation process used to derive an average SES for the traffic zones.

500 Blishen Scale Occupations (by sex)
↓
22 Major Occupational Groups as defined by Statistics Canada (by sex)
↓
Labour Force 15 years and over by Major Occupation Groups (by sex) for Metro Area
↓
Weighted Average SES (by sex)
↓
Weighted Average SES by Census Tract
↓
Average SES by Traffic Zone (using conversion factor)

Figure 1. Socioeconomic Status Calculation Procedure

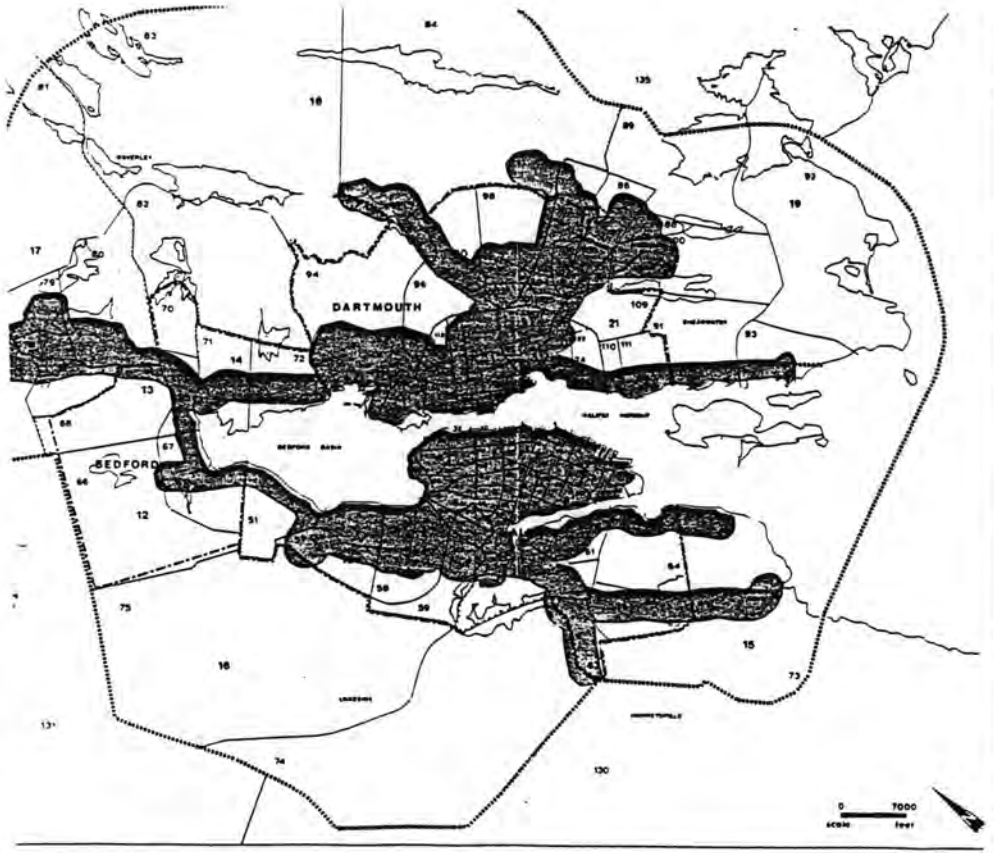
The choropleth diagram (Figure 2) depicts the Metro region using the Blishen Scale. Note that these values have been updated to reflect 1985 demographic statistics. Similar visual displays of the Metro Transit area can be produced based on population and employment densities, family income levels, age and other characteristics.

3.0 DEFINING THE LEVEL OF TRANSIT SERVICE

For the purposes of this research, level of transit service was defined as transit capacity and accessibility for a given geographic area. Transit capacity or the number of available transit seats for a given time period and transit travel time for area residents are the yardsticks used to define level of service. A ribbon or catchment band was used. This assumes that a transit route within 450 metres (as the crow flies) is considered accessible. Figure 3 shows those portions of the Metro region which are within the defined transit service catchment area.

Transit capacity was calculated using transit segments or links which were defined for the entire Metro Transit system. Using a computer program designed for this research, the number of available bus seats per hour was tallied for each transit segment within each traffic


Figure 2
Distribution Of SES By
Traffic Zone
Socioeconomic
Status
> 52.00
50-52.00
48-50.00
46-48.00
44-46.00
42-44.00
< 42.00
DARTMOUTH
BEDFORD



Halifax - Dartmouth Metropolitan Area

LEGEND

Study Area Boundary

Municipal Boundary

Transportation Zones

Transit Catchment Area

Figure 3
TRANSIT CATCHMENT AREA 1985

Prepared by : OPERATIONS PLANNING GROUP

Date : AUGUST 1985

GALLERY

zone. A series of transit route frequency data sets were accessed depending on the time of day and day of week. These data files therefore consisted of the segment numbers within each traffic zone, the routes operating on each segment and the route capacity (frequency X bus seats per unit) for each time period.

Service coverage for a traffic zone was considered to be the percentage of the area's population within the transit catchment band. Therefore the level of transit service or transit capacity was weighted according to the population served and correspondingly, areas which were not totally within the 450 metre 'ribbon' had reduced level of service.

The level of transit service capacity can be summarized by the following equation:

$$\text{Level of Service}_N = (\text{Cap.}_j^i)_N \quad X \quad \text{Cov.}_N$$

where: $\text{Level of Service}_N$ is the # of bus seats available to area N

Cap._j^i is the transit capacity for segments i through j in area N

Cov._N is $\left\{\frac{\text{population served}}{\text{total population}}\right\}$ of area N

This simplified equation was applied to various time periods of the day and days of the week to yield summaries of transit level service capacities. The calculations were written in Basic, however the data sets were created using Lotus spreadsheet files. This allowed the data to be easily updated as transit route frequencies changed or populations increased.

While level of transit service measured in terms of capacity provides an indication of the supply of transit available to area residents, it does not reflect the actual travel trip patterns and trip times. Using an accessibility algorithm, existing trip patterns can be simulated resulting in plots of cumulative frequency diagrams of transit travel times for an area. Essentially, the computer program was designed to randomnly select origin-destination pairs from a data set, however the data was weighted according to actual travel patterns in the Metro area. For instance, if 40 percent of all transit travel from Area i is to/from Area j, then the probability that origin-destination pair ij is selected would also be 40 percent. The cumulative frequency diagrams for each area provided a visual comparison of the trip times involved in transit travel for different areas. Figure 4 illustrates the results of comparing three areas in Halifax-Dartmouth which are a similar distance from the downtown business core. If one considers 60 percent of all transit travel as the criterion for comparison, then Area A has superior travel times or accessibility than Areas B and C.

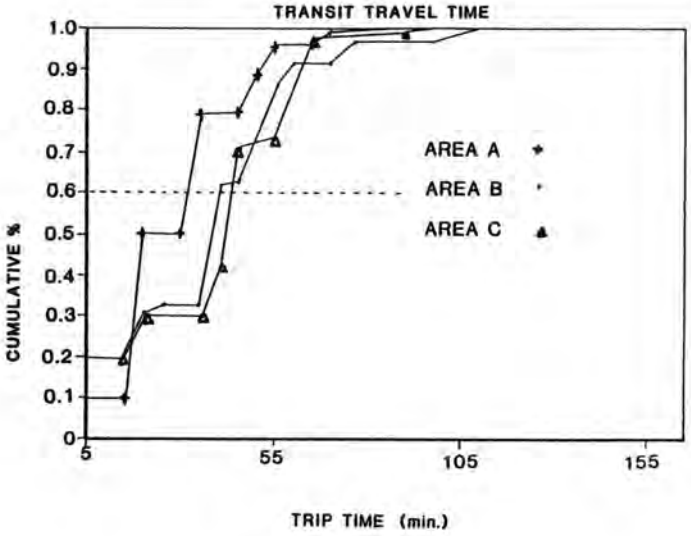


Figure 4. Accessibility

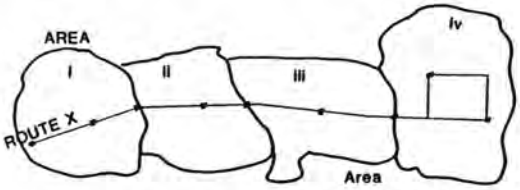
Another measure of transit supply is the amount of route kilometres within the boundary of a geographic area. Odometer readings for each route were allocated to the areas in which they were incurred. Metro Transit maintains an inventory of route kilometres, however similar data could be collected with the use of a planimeter and a system map or computer storage of the x and y coordinates of digitized routes. "Deadhead" or non-revenue kilometres were divided among the areas which a route travelled according to the percentage of revenue kilometres in each area by route. In this way, no one area at the terminal points on each route bore the majority of deadhead kilometres.

4.0 DEFINING TRANSIT USAGE

For all transit operations, the predominant productivity measure is system ridership. Either a system wide or route level, ridership statistics provide a meaningful indication of performance and transit usage. For an area by area analysis however, ridership must be further refined to indicate where passengers alight and board each route. Electronic farebox and passenger counting systems are available which can allocate passenger ridership to a specific bus stop location. For area analysis a less sophisticated method of data collection was used, ie. the passenger loadcount surveys. Loadcount surveys or on/off counts are normally gathered on a route by route

basis for various station points. From the loadcount data, annual passenger ridership (revenue plus non-revenue passengers) figures by route can be allocated to specific areas based on the percentage of route ridership boarding in each area. Figure 5 illustrates the accounting procedure used to divide passenger loads by area.

Figure 5 illustrates an ideal situation where loadcount stations are located on the area boundaries. In reality, as in the Metro Transit system, the data collection stations do not conform exactly to area boundaries and thus the information was massaged to reflect actual passenger loading in each of the 19 residential areas.



Route	Date	Time	i	ii	iii	iv	iii	ii	i
X	85-01-23	7:03	25	13	22	6	3	2	4
		7:18	22	6	7	4	2	1	6
		7:33	12	4	3	4	2	4	8
		⋮							
		23:03	2	0	4	13	7	2	1
	85-07-12	7:03	22	8	6	2	8	5	9
⋮		⋮							
		TOTAL T	t_i	t_{ii}	t_{iii}	t_{iv}	t_{iii}	t_{ii}	t_i
		%	$\frac{t_i}{T}$	$\frac{t_{ii}}{T}$	$\frac{t_{iii}}{T}$	$\frac{t_{iv}}{T}$	$\frac{t_{iii}}{T}$	$\frac{t_{ii}}{T}$	$\frac{t_i}{T}$

Figure 5. Allocation of Passenger Ridership by Area

Passenger ridership was recorded for each area at the station of boarding, therefore a return trip from a suburban area to the downtown core would be allocated as a trip in both trip end location areas. The ridership summaries therefore indicated a high percentage of trips accredited to major trip attraction centres such as the CBD.

A more elaborate and expensive method of defining transit demand is through household surveys of transportation patterns. In 1981, such a Travel Demand Survey was carried out in the Halifax-Dartmouth area. From this survey, origin-destination tables were produced including transit travel tables. From the O-D table transit trips or transit usage can be tallied on an area basis. To update the O-D table through correlation with annual ridership data, the base year O-D table must include all transfer transit trips, not just the travel trip ends. Therefore the O-D survey questionnaire should be structured to include origins and destinations as well as the

transfers required to complete each transit trip.

The travel demand survey results also provided transit trip generation statistics such as trips per household, by sex and income group, travel patterns by time of day, and trip purpose. This type of comprehensive study clearly defines transit usage patterns and provides a good socioeconomic breakdown of the transit patrons.

5.0 ANALYSIS OF TRANSIT SERVICE DISTRIBUTION

Three factors have been described which form the basis for transit service distribution analysis:

1. area socioeconomic description
2. transit supply by area
3. transit demand/usage by area

A comparison of these elements yielded interesting results pertaining to the supply and demand of urban public transit in the Metro area.

5.1 Area Description

The urban area of Halifax-Dartmouth can be considered a 'typical' urban centre with suburban sprawl surrounding the central business core. However, the suburban areas tend to have lower SES values than the older residential areas located in the Halifax Peninsula as shown in Figure 2. Because of the distances involved from the suburbs (lower SES) to the business districts, there is little positive correlation between SES and the numbers of automobiles that a family owns. The general trend is that higher SES populations own more than one vehicle, but our regression analysis of this aspect did not prove to be statistically significant. As expected, higher SES population areas have corresponding high income levels. Table 1 details some of the results of the simple regression analysis of these socioeconomic variables.

In addition, crosstabulation results indicated that the majority of elderly persons live nearer the downtown core and youth populations are greater in the suburban areas. These two transit dependent groups are therefore situated at different geographic locations in the Metro Transit area.

5.2 Transit Level of Service

A comparison of transit supply and the socioeconomic status of area residents did not yield results which were not statistically significant, but did indicate trends. Thus on a global basis, transit in the Metro area was not distributed to favour particular SES population groups. The data trends indicated that with increasing SES, transit capacity also increased. This can be verified by the fact that as distance to the CBD lessens, SES increases and transit capacity increases. The level of service capacity distribution by time of day for weekday periods followed a

Table 1

Socioeconomic Variables
Simple Linear Regression Results*

Variables	Correlation Coef. r	Level of Significance**
SES-Household Income	(+) 0.825	1%
SES-Low Income Families	(-) 0.560	1%
SES-Population Density	(+) 0.129	REJECT
SES-Elderly Population	(+) 0.185	REJECT
SES-Distance to CBD	(-) 0.386	1%
SES-Auto Ownership	(+) 0.119	REJECT

* Further statistical tests have also been performed but are not presented here.

** Degrees of freedom will vary depending on the sample size. The data sets of the variables are analyzed on a census tract basis (ν = 56) and on a traffic zone basis (ν = 117).

similar trend. Sunday and Holiday service level capacities tended to serve the older residential neighbourhoods and correspondingly higher SES areas.

Graphical interpretation of supply by area and socioeconomic groups can also be accomplished by using a series of overlay choropleth drawings. By setting the shading grid to indicate similar transit dependent groups with similar shading intensities, overlain transparencies will highlight the most transit dependent areas. As shown in Figure 6 transit capacity illustrated by columnar bar graphs overlaying transit dependency areas provides a visual comparison of supply by area. A brief glance shows that those lightly shaded areas (lower income and SES areas) also had lower levels of transit service capacity during the a.m. peak hours.

In terms of transit accessibility, or average transit trip times, an analysis using 60 percent of all trips as the criterion, demonstrated that higher SES groups have lower transit travel times. Once again, this phenomena can be attributed to the residential locations of higher SES groups closer to the core areas and supplied with increased transit capacity. However, a subanalysis of areas which are a similar distance from the CBD produced regression statistics indicating that higher SES groups also receive higher level of transit accessibility. Note that the random selection of transit trips is drawn from a data set which is weighted according to actual transit trips taken and thus may indicate that travel times are less



Figure 6. SES and A.M. Peak Capacity (Bus Sector)

for persons of higher SES due to the fact that they are less willing to travel on time-consuming transit trips. If the origin-destination pairs are chosen entirely at random with no regard to existing travel patterns, then those areas of similar distances from the CBD with higher SES still experience less travel times, but the trend is less significant.

5.3 Transit Demand/Usage

Using the 1981 Household Travel Demand Survey and ridership by area data sets, transit travel patterns can be reviewed. As one would expect, as the number of automobiles per household increases, the number of daily transit trips per household decreases. Also, a simple regression run of SES and a.m. peak hour transit trips/household indicates a reverse correlation whereby higher SES households take fewer transit trips. This trend is also evident in off-peak travel and Sunday and Holiday transit travel. These statistical patterns help to define the transit dependent population as those with lower SES values and a lower incidence of auto ownership.

To further examine transit use by household groups, those areas with similar levels of transit capacity available to them have been aggregated for analysis purposes. Low service levels (less than 150 bus seats per a.m. peak hour or a frequency of 30 minutes and less) for area residents showed that the lower SES groups were most apt to increase the number of transit trips as capacity levels increased.

SES and the number of transit trips per a.m. peak hour were negatively correlated, but the increase in transit use rose sharply with increased capacity for lower SES groups (Figure 7). For moderate transit capacity areas (between 450 and 1200 bus seats per a.m. peak hour of frequencies of 10 and 4 minutes), the negative correlation between SES and transit trips remained, however any increase in service capacity had less of an effect on the travel patterns of lower SES groups ($\Delta_3 < \Delta_1$ in Figure 7B). Mathematical interpretation of the propensity to travel by transit for various income groups as a function of the available level of service can therefore be derived. Those areas with the highest transit capacity are omitted from this subanalysis because travel to these areas is a function of the trip attraction centres, not the residence based trips of the area. The Halifax core traffic zone has a capacity of 5400 bus seats per a.m. peak hour and a resident population of only 700 persons (1985). In this instance, employment populations would be a more realistic variable to assess transit trips.

The manipulation of crosstabulations of the variables by areas of similar capacities produced useful factors which can be used in transit trip behaviour modelling. For a given transit capacity, values for expected transit trip generation rates by population groups of different SES, income levels, distance from the CBD or auto ownership can be found. Rigorous statistical analysis is required to ensure that the regression results are in fact correlated and not attributable to causation only.

As previously outlined, ridership by residential area was tallied from passenger loadcount surveys. An average fare per rider was assigned to yield total passenger revenue by area. System costs by area were calculated from route kilometres in the area multiplied by an average cost per kilometre of service. A resulting value of total transit subsidy per area and per capita was then determined. It should be noted that in areas of major trip generation such as the CBD, the high levels of revenue recorded for trip beginnings tend to be offset by the costs of large number of route kilometres throughout the area.

A simple regression analysis comparing SES of the residential area with the subsidy per capita in the area indicated a slight trend that higher SES groups receive less transit subsidy per person, however the trend could not be proven beyond the r^2 coefficient of regression. The SES groups receiving the highest subsidy were the middle income residents living away from the CBD. The highest SES groups received the least subsidy and in fact, two such areas generate revenues in excess of the cost of providing service to them. This can be attributed to the trip attraction points within the area rather than the residence based transit trips. The lower SES groups were also subsidized but to a lesser extent than the middle income earners. The exception to this was one residential area having a low average SES, but the highest calculated subsidy per person of $169 annually. This is an indication of a purely "social" transit service which is not based on a capacity equivalent to the demand/use for the transit service.

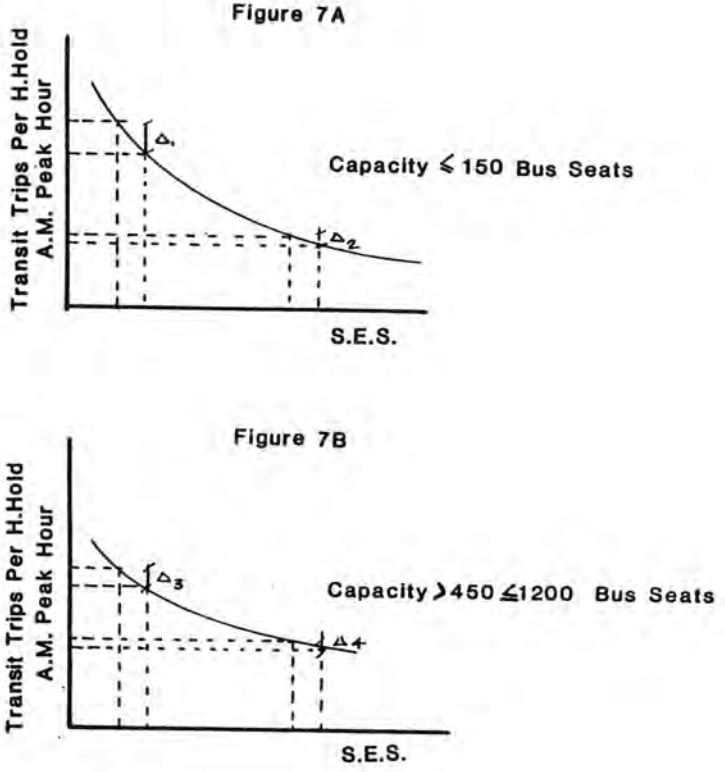


Figure 7. Transit Trip Generation Rates - Theoretical Models

6.0 SUMMARY

A practical framework has been presented outlining supply and demand models of transit service distribution. The case study of Halifax-Dartmouth was used to illustrate the simplicity of the data requirements and the modelling approach.

This research indicates that in general, transit service is distributed equitably to the metro area as a whole. However, specific sectors of the population are supplied with a level of service greater than the demand warrants. Middle income family

groups living on the urban fringe tend to have good transit access to routes which travel between the suburban areas and the downtown core and yet ridership revenue does not yield much of the service kilometre costs in the area, therefore subsidy per capita levels in these areas exceed the system average. Subsidy levels are less for higher SES groups and lower SES populations.

Most of the mathematical interpretation of the variables correlated indicates that for level of service indicies, as SES values climb, so does the level of service. As explained, this observation is attributed to the location of the higher SES groups living closer to the CBD. Transit trip times or accessibility echo this trend and the model developed illustrates that increasing SES groups have lower trip times by transit. Subarea analysis of those traffic zones of similar distance to the CBD indicates that higher SES groups have shorter transit travel times, but the level of significance is less than with the regional results.

Transit trip behaviour observations also became apparent from this research. The lower SES groups are more likely to increase their propensity to travel as the level of service capacity increases (low frequency of < 30 minutes) than higher SES populations. Factors such as trip generation rates by household for a given level of service can also be calculated from the data collected for the study. Other trip rates are easily tallied from the disaggregate analysis of the various models presented.

This paper outlines a simplified process consisting of data manipulation models for use as a decision-making tool in the distribution of transit service. It is hoped that future transit service will be distributed based on sound transit planning principles, however an analysis such as this helps to point out the inefficiencies and inequities of existing and proposed transit service. The models are easily set up on personal computers with BASIC language and spreadsheet software packages. LOTUS has been used to establish the data sets of socioeconomic and transit systems operations variables and accessed via BASIC programming. The editing and graphics capabilities of LOTUS added to the ease of data manipulation. Although this analysis is data intensive, the variables can be obtained from the 1986 Statistics Canada Census material by census tract and from the operating transit system. These two sources of data provide adequate information to carry out the analysis without the necessity of a comprehensive travel demand and household information survey.

The paper highlights the modelling involved and some of the statistics used to evaluate the equity of transit service distribution on Halifax-Dartmouth Metro Transit. This decision-making tool can be used for transit planning of service options when operating with scarce government funds.

7.0 REFERENCES

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8.0 ACKNOWLEDGEMENT

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TRANSPORTATION AND REGIONAL DEVELOPMENT

THE NEWFOUNDLAND RAILWAY AT THE CROSSROADS

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TRANSPORTATION AND REGIONAL DEVELOPMENT

THE NEWFOUNDLAND RAILWAY AT THE CROSSROADS

PART I - BACKGROUND

Discounting the activities centuries earlier of the Norseman, "Eric the Red", it is generally conceded by historians that North America was "discovered" by the Europeans when John Cabot landed on the coast of Newfoundland in 1497. Cabot returned to England with incredible stories of fish so plentiful that one had merely to lower a basket over the side of the ship and, upon pulling in the basket, it would be "brimming" with fish. These stories excited the fish merchants of England who soon began to finance fishing expeditions to this new land. To protect their economic interests from "unfair competition" the English merchants eventually persuaded the Sovereign to "outlaw" colonization of the island. Over the next several centuries Newfoundland was to be relegated to the status of "fishing base" for European (primarily English) fishing merchants. This situation was changed in 1825 when, by Imperial Statute, Newfoundland was elevated from the status of "fishing base" to that of "colony". The first governor, Sir Thomas Cochrane, arrived on the island in that year.

At the time of Cochrane's arrival in Newfoundland there were no roads and no railway. All movement was by "manpack" or by sea. Under his leadership the first roads were built from St. John's to Portugal Cove, a distance of nine miles to the North and St. John's to Topsail, a distance of 12 miles to the West. The fragile beginnings of a "transportation system" for the island had commenced.

From this rudimentary start were spawned grandiose plans for additional roads and a trans-Newfoundland railroad that would connect the hundreds of towns and villages around the island as well as promote economic development by permitting access to the alleged vast wealth of the interior.

After years of planning, actual work on the construction of a railway commenced in 1881. The early construction was undertaken by private enterprise which soon ran into financial difficulties. In spite of many bankruptcies and associated financial setbacks a trans-Newfoundland railway extending 547 miles from St. John's

to Port aux Basques was completed in 1897. Initially, it was operated by private enterprise through the Reid Newfoundland Company. However, the railway was never financially sound and the financial burden of ongoing expansion through the addition of branch lines eventually resulted in the railway being nationalized in 1923 and operated thereafter as a public utility.

In 1949, in accordance with the Terms of Union between Canada and Newfoundland, the federal government assumed full responsibility for the operation of the railway and undertook to "... relieve the Province of Newfoundland of the public costs incurred ..."(1) in its operation. From that day to the present the federal government has, in one form or another, underwritten the annual operating deficit of the Newfoundland railway. In the 1980's this burden has risen to a figure of approximately $50 million per annum.(2)

This ever-increasing financial obligation has been of considerable and pressing concern to successive federal governments since the mid-1960's. The many national social programmes undertaken by the federal government required massive infusions of funds. In accordance with the tenor of the times "deficit financing" was used to acquire the necessary finances. This naturally led to a large national debt over a relatively short period of time, which in turn, led to ever-increasing taxes, particularly personal income taxes, as governments searched for ways to acquire new financial sources to sustain the cost of its social programmes. During the 1970's governments began to become increasingly more concerned about the political ramifications of this trend. Efforts were made to gain control of government spending spurred on by the great issue of that decade: inflation. Amongst many initiatives at "cost-cutting" the federal government commenced programmes designed to carefully scrutinize its spending habits. The office of Auditor-General became much more critical of government spending habits, and as a result, "fiscal responsibility" became the catchword for the 70's and 80's.

It was at this time that the Department of Transport began to take a long, hard look at its subsidization programmes. The wisdom and utility of the large amount spent to subsidize the operation of the Newfoundland railway came under close scrutiny. It was soon discovered that, apart from the political sensitiveness of the issue, any "negative tampering" with the matter of the operation of the Newfoundland railway also contained serious legal implications of a constitutional nature. In true bureaucratic style the response was to "study" the issue. As a result, during the 15 year period from 1972 to the present, there were at least 18 "studies" or "inquiries"

into the Newfoundland transportation system. A few examples are:

(1) A Transportation Needs Study - 1970;

(2) Newfoundland Mainland Transportation Study - 1972;

(2) Trans-Newfoundland Corridor Transportation Study - 1974;

(4) Newfoundland Transportation Systems Evaluation - 1976;

(5) Report of the Commission of Inquiry into Newfoundland Transportation (Sullivan Inquiry) - 1978;

(6) A Program for the Rehabilitation of the Newfoundland Railway: Newfoundland Railway Study - 1980; and

(7) Role of the Modes Study - 1984.

Of the multitude of studies conducted the latter three appear to have been of the most importance in terms of affecting the ultimate fate of the Newfoundland Railway.

PART II - THE ISSUES

It was essentially the far-reaching recommendations of the Sullivan Report that first sounded the alarm over the fate of the Newfoundland Railway. The Commission noted that:

> "... In short, the preponderance of opinion and evidence available to the Commission suggests that the Newfoundland railway will not, and cannot, be commercially viable under any circumstances..."(3)

This conclusion caused consternation amongst at least one of the Commission members, Mr. Esau Thoms, who felt moved to file a "minority report" in which he stated:

> "... I cannot agree with the general premises and conclusions arrived at by the majority of Commissioners ... dealing with the future of the railway in Newfoundland and in the recommendations which are based thereon.
>
> In my view, it is not the least inevitable that the volume of traffic offering on the Newfoundland railway will

> decline to a negligible amount within the next ten years...
>
> Since I do not believe in the inevitable end of railway freight traffic in Newfoundland, I can see no basis to conclude that the optimum transportation network will develop without an important place for rail services ..."(4)

What Mr. Thoms was primarily objecting to in his minority report was the proposal by the Commissioners that a plan of action, as proposed by them, be adopted by both levels of government which would, in essence, oversee the phase out of the railway over a ten year period. In support of its recommendation, the Commission raised the following questions:

> "... We must return, therefore, to the basic question. Should the railway in Newfoundland continue for an indefinite period? The decision must be formed, in part, by the knowledge that the Gulf and railway operation is extremely costly, a subsidy of 50 million dollars having been required in 1976. Since a comparable amount of traffic could be moved by water at considerably less than half that cost and since there is also little doubt that the deficit associated with the Gulf and railway will increase as the years go by, we must ask whether we can afford to spend so much for an inefficient service. Could not that amount of money be spent to greater advantage on some other transportation facilities or on the economic development of the Province?..."(5)

The gauntlet had been thrown by the Commission. Still reeling from the shock of having lost its rail passenger service, disgruntled with the CN Roadcruiser Service, Newfoundland was now faced with a recommendation that the "coup-de-grace" be applied to the Newfoundland Railway and that the "Bullet" be laid to eternal rest, the victim of its own economic malaise. The provincial government reacted swiftly to the recommendations of the Sullivan Commission with respect to the railway. Essentially, it rejected the view of the majority and embraced the minority opinion of Commissioner Thoms. In particular, it challenged the views of the Commission with respect to Newfoundland's legal position as well as the more pragmatic issue of the future commercial viability of the railway. It supported Mr. Thoms' position that "... every reasonable step should be taken to encourage the growth and expansion of the rail service..."(6).

PART III - THE LEGAL ISSUE

The legal issue concerning the extent of the obligations of Canada with respect to the Newfoundland railway essentially revolves around the interpretation of Sections 31 and 32 of the Terms of Union and the legal significance to be afforded to a letter signed by the Prime Minister of Canada coincident with the signing of the Terms of Union.

By Section 31 Canada agrees, inter alia, to take over the operation of the railway and to relieve the Province of the public cost incurred in its operations.

By Section 32 Canada agrees to maintain "in accordance with traffic offering" a freight and passenger steamship service between North Sydney and Port aux Basques.

The letter given to Newfoundland and signed by the then Prime Minister of Canada stated that, after the date of Union, the CNR would be entrusted with the operation of the railway and that it will be their responsibility to see "... that services are furnished commensurate with the traffic offering."

There has been considerable legal argument over the significance, if any, of this letter signed by the Prime Minister. The Sullivan Commission took the position that the letter played an instrumental role in enticing the Newfoundland delegation to sign the Terms of Union and hence was, in law, a binding legal document that was intended to be, and must be, read in conjunction with the Terms of Union before the true meaning and intent of the Terms of Union can be ascertained. Undoubtedly this is the interpretation most favourable to Newfoundland. However, such issues can, of course, only be finally determined by the Supreme Court of Canada. In the interim, the weight of legal argument would appear to support the position of the Sullivan Commission in this regard.

There has also been considerable legal argument over the meaning to be given to the phrase "in accordance with traffic offering". The phrase appears in S.32 of the Terms of Union and in the letter signed by the Prime Minister of Canada. The essential issue is whether or not the federal government is absolutely and irrevocably bound to maintain the railway, regardless of cost, so long as there is traffic offering or whether there is a "reasonableness" criteria to be implied in the use of the term "traffic offering" and that when the traffic offering dips to a point where it is clearly unreasonable to spend huge

sums of money in support of it, the federal government has the authority to discontinue the service.

This issue constitutes a much thornier constitutional issue than the matter of the significance of the "letter" dealt with previously. The "reasonableness" argument is most assuredly attractive and undoubtedly has merit. The issue then becomes what constitutes "reasonable". There can be no question but that so long as a reasonable volume of traffic offers there is a constitutional obligation on the part of Canada to maintain the railway and that it could not be constitutionally abandoned without the consent of Newfoundland coupled with a legally effected amendment to the Constitution.

Assuming that a Reference to the Supreme Court of Canada resulted in an interpretation of the constitutional requirement favourable to Canada, there is no guarantee that the court would reach the same conclusion reached by the Sullivan Commission. The Commission concluded:

> "... If, in the normal course of events, the amount of traffic on the rails declined until it reached or approached zero, the federal government would be released from its obligation to maintain the rail service in Newfoundland."(7)

It is this conclusion that set the stage for the Commission to further conclude that "... the complete railway service in Newfoundland will probably not survive beyond another decade..."(8). But this conclusion, it appears, is predicated on the assumption that once relieved from a constitutional obligation the relief is final and irrevocable. Surely Newfoundland could argue, with considerable plausibility, that even if the court adopted the "reasonableness" standard and, as a result of its application, Canada was able to legally discontinue the railway service in Newfoundland, that is not to say that the cessation of the service is final. Suppose that the level of traffic offering returned at some future date to a level sufficient to warrant the continuance of the service by the federal government; is it not conceivable that the court may find that the constitutional obligation of the federal government would be "reactivated". In other words the application of a "reasonableness" standard would serve only to put Canada's constitutional obligations in abeyance for so long as it was reasonable to do so. Once it became unreasonable, i.e., the traffic offering was of sufficient volume to invoke the reasonableness standard in favour of Newfoundland, then Canada's constitutional obligation was revived and was enforceable at the discretion of Newfoundland. Such an

interpretation would, it is suggested, provide the Court with a way to protect Newfoundland from artificial manipulation of the situation on the part of Canada while still extending to Canada the basic protection of a reasonableness standard.

The difficulty, for both sides, in engaging in legal jostling is that, in the end result, legal determinations usually produce "win-lose" scenarios. This result could be politically undesirable for the "loser" whomever it may be. In any event, the "legal question" in this whole matter may be somewhat of a "red herring". From the available data, it appears that the largest percentage of the overall deficit with respect to the Newfoundland railway is attributable to the "Gulf Ferry" segment of the operation. The constitutional requirement with respect to the Gulf Ferry is straight forward. The only legal argument is with respect to the interpretation of the phrase "in accordance with the traffic offering." The Newfoundland railway segment presents a different legal scenario in that it hinges on the applicability, if any, of the letter signed by the Prime Minister on the constitutional obligations of Canada. The fact that neither Canada nor Newfoundland has seen fit to date to mount a formal legal challenge to the interpretation of the Terms of Union would indicate that both parties are aware of the risk involved in a legal determination and are prepared to try and produce a "win-win" situation through political accommodation and agreement thereby avoiding the "win-lose" consequences of a judicial determination.

PART IV - OPTIONS

The opinion of the Sullivan Commission that "... At the present time the Province could expect to receive a substantial "trade-off" if it agreed that the railway should be abandoned..."(9) resulted in considerable speculation as to what would be an acceptable trade-off to Newfoundland in return for not opposing Canada's phase out of the railway. Over the years there were many ideas put forth from time to time: e.g. A tunnel across the Strait of Belle Isle; a trans-Labrador highway; Hovercraft service between Newfoundland and Nova Scotia and Newfoundland and Labrador; a four-lane divided TCH through Newfoundland; and additional cargo ferry services across the Cabot Strait.

However, all other "options" became pure academic speculation when the basic conclusion of the Sullivan Commission concerning the ultimate demise of the railway was rejected by both levels of government.

The choice of an option for Newfoundland became apparent in 1980 when "A Program for the Rehabilitation of the Newfoundland Railway" was published. Produced by the government of Newfoundland this study adopted the position that the railway had a proper role to play in the Newfoundland transportation system and, further, that given an innovative operational facelift, it could again become a viable competitor within the inter-modal provincial transportation system. One of the innovations suggested in that report was that Terra Transport, a division of CNR, inaugurate a domestic container service. This suggestion was incorporated into Canada's "Strategic Transportation Plan for Newfoundland". A Rail Testing and Evaluation Program was designed for Newfoundland which had, as its key component, a containerization plan for rail freight. The program was put into effect in April, 1980 with the backing of $77 million in federal funds. The results proved to be very positive indeed.

In April, 1984 Transport Canada reported the following:

> "... In 1974, rail handled 59.3 percent of the total inbound freight while direct water shipping captured 26.6 percent and truck only 14.1 percent. By 1980, direct water shipping was responsible for 43.0 percent of the total inbound freight volume. This large increase in the share moving by direct water was at the expense of rail which dropped to 26.1 percent of the total tonnage. The trucking industry also had increased its share at the expense of rail, rising from 14.1 percent in 1974 to 30.9 percent in 1980.
>
> Reviewing ... 1983 volumes, it is evident that rail has stopped the declining trend in its share of the total market and now handles 35.8 percent of the total inbound general freight tonnage. This has been done at the expense of direct water shipping which has fallen from a high of 43.0 percent in 1980 to 32.0 percent in 1983 ..."(10)

It is obvious from the statistics that the introduction of containerization has significantly affected the position of the railway with respect to its ability to effectively compete in an intermodal environment. The results of the containerization experiment clearly indicate that innovative and aggressive management can make a difference. In fact, the "dominant mode" projections, set out in the Modal Roles Assessment,

indicate that by 1991 the railway could capture 52% of the inbound freight market. Even under its assessments of the "status quo" and "expanded service" options it is forecast that the rail percentage of the market would rise to approximately 38% before levelling off.(11)

The rail revitalization program would appear to support the position of Commissioner Thoms that: "... through proper management, rail traffic will continue to grow and form an even more important segment of the Newfoundland transportation picture.(12)

More importantly, it confirms the wisdom and utility of avoiding the finality of a judicial determination and focusing instead on the substantive economic and industrial difficulties encountered in the Newfoundland transportation system.

The position taken by the federal government with respect to the rail revitalization program should contribute significantly to the dissipation of the air of mistrust noted in many of the reports over the years. Surely, as a minimum concession, Newfoundland must concede that the rail revitalization program is inconsistent with "... a conscious attempt on the part of the federal government or CN to downgrade the railway."(13)

The success of the containerization program should have the effect of heralding a new era of mutual co-operation between the two levels of government. For example, if it has not already done so, Canada should perhaps now consider the possible conversion of the railway, in whole or in part, to standard gauge. This was dealt with by Newfoundland in its study(14) which contains very interesting plans, statistics and projection figures which certainly appear worthy of a detailed costs and benefits study.

PART V - EFFECTS OF DEREGULATION

It is clear that deregulation of the railway transportation industry in Canada was necessitated by the passage of the Staggers Rail Act by the American Congress in 1980. Some American railways operate in parts of Canada and, likewise, Canadian railways operate in parts of the U.S. Hence, deregulation within the U.S. was, by necessary implication, to have repercussions within Canada. The Canadian government responded in 1985 with a policy paper entitled "Freedom to Move: A Framework for Transportation Reform". After public hearings and discussion of the policy paper legislation was drafted to formalize the policy for debate and passage into law by the government. Bill C-38: "An Act Respecting National Transportation" (known as the National Transportation Act,

1986) has now passed 2nd reading by the House of Commons and has been referred to Standing Committee of the House for clause by clause review and debate.

In general terms the overall tone and intent of the legislation is to promote and facilitate reliance on competition and market forces rather than regulations within the transportation industry. With respect to railways the legislation will contain important changes in the following areas:

(1) confidential contracts will be permitted between railway and shipper;

(2) common-carrier obligations may be dispensed with, in part or in full, by confidential contract;

(3) the focus of "captive shipper" protection will be redirected from "maximum rates" approach to "competing carriers" approach;

(4) imposition by the Governor in Council of joint-track usage or shared railway running rights;

(5) the phased removal of the present legislated requirement that a railway's rates be "compensatory" with reliance upon anticombines legislation for protection against predatory pricing;

(6) new regulations with respect to branch line abandonment;

(7) changes to the regulatory process with provisions to ensure that regulatory action is compatible with government policy;

(8) the creation of a new Regulatory Agency to replace the Canadian Transport Commission; and

(9) new approaches to dispute-resolving mechanisms through less formal and expensive procedures which will facilitate speedy resolution of disputes where the matter is essentially "private" while still retaining the present mechanisms for disputes involving significant public interest.

On its face, the new National Transportation Act, 1986 appears to contain no provisions which would be of serious concern to the fragile status of the Newfoundland railway. Based on the history of the Newfoundland

railway, the main issues of concern to Newfoundland would undoubtedly be abandonment and subsidization.

Although the new legislation does provide for abandonment there is built-in protection for what is referred to as "a protected line". There can be no question but that the Newfoundland railway falls within this category. Hence abandonment will not be possible unless the Minister of Transport is first "... convinced of the appropriateness of recommending variance of the Order-in-Council protecting the line."(15). In a sense this is merely stating the obvious since in any event the law is clear that an Order-in-Council can only be varied by the Governor in Council. Notwithstanding, the important point is that, essentially, the new legislation, if passed, will not change the "status quo" as regards the positions of the essential players with respect to the ultimate fate of the Newfoundland railway.

Regarding the matter of the subsidization of the Newfoundland railway there would also appear to be little cause for concern. The draft legislation provides for "compensation for imposed public duties". It appears that the net effect of the new legislation will be to eliminate the "hidden subsidies" as, for example, cross-subsidization and cost-plus formula subsidization. Subsidization will continue for imposed public duties that are unprofitable. Again, it would appear that the Newfoundland railway would fit into this category and hence subsidization would continue but only in the form of "direct public subsidy".

There are two areas which, although less pressing and less obvious, may prove to be detrimental to the recovery of the Newfoundland railway. They are the matters of captive shippers protection and minimum rate regulation. (One has to wonder how these restrictive mechanisms can be compatible with a policy that espouses "freedom to move".)

As regards captive shippers, the government proposes to repeal Section 278 of the Railway Act. In its stead, the government further proposes to protect the captive shipper by providing, through the legislation, access to the lines of competing rail carriers through a "joint-line rate" from the traffic's origin to destination. This approach assumes the existence of, at least, a second railway company. It is not clear what the implications for this may be in Newfoundland where there is only one rail carrier. It may be that the effect on the Newfoundland railway of the captive shipper provisions will be negligible. Nevertheless, it will be an area where Newfoundland will want to closely monitor the effects of the new legislation.

With respect to minimum rate regulation, once the 5 year sunset provision has expired, there will be no minimum rate restrictions except those imposed by the existing anticombines legislation. This provision may be a boon to the Newfoundland railway and may inadvertently produce the dominant mode system option referred to earlier in this paper.(16) Should this scenario result from the legislative provisions, Newfoundland will want to seriously consider the effect on the trucking and direct water modes. Although the railway may do well with the removal of minimum rate regulation the overall effect may not be in the best interests of the transportation industry at large in the province.

PART IV - CONCLUSIONS

The Newfoundland railway has experienced a difficult history characterized throughout by poor economic performance, continued large annual operating deficits, apparent lacklustre performance and lack of innovative vision by senior management coupled with the physical restrictions of the province's topography and the inherent restrictions of the narrow-gauge track. The number of studies of Newfoundland transportation systems over the years can only be termed as "incessant". However, it appears that the Sullivan Report of 1978 may have been the turning point for the redemption of the Newfoundland railway. The majority opinion of the Commission heralded the demise of the railway within 10 years. It also recommended that this fate be accepted and that plans be made to facilitate the inevitable rather than defer it. In retrospect this opinion, in conjunction with the minority and opposing opinion of Commissioner Thoms, appears to have lit a fire under both levels of government. After years of jealously guarding jurisdictions, arguing over constitutional obligations and failing to freely exchange information it now appears that a new era of co-operation and facilitation has evolved. For the first time in many decades a ray of light is visible at the end of the tunnel. "A Program for the Rehabilitation of The Newfoundland Railway" contains some interesting and thought provoking proposals that appear worthy of serious consideration. The federal government has responded with the five year "Strategic Transportation Plan for Newfoundland". An integral aspect of this plan is the "Newfoundland Rail Testing and Evaluation Program". The very positive impact of this program is set out in the "Modal Roles Assessment" report of 1984.

It appears that the political and corporate "will" needed to turn the situation around is now present. The "innovative management" (the apparent lack of which has often been criticized) appears to have been found and, equally as important, given the mandate and funds to put

innovative concepts to the test. This present situation should be encouraged to expand as success mounts.

The Newfoundland railway, it appears, is far from dead. It can and does have a future in the Newfoundland transportation industry if only the "human will" is present and willing to work toward finding its rightful place in that industry. Hopefully, at some point in the future, it can discard its image as an "albatross" and become a viable economic entity worthy of the allocade "good corporate citizen". For, as Commissioner Thoms said: "... Surely the citizens of Newfoundland are entitled to a mode of transportation equal to that existing in the other nine provinces ..."(17). With "dual-tracking" fast becoming a reality in Western Canada perhaps this is too high an expectation today. Notwithstanding, now that it appears that it may be possible to eventually turn the Newfoundland railway into a more viable economic venture, it would not be unreasonable for Newfoundland to expect a system equal to that existing in the other eastern maritime provinces. This, of necessity, implies addressing the crucial issue of track conversion. As long as Newfoundland has a narrow gauge track it can never be fully integrated into the North American system. It is suggested that, economic recovery notwithstanding, this is the issue that will determine the longer term fate of the Newfoundland railway.

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FOOTNOTES

(1) Terms of Union, Section 31. See R.S.C. 1970, Appendices.

(2) This figure includes the cost of subsidization of the Gulf Ferry service which, in accordance, with S.32(2) of the Terms of Union was to "... be treated as all rail traffic".

(3) Report of the Commission of Inquiry into Newfoundland Transportation, Volume I, July 1978, p. 189. (The Sullivan Commission)

(4) Ibid; p. 267.

(5) Ibid; p. 191.

(6) Ibid; p. 267.

(7) Ibid; p. 192.

(8) Ibid; p. 192.

(9) Ibid; p. 192.

(10) Modal Roles Assessment: Newfoundland Inter-provincial Freight, Transport Canada Strategic Planning Group, April 1984, p.p. 2.4/2.5.

(11) Ibid; chapters 8, 9 and 11.

(12) The Sullivan Commission; p. 267.

(13) A Program for the Rehabilitation of the Newfoundland Railway. Government of Newfoundland and Labrador, October, 1980, chapter 13.1.

(14) Ibid, chapters 9, 10 and 12.

(15) Freedom to Move: A Framework for Transportation Reform, Minister of Supply and Services Canada, 1985, p. 39.

(16) Supra; footnotes 10 and 11.

(17) The Sullivan Commission; p. 268.

TERRATRANSPORT'S ROADCRUISER BUS SERVICE:

A Case Study of an Intecity Bus Operation on the Island of Newfoundland

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TerraTransport's Roadcruiser bus service is the major means of intercity public passenger transport on the island of Newfoundland. In a number of ways, this bus service is unique in Canada. The purpose of this paper is to present, in historical perspective, how the Roadcruiser bus service has developed and to assess its prospects for the future.

Background

After Newfoundland entered Confederation in 1949, the Government of Canada took over the Newfoundland Government Railway and made a commitment to provide transportation services across Newfoundland and between Newfoundland and North Sydney, Nova Scotia. The Government of Canada then ordered Canadian National Railways to provide transportation services for the new province. To this end, in April of 1949, Canadian National Railways was directed to assume ownership and operation of the Newfoundland Government Railway which became part of the Canadian National system and fell under the jurisdiction of the Canadian Transport Commission's predecessor - the Board of Transport Commissioners.

The Roadcruiser bus service replaced much of the passenger train service operating on the Island. The passenger trains, notably the service known as the Bullet, had been paying their way during the war years and into the 1950s. During 1942, the railway carried 424,323 people, more than the population of Newfoundland at that time. Because air services were not well developed and roads were primitive, the trains succeeded in attracting passengers. Therefore, in the absence of a viable alternative, large numbers of passengers continued to patronize the "Bullet" through most of the 1950s. With road improvements and better air services, the numbers using the trains began to slide sharply. By 1962, passenger volumes on the passenger trains had dropped to 126,567 and Canadian National Railways started reducing services. During 1969, the discontinuance of the Bullet and its replacement by the Roadcruiser marked the beginnings of an overall increase in the patronage of the Canadian National trans-Newfoundland passenger services.

The Regulatory Framework

In late 1967, Canadian National applied to the Canadian Transport Commission to discontinue its main line rail passenger service between Port-aux-Basques and St. John's and substitute in its place a bus service operating along the Trans Canada Highway

serving the same points. After a nine month trial period, during which both the bus and train were operated simultaneously, the Commission's Railway Transport Committee allowed CN to discontinue its rail passenger service in July of 1969.

In order to fully appreciate how an island-bound bus passenger service could have fallen under the regulatory control of a Federal agency, some explanation of Canadian jurisdictional arrangements is necessary. In Canada, any transportation undertaking providing extraprovincial motor carrier services is considered to be an extraprovincial motor carrier undertaking falling under Federal jurisdiction. To be considered an extraprovincial undertaking, the carrier must perform transport between provinces and/or between one or more provinces and the United States. Therefore, extraprovincial undertakings are those which offer any interprovincial and/or international transport services; for example, a carrier which only derives 10 per cent of its revenues from extraprovincial transport would be deemed to be an "extraprovincial undertaking" under Federal jurisdiction. On the other hand, an "intraprovincial transport undertaking" under provincial jurisdiction only performs transport within a province or provinces and does not offer transport services connecting provinces. The Roadcruiser passenger service was considered to be an extraprovincial undertaking because like the previous rail service that it replaced, it was a service connected to Canadian National's network of passenger services across the country.

Since the new service was a motor carrier undertaking, it was regulated by the Newfoundland Public Utilities Board. Although the bus service was regulated under the provincial Motor Carrier Act, the Board refused to recognize the authority of the federal Motor Vehicle Transport Act (1954). The Board did not allow CN an increase in bus fares equivalent to the level of rail passenger fares elsewhere in Canada. As a result, CN appealed the Board's jurisdiction to the Supreme Court. In 1975, the Court ruled that the service fell within the exclusive jurisdiction of the Parliament of Canada and, as such, could only be regulated by the Public Utilities Board pursuant to the federal Motor Vehicle Transport Act (1954).

In 1976, CN applied to the Public Utilities Board for a licence under the Federal Act and for approval of a 150 per cent increase in fares. The Board permitted a 30 per cent increase subject to the provision of supporting documentation. CN appealed to the Supreme Court of Newfoundland and, while the decision was pending, increased the fares by 30 per cent without submitting the required documentation. The Board still refused the federal licence and began issuing summonses to the Roadcruiser buses for operating violations. CN retaliated by suspending service on July 13, 1976.

The federal Minister of Transport then intervened and by Order-in-Council P.C. 1976 - 1832, dated July 16, 1976, the Roadcruiser service came to be exempt from the provisions of the Motor Vehicle Transport Act (1954) and subject to Part III of the National Transport Act and to the Canadian Transport Commission's Motor Vehicle Transport Committee. Under this order, Canadian National was required to restore the Roadcruiser service immediately with the thirty per cent increase in effect in the interim. To date, no other Federal undertakings have been exempted from the provisions of the Motor Vehicle Transport Act (1954).

A Description of the Roadcruiser Bus Service

Roadcruiser provides daily bus service in each direction between St. John's and Port-aux-Basques. This route follows the Trans-Canada Highway a total of 906 kilometres. Intermediate services also operate daily between St. John's and Grand Falls with additional runs on Friday and Sunday and from Grand Falls to St. John's once daily. These runs provide an additional 28 kilometre diversion into Lewisporte. Daily service in each direction between Corner Brook and Port-aux-Basques is also provided, with a 26 kilometre diversion into Stephenville. An additional run from Port-aux-Basques is offered into Corner Brook on Sunday.

Roadcruiser connects with several other local bus lines at locations along the route including Whitbourne, Clarenville, Grand Falls and Corner Brook. These local operators provide service to the Placentia, Bonavista, St. Albans, Harbour Breton, Baie d'Espoir and Great Northern Peninsula areas.

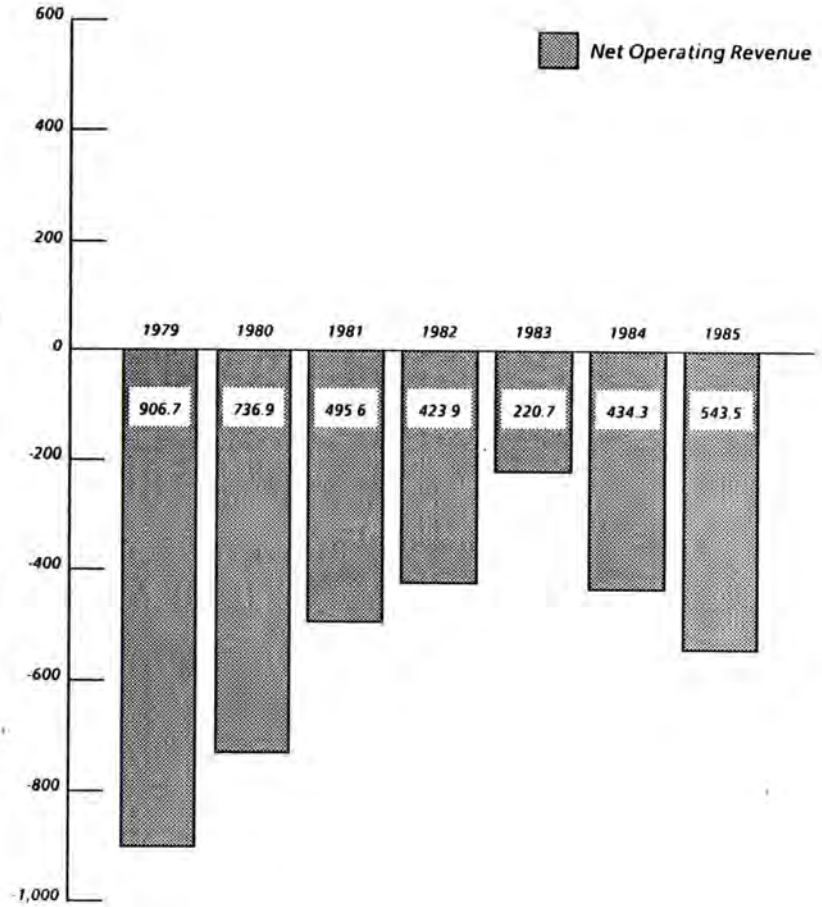
Financial Performance

Since 1969, the Roadcruiser bus service has not been able to cover its operating expenses. The financial results were, however, improving gradually to the point that, by 1983, the annual shortfall in operating revenues had been reduced to approximately 5 per cent. However, the information for 1984 and 1985 reveal a reversal in this trend. During 1985, operating expenditures exceeded operating revenues by more than 10 per cent. Whether or not these results indicate a temporary setback are not yet known. At the time of writing, the 1986 financial results were not available.

In order to compare Roadcruiser's financial performance with other bus companies, Statistics Canada was asked to compile statistics on groups of intercity bus operators. The common factors which were the basis for these groupings were operating revenues, distance logged, number of intercity buses operated, government ownership (i.e., owned by crown corporations or directly government owned), and whether or not the carriers were based in the Atlantic provinces. Roadcruiser's 1983 operations fell within the boundaries defined for each of the above groups. In some instances, the same carriers fell into more than one grouping. In

TERRATRANSPORT
CN-ROADCRUISER NET OPERATING REVENUES
(1979-1985)

(in thousands of dollars)



Source: Terratransport Income Statements

TABLE 1

FINANCIAL PERFORMANCE OF CANADIAN INTERCITY MOTOR COACHES, 1983
(In millions of dollars)

	Revenues Over $40 Million	Revenues $4 to 5 Million	1.5 to 2.5 Million Passenger-Miles	With 15-35 Buses	Domiciled Atlantic Provinces	Government-Owned	CN Roadcruiser
Average Revenues							
Passenger Service	42.2	2.4	2.5	5.4	2.5	10.4	3.2
Charters, Tours, etc.	5.1	1.0	0.9	0.6	0.7	2.3	0.3
Parcel Express	9.1	0.6	0.5	1.9	0.6	1.8	0.3
Other Revenues	1.8	0.1	0.1	0.1	0.1	1.4	1.0
Total Revenues	58.1	4.1	4.1	7.9	3.8	15.8	4.8
Average Expenses							
Transport Expenses	27.8	2.2	2.3	4.9	1.8	9.8	2.8
Maintenance	8.5	0.9	0.9	1.3	0.8	2.8	0.9
Terminal	11.3	0.5	0.6	1.6	0.6	2.9	0.8
Traffic & Sales	1.5	0.1	0.1	0.4	0.1	0.6	0.1
Administration, General & Insurance	5.4	0.7	0.7	0.9	0.6	2.1	0.5
Total Expenses	54.5	4.4	4.6	9.0	4.0	18.2	5.1
Net Operating Revenues	3.7	(0.3)	(.5)	(1.1)	(0.2)	(2.4)	(0.2)
Average Subsidies	0.0	0.3	0.5	1.6	0.3	1.9	
Total Subsidies	0.0	1.1	2.3	9.7	1.2	9.7	

Source: Roadcruiser data is tabulated from the files of the Motor Vehicle Transport Committee, while the remaining information is derived from Statistics Canada's 1983 Motor Carrier Passengers survey.

addition to these groupings, tabulations were also made for carriers earning over $40 million in operating revenues in order to draw comparisons with a group of the largest and most dominant carriers. The tabulations were for 1983, which was the year the Roadcruiser lost the least amount of money. Table 1 indicates that, on average, during 1983, the financial performance of the Roadcruiser service compared favourably with the results of other companies with similar characteristics when subsidies received from various sources were excluded from operating revenues. The group of carriers which did not have any characteristics in common with the Roadcruiser bus operation were the four bus companies with operating revenues exceeding $40 million. This group of carriers, which did not report receiving any "subsidies", were also the only group whose operating revenues (excluding subsidies) were exceeded by their operating expenses. In comparing average net revenues, excluding subsidies, of the five groups of carriers, Roadcruiser's five per cent shortfall in revenues appears to represent better performance than many of the other carriers in the other groups.

On the revenue side, the Roadcruiser operation generated proportionally lower charter, tour and parcel express revenues. In the intercity bus passenger industry, these "ancillary" services are generally considered to be more profitable than regular passenger service. This apparent inability to generate revenues from these sources was a result of some unique features of the market faced by Roadcruiser. The provincial economic and demographic nature of the province limits growth in these areas. For example, Roadcruiser's bus parcel express operated in a small market and competed with couriers, the Post Office and in some cases, CN Express, for small parcels. Furthermore, being on an island limits the economic viability of tour and charter operations. On the expenditure side, Roadcruiser's expenses did not appear to be out of line with the average expenses of other groups of companies included in Table 1.

Passenger Tariffs

Since 1976, TerraTransport has filed twelve passenger tariffs as well as a smaller number of bus parcel express (Roadpac) and charter tariffs. The following table summarizes the average percentage increases in passenger fares represented by all of the tariffs which have been filed with the MVTC.

HISTORY OF PASSENGER TARIFF INCREASES

Special Passenger Tariff Number	Effective Date of Tariff	Average Percentage Increase
4-1	July 1976	30.0%
4-2	March 1977	8.0%
4-3	November 1977	15.0%
4-4	March 1980	20.0%
4-5	October 1980	16.0%
4-6	March 1981	7.5%
4-7	October 1981	8.5%
4-8	April 1982	7.0-13.0%
4-9	January 1983	6.0%
4-10	January 1984	5.0%
4-11	January 1985	8.0%
4-12	March 1986	9.0%
4-13	August 1986	6.0%

In Tables 2 through 7, Roadcruiser passenger bus fares between selected origins and destinations were compared to fares of six other bus operations for similar distances. In comparing the structure of the Roadcruiser passenger tariff with the tariffs of other bus operations, it must be remembered that the current Roadcruiser tariff is derived from the tariff structure developed for the previous rail passenger service. As a result, the tariff retains the railway's characteristic decline in fares per kilometre as distance increases. On the other hand, the norm in the intercity bus industry is to have a more or less constant fare per kilometre, irrespective of trip length. With one notable exception, the intercity bus operators reviewed in Table 2 to 7 charge a constant fare per kilometre for trips of different lengths. The exception to this are the fares charged by Voyageur Colonial which generally decline on a per kilometre basis as trip length increases; however, even in Voyageur Colonial's tariff, this pattern is not as pronounced as it is for the Roadcruiser tariff.

In comparing Roadcruiser fares with those of Voyageur Colonial, Ontario Northland and Vancouver Island Coach Lines, the Roadcruiser fares were relatively higher for shorter trips and lower for longer trips. However, the fares of SMT (Eastern), Acadian Bus Lines and Grey Goose Bus Lines were lower than or equal to Roadcruiser fares. Fares for trips in excess of 300 kilometres for SMT (Eastern) and 600 kilometres for Grey Goose are approximately equal to similar Roadcruiser fares while for the trips of shorter length, the Roadcruiser fares were generally higher.

TABLE 2

COMPARISON OF CURRENT FARES

CN Roadcruiser			SMT (Eastern) Ltd.		
Origin - Destination Points Within Newfoundland	Km	Current Tariff Fares ($)	Current Tariff Fares ($)	Km	Origin - Destination Points Within New Brunswick
Corner Brook - Pasadena	26	4.00	2.75	26	St. Stephen - Bayside
Glovertown - Clarenville	89	10.00	7.75	89	Lower Bocabec - Spruce Lake
Stephenville Crossing - Deer Lake	150	13.00	8.75	150	Musquash - River Glade
Bishop's Falls - Deer Lake	225	20.25	20.50	225	Bethel - Boundary Creek
South Brook - Clarenville	322	26.50	25.50	322	Oak Bay - St. Joseph
Deer Lake - Glovertown	364	29.50	29.00	364	Gillman's Corner - Amherst

Source: Compiled by the Canadian Transport Commission, March 1987.

TABLE 3

COMPARISON OF CURRENT FARES

CN Roadcruiser			Acadian Bus Lines Ltd.		
Origin - Destination Points Within Newfoundland	Km	Current Tariff Fares ($)	Current Tariff Fares ($)	Km	Origin - Destination Points Within Nova Scotia
Corner Brook - Pasadena	26	4.00	2.00	26	Halifax - Fall River
Glovertown - Clarenville	89	10.00	6.25	89	Halifax - Hilden
Stephenville Crossing - Deer Lake	150	13.00	10.50	150	Enfield - Barney's River
Bishop's Falls - Deer Lake	225	20.25	15.25	225	Westville - Big Harbour
South Brook - Clarenville	322	26.50	22.50	335	Bedford - Nyanza
Stephenville Crossing - Norris Arm	399	30.50	23.50	399	Lantz - Sydney River

Source: Compiled by the Canadian Transport Commission, March 1987.

TABLE 4

COMPARISON OF CURRENT FARES

CN Roadcruiser			Ontario Northland Transportation Commission		
Origin - Destination Points Within Newfoundland	Km	Current Tariff Fares ($)	Current Tariff Fares ($)	Km	Origin - Destination Points Within Ontario
Robinson's Jct. - Flat Bay Jct.	27	4.00	2.45	27	New Liskeard - Earlton
Robinson's Jct. - Corner Brook	111	11.50	8.70	111	Timmins - Gogama
South Branch - Pasadena	188	17.25	16.65	188	North Bay - Earlton
Deer Lake - Bishop's Falls	225	20.25	20.65	225	New Liskeard - Cochrane
Stephenville - Badger	314	25.25	24.75	314	Timmins - Sudbury
Pasadena - Port Blandford Jct.	444	34.00	39.85	444	North Bay - Smooth Rock Falls
St. Fintan's - St. John's	809	53.25	78.15	808	Sault Ste. Marie - Hearst

Source: Compiled by the Canadian Transport Commission, March 1987.

TABLE 5

COMPARISON OF CURRENT FARES

CN Roadcruiser			Vancouver Island Coach Lines		
Origin - Destination Points Within Newfoundland	Km	Current Tariff Fares ($)	Current Tariff Fares ($)	Km	Origin - Destination Points Within British Columbia
Deer Lake - Pasadena	22	3.00	1.40	16	Victoria - Goldstream
Gambo - Glenwood	63	7.50	5.60	61	Victoria - Duncan
Deer Lake - Springdale Jct.	117	12.00	9.80	117	Victoria - Nanaimo
Glovertown Jct. - St. John's	275	23.50	22.40	274	Victoria - Campbell River
Doyle's - Glenwood	510	37.50	50.75	515	Victoria - Port Hardy

Source: Compiled by the Canadian Transport Commission, March 1987.

TABLE 6

COMPARISON OF CURRENT FARES

CN Roadcruiser			Grey Goose Bus Lines		
Origin - Destination Points Within Newfoundland	Km	Current Tariff Fares ($)	Current Tariff Fares ($)	Km	Origin - Destination Points Within Manitoba
St. Fintan's - South Branch	40	5.00	2.10	34	Winnipeg - Grosseaisle
Clarenville - Gander	145	14.00	9.65	146	Winnipeg - Piney
Lewisporte - Robinson's	420	34.50	27.15	422	Winnipeg - Pine River
Flat Bay Jct. - Port Blandford Jct.	554	39.75	36.90	554	Winnipeg - Mafeking
Port-aux-Basques - St. John's	904	58.50	54.40	900	Winnipeg - Flin Flon
			61.10	962	Winnipeg - Snow Lake
			48.60	764	Winnipeg - Thompson

Source: Compiled by the Canadian Transport Commission, March 1987.

TABLE 7

COMPARISON OF CURRENT FARES

CN Roadcruiser			Voyageur Colonial		
Origin - Destination Points Within Newfoundland	Km	Current Tariff Fares ($)	Current Tariff Fares ($)	Km	Origin - Destination Points Within Ontario
Robinson's Jct. - Flat Bay Jct.	27	4.00	3.35	29	Carleton Place - Smiths Falls
Norris Arm - Gambo	97	10.50	8.75	98	Brockville - Cornwall
Gander - Clarenville	145	14.00	15.85	143	Ajax - Belleville
Deer Lake - Bishop's Falls	225	20.25	22.10	225	Carleton Place - Peterborough
Port Blandford Jct. - Springdale Jct.	304	25.50	32.00	304	Ottawa - Port Hope
Pasadena - Gambo	368	29.75	32.15	372	Ottawa - North Bay

Source: Compiled by the Canadian Transport Commission, March 1987.

Conclusions

Since its inauguration in 1969, TerraTransport's bus service has not been able to cover its operating expenses. In contrast, it has been the public perception that other bus operators in Canada appear to be quite profitable. This perceived contrast in financial performance could be attributed to a number of differences between Roadcruiser and other Canadian bus operations as well as events and circumstances which had impacts on the Roadcruiser bus operation not felt by other Canadian bus passenger carriers.

Most bus companies are not compelled to offer passenger services as an imposed public duty. Where this occurs, as it does for bus operations owned by government or crown corporations, the revenues from such services do not normally cover operating expenses without subsidy payments. Taking this into consideration along with the fact that, to date, the proportion of Roadcruiser revenues generated from tours, charters, and bus parcel express services is significantly lower than it is for other Canadian bus operations, the financial performance of the passenger service is reasonable. The best prospects of improving the financial performance of Roadcruiser's service appears to be in continuing to fully exploit opportunities in the markets for tours, charters and bus parcel express while continuing the quality of current passenger operations in order to maintain passenger volumes.

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1. Atlantic Provinces Transportation Commission, Transportation Review and Annual Report 1969-70, Moncton, N.B., 1970.

2. Kates, Peat, Marwick & Co., Trans-Newfoundland Corridor Transportation Study. Prepared for the Canadian Transport Commission. Ottawa, March 1974.

3. Transport Canada. News Release. "Federal Government to Restore Newfoundland Bus Service", July 16, 1976.

ENDNOTE

The views expressed in this paper are those of the authors and not particularly those of the Canadian Transport Commission.

FORECASTING FOR SUBSIDY PURPOSES: IDIOSYNCRASIES IN THE WESTERN GRAIN TRANSPORTATION ACT

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A long standing criticism of subsidy programs generally is that payments are made long after expenditures are incurred. The Western Grain Transportation Act attempts to get around this problem by incorporating forecasts in establishing annual subsidy levels. Specifically, the Canadian Transport Commission reviews the railways' projections of input price indices and makes its own forecast of these indices. Similarly, the Grain Transportation Agency is required to forecast the volume of grain that will be moved in the forthcoming crop year.

This volume forecast must be made in February for the period August to July (6 to 18 months into the future). This must be done before the crops are planted, let alone harvested! Prairie grain and oilseed production is extremely variable. Over the last nine crop years (1978-79 to 1986-87), production of the six major crops has ranged from 31.1 million tonnes to 52.5 million tonnes. Put another way, the rate of increase in Prairie crop production for the 25 year period 1960-85 has been two percent; the standard error around that trend line has been 4.92 million tonnes. Although year to year variations in plantings are a factor in this production variability, the major variable is climatic condition during the crop growing season, e.g., seasonal rainfall, heat, time of frost, etc.[1] Couple this with the vagaries of the international grain market, and the task of forecasting the volume of grain to be moved is indeed a difficult one.

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[1]For a detailed discussion of the role of climatic factors influencing grain production, see D.F. Kraft and J. Karman, Analysis of Procedures used to Forecast Grains and Oilseeds Shipments, University of Manitoba, November 1986.

This paper sets out some desirable criteria in developing forecasts for subsidy purposes, describes the volume forecasting procedures as established by the Western Grain Transportation Act, assesses how well these requirements have been met, and suggests improvements in the volume forecasting procedures.

Desirable Criteria for Developing Forecasts

A number of criteria should be considered in developing forecasts for subsidy purposes.[2] Some of these include:

1. Understanding the purpose for which forecasts are being developed. Clearly, forecasts are not an end in themselves. Forecasts can be and are used for many purposes: guides for production and investment, transmission of market signals, influencing policies, and even manipulating the outcome of policies. In the case of forecasts for subsidy purposes, the developers and users of the forecasts must clearly understand the purpose of the subsidy as laid out in legislation.

2. Objectivity. A credible forecast must be free of conflict of interest - real or apparent. Forecasters should not be in a position to either gain or lose from the results of their work. Also, forecasts should not over-react to short-run deviations from long-term trends.

3. Developing and using a good data base. A good data base should be accurate, relevant to the task, and timely for forecasting purposes.

4. Maintaining consistency. Short-run forecasts should be consistent with and lead into long-term forecasts.

5. Recognizing and accommodating uncertainty. No matter how sophisticated the analytical techniques used in forecasting, uncertainty cannot be eliminated. Nevertheless, forecasting procedures should take account of uncertainty and attempt to minimize the impact of uncertainty and its ramifications.

Volume Forecasting Procedures in the WGTA

The Western Grain Transportation Act which came into effect in January 1984 clearly established, among other

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[2]For a more general discussion of forecasting for subsidy purposes, see L.A. McCoomb, "Criteria for Credible Forecasting," CTC Research Seminar Series, Spring 1985.

things, that:

1. the railways would be compensated for their costs of moving grain, doing away with the increasing losses experienced under the Crow's Nest rates;

2. the federal government would commit itself to an annual subsidy payment of $658.6 million, defined as the Crow benefit, and its share of inflation; and,

3. the producer would be responsible for future cost increases.

The intent of the WGTA was that the federal government would limit its payments and that the producer would pay a proportionately larger and larger share of the rate over time. The railways would be compensated for the movement of grain not years after the fact as had been the experience with the branch line subsidy program, but immediately and for all costs incurred. The railways are, in general, compensated the month after the movement has taken place, on a monthly basis, based on annual rates established for the crop year by the CTC.

Space does not permit a thorough explanation of the forecasting and rate-making procedures specified by the Western Grain Transportation Act. Figures 1 and 2, taken from Kraft and Karman[3] do provide a schematic illustration of the procedures.

One of the key procedures in the establishment of the annual grain freight rate is the forecast of grain shipments. Section 18(1) of the WGTA states that the Administrator of the Grain Transportation Agency:

> "(a) on or before February 28th of each calendar year provide the Commission (CTC) and the Committee (Senior Grain Transportation Committee) with a tonnage forecast for the movement of grain in the next crop year".

This tonnage forecast is critical because the WGTA specifies that the producer will be responsible for the full cost of transportation in excess of the government commitment. Accordingly, as the tonnage forecast rises so does the producer's absolute freight rate as well as his share of the total per tonne freight rate. At the same time, the government share of the freight rate on a per tonne basis would fall. To complicate matters a little further, there are two types of costs estimated by

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[3]Kraft and Karman, op.cit.

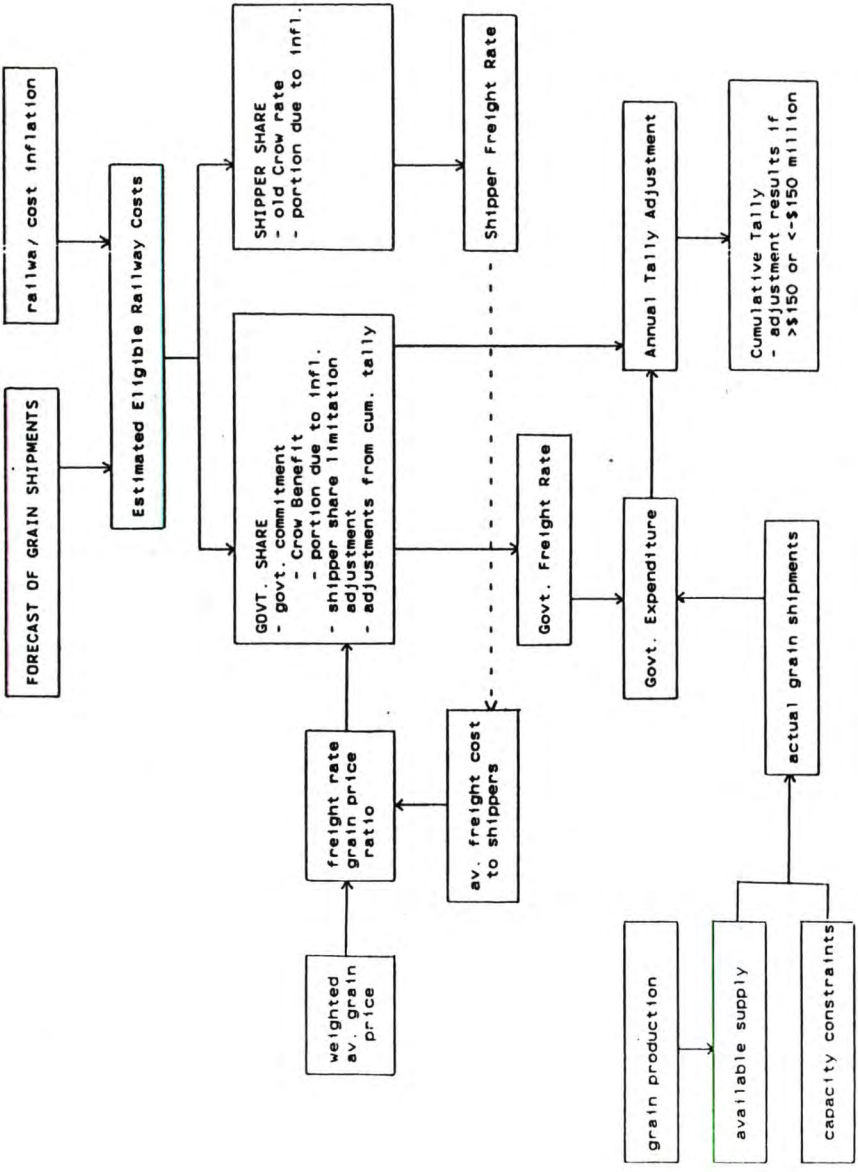


Figure 1: The Rate Setting Process Under the WGTA

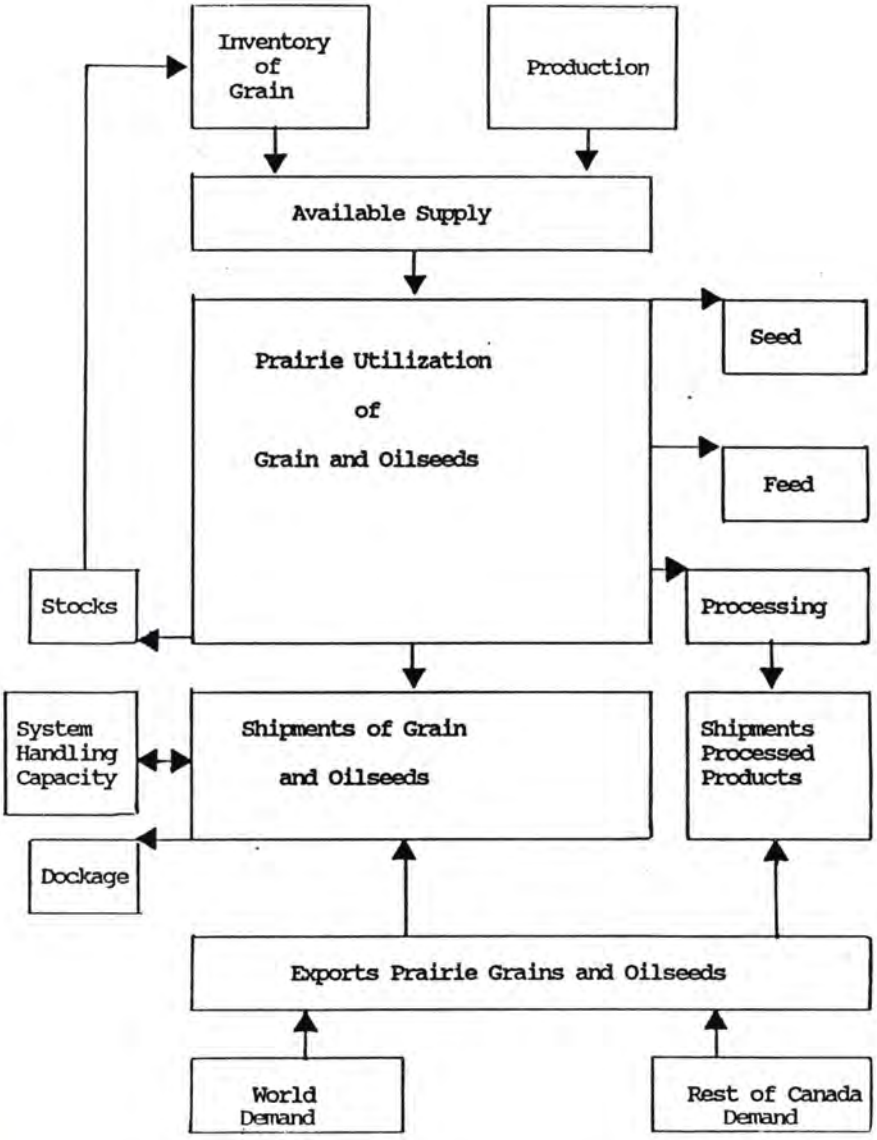


Figure 2: Components of Forecasting Grain Shipments

the CTC in the calculation of the rate - the volume related variable costs and the volume independent line related costs. Again, as the tonnage forecast increases, the portion of the rate tied to line related costs falls on a per tonne basis.

An example may help illustrate the issues mentioned above. (See Table 1). For the 1986-87 crop year the volume related costs were $23.06 per tonne and the total line related costs were approximately $104.0 million. The contribution to constant costs is calculated as 20 percent of volume related costs, another cost component which is affected by the volume forecast. As the volume forecast increases, so does the volume related variable cost and, in turn, the constant costs.

Based on a tonnage estimate of 28.5 million tonnes, the producers' average freight rate would be $5.97 per tonne with the federal government share at $24.97 per tonne for a total rate of $30.94 per tonne.

In the case where the tonnage forecast is 34.0 million tonnes, the total freight rate falls marginally to $30.43 per tonne, as the line related costs are spread over a greater tonnage. However, the producer/federal government share of the freight rate changes significantly. The producer now pays a freight rate of $9.17 per tonne (an increase from 19.3 percent to 30.1 percent of the total) while the government pays $21.26 per tonne (a decrease from 80.7 percent to 69.9 percent of the total).

These examples illustrate two problems related to forecasting volumes of grain movement: (1) what the producer and federal government have paid versus what they should have paid, and (2) what the railways receive versus what they should have received. Assuming that the movement for the 1986-87 crop year will equal 34.0 million tonnes (it actually appears that this movement will be attained or exceeded), the payout, basis a 28.5 million tonne forecast, and a 34.0 million tonne movement is shown below:

Government	$24.97	x 34.0 =	$ 848.98	million
Producer	5.97	x 34.0 =	$ 202.98	"
Railways' Receive			$1,051.96	"

However, basis a 34.0 million tonne forecast, the payouts and receipts would have been:

Government	$21.26	x 34.0 =	$ 722.84	million
Producer	9.17	x 34.0 =	$ 311.78	"
Railways' Receive			$1,034.62	"

Table 1

1986-87 Freight Rate Calculations

Volume Related Variable Cost	$ 23.06/tonne	$ 23.06/tonne
Volume Forecast (million tonnes)	28.5	34.0
Total Volume Related Costs	$ 657.21 million	$ 784.04 million
Contribution to Constant Costs (20%)	131.44 "	156.81 "
Line Related Costs	104.00 "	104.00 "
Total Eligible Costs[a]	$ 882.25 "	$1034.45 "
(Less CN adjustment of $10.4 million)		
Government Commitment	$ 710.30 "	$ 722.98 "
(Less CN adjustment of $10.4 million)		
TOTAL FREIGHT RATE[b]	$ 30.94 / tonne	$ 30.43 / tonne
Government Rate	$ 24.97 / "	$ 21.26 / "
Producer Rate	$ 5.97 / "	$ 9.17 / "
Government Share	80.7%	69.9%
Producer Share	19.3%	30.1%

[a]Costs are reconstructed and may not correspond precisely with all CTC procedures and calculations.

[b]Average freight rate as per CFAW Tariff 4310.

With the rate set on a forecast of 28.5 million tonnes but with an actual movement of 34.0 million tonnes, the government has overpaid by $126.14 million and the producers have underpaid by $108.8 million with the railways receiving an overpayment of $17.34 million for line related costs.

In drafting the WGTA, the legislators clearly recognized these potential problems. In Section 54 of the WGTA provisions were made to account for over or under payment by the producer or federal government in the next year's freight rate. That is, the government commitment would be adjusted accordingly the following year to take into account any over or under payment.

However, no adjustments were put into place to account for railways' over or under payment due to the apportionment of line related costs. The intent of the WGTA was that the over and under payments to the railways would balance themselves out over time. It must be remembered that the reverse happens as well. Every time the actual movement is less than the estimated or forecast movement, the railways will be underpaid.

Assessment of Volume Forecasting Procedures and Subsequent Adjustments

What type of success has been achieved? Average producer freight rates per tonne rose from $5.72 in 1983-84 to $7.70 in 1984-85 and fell to $6.00 in 1985-86. Naturally there was confusion as to how the freight rate to the producer was being set. As noted earlier, everyone expected the producers' freight rate to rise. Yet in three short years the freight rate rose to a high of $7.70 and then fell to $6.00. The problem, if that is the way to define it, is that given the differences between the actual movement and forecast movement, the interim adjustments could materially affect the following year's freight rate. Very simply, a $60 million overpayment in one year could lead to a $2.00 per tonne reduction in the freight rate the following year (basis a 30 million tonne forecast) as the government's commitment would be reduced by that amount. That, in fact, is what happened in the setting of the 1984-85 rate. For that crop year the government commitment was calculated at $639.0 million. However, with an adjustment of $60.1 million, the federal share, after taking into account the CN adjustment, was reduced to $560.9 million, basis a 31.8 million tonne forecast. This meant that the federal share of the freight rate, on a per tonne basis, declined from $19.52 per tonne to $17.64 - a difference the producer had to make up.

While the forecast and the subsequent interim and final adjustment achieved the objectives of compensating the railways in a timely fashion, these were difficulties that were hard to ignore. Concern was rapidly increasing about the fact that, in the short history of the WGTA, the producer freight rate exhibited some significant (some would say strange) gyrations.

Attention was turned to providing a more stable rate environment; that is, regular but gradual freight rate increases. In 1985, in consultation with the Senior Grain Transportation Committee, the Grain Transportation Agency developed a "tally system" which became part of Bill C-44, an Act to amend the Western Grain Transportation Act, which was passed on June 27, 1985.

The concept was fairly straightforward. The Agency would continue to forecast grain movement as it had, but rather than try and "balance the books" in the following year through freight rate adjustments, a tally would be kept of over and under payments. The expectation was that, over time, any over and under payments due to differences in actual and forecast movement would be equal to zero. While the tally may be technically appealing, its "success" was even less than that of the original interim and final adjustments. The intended purpose of the tally didn't even survive a year.

For the 1985-86 crop year the Grain Transportation Agency forecast a movement of 31.8 million tonnes. However, 1985-86 turned out to be the second poor crop in a row. Ultimately, 27.5 million tonnes of grain, or 4.3 million tonnes less than the forecast 31.8 million tonnes was moved. This resulted in a build-up of $60 million of producer money in the tally. For 1986-87, the GTA's initial volume forecast of 30.64 million tonnes (less than the previous year due to inventory adjustments) would have resulted in a producer freight rate of $7.50 per tonne, up $1.50 from the then (1985-86) freight rate of $6.00 per tonne, a not unexpected or unrealistic freight rate increase.

However, production, prices and world markets for 1986-87 were expected to be poor and the GTA was criticized by most groups in the grain handling and transportation industry for its unrealistic forecast. Given this criticism and the fact that over $60 million of producers' money was in the tally, pressure was brought to bear on the federal government and ultimately the GTA was directed to lower its forecast. A volume of 28.5 million tonnes was selected which in turn led to a producer freight rate of $5.97 per tonne - a rate nearly identical to the previous year's $6.00.

What will the effect be on the tally? Using the example mentioned earlier the government will have overpaid by $126 million and the producers will have underpaid by $108 million with the railways having received an overpayment of $17 million for line related costs. However this will not happen. Bill C-44, which introduced the tally system, also has a number of clauses which will materially affect what is put into the tally and what the railways will receive.

Section 43.1 states that... "the portion of the rate payable by the shipper ... (for) ... the 1986-87 crop year shall not exceed the portion of the rate that was payable by the shipper under the tariff that was so filed and published by the railway company in respect of the 1984-85 crop year for such movement." Section 55.2 also states ... "where the transitional tally adjustment in respect of a crop year is a positive amount, the Minister shall reduce any payments due to the railway companies under this Act by the amount by which the transitional tally exceeds ..."

No one was concerned about these sections when the 1986-87 rate was being established as it appeared the movement would be below normal levels with the resultant producer rate below $7.70 per tonne. However, it is estimated that grain movement this year will be in excess of 34 million tonnes - well above average. Had the forecast been 34 million tonnes, these clauses would have come into effect. At 34 million tonnes the producers share would have been in the order of $9.17 per tonne and the federal portion of $21.26 per tonne, but Section 43.1 would have limited the producer portion to $7.70 per tonne. In addition, the federal share of the rate would have equalled $21.26 and not $24.97 per tonne. As a result, it is now estimated that the railways will have to pay back some $90 million. These clauses are retroactive. In effect almost the entire railway contribution to constant costs will be eliminated for 1986-87.

Some have chosen to interpret the 1986-87 situation as one where the railways have simply been overpaid. It must be made clear that the 1986-87 situation is not an overpayment to the railways for their costs but an overpayment through a definition that tried to limit the increase in the producers rate. It is also a definition that will not apply beyond the 1986-87 rate setting exercises.

For 1987-88, the producer freight rate will be in the order of $8.50 per tonne - a dramatic increase from $5.97. However, had the intent and principles of the tally and forecasting mechanism been followed, the

increase in the producer share of the freight rate would have been gradual - from $6.00 in 1985-86 to $7.50 in 1986-87 to $8.50 in 1987-88.

In essence, the tally has some potentially serious drawbacks. First, the cumulative tally may not always return to zero within a reasonable time horizon. There are five reasons why this is so:

1. The farmer never pays less than the old "Crow Rate;" the government underpayment in low volume years can be less than the overpayment in correspondingly high volume years; the tally is therefore biased.

2. Although there is an equal probability of overestimating or underestimating the volume, there may not be equal probabilities attached to the size of the error. Again, the tally could therefore be biased in whichever direction lies the chance of the larger error.

3. If the long term growth rate changes, there will be a period when volume estimates are either consistently overestimated or underestimated, and the tally will be driven one way or the other.

4. A particularly high or low volume year can result in an addition to the tally from which it is unlikely to recover.

5. Although there is no lower limit to volume shipped (in the event of a crop failure), there is an upper limit imposed by the capacity of the grain handling and transportation system.

Second, once the cumulative tally reaches its ceiling (now set at $150 million) the effectiveness is destroyed, and the "tally" adjustments have the same effect on rates as did the previous "interim" and "final" adjustments.

Third, the prospect of something in excess of $100 million being owed to the farmer is unpalatable to some grain industry participants as was evidenced during the establishment of the 1986-87 freight rates.

The current forecasting and freight rate setting mechanism compensates the railways almost immediately after the movement takes place, with the major exception of the 1986-87 crop year. However, the current procedures, even with the tally, are quite incompatible with the objective of trying to stabilize producer freight rates.

Returning to the desirable criteria for forecasts mentioned earlier, how does the WGTA volume forecasting procedure rate? With respect to understanding the purpose for which forecasts are being developed, it would appear that the GTA and most industry groups have a clear understanding of the role of volume forecasts as envisaged in the WGTA. However, pressure on the federal government to "adjust" the volume forecast in order to minimize producers' freight rate increases in 1986-87 led to producer freight rates that are quite inconsistent with the original intent of the WGTA.

The economic difficulties of Prairie grain producers are a matter of great concern. It is more appropriate to deal with these difficulties through other policy measures such as emergency income support programs, and not through changes to the intent and procedures in volume forecasting under the WGTA.

On the matter of maintaining consistency, the "adjustments" to volume forecasts have resulted in short-term freight rate adjustments which are not consistent with long-term trends. The tally system attempts to cope with this, but its degree of success is questionable.

Recognizing and accommodating uncertainty is perhaps the most difficult area facing the volume forecasters. No amount of improvement in analytical techniques will eliminate the variability in Prairie grain production. Clearly, what is necessary is a reduction in the need for volume forecasts in establishing subsidy levels. Some preliminary suggestions along these lines are contained in the next section.

Turning to objectivity and a good data base, there appear to be no "threats to objectivity" with respect to the procedures followed by the forecasters in volume forecasting. Also, the data base available in the Prairie grain production and marketing sector is well-developed and is being used effectively.

Some Recommendations For Change

Given the requirement of a fixed (in current dollars) federal government commitment for payment of the Crow benefit and the reality of fluctuating grain volumes, fluctuating freight rates to grain producers are inevitable. It is quite clear that the current tally system is not able to overcome these difficulties.

A recent report by Kraft and Karman[4] concluded that the shortcomings of the volume forecast did not rest with the methodology but rather with the task at hand, and that a procedure less reliant upon foretelling the future would be preferable. More specifically, they recommend establishing a rate based on a volume unlikely to be exceeded in any crop year and then allowing a rebate to producers at the end of each shipping season where shipments fail to equal this volume. However, this would likely lead to a regular underpayment to the railways for line related costs. Also, the practicality, and acceptability, of having the producer always paying a larger than expected freight rate is questionable.

Two other possible adjustments that would lessen some of the fluctuations in freight rates would be:

1. A separate payout to the railways for line related costs. This would avoid over or under-payment to the railways due to differences in the volume forecast and actual grain movements.

2. A holdback of a portion of the Crow benefit, with any residual to be paid the following year in the form of a final payment. This would be similar to the Canadian Wheat Board's concept of the initial and final payment for grains marketed through the CWB. The concept is that the producers' freight rate would be based on a government commitment of, say, $500 million rather than the $658.6 million. This would result in the producer paying a higher initial freight rate. However, at the end of the year, once the movement was known, he could, potentially, receive a rebate. If actual movement was much higher than forecast, then the rebate would be small or non-existent - as the holdback would be used to cover government payments. If less than expected, he would receive a larger portion of the $158 million held back as it would not have been spent. Again, this proposition has a similar limitation to the Kraft and Karman suggestion, namely questionable producer acceptability.

Notwithstanding the political sensitivity of the "method of payment" issue, many of the problems inherent with the present legislation with respect to volume forecasting, rate setting, and producer/government sharing of freight costs could be minimized by amending the legislation to permit a "pay the producer" approach. For example, a payout of the federal government

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[4] Ibid.

commitment, as recommended by the GTA[5] would result in the producer being responsible for the entire freight rate with the only changes being due to changes in costs. No volume forecasts would be necessary, and no division would have to be made between the federal and producer share.

Another option under the "pay the producer" umbrella would be to incorporate the federal government commitment into the Western grain Stabilization Program. This approach would explicitly take account of the instability associated with Prairie grain production and producers' ability to pay higher freight rates. This is explored in more detail in another paper at this Conference.[6]

Although the Western Grain Transportation Act has achieved, in general, one of its objectives, namely to compensate the railways for their costs of moving grain, it has been less than successful in bringing about a reasonable adjustment in freight rates that reflect cost changes. Part of that problem lies in the difficulty inherent in forecasting grain shipments. More of the problem lies with interference in the technical procedures of forecasting and rate making.

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[5]Grain Transportation Agency, Review of the Western Grain Transportation Act, April 1986.

[6]P.D. Earl and E.W. Tyrchniewicz, "An Alternative Mechanism for Paying the Crow Benefit: The Western Grain Stabilization Program."

MARITIME IMPACT STUDIES, A Different Game

AUTHOR John L. Eyre

Introduction

" One job in six depends on the Port "

" Our National Shipping Line preserves foreign exchange "

Familiar statements,- often they are true, but not always. Transportation is not a vital issue for most people. Shipping is seldom more than a passing point in a poliitical campaign.

> " As a result, transportation has no public politics of its own, only a private politics. It waits in the wings until the votes are counted, the audience has left, and the lights are turned down; then it moves onto the stage for a private showing of the politics of government. And the system suffers from it. " (1.)

Because so few look behind the calculations of port and maritime people, they feel secure in making bold claims. When they are challenged, it is by their customers who are less vocal and poorly organized. Maritime people (the author included) see their industry as vital, an end in itself. But shipping is a service industry. The numbers that matter relate to rates and services.

Eighty percent (by weight) of international trade moves in ships. While air does well with diamond watches, currency and computers, most general cargo and all bulk (ores, oil etc.) moves more cheaply by water.

Shipping and port people, aware of their importance, come to governments with requests for finance, cargo preferences, sympathetic laws and protection from destructive competition. In so doing they make public claims about the impact of their activities,- some accurate and some not. In this paper a member of the maritime industry argues that the game has changed.In part this results from the wartime discovery of something called logistics.

THE CARGO OWNER,- LOGISTICS

When a cargo, say ladies sweaters, is shipped from Ireland to Chicago or Santiago the exporter must provide or borrow money to cover the value of his goods until they are delivered or paid for. Someone is out of pocket from the start to the end of the deal. This kind of short term money costs between ten and twenty percent. An air shipment may get the sweater man paid within ten days. By surface (truck/rail/ship) he will wait at least two months. The sweaters are stored in his mill , again at several seaports (or airports) and again at a distribution center. Warehouse and handling charges result.

Being valuable ($10,000 a ton) and perishable, they must be insured from the day their voyage starts.

The paper work is enormous, correspondence telexes and phone calls to make the deal, order documents, customs forms, bills of lading, export permits, billing and tax statements.

All of this is, or should be, organized under the heading of logistics. The Harvard Business School teaches a full year course on the subject. The various pieces, inventory, order processing, storage and handling can be measured, computerized and organized because they form parts of a beautiful system. Woolworths, the A and P, Harrods, L.L.Bean, Migro, IGA, and the MacDonald hamburger people live or die on the skills of their logistics specialists. No longer does the New York Times carry job wanted adds for traffic managers. Now it is Distribution Directors who are in charge, better paid and much in demand. Their new art is sonetimes grandly called " the total distribution concept ".

This means two things to maritime people;

1. That any freight rate is multiplied by two or more if logistic costs are added.

2. That survival requires concern for the entire SYSTEM,- including ports and other modes (truck and rail).

Prof. Jim Heskett at the Harvard Business School was an early poineer in logistic teaching. He explained that;

> "The word "systems" in the business world is becoming comparable in its attractivenes to "sex" for the general public."

He was one of the authors of an early classic called BUSINESS LOGISTICS (2) which summarized its message in Exhibit I.

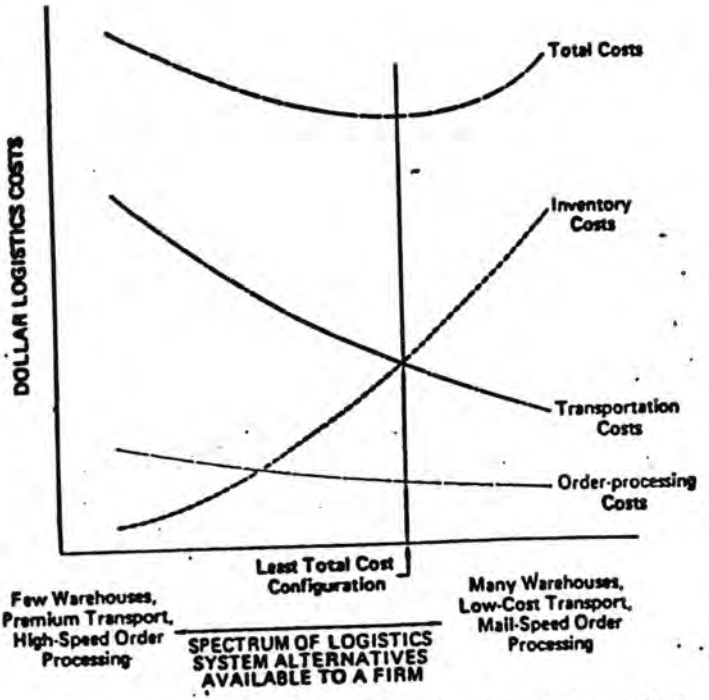


Fig. 2–3. A simplified illustration of the total cost concept, showing hypothetical trade-offs among transportation, inventory, and order-processing costs.

EXHIBIT 1. from BUSINESS LOGISTICS, by James L. Heskett, Nicholas A Glaskowski, Jr. and Robert M. Ivie, the Ronald Press, New York 1973, page 35. This chart summarizes what has become a full year course at many graduate schools in Europe and the USA. While the ideas in this book have been familiar for many years in OECD countries , they are still new elcewhere. This concept set the stage for JIT (just in time) theories in manufacturing.

This shows the tradeoffs that our Irish shipper must consider. If his sweaters have gold buttons and jewels on the necklines, a shipment may be worth a hundred thousand dollars. Then the inventory cost curve in the graph above will rise sharply, and he should consider expensive air freight. If they are cheap machine jobs, the inventory cost curve will be flatter. The least cost line will indicate water transport. In any event the total cost curve (top of the graph) will more than double the freight payments.

The freight rate curve relates to a choice between modes which need about the following payments;

TABLE 1.

Ship/barge	0.89	cents per ton mile
Pipeline	1.30	"
Rail	3.28	"
Truck	20.15	"
Air	43.22	"

Source, Magee,Copacino and Rosenfeld page 128 per note (3)

These are approximate, subject to wide variations.Thus,for example Evergreen, a Taiwanese round world containership line, moves general cargo for about a half cent, and USA river barge systems move grain downstream for less than that. Some super automated integrated rail services are under three cents a ton mile. Long haul truckmen with double jumbo trailers need less than eight cents. The above figures reflect averages and bring out cost relationships. Note that the fastest service tends to be the most expensive but the best for high value goods. These revenues also reflect service levels, including reliability.

Transportation/logistics consume more than eighty percent of the final delivered price of some commodities. Canadian coal and Tanzanian coffee are examples. For expensive jewelry, the total distribution cost is seldom more that one percent of value.The United Nations worries about freight payments that developing countries must pay for their exports, and they keep track of the relation between value and ocean freight rates.In considering their latest tally (Table 2) remember that this covers ocean freight alone. Including port and inland transport costs would about double these percentages, and the logistic costs will double the total again.

Table 2.

Ratio of liner freight rates to prices of selected commodities, 1970 and 1980-1983

Commodity	Route	Freight rate as a percentage of price a/ b/ c/				
		1970	1980	1981	1982	1983
Rubber	Singapore/Malaysia Europe	10.5	8.9	7.3	8.7	5.9
Tin	Singapore/Malaysia Europe	1.2	1.0	1.2	1.2	0.9
Jute	Bangladesh-Europe	12.1	19.8	21.4	21.7	21.4
Sisal hemp	East Africa-Europe	19.5	15.7	15.4	15.3	14.8
Cocoa beans	Ghana-Europe	2.4	2.7	3.0	3.6	2.6
Coconut oil	Sri Lanka-Europe	8.9	12.6	14.4	17.3	11.0
Tea	Sri Lanka-Europe	9.5	9.9	10.2	10.7	8.1
Coffee	Brazil-Europe	5.2	6.0	9.0	7.8	7.4
Palm kernels	Nigeria-Europe	8.8	18.3	27.7	31.7	22.6
Coffee	Colombia (Atlantic ports)-Europe	4.2	3.3	3.8	4.2	4.4
Cocoa beans	Brazil-Europe	7.4	8.6	9.3	11.9	9.7
Coffee	Colombia (Pacific ports)-Europe	4.5	4.4	5.5	5.0	5.2

Source : Compiled by the UNCTAD secretariat on the basis of data supplied by the Royal Netherlands Shipowners' Association.

a/ C.i.f. prices were quoted for rubber (London-RSS), tin, jute (UK-pwc grade), sisal hemp, cocoa beans (Ghana-Europe) and palm kernels. For cocoa beans (Brazil-Europe) and coffee (Colombia-Europe and Brazil-Europe), unit values of exports were quoted. Prices of the remaining commodities are quoted on f.o.b. terms.

b/ Freight rates include, where applicable, Suez Canal surcharges, bunker and currency adjustment factors, a "tank cleaning surcharge" (for coconut oil only), port delay and additional port surcharges and a low productivity surcharge (for Colombia only). Conversion of rates to other currencies is based on parities given in International Financial Statistics published by the International Monetary Fund. Annual freight rates were calculated by taking a weighted average of various freight rates quoted during the year, weighted by their period of duration.

c/ For the period 1980-1983, the prices of coconut oil and sisal hemp were taken from UNCTAD, Monthly Commodity Price Bulletin, in the December issue of the respective following year.

For imports Third World countries, according to the UN, pay ten percent of value for ocean freight (not including inland transport and logistics).

Table 3 offers that authors estimates on relationships for various types of cargo

TABLE 3 DISTRIBUTION COSTS AS A PERCENT OF DELIVERED VALUE

COMMODITY	OCEAN FREIGHT/	INLAND FREIGHT/	LOGISTICS/	TOTAL
Cheap bulk (ores, coal, fertilizer)	30	25	15	70
Grain	12	14	10	36
Cheap General (wood, metal etc)	10	10	15	35
Manufactured General cargo	4	4	12	20

SHIPPING AND THE BALANCE OF PAYMENTS

Canada is a cargo owning nation with vast anounts of coal, grain, ore and forest products to export. These are the cargos in Table 3 above that are sensitive to cost/service levels. Few merchant ships fly the Canadian flag. The shipping industry has been depressed during most of the post World War II period. Canadians have been pleased to sit back and enjoy the low rates and good services that result from the subsidies that most other nations pay to their ships and shipyards. Having no home flag lines to defend, Canadians are promoters of free trade on the high seas.

Elcewhere the story is different. Practically every salt water nation has a ship line and a vocal lobby of union and management promoters. In seeking government support shipping people say that they are an asset in the national balance of payment account. This is true if their shipping companies earn profits (by commercial accounting standards). But, if these lines need subsidies, protection, or preferential treatment (low port dues, cheap fuel, tax exemption etc.) the opposite may be true.

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 one 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 must admit that eighty percent of a ship's expenditures are constant and not changed by a flag transfer. A Chilean named Brown (World Bank advisor) devised a simple formula for payment balance 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 purchase price of the ship plus finance costs. The best and cheapest ships are built in Japan, Korea, Taiwan and China.Most shipping money is borrowed in big US/UK/European banks, or from rich Arabs. For nations without finance or competitive shipyards, again no gain. Fuel is 20%, purchaced in the open market where it is cheapest,best and located on a vessel's trading route. Insurance, say 7% usually comes in the London market. When all cost elements are considered , only three offer balance of payment gains, These cover management, crew and profits. They can add up to about twenty percent of gross costs or earnings.

Even these are watered down. Management expenditures are heavy in overseas ports (agents or captive offices). Crews are smaller every year and spend some of their earnings in foreign ports. Few Government owned shipping lines earn profits.

At the third and most exact level the costs of subsidies and protection are included. Subsidies are paid for by general taxpayers. Protection is paid for by the cargo owners and industries of nations that do not permit free market shipping.

For example, Brazil has cargo sharing agreements with the USA and also with the following nations;

1. Argentina	5. Portugal	9. The USSR
2. Poland	6. Nigeria	10. Germany (both)
3. Romania	7. France	11. Peru
4. Chile	8. Mexico	12. Uruguay

In most cases these call for flat fifty-fifty sharing monopolies for the flags of the trading partners. This means that cross traders and outsiders (Greeks, Norwegians, Asians etc.) are excluded,- also that rates and service levels are protected from competition. In special cases exemptions are allowed. As a result Brazilian flag ships carry 45% of their general cargo trade and others carry 55%.

If the Brazilian flag ships are profitable (without subsidies),they could contribute about fifty million dollars to the balance of payment account. However, because the trade is closed (no competition) rates are higher and service levels lower. The difference in logistic costs (Brazil trades vs free market) is at least twenty percent. Non Brazilian ships enjoy these excess rate levels to the tune of about $71 million.Thus the balance of payment losses (paid by Brazilian cargo owners) exceed the gains by a factor of seven to one.

Table 5 lists some of those nations that,according to the United Nations (UNCTAD) have cargo preference schemes.

Column 1. lists the shipping balance of payment gains, assuming that the home flag ships are profitable without any form of subsidy.

Column 2. shows for each nation the percentage of general cargo trade carried under other than the home flag.

Column 3. shows extra earnings of non nationals because rates are higher and services lower.

TABLE 5 BALANCE OF PAYMENT SHIPPING GAINS AND LOGISTIC LOSSES

COUNTRY	SHIPPING PAYMENT GAINS	PERCENTAGE CARRIED BY OTHERS	LOGISTIC PAY'T LOSSES
Argentina	$ 34 million	50	$ 93 million
Brazil	50	55	371
Chile	5	69	85
Colombia	11	50	86
Ecuador	8	60	41
India	72	58	309
Indonesia	40	78	362
Korea S	52	50	894
Malaysia	23	80	480
Mexico	7	75	502
Pakistan	17	85	186
Peru	10	60	57
Philippines	37	80	224
Spain	47	55	667
Turkey	28	75	257
Uruguay	12	85	61
Venezuela	10	70	221

Details in Appendix 1,

Payment losses exceed gains by ten to one (av.) because so much excess freight is paid to trading partners.Table 5 is based on figures from Lloyds Register, the World Bank. The United Nations, The U.S. Maritime Admin. and the Bremen Institute.

CHANGE

Table 5 would have told a different story in 1937 because shipping and ports were once people affairs, labour intensive. Automation and computers have altered the nature of their impact.

Maritime traditions are in trouble. Merchant seamen have almost become history. Norsk Veritas, Norway's respected ship inspection society sees a normal cargo ship with only six men.

If we can send a missle to the moon with three men, we can send a bucket of ore to Rotterdam with twelve. The ship of the future (1997) will have about eight officers and four trainees (Kings Point Cadets). Mooring lines can be fired mechanically, maintenance can be in port or by roving gangs. The distinction between ships and jumbo jet planes is fading. Getting the vehicle from point A to B is all that matters.

Ashore the story is similar. Not long ago a discharging freighter gave work to four hundred men. Now forty is too many. Soon cranes will transfer containers directly between ships and rail cars. A longshoremen will earn sixty thousand dollars a year, more than a Harvard Business school graduate.

PORT IMPACTS

A hundred years ago port related activities were the main generator of jobs and the economy of New York, London and Rotterdam. Now the Port of New York/NJ. Authority can only say that the port industry accounts;

> " for approximately three percent of the Gross Regional Product and also..... about three percent of regional employment" (4)

In ten years less than two percent of New York jobs will be port generated for reasons which the Port Authority admits in their honest impact study. In 1982 the port generated 191,600 jobs, of which 103,100 were in stevedoring, ocean transport, warehousing, banking , forwarding, trucking etc. However, most North Atlantic ports are saddled with make work labour contracts that cannot last. Even white collar computer work is fleeing to Barbados and San Juan as carriers (air,truck,rail and ship) seek to avoid big city costs and union restrictions.

Not all port impact studies are as honest as the New York one. Most of these are paid for by port organizations. Their object is usually to convince the public (and a Government) on the merits of a subsidy (New Orleans), tax exemption for their bonds (New York), dredging by the US Army Engineers, or some other financial benefit.

Familiar tricks off the impact study trade are the following;

1.MULTIPLIERS;

If a longshoreman has a mother in law living with him, and she buys a television set, the television store is deemed port elated. There is some merit in this point, but it is easily overstated.

2. SHIP CREW EXPENDITURES

When ships carried big crews and spent much time in port this was important. Now crews are small, mostly Asian and low paid. A containership turns around in a day. A bus load of Golden Age tourists will spend more in New York City than will the average 1987 ship crew.

3. SAND,GRAVEL AND GARBAGE BARGES

Employment on local construction and housekeeping can pad impact figures. While statistically correct, these entries seldom have a bearing on foreign commerce or the issue before the public.

4. ALTERNATE USES OF THE LAND AND MONEY

The usual port impact study is confined to the benefits, with no mention of costs. Manhattan Island is filled with high rise apartments, convention centers, and stores replacing departed superliner piers. These also employ bank clerks, insurance people, most of the skills that are claimed for port activities. It is no accident that Bremen, Rotterdam, San Francisco and London have pushed the ships away from their city centers.

CONCLUSION

Ships and ports have an enormous impact. In logistic terms they influence (Table 3) from twenty to seventy percent of the value of goods shipped. Their importance lies not in the benefits that their activities generate, but in the rates and services that they give to their customers.

NOTES

1.The Great American Motion Sickness, by John Burby, Little Brown and Co. 1971, page 213,, an account of the early days of the US.Dept. of Transportation.

2.Business Logistics, by Heskett, Glaskowski and Ivie, the Ronald Press,NY, 1973, Jim Heskett's comment is at page 2, and Exhibit I is at page 35. This was the earliest " Bible " for logistic scholars, and it is still one of the most understandible. While computers and intermodalism have blossomed since then, the basic principles have not greatly changed.

3.Modern Logistics Management, by Magee, Copachino and Rosenfeld, John Wiley & Sons 1985, the most up to date book on the subject with good sections re the place of logistics in corporate executive decisions on seemingly unrelated issues.. Table 1 was extracted from their Table 5.5 at page 128.

4.The Economic Impact of the Port Industry on the New York-New Jersey Metropolitan Region, The Port Authority, April 1985,pg.5

RE TABLE 5 AND APPENDIX I

These make the paper's central point. As noted on page 12, the data sources are above reproach, ie. Lloyds, the World Bank and the U.S. Maritime Admin. The nations are those listed in UNCTAD'S 25 Aug. 1986 (TD/B/C.4/301) report " Major Issues in World Shipping ".Table 4 at page 8 selects them,but its footnote comments that " cargo preference schemes are also in effect in the following countries; Algeria, Angola, Bangladesh, Benin, Bolivia, Burma, Cameroon, China, Congo, Cote d'Ivoire, Cuba, Dominican Republic, Egypt, Ethiopia, Gabon,Ghana,Guinea,Kuwait, Libyian Arab Jamhiriya, Morocco, Nicaragua, Nigeria, Paraguay, Saudi Arabia, Senegal, Sri Lanka, Thailand, Togo, United Arab Emirates, and Zaire."

The assumptions can be debated, and could be off by twenty percent in either direction. For example, it is perhaps not safe to say that all government owned ship lines earn profits by commercial accounting standards. However, allowing for this, the central message is powerful, namely that most of the countries that practice shipping protectionism do enormous harm to their own industries, mines and farms also incur large payment losses.

French protectionism is mostly in bulk trades,and the the USA has free general cargo shipping trade, except in Latin America and with Government financed (AID,Military etc.) business. Thus there is no entry in Cols.5 and 7 for them.

All money figures are in millions of 1984 US dollars.

APPENDIX I CALCULATIONS, SOURCES AND ASSUMPTIONS FOR TABLE 5 on Balance of Payment Shipping Gains and Logistic Losses.

COUNTRY/	1.DWT. (000)	2.GROSS	3.GAINS	4.LOGISTICS	5.EXTRA	6.%	7. LOSS
Argentina	843	$ 169M	$ 34M	$ 981M	$ 196M	50%	$ 98M
Brazil	1243	249	50	3377	675	55	371
Chile	118	24	5	615	123	69	85
Colombia	287	57	11	860	172	50	86
Ecuador	206	41	8	342	68	60	41
France	1639	328	66	27680	NA	70	NA
India	1802	360	72	2662	532	58	309
Indonesia	995	199	40	2321	464	78	362
Korea S	1307	261	52	8935	1787	50	894
Malaysia	580	116	23	3000	600	80	480
Mexico	173	35	7	3350	670	75	502
Pakistan	431	86	17	1095	219	85	186
Peru	253	51	10	472	94	60	57
Philippines	972	194	39	1404	280	80	224
Spain	1184	237	47	6063	1273	55	667
Turkey	709	142	28	1716	343	75	257
U.S.A.	4373	875	175	78263	NA	70	NA
Uruguay	59	12	2	143	72	85	61
Venezuela	262	52	10	1580	316	70	221

SOURCES

Col.1.DWT Tonnage of General Cargo and Containerships only from Lloyd's Register of Shipping Statistical Tables 1984, London all figures are for thousand (000) deadweight tons of shipping

Col.2. Col. one divided by 20,000 and Multiplied by 4 million US dollars on the assumption that each 20,000 tons of shipping had gross earnings of that amount in 1984.

Col.3 Balance of payment gain, twenty percent of col.2.

Col.4.Twenty percent of the dollar value of the general cargo trade of each nation as reported for 1984 in the World Bank's WORLD DEVELOPMENT REPORT 1986,tables 9,10 and 11.pages 194 to 201.This reflects logistic costs per Table 3 pg.6 of the paper.

Col.5 Twenty percent of col.4 on the assumption that free market shipping would provide cheaper/better service and that the difference in dollar logistic terms is 20%.

Col.6 Percentage carried by other than a home flag as reported by the US Maritime Admin. in their MARINE SUBSIDIES, dated Feb.1983 supplemented by data from Seatrade and the Bremen Inst.

Col. 7 Col. 5 multiplied by Col.6. to show how much other flags extracted from the home flag payment account. On average this was in 1984 ten times the shipping gain.

INTERMODAL TRANSPORT AND VERTICAL INTEGRATION

Michel Archambault

Transport Canada
Economic Analysis

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ABSTRACT

The aim of the paper is to summarize major intermodal corporate strategies and organizational behaviour of individual companies in the supply of intermodal services. The paper makes reference to the diversity of commercial agreements surrounding sea-rail intermodal arrangements in the context of Canada's and U.S.A.'s overseas waterborne trade. The main thrust of this paper is, on the one hand, that the new economic regulatory environment has given greater opportunities for large transport companies, in any mode of transportation, to proceed with a vertical financial integration of their activities. On the other hand, it has also favoured the growing use of contractual inter-company agreements of co-ordination to achieve similar results as would an integrated transportation company, and to meet the challenge of the new competitive environment.

1. NEW MARKET ENVIRONMENT

An important aspect of the liner shipping industry is the increasing range and quality of services offered and/or available to various shippers. Internal market forces, from both the demand and the supply sides, are forcing liner companies to differentiate the quality of their services in terms of the accessibility and availability of a reliable intermodal transport.

From the demand side, one major impact of containerization is that it has implied a standardization of liner shipping services. In the eyes of shippers, there is increasingly a lack of discernable differences in strictly

maritime services, due to the inter-changeability of maritime services offered by different liner companies and to the greater uniformity of handling and stowing methods. However, shippers are finding their own advantages in the intermodal approach with an enhanced range of competitive routing options. The advent of intermodalism, in which the sea transport is one link in the transportation chain, has implied that shippers are no longer obligated to send their cargo through the nearest available port. The determinants of shipper's choice of container lines are increasingly related to the overall quality of services and the total transportation cost from origin to destination.

On the supply side, numerous institutional and structural changes have taken place over the last seven years both in the international liner shipping industry and in all surface modes. In the maritime industry, there have been threats of new entrants from both (often) subsidized liner fleets of certain developing countries and other highly competitive and large Far Eastern liner companies. Furthermore, related to the ever increasing size of vessels, there has been the introduction of the round-the-world services, mainly deployed on the mainstream trades. Moreover, greater productivity and efficiency in container handling and trans-shipment activities have lead to an intensification of competition among liner companies. An integrated intermodal approach and competition have taken place in the market and posed new challenges to traditional port-to-port shipping services. In particular, many sea-rail intermodal activities and container related technologies are coming to maturity, including mini- and micro-landbridge systems, intermodal railway unit trains (either double-stack or conventional COFC), inland load centres organizational developments and computerized support systems of cargo tracking.

It is generally agreed that, from the early stages of intermodalism, the issue of the sea-rail interface became a critical element in international intermodal development. Moreover, inland load centres are recent organizational and logistical developments which are enhancing both the intramodal and intermodal competition. They are leading to new economics of container movements by facilitating the extent of the sea-rail intermodal journey, where co-ordinated rail-road cargo interchanges and/or container

interchanges between different unit trains can be (and, in fact, are) performed. In short, the traditional unimodal common user services approach, where each leg of transportation is done as a separate activity and under separate entities, is increasingly replaced by inter-company co-ordination and operational integration in order to supply intermodal through transport of cargo from origin to destination. The intermodal transport approach is more than simply the movement of cargo by two or more different modes, however. Intermodalism is the carrying out of a series of successive and complementary transportation functions, where there is a significant structural interdependence between activities aiming to be operationally integrated in the distribution process, in such a way as to offer continuous cargo movements.

2. INTERMODAL TECHNOLOGY EVOLUTION AND THE NEW ECONOMIC REGULATORY ENVIRONMENT

Intermodal related technologies have greatly evolved in recent years. One important feature of this evolution has been the benefits of technological homogeneity between the various successive activities involved in intermodal transportation. This homogeneity of intermodal technologies together with the structural interdependence between the constituent activities have encouraged certain large transport operators to vertically integrate certain key adjacent activities. Such intermodal corporate strategy aims to provide all (or most) of the successive transportation functions involved in an intermodal transport supply. The intermodal strategies of CP Ltd., of American President Co. and of CSX Corporation in taking over the major American container line Sea-Land are only examples among others of large transport companies having already reached a high degree of commitment to the intermodal approach. These companies are becoming true integrated intermodal transport operators.

However, in the market place, there is a continued presence of transport operators, confining their operations to one of the individual constituent activities making up an intermodal through transport movement. For such operators, there exists an operational separability between the successive

transportation services and the related activities involved in the supply process of any intermodal services. It then implies, together with the intermodal feature of technological homogeneity, that for non-integrated transport operators the possibilities exist to enter into intercompany coordination agreements in such a way as to arrange for the provision of continuous and competitive cargo movements through the entire (or a large portion of the) transport chain. The vertical financial integration is one intermodal strategic option. There are various other competitive corporate strategies, which aim at the supply of intermodal services and enable participating transport operators to meet the challenges of the market place.

The growing use of voluntary contractual arrangements for joint and/or co-ordinated transportation services, observed over the last three or four years and involving carriers of different modes, directly reflects the market place competition, greater consciousness of shippers for the quality of service and technological forces which are restructuring the overall transportation industry. Moreover, the forthcoming new Canadian transportation regulatory regime, together with the recent U.S. transportation regulatory reform, are defining a new economic regulatory environment which, to a large extent, is merely supporting the aforesaid developments in intermodal market strategy and competitive environment.

Briefly, the favourable regulatory environment for intermodalism embodies various statutory provisions specifically dealing with antitrust immunity for certain concerted actions by common carriers regarding the provision of intermodal services; with both railway and maritime service contracts; with rights of individual members of a shipping conference to take independent action; and with third parties (such as N.V.O.C.C.) arranging for the provision of intermodal services and quoting single factor rates. It then results in a greater flexibility and freedom for all transport operators in deciding what level to set their strategic variables (what market(s) to enter, services to offer, rates to charge, etc.) in an attempt to obtain a secure and advantageous position within their respective competitive environment.

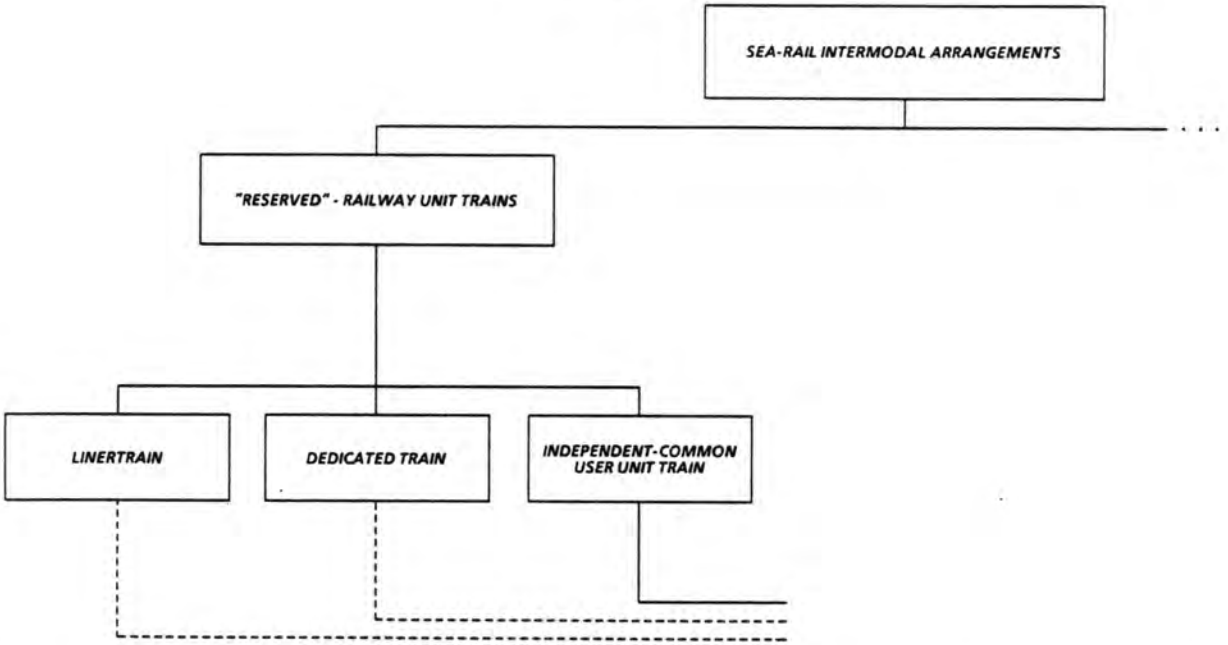
3. DIFFERING CORPORATE INTERMODAL STRATEGIES

The differing corporate strategies which surround the provision of continuous intermodal services are related to the various contractual rail transport arrangements which embody the supply of containerized unit trains. Three dynamic elements concur with that:

> First, international intermodal developments have relied in large measure on the implementation of containerized unit trains. Economies of scale in containership operations and the rationalization of mainline ports of call would have been jeopardized in the absence of complementary progress in inland transport capability and capacity to handle large volume of cargo and carry it over long distance.
>
> Second, the logistics and economics of containerized unit trains--traffic density and steady and balanced cargo flows--are not different to those of liner shipping operators, particularly since the introduction of the second generation of container vessels. Furthermore, because of the inherent intermodal character of container operations, rigid structural interdependence between these two transportation activities are prevailing.
>
> Third, the synchronization of mainline containerships and containerized unit trains schedules has come to be an efficient way to create further economies of scale from two transportation systems with already economies of scale in their individual operation.

These three elements, added to the operational requirement to maintain continuity of flow, have been important incentives for voluntary contractual arrangements of co-ordination not only between one railway and one shipping line but also, between any of these two common carriers and third parties. Three generic types of intermodal behaviour can be used to describe how liner shipping companies are responding to new competitive conditions: (1) adoption of integrated intermodal approaches, (2) all-water primary activities supplemented by intermodal arrangements and (3) asset-conscious strategies of small-medium sized liner companies. Figure 1 summarizes the various intermodal arrangements which can be retained by a shipping line. All of these intermodal strategies can be mixed in any combination according to the size of the market(s) to be served and the operational capability of the company.

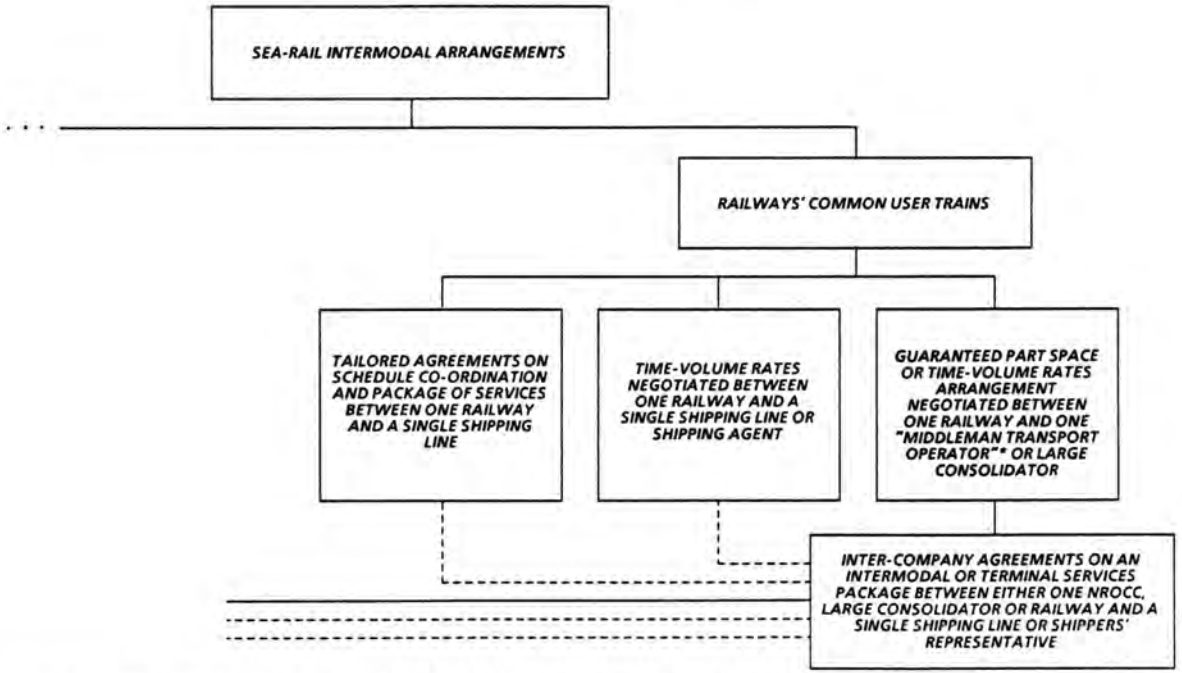
FIGURE 1



NOTE:

THE BROKEN LINES MEAN THAT INTER-COMPANY SEA-RAIL INTERMODAL ARRANGEMENTS CAN BE SUPPLEMENTED BY OTHER INTER-COMPANY ARRANGEMENTS NEGOTIATED BETWEEN A SHIPPING LINE (OR A SHIPPERS' REPRESENTATIVE) AND EITHER A CONSOLIDATOR, LARGE FREIGHT FORWARDER OR ANY OTHER TRANSPORT ENTITY IN ORDER TO ARRANGE FOR THE PROVISIONS OF AUXILIARY SERVICES AND/OR INTERMODAL RELATED SERVICES.

FIGURE 1 (continued)



* A MIDDLEMAN TRANSPORT OPERATOR CAN EITHER BE A NON-RAILWAY OWNING COMMON CARRIER (NROCC), AS 'TERMINAL TRANSPORTATION INC.' IN THE U.S., OR AN INDEPENDENT COMPANY FACILITATING ROAD/RAIL CONTAINER TRANSPORT SERVICES FROM/TO SPECIFIED INLAND LOAD CENTRE POINTS AS 'CONTAINERPORT GROUPS' IN THE U.S. AND 'ALBERTA INTERMODAL SERVICES LTD.' IN CANADA.

SOURCE: CANADIAN TRANSPORT COMMISSION, RESEARCH BRANCH

3.1 Integrated Intermodal Approaches

Without any doubt, sea transport is characterized by substantially lower transport costs per ton-mile than any other transport modes. However, traditional all-water and round-the-world services suffer from inferior service quality, relative to the intermodalism approach, due to their slower delivery time for inland cargo. In the context of containerized cargo, which is usually of high unit value, the overall transportation time factor represents an important component of shippers' requirements.

Capitalizing on developments in intermodal technology, certain container lines companies have opted for the intermodal approach by offering overland transportation and a broad range of transportation related services, and by assuming responsibility for the various stages of the movement with a single bill of lading. The market strategy of these latter companies have centered on the development of market niches based on: first, a custom-tailored transportation package; and second, specialized and geographically demarcated services. This strategic specialization aims to generate an efficiency in port and inland load centre operations in such a way as to provide the company with an ability to realise a high load factor for its cargo generating units over specific corridors and then, to offer profitable and attractive services to the shippers at a competitive logistics cost. Cast (1983) Ltd., on the North Atlantic, and American President Line, on the Pacific, are two examples of shipping lines pursuing such competitive intermodal strategy. The Japanese container line Showa Line, calling at American Gulf ports and operating its vessels only on the Pacific trade routes, is another example of a container line seeking to offer overland transportation as an integral part of its maritime activities.

Partly as a result of the new U.S. economic regulatory environment and of the recent adaptation of double-stacking intermodal technology, Linertrain and Dedicated train services correspond to the first two types of sea-rail contractual agreements. These intermodal agreements make reference to contractual rail transport arrangements between at least one railway and a single shipping line, where the agreed rail services package is strictly reserved and provided for the contracting single transport operator. One

key factor of these reserved-railway unit trains is a high-volume of cargo to be regularly moved on long-haul corridors to single destinations.

More specifically, linertrain contractual arrangements correspond to a unit train--either double-stack or single-stack--which is reserved for and managed by one specific shipping line. The shipping company, either owning or leasing parts of its railway rolling-stock, is contracting the railways to provide only the track, locomotive and rail crews over specified corridors. Usually through a subsidiary company, the container line has full responsibility to manage and solicit cargo in both directions, including pricing and marketing. Furthermore, although in most cases the marshalling of the linertrains is done through the railway companies own yards, not all intermodal activities (related to linertrains) necessarily make use of the contracted railways' facilities. Container lines having thus far contracted linertrain services have already entered into a vertical financial integration of certain key related activities. The companies then usually combine their own expertise with other sophisticated sub-contracting arrangements to solve the logistical problems of transport synchronization and co-ordination.

In regard to dedicated train services, which are usually contracted by either large or medium-sized container lines, they also make reference to a rail transport capacity reserved for one specific shipping line. Similar to linertrains, the inter-company agreements imply for the shipping line a volume commitment of its intermodal traffic to be moved over designated rail corridors with a specified frequency. Under the agreement, the railway has to respect an agreed operating schedule in order to ensure an operational synchronization of the train with the shipping line's arrival/departure schedule. However distinct from linertrains, the shipping line contracting for a dedicated service does not usually own any rolling-stock and, makes use of the contracted railways' intermodal yards and facilities for a number of its intermodal activities. This implies that, for most dedicated train services, all the train operations generally remain under the control of the railway or the group of interconnecting railways involved. Another distinctive feature of the dedicated trains, relative to linertrains, is that the railways do not systematically permit the contracting shipping line

a completely free hand in respect to filling the backload with domestic cargo when, because of international traffic imbalance, the line has a shortage of international cargo. Railways have rather developed flexible contract arrangements to limit the propensity of certain shipping lines to enter into the domestic railway's market.

A third type of contractual arrangement, related to the integrated intermodal approach of some container lines, involves the negotiation of a «Tailored rail intermodal services package». Under such an arrangement, the shipping line's containers are moved on common user railway unit trains (either double-stack or single-stack) as opposed to reserved-railway unit trains. Common user intermodal trains combine the volumes of various shipping lines as well as other rail customers to achieve the expected line-haul and traffic density economies.

Tailored rail intermodal services are usually contracted by medium-sized container lines which operate at a lower scale of operations (which restrict their capability to support the logistical costs and operational requirements linked to reserved-railway unit trains), but nevertheless have sufficient volume of traffic to be moved on specific corridors. Conditional to the level of intermodal commitments that a shipping line desires to achieve and, more importantly, that its relative scale of operations may enable it to reach, tailored services can provide a shipping line with: (1) either a blocked or flexible space of cars on a railway unit train (2) a reserved space at one railway intermodal inland terminal and (3) adapted services to meet its own requirements. Again, under such a contract agreement, the company agrees to commit a major part of the intermodal traffic it handles on designated routes served by the contracted railway. As example of adapted services, a negotiated services package may comprise the routing of the shipping line's containers from the ships' berth to a reserved inland terminal space.

If carefully designed, a tailored services package can give the shipping line an efficient capability to offer competitive intermodal services to remote shippers, as well as, to enhance the overall profitability of its own overland intermodal activities. Examples of such intermodal strategic

options are the CP Rail and Cast (1983) Ltd., tailored agreement of rail intermodal services over the Montreal/Toronto corridor, and the Southern Pacific/Showa Line contractual volume arrangement on different St. Louis/ Memphis corridors connecting with American Gulf ports area. In particular, it can be said that the recent CP Rail and Cast (1983) Ltd., commercial agreement of co-ordination has enabled the container line to make the best use of rail and truck combinations, by combining the longhaul efficiency of rail with the flexibility of its own truck fleet for the remaining parts of its intermodal services. In short, for container lines which can not commit themselves to fill a full train load to single destinations, the common user intermodal trains supplemented by adequate tailored services package can provide individual shipping lines with an ability to offer profitable intermodal services. These services not only may compete with the overall quality and reliability of the services offered by larger integrated carriers but also, provide shippers with low logistics cost.

3.2 All-Water Primary Activities Supplemented by Intermodal Arrangements

The recent past has witnessed the introduction of new generations of large scale containerships and the implementation of round-the-world (RTW) services. The most publicized of these latter services are those offered by Evergreen Lines but numerous other lines offer variations on the RTW theme--including ABC Containerline, Barber Blue Sea Line/Scan Carriers, Hamburg-Sud, and Neptune Orient Lines/Orient Overseas Container Lines/ K-Line. The other operators of large scale containerships (not offering RTW services) generally concentrate their services on either the transPacific or the transAtlantic trades, reflecting that Western Europe and Asia dominate with North America the world container traffic.

The economics of all-water services sustained with large-capacity containerships are based on (1) expected scale economies in vessel size and (2) undoubted attractions of lower total sea transport costs relative to the total cost of the alternative intermodal approach. These lower costs per container-slot/mile of all-water routes can not be achieved without a relatively high load factor of individual large-scale vessels, however. There is an important corollary to the increased vessel capacity: the larger

the ship size the more sensitive are its expected scale economies to the negative effects of increased time in ports. This implies that operators of such vessels have to limit the number of ports of call which would secure economies of scale. Moreover, container lines' interest in operational scale economies and rationalization of activities have to be harmonized with shippers' interests. Shippers' interests involve the availability and frequency of the maritime services, as well as considerations for the facility and/or availability of reliable overland transport.

These preoccupations vis-à-vis overland transport are also shared by all-water maritime operators. They can hardly ensure themselves a high load factor for their large containerships with itineraries which would only be made up of ports characterized with a high ratio of locally generated trade. Locational distribution of the cargo implies that lines also have to focus upon efficient rail-connected seaport terminals. Indeed, vessel itineraries of these container lines generally consist of a combination of ports where there exists a high ratio of locally generated trade and of ports having efficient rail connections with dense industrialized inland markets.

The market strategy of these latter companies remains a low cost strategy which centers on their economical large-scale maritime operations. Such a low cost strategy leads all-water ocean carriers to set themselves, individually «apart» from their competitors (mainly the intermodal maritime operators) by creating a distinctive image based on the lowest maritime costs, service reliability and frequency, and the diversity of overseas markets which they make accessible. However, partly because of a major evolution in intermodal technologies and of the fiercer competition of container lines having opted for the intermodalism approach, ocean carriers pursuing an all-water specialization have had to broaden the scope of their services.

More specifically, and in spite of their strong intra-industry competitive posture, all-water ocean carriers have to strengthen their competitiveness by addressing solutions to the logistics problems and particular needs of targeted remote customers. As a result of the recent transportation deregulation, which permits flexible contractual relationship between shipping lines, railways and third parties (such as large consolidators or shipping

agents), certain large all-water ocean carriers have started to arrange for reserved-unit train services to complement their all-water services.

Such enlargement in the scope of their services is designed mainly to protect their markets by competing with the intermodal maritime operators on the overall quality of services offered particularly to remote interior shippers. The great majority of all-water ocean carriers having contracted for (double-stack) reserved-unit trains (see Table 1) have, in fact, done it by implementing co-ordinated micro-landbridge services connecting different Mid-western interior points. The economics of all-water services already give them strong competitive posture against either mini-landbridge or complete landbridge services.

Partly because of their strategic specialization, all-water ocean carriers will not generally seek or attempt to exercise full and/or direct control on the overall distribution and handling of the cargo. As opposed to intermodal maritime carriers (such as APL, Sea-Land or Cast (1983) Ltd.) offering overland transportation services as an integral part of their shipping activities, all-water carriers' intermodal strategies would rather rely on railways contractual arrangements of co-operation and co-ordination, and on the use of specialized third-party companies to perform (all or part of) the overland distribution services. All-water ocean carriers having already contracted for dedicated trains give evidence of such organizational devices. Y-S Line's dedicated trains correspond to guaranteed space on two inbound unit trains per week on the daily common user double-stack trains of Santa Fe. The Railway markets the westbound (back-haul) operations. Similar arrangements characterize the dedicated trains contracted by Mitsui-OSK Lines, NYK and certain of the six trains contracted by Sea-Land. Usually container lines have to take full responsibility for the inbound movements, whereas the railways retain part or all of the backhaul capacity under their control if the lines become short of international cargo. Another organizational approach is that of O.O.C.L. which has its dedicated trains managed by the shipping agent Seapac's intermodal subsidiary, Express System Intermodal.

Moreover, all-water ocean carriers make great use of the common user railway unit trains, with daily departures to multiple inland destinations. By way of flexible service contract arrangements and/or time-volume rates, these ocean carriers can effectively expand their overland services at a competitive price, without having to organize for blocks of cars or the entire trainload to each destination as implied with dedicated trains. Since the end of 1985, major North American railways have started to operate common user double-stack trains (Table 2). The minimal 33% share of the railways, in the total one-way double-stack capacity of transport deployed in the U.S., does not effectively seize the role held by the common user railway services. If it had been possible to collect similar information on the intermodal single-stack trains capacity, the railways would have dominated the overall capacity of rail intermodal services offered in North America. Indeed, for large-scale containership operators, there are possibilities in using their high volume of cargo (which interests the railways) as leverage to negotiate satisfactory railway service contracts including logistical considerations on distribution services. The strategies of all-water ocean carriers differ from those of the integrated intermodal maritime operators in that, these container lines would search further for flexible commercial/organizational arrangements enabling them to arrange for the provision of competitive overland services to their potential remote customers--with nevertheless a single bill of lading--rather than seek to provide themselves the various services involved in an intermodal cargo movement as an integral part of their maritime activities.

3.3 Asset-Conscious Strategies of Small-Medium Sized Liner Companies

Aside from integrated intermodal maritime operators and all-water large-scale containership ocean carriers, there is a third group of shipping lines operating containerships of smaller size. These latter ocean carriers usually operate their shuttle services on particular market segments and compete with larger container lines by choosing a pair or a combination of ports different from those selected by the first two groups of carriers. They may provide their shuttle services as conference or as non-conference

TABLE 1: LIST OF SHIPPING LINES INVOLVED IN DOUBLE-STACKING INTERMODAL UNIT TRAINS (AS OF JANUARY, 1987)

Container Line	Origin/Destination Corridors	Total Weekly Inbound FEU Capacity*
APL	L.A. - H/N.O./Atl.	472 (2/W)
(All linertrains	L.A. - Chicago	472 (2/W)
services)	Portland - Chicago	236 (1/W)
	Seattle - Chicago	236 (1/W)
	L.A. - Chic./N.Y.	236 (1/W)
	Oakl. - Chic./N.Y.	236 (1/W)
	Seattle - Chic./N.Y	236 (1/W)
Sea-Land	Tacoma - Chicago	400 (2/W)
(Two first linertrains,	Tacoma - Chic./N.Y.	200 (1/W)
others are dedicated	L.A. -H./N.O.	N/A (1/W)
trains)	L.A. -Chicago/Atl.	200 (1/W)
	L.A. - Chicago/N.Y.	120 (1/W)
U.S. Lines	Oakland - Chicago	200 (1/W)
(Dedicated trains)	Savannah - N.O./Atl.	200 (1/W)
O.O.C.L./Seapac	L.A. H./N.O.	80 (1/W)
(Dedicated trains)	L.B. - Chicago/N.Y.	N/A (2/W)
Maersk	Tacoma - Chic./N.Y.	200 (1/W)
(Dedicated trains)		
Mitsui - OSK Lines	L.A. - Chic./Columbus	150 (1/W)
(Dedicated trains)		
NYK	L.A. - St. L./Chic./Cinc.	200 (1/W)
(Dedicated trains)		
Y-S Line	L.A. - Chicago	200 (2/W)
(Dedicated trains)		
K Line	L.B. - Chic./N.Y.	200 (1/W)
(Dedicated trains)		
Japan Line	L.A. - Chicago	200 (1/W)
(Dedicated trains)		
Evergreen	L.A. - Chic. (N.Y. exten-	150 (1/W)
(Dedicated trains)	sion through single-stack or truck)	
		4 824

*Conservative inbound rail container capacity deployed per week with frequency given in brackets.
N/A: Not Available.

Source: C.T.C., Research Branch, WP 20-86-24.

TABLE 2: RAILWAYS COMMON USER DOUBLE-STACK UNIT TRAINS
(AS OF JANUARY, 1987)

Railway Companies	Origin/Destination Corridors	Total Weekly Inbound FEU Capacity*	Frequency
Chessie System Railroad	Baltimore - Chicago	280	Daily
ConRail	Chicago - New York	N/A	6/Week
Seaboard System Railroad	Savannah - N. Orleans/Houston	200	1/Week
Santa Fe	Los Angeles - Chicago	700	Daily
Southern Pacific	Los Angeles - Houston/N. Orleans	214	1/Week
Burlington Northern	Tacoma/Seattle - Chicago	960	6/Week
Canadian National	Halifax - Toronto	N/A	Test
Soo Line/CP Rail	Chicago - Vancouver and/or Toronto/Chicago - Vancouver	N/A	Test
		2 354	

Notes: N/A = Information Not Available.
*Conservative inbound rail container capacity deployed per week.

Source: Canadian Transport Commission, Research Branch, WP 20-86-24.

members depending on which position would better serve their individual operational profitability and/or return on investment.

These ocean carriers have to strengthen their relatively weak intra-industry competitive posture by adapting and incorporating in their operations the new intermodal/organizational ways of moving containerized cargo. The new economic regulatory environment provides these container lines with greater opportunities and flexibility to offer a variety of distribution services adapted to their respective scale of operations. In addition to a market strategy which would center activities of a small container line on particular customers and/or market segments, adapted contractual intercompany agreements of coordination can result in substantial savings in overall logistic costs, and avoid this company to retrench itself in "submissive defender" strategy.

The various corporate intermodal strategies of the small-medium sized container lines focus mainly on the common user railway unit trains (either double-stack or single-stack) and tend to embody a variety of short-term and long-term arrangements individually negotiated with the railways. Along this line, with the advent of confidential railway service contracts already in use in the U.S. and soon to be introduced in Canada, the kind of railway intermodal agreements a shipping line will be able to negotiate would be conditional on the level of intermodal commitments that its relative scale of operations may enable it to achieve. However, alternative solutions exist for the small and medium-sized container lines, as well as for some larger shipping lines which may have problems to arrange for the transportation of a small number of containers to inland points beyond their main remote markets.

An alternative option for these companies is to turn to large consolidators or any other middleman transport operators arranging for or facilating the provision of continous intermodal transport. Two recent organization developments would likely provide a stimulus to go toward this direction. One relates to the implementation of inland load centres adjacent to railway intermodal terminals which are operated by new intermodal third-party entities. The other one refers to a diversification process of certain shipping

agent companies, setting up an intermodal subsidiary to carry out overland cargo distribution services.

To a large extent, these recent organizational developments result from:

> First, particular market principles giving advantages of greater negotiating leverage to larger railway customers;
>
> Second, a belief that in some particular market segments certain economies of potential cargo volume have not been fully exploited; and
>
> Third, fears of anti-trust problems for shipping lines co-operating or pooling together their overland cargo volume, with a view to jointly negotiate services package with surface carriers. These latter antitrust fears come from certain provisions of the U.S. Shipping Act (applying to all maritime carriers) and certain provisions of proposed Canadian SCEA (applying only to members of conferences). An antitrust immunity is given to discuss and agree on the inland portion which shipping lines can charge a shipper/consignee as part of a single intermodal rate factor. However, a similar immunity is not given to agree on the inland division, rates and prices which an inland carrier may charge the ocean carriers for moving loaded and empty containers between inland points and ports.

The competitiveness and profitability of the new entrants into the supply of intermodal services are based on their attempt to carve for themselves a niche in the market, by aggregating fragmented and dispersed cargo flows from various customers which are bound to the same destinations. In particular, for a shipping agent, which is already taking responsibility to manage/handle part of maritime activities on behalf of certain shipping lines, relatively low additional costs will be incurred in order to enter into the supply of intermodal overland services. As argued in Section 2, there is a continued presence in the market place of non-integrated operators confining their operations to one of the individual constituent activities which enables any specialist broker to arrange for the provision of adapted intermodal services package.

In both Canada and in the United States, there are examples of independent inland load centre activities and of shipping agents having diversified their activities in overland cargo distribution. One recently publicized Canadian example is the intermodal arrangement negotiated with CP Rail, over the

Montreal - Toronto corridor, by the shipping agent company Morflot Freightlines Ltd. The agreement is similar to that contracted by Cast (1983) Ltd. The Morflot company is a general agent for BaltCanada Line, Artic Line and Blasco Canada Line. Another Canadian example is the independent Alberta Intermodal Services Ltd., which started operations in January, 1986. Headquartered in Calgary, the company has its facilities located close to CP Rail intermodal yards both in Calgary and in Edmonton. Alberta Intermodal has contracted a price-sensitive time-volume contract with CP Rail to haul containers between its Edmonton/Calgary terminals and either the Vanterm terminal (in the port of Vancouver) or the CP's facility at Coquitlam (a Vancouver's suburb). The agreements with the railway company provide Alberta Intermodal with a fleet of leased container cars. The independent company is dovetailing its contracted capacity of transport to either shipper' representatives or shipping lines at competitive rates.

In the United States, World Shipping Inc., a major shipping agent based in Chicago, started similar activities to those provided by Alberta Intermodal Services Ltd. The company has formed an intermodal subsidiary company, named Containerport Group. Containerport Group provides a broad range of inland load centre services at or adjacent to intermodal railway terminals located at Cleveland, Columbus, Cincinnati, Detroit and St. Louis. Containerport Group can also manage and/or arrange for surface transport between those inland terminals and Chicago, or Baltimore. Another U.S. example is the already mentioned activities of the intermodal subsidiary of the shipping agent Seapac, Express System Intermodal. Express System Intermodal arranges surface transportation activities on the behalf of certain major container lines operating on either the U.S. Atlantic or Pacific trade routes.

A last major organizational innovation involves the supply of railway unit train services by an independent third party transport operator. The particularity of these latter unit trains is that they are managed by an independent transport entity which is not affiliated with nor owned by a shipping line or a railway company. This kind of train operator secures its transport capacity first, by negotiating a line-haul arrangement with a railway company to provide the power, tracks and crew over a specified corridor and,

second, by leasing the cars, chassis and containers. In some way, the aforedescribed train operator can be defined as a "non-railway-operating common carrier" (NROCC), who offers its surface transportation expertise and dovetails its capacity of transport to smaller shipping lines or shippers' agents. In all probability, the services offered by such NROCC would mainly attract low volume container lines and shippers' representatives; whereas the railways would retain larger container lines and most shipping lines who generate high volume, regular and full container load cargos destined for single destinations.

So far, only one North American independent-common user services has been identified. The service started in September 1986 and is managed by Terminal Transportation Inc. The train links Chicago and Stockton, California twice a week in both directions. Terminal Transportation Inc. negotiated a line-haul agreement with Union Pacific and leases the necessary cars and containers from the various specialized leasing companies. The emergence of this type of operator (NROCC) supports the earlier assertions of container technology homogeneity and of an operational separability of constituent activities involved in the supply of any intermodal services. The development of NROCCs may also signify the arrival of a new competitor to railway companies.

4. CONCLUSION

The recent developments in the North American economic regulatory regimes have given greater flexibility and opportunities for both international liner companies and railway companies to co-ordinate and synchronize their services, by either operationally integrating their services or financially merging their operations. Moreover, it has already been recognized that both the liner shippping industry and the railway industry are two concentrated industries where, in each industry, a company without joint operating arrangements with other carriers is more the exception than the rule. One likely inference, from both the ongoing changes in intermodalism and the industry concentration observed in both shipping and railway sectors,

is that the end result would be a fiercer rivalry among carriers of different scale and a growing integration of transport services.

Nevertheless, by also taking advantage of the actual economic regulatory regimes, certain small and medium-sized container lines have been able to counteract with competitive and strategic adjustments. These market reactions, by ways of various voluntary inter-company agreements of co-ordination and/or of contractual arrangements with third party transport operators, have enabled them to arrange for the provision of a broad range of distribution services adapted to their respective scale of operations. These latter innovative organizational approaches have also depended, to a large extent, on two important features of the container/intermodal related technologies.

First, there is a technological homogeneity between the constituent transportation activities involved in the supply of intermodal transport. Second, an operational separability between the successive transportation services and other related activities still prevails in the market place, with a continued presence of transport operators confining their operations to one of the individual constituent activities. Indeed, various other competitive corporate strategies--as opposed to the vertical financial integration alternative option--allow participant companies to meet the challenges of the new intermodal competitive environment.

If only one point emerges from this paper, it is that the organizational approaches to cargo distribution, and in particular the intermodal approach, have evolved greatly over the recent past. These developments will undoubtedly continue to evolve. Liner companies, railways and third parties providing distribution services are individually continuing to develop/improve their organizational approach to more competitive and complete distribution services.

In the liner industry, the intermodal transport concept has increasingly been adapted by most shipping lines. In a less regulated transportation environment, individual liner shipping company's corporate strategy increasingly encompasses: (1) a market strategy to position their respective mari-

time activities competitively in the maritime industry and (2) an intermodal strategy to meet the challenges of the market place. Overall quality of services, for a continuous movement of cargo, and single intermodal rates are among the most important factors along which both intramodal and intermodal competition take place.

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A MODEL FOR AN INTEGRATED MARINE/TRADE STATISTICAL SYSTEM

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ABSTRACT

This paper describes a systems model for the production of International Marine Transport statistics from a database composed of transport and trade variables. It outlines the principles and mechanics underlying the linkage of commodity information, derived from Customs documents, with data obtained from vessel movement records.

INTRODUCTION

Conceptually, trade and transport are closely related; international trade statistics reflect the flow of goods from the country of production to the country of consumption, whereas transport statistics measure the flow of goods from the place of loading to the place of unloading.

The potential inter-relationship of trade and transport is readily apparent when one examines the transaction documentation collected within Customs administrative systems; indeed, Customs documents are the source for the statistical detail collected on international trade and the international movement of goods.

In Canada, the International Marine Transport Statistical Program has been carried out independently of the International Merchandise Trade Statistics Program. Until now, the existence of separate data capture and processing systems, within both Statistics Canada and Customs, precluded the development of an integrated database[1]. However, current system and procedural changes[2], resulting partially from the implementation of the Harmonized System[3], have made possible the linkage of marine transport and trade data.

The merits of integrating marine/trade statistics have been recognized for a number of years. In 1971, an article appeared in the Journal of the Royal Statistical Society describing ".... a new method of approach to the collection of shipping data that will enable statistics of trade and shipping to be intimately related"[4]; it was acknowledged at the time, however, that the feasibility of implementing such a proposal remained to be determined.

In the early 1980's, the United Nations developed the Uniform System for Collecting Economic Statistics of Shipping, described as "a statistical system in which a shipment of a commodity defined by the Standard International Trade Classification (SITC), or any other classification convertible to the SITC, is linked to the ship in which the shipment in question is carried so that the commodity may be correlated with all the available information about the ship."[5]

In Canada, transportation analysts have noted the analytical limitations of working with distinct trade and transport statistics. A study on the impact of transportation policy on Canada-U.S. trade, published in 1969, points to "the lack of development of a classification of commodity trade that is meaningful and complete from the points of view of both production and transportation" and the difficulties arising from the "existence, in Canadian government statistics, of different systems of commodity classifications for imports, exports, rail transport, road transport and water transport ...".[6]

Thus, while the concept of a marine/trade linkage is not new, the approach characterized by the model described in this paper can be considered to be innovative in respect to the prevelance of automated linkages and imputation procedures, the effective use of external databases and the manner in which the requirement for full coverage of the transport activity (particularly in relation to transshipments) could be met.

The first part of this paper assesses the impact of the Marine/Trade (M/T) Model on the composition, availability and scope of international marine statistics. The second part provides an overview of the model's source components, data linkages and underlying methodology.

MARINE/TRADE MODEL: STATISTICAL IMPACT

Currently, the Marine Transport program provides vessel movement and related cargo flow information for international shipping activities at Canadian ports. Vessel movement data, obtained from the A6 General Declaration filed by the carrier, comprises vessel characteristics (type, capacity, flag of registry) and movement detail (routing, type of service); on the basis of supporting cargo manifests (e.g. bill of ladings), cargo handled in relation to the respective vessel movement is described in terms of commodity type, tonnage and port of loading or unloading.

Alternatively, the International Trade Program provides commodity information in terms of value (and various units of measure) and on an origin/destination basis from a trade perspective (i.e. province of origin/country of consumption or final destination).

CHART 1: IMPACT OF M/T MODEL ON DATA PRESENTATION

EXPORTS/OUTBOUND CARGO

		Current Marine System	Marine/Trade Model	
			Canadian-origin Cargo	Transshipments
Commodity Information	Variables	• Containerized/ Non-containered Tonnage & TEU'S	• Containerized/ Non-Containerized Tonnage & TEU's • Commodity Value	• Containerized/ Non-containerized Tonnage & TEU's
	Description	• Limited Commodity Structure (80-90 groupings) • Modified SCC	• Comprehensive Commodity Classification • Based On Harmonized System	• Transport-based Commodity Structure • 80-90 groupings • Reconciled at Aggregate Level with Canadian-origin Commodities
	Geographical	• Canadian Port of Loading • Foreign Port of Unloading	• Province of Origin • Canadian Port of Loading • Foreign Port/ Country of Unloading • Country/State of Destination	• Canadian Port of Loading • Foreign Port of Unloading
Vessel Information		• Vessel Characteristics (capacity, type flag, etc.) • Vessel Itinerary	• Vessel Characteristics (capacity/type flag, etc.) • Vessel Itinerary Based on Lloyd's Database	• Vessel Characteristics (capacity, type, flag, etc.) • Vessel Itinerary Based on Lloyd's Database

The M/T Model seeks to integrate key trade and transport variables relating to commodity detail and geographical parameters while maintaining the link, critical to transport statistics, between means of transportation and cargo composition.

The impact of the M/T Model on data presentation is summarized in Chart 1 for outbound cargo. The chart compares the principal data variables available from the M/T Model with those generated within the framework of the current Marine Transport program.

Commodity Statistics

The current program for marine statistics is based on a transport-oriented commodity classification structure comprising approximately 80-90 groupings. Although based on the Statistics Canada Standard Commodity Classification (SCC), the commodity structure for marine transport statistics is distinct from those used for the export and import series.

The use of trade documents to develop transportation statistics on commodity flows would improve the quality and expand the detail of commodity information for the marine transport mode. Commodity information for both the International Trade program and the M/T Model would be based on the Harmonized System and, as such, would be comparable. Although trade data could be compiled according to more than 5000 separate categories, commodity statistics generated within the framework of the M/T Model would be presented at a level of aggregation suitable for transportation statistics.

Geographical delineation of commodity flows would also be expanded, integrating origin/destination information with loading/unloading detail. In the case of exports, as noted in Chart 1, the proposed model provides the possibility of linking the province of origin of the goods, the port of loading in Canada, the port of unloading abroad, and the country of final destination.

The basic unit of measure for commodity in the current Marine program is tonnage; tabulations are produced for containerized and non-containerized cargo. Although some degree of imputation can be expected in order to generate tonnage information from trade documents, particularly in the case of imports (as explained below in the section on **Imputation**), the M/T Model would permit the linkage of commodity tonnage and value; the model would also continue to meet the need for differentiation of cargo in regards to containerization. The availability of containerized detail, cross-referenced with vessel type (e.g. cellular vessel) would permit derivation of a widely used industry standard for container load, i.e. TEU or twenty-foot equivalent unit capacity.

Vessel Statistics

The Marine Transport program produces data on vessel characeristics and routing based on information supplied to Customs authorities upon the arrival or departure of a vessel (A6 General Declaration completed by the carrier or shipping line agent). While dependence on the A6 form would be greatly reduced in the M/T Model, vessel and movement statistics in relation to commodity flows would be available as a result of the linkages with external databases (principally Lloyd's Maritime Information Services)[7]. There remain to be established sources or methods of imputation for certain vessel-related elements (e.g. liner and conference detail) required by major users but considered to be outside the operational scope of the data capture functions inherent in the proposed model.

Transshipments

With respect to measuring total transport activity, the use of trade documents results in a problem of undercoverage in that transshipments are not reflected on either the International Trade or Customs System[8]. Within the framework of this model, such a shortfall could be resolved by obtaining compatible data from port authorities and shipping lines on transit cargo handled at Canadian ports. Arrangements for access to such data in a computerized manner (e.g. magnetic tapes, direct transmission) have been concluded with major ports and shipping lines. Any residual undercoverage could be met through data captured from vessel records and/or cargo manifests.

Commodity detail on transshipments would be affected by the high level commodity coding structures presently employed by port authorities. These classification systems are geared to the transportation function which, by definition, is less concerned with commodity detail than a trade system. As such, while commodity information relating to the trade records would be more extensive than that for transshipments, reconciliation of commodity detail for these two sets of data at an aggregate level would permit production of a comprehensive set of statistics.

Furthermore, port and liner data, containing transport variables such as ports of loading and unloading, could be used in the data assurance process to ensure accurate and complete geographical information on commodity flows.

Marine/Trade Database

The composition of the Marine/Trade Database resulting from the proposed model reflects the need for compatability between export and import data elements so as to produce a balanced set of statistics. The principal elements comprising the Marine/Trade Database are listed below:

- Canadian Handling Port
- Commodity
- Tonnage
- Value
- Container Indicator
- Province of Origin (for exports)
- Inland Destination (for imports)
- Foreign Port/Country Unloading/Loading
- Final Country of Destination (for exports)
- Country of Origin (for imports)
- Vessel Name
- Vessel Type
- Gross Register Tonnage
- Net Register Tonnage
- Flag of Registry
- Charter Indicator
- Lloyd's Registration Number

MARINE/TRADE MODEL: A DESCRIPTION

The underlying premise of the M/T Model is the linkage of vessel and commodity information derived from trade and transport-based sources. Chart 2 details the basic sources of data for the export and import components of the model.

CHART 2: M/T MODEL – SOURCES OF DATA

EXPORTS

- B13, Customs & Excise Export Declaration (Revenue Canada)
- A6, Customs & Excise General Declaration (Revenue Canada) and related Cargo manifest documents
- Lloyd's Maritime Information database

IMPORTS

- B3 or B6, Customs & Excise Import Entry Declarations, (Revenue Canada)
- Cargo manifests
- Lloyd's Maritime Information database

TRANSSHIPMENTS

- Vessel movement and freight origin/destination data supplied by port authorities and shipping lines; where data are not obtainable in required format from ports or shipping lines, source is to be A6 and associated manifests

For exports, or outbound cargo, the primary source for commodity information is the Customs & Excise B13 Export Declaration document. Completed by the shipper or exporter, this form provides, among other detail, commodity description, weight, value and identifies province of origin and country of final destination.

The source for vessel-related statistics is the A6 General Declaration (filed by the carrier or ship agent) complemented by select information from Lloyd's Maritime Information Database.

Similarly for imports, or inbound cargo, commodity information is derived from the Customs entry declaration document (B3/B6). Unlike the export component, where all commodity information is obtainable from the trade document, tonnage information for an import shipment must be captured from the carrier cargo manifest (e.g. bill of lading). The cargo manifest also serves as the link key between commodity trade flow and vessel data.

Lloyd's Maritime Information Services maintains a number of interrelated databases on various facets of marine transport activity; of relevance to the Marine/Trade project are the following Lloyd's files:

(1) Vessel Characteristics - comprises parameter-type information relating to vessel type, name, capacity, flag of registry, ownership, etc.
(2) Vessel movements - consists of routing data, indicating the itinerary of individual vessels; this file would be used to assign or impute information or port/country of loading/unloading.
(3) Charter fixtures - provides information on chartered vessels.

The access to Lloyd's database would reduce data capture requirements with respect to the A6 and reduce follow-up/research required in respect to compilation of vessel libraries. This source would also provide particulars on vessel voyage itinerary; such information would allow the assignment of port of loading/unloading to complement origin/destination as obtained from the trade documents.

While it is expected that Lloyd's data would not cover all vessels operating international services into/out of Canada (e.g. tugs and barges), a parallel vessel support function would be developed for the survey component not covered by Lloyd's on the basis of current vessel libraries and routing patterns.

The respective input of each of these sources to the M/T Model and the linkages and interrelationships underlying the data elements are elaborated in the discussion on the processing functions.

PROCESSING FUNCTIONS

The M/T Model comprises the following five major processing functions:

- data capture and edits
- linkage/formation of M/T records
- imputation
- data assurance
- updates

Chart 3 delineates these functions with respect to export and import data; a brief description of each of the functions is provided below.

Data Capture & Processing - Exports

As outlined earlier, the export component entails the use of three basic sources of data: the B13, the A6 and Lloyd's Maritime Information Services. Cargo manifests, submitted as per Customs reporting requirements with associated A6 declarations, would not be routinely data captured but used only to supplement deficient M/T records where necessary.

The respective function (in terms of data elements supplied) of these sources and the nature of the interrelationships or linkages among them are summarized in Chart 4.

Data capture in respect to the A6 would comprise only those variables required for linkage with B13 documents, Lloyd's files and the cargo manifests; as shown in Chart 4 data capture of the A6 would be limited to the following four variables:

- customs port
- sailing date
- vessel name
- A6 report number

While the first three data elements would be used to link trade records with shipping movement information, the A6 report number would serve to identify cargo manifest batches required for updating purposes.

Similarly the B13 document is data captured for all fields required for tabulation and linkages purposes; the variables required for the M/T Model are listed in Chart 4.

Relative to the current procedures of the International Trade Division, the export component of the model calls for the capture of four additional fields: gross tonnage and container indicator are required for tabulation purposes, while carrier/vessel name and date of customs stamp are required for linkage purposes.

CHART 3: M/T MODEL: MAJOR PROCESSING FUNCTIONS

EXPORTS	IMPORTS

- **DATA CAPTURE & EDITS**

EXPORTS	IMPORTS
• DATA CAPTURE AND PROCESSING OF B13 BY INTERNATIONAL TRADE SYSTEM (STATISTICS CANADA) • DATA CAPTURE OF SELECTED A6 FIELDS AS REQUIRED FOR TABULATION AND LINKAGE	• DATA CAPTURE & PROCESSING OF CARGO INFORMATION BY REVENUE CANADA'S CARGO SYSTEM (CARGO MANIFESTS) • DATA CAPTURE & PROCESSING OF IMPORT DATA BY REVENUE CANADA'S CUSTOMS COMMERCIAL SYSTEM (B3, B6)

- LOADING/UPDATING VESSEL FILES USING LLOYD'S DATABASE

- **LINKAGE/FORMATION OF MARINE/TRADE (M/T) RECORDS**

EXPORTS	IMPORTS
• LINKAGE OF LLOYD'S VESSEL DATA WITH A6 DATA • LINKAGE OF VESSEL DATA (LLOYD'S + A6) WITH COMMODITY DATA (B13) TO FORM NEW M/T RECORD	• LINKAGE OF VESSEL/CARGO DATA WITH IMPORT DATA TO FORM NEW M/T RECORD • EXPANSION OFM/T RECORDS WITH VESSEL INFORMATION BASED ON LLOYD'S MATCH

- **IMPUTATION**

- IMPUTATION OF PORT/COUNTRY OF UNLOADING/LOADING USING ALGORIGHTM BASED ON LLOYD'S VESSEL MOVEMENT INFORMATION

- **DATA ASSURANCE**

- IDENTIFY DATA DEFICIENT FIELDS ON M/T RECORDS
- IDENTIFY M/T RECORDS REQUIRING SUPPLEMENTARY GEOGRAPHIC INFORMATION FROM CARGO MANIFEST

- **UPDATES**

- M/T RECORDS CORRECTED/SUPPLEMENTED BY MEANS OF ON-LINE INTERACTIVE SYSTEM USING CARGO MANIFEST INFORMATION

Lloyd's database would be the source for information relating to vessel registry, capacity, type, charter status, and vessel itinerary. The linkage between the A6 and Lloyd's data on the basis of vessel name and sailing date would result in the creation of a comprehensive vessel record.

Linkage/Formation of M/T Records - Exports

Two linkage functions are inherent in the model for export data.

(1) The first of these involves the linkage of Lloyd's vessel/movement data with A6 data. As illustrated in Chart 4, the linkage key between the A6 data and Lloyd's files is a combination of the vessel name and sailing date.

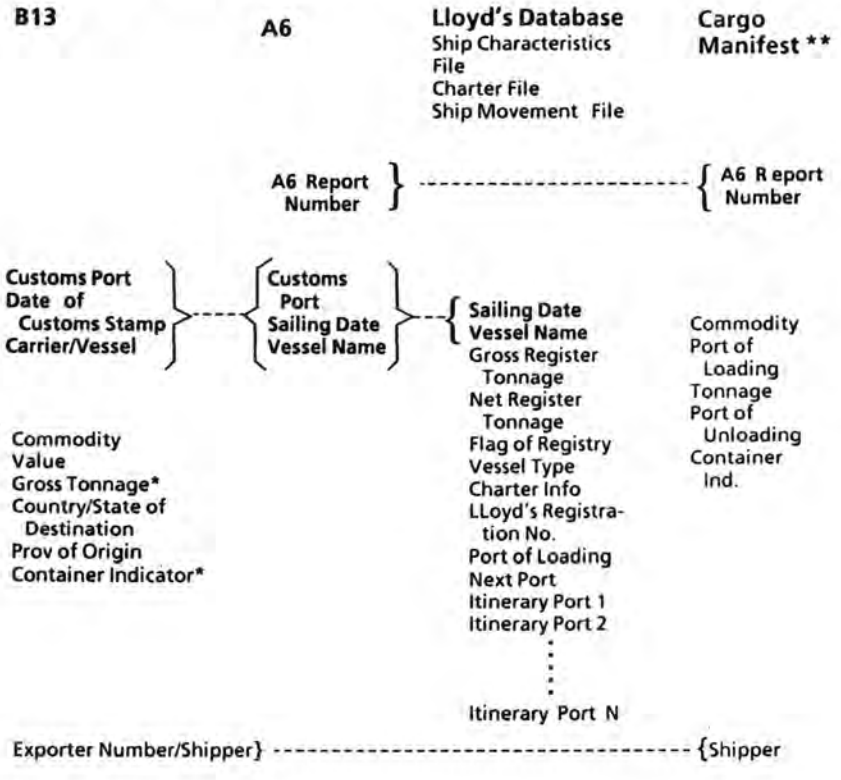
(2) The linkage or expansion of the commodity data (B13) with vessel data (A6 + Lloyd's) is based on three elements:
- . customs port
- . date of transaction
- . carrier/vessel name

Results from a test match of marine and trade documents indicated that these three elements can be used to generate an automated match of A6 and B13 data.

By means of this linkage and as part of an automated process, the A6 report number (unique for each A6 and set of cargo manifests) is also assigned to the M/T record. This assignment, in conjunction with exporter information captured from the B13, permits identification of the appropriate set of cargo manifests in situations where these are required to update/supplement M/T records.

The linkage between the B13 record and vessel data elements also provides a mechanism whereby appropriate B13 information can be verified for vessel itineraries involving multi-port destinations. Port of destination information might then be assigned or imputed using Lloyd's data according to the algorithm described in the section on Imputation.

CHART 4: M/T MODEL – EXPORT COMPONENT DATA ELEMENTS BY SOURCE & LINKAGE KEYS



* these fields may be supplemented using information from the cargo manifest

** data elements from this document would not routinely be captured but used only to correct/supplement B13 records on an exception basis.

}----------{ denotes linkage key

Data Capture & Processing - Imports

Chart 5 illustrates the nature of the interrelationship between the different data sources for imports and the basis for the linkages among them. This chart also lists the respective data elements supplied by the three information sources: B3/B6, cargo manifests and Lloyd's Maritime Information Database.

The Import entry documents (B3/B6) as well as the the carrier cargo manifest could be processed by Revenue Canada within the framework of the current arrangement with the International Trade Division of Statistics Canada.

With respect to the data from the trade documents (B3/B6) listed in Chart 5, the requirements of the M/T Model could be met by Revenue Canada's Customs Commercial System as modified for the implementation of the Harmonized System in 1988. However, information currently entered on Revenue Canada's Cargo System from the carrier cargo manifest does not extend to key data elements required for the marine/trade linkage. Supplementary data to be captured on Revenue Canada's Cargo System extend to the following elements:

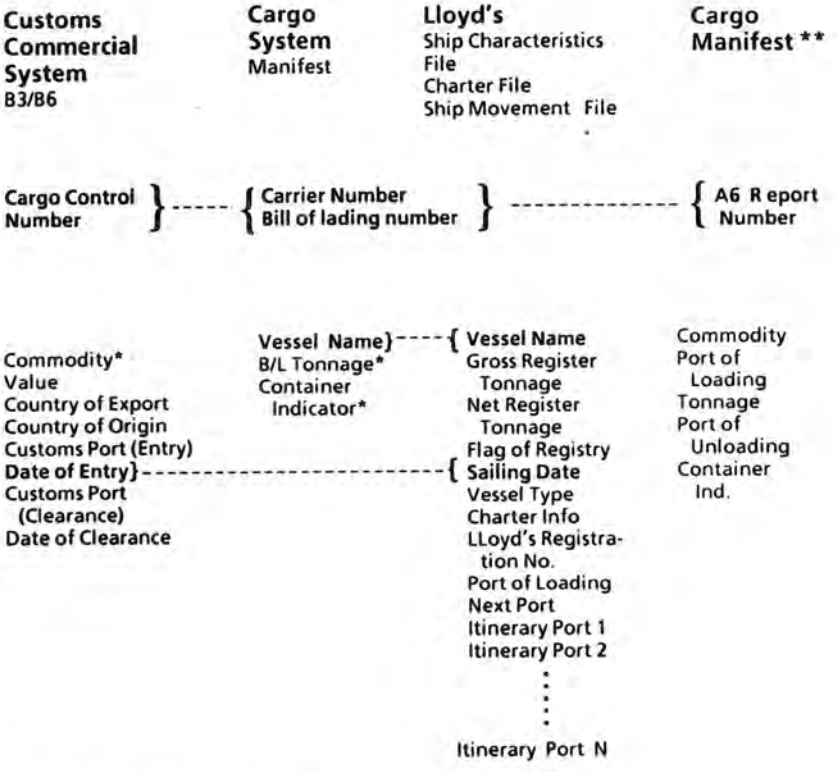
- vessel name
- tonnage at the bill of lading level
- indication of containerization of the goods

Link & Formation of M/T Records - Imports

The import component of the model entails the linkage of cargo detail from the carrier manifest with commodity description and flow information from the trade documents (B3/B6). The key to the match of these two sources is the cargo control number, comprised of the A6 report and bill of lading numbers. The subsequent formation of the M/T record through the integration of commodity data with Lloyd's vessel information involves elements from both the trade documents and the cargo manifest as depicted in Chart 5.

While the linkage between the B3 entry and the cargo control number should present minimal difficulty, a direct linkage at the level of the trade commodity line and the manifest tonnage information would not always be possible. The Cargo system will have a tonnage for each bill of lading number or cargo control number in the system. Therefore a total tonnage at the entry (B3) level will only be available. As the commodity detail and the quantity requirements are extensive for imports, and especially for goods generally imported by the marine mode, the expectation is that a commodity line/quantity/tonnage allocation algorithm could be developed to provide acceptable results at the commodity level.

CHART 5: M/T MODEL – IMPORT COMPONENT DATA ELEMENTS BY SOURCE & LINKAGE KEYS



* these fields may be supplemented using information from the cargo manifest

** cargo manifests submitted to Statistics Canada with A6 report; data elements from this document would not routinely be captured but used only to correct/supplement M/T records on an exception basis.

}----------{ denotes linkage key

Imputation

Some degree of imputation will be required to generate tonnage information. For **imports**, tonnage information will have to be assigned to trade transactions (at the commodity level) using composite weight from the cargo document, and quantity and unit of measure information from the B3 documents. This methodology is expected to result in a slight deterioration of weight information for multi-commodity shipments. For **exports** the tonnage will be derived from the B13 document; since multi-commodity shipments on these documents are the exception, minimal deterioration in data quality is expected.

Activity data related to foreign port of loading/unloading is a critical element for government and industry users. While these geographical delineations are not available from trade documents, it would, nevertheless, be possible to impute transport origin/destination detail (e.g. foreign port of unloading) using Lloyd's Maritime Information database.

The identification of M/T records associated with vessel movements involving, in the case of outbound traffic, multiple foreign port destinations and the subsequent assignment/imputation of destination data (port/country of unloading) would rely on the Lloyd's vessel movements file and would be based on the following algorithm:

- where vessel itinerary involves only one foreign port, it may be assumed that all commodities related to that movement would be unloaded at that port, regardless of the final destination shown on the B13.

- where the vessel itinerary indicates two or more foreign ports within the same country, two options exist - (1) to assign country of unloading as derived from Lloyd's to all commodities related to that movement or (2) to flag all pertinent M/T records for review and subsequently assign actual port of unloading information from cargo manifest.

- where Lloyd's vessel itinerary indicates ports of destination in two or more countries, two options exist - (1) to impute country of unloading based on such variables as commodity, country of final destination, historical patterns, etc. or (2) as per above, to flag M/T records for review and subsequently and assign actual port of unloading information from cargo manifests as part of Update function.

The process employed for imports would be similar to that described above for exports. The only variation is that country of export and country of origin (from trade files) may be used in the determination of port of departure in conjunction with Lloyd's vessel movement data.

Data Assurance & Updates

The purpose of the Data Assurance module is to identify (i) M/T records requiring further assignment of transport destination detail from cargo manifests and (ii) M/T records with data deficient fields requiring manual updates (e.g. tonnage, container indicator) via interactive terminal.

Fields on export (B13) records subject to data deficiency checks and which may be corrected/supplemented with information from the cargo manifests are as follows:

- gross tonnage
- container indicator

A preliminary test on the quality of these fields was undertaken by manually matching a selected number of B13 documents with cargo manifests (batched by A6 report number) on the basis of customs port, date of stamp, vessel name, and exporter/shipper. Results indicated a high degree of compatability between the B13 and cargo manifests for commodity description and cargo tonnage; the test also revealed a relatively low frequency of non-response or erroneous reporting of information on containerization of cargo. Reliable statistics on tonnage and containerization for outbound cargo can be expected from the model with only a minimal requirement for imputation.

For Import records, tonnage assignments based on automated criteria may be incomplete due to a lack of quantity detail at the commodity level. For small tonnages or insignificant trade value transactions, imputations would be made. Transactions above a certain threshold would be considered for verification against the A6 and manifest information.

Similar criteria would be applied in determining port loading/unloading data where the Lloyd's match was not successful and the input of supplementary data deemed necessary in order to derive the vessel characteristic and movement information.

For both exports and imports, updates to the M/T records would be performed by means of an on-line interactive system where an operator would enter requisite data from cargo manifest documents.

CONCLUDING NOTE

Typically "pure" transport statistics provide a measure of the flow of goods (magnitude, type) in relation to the means of transportation used (vessel characteristics, routing); geographical parameters are normally limited to modally-specific points of transport flow.

Pure trade statistics tend to provide more reliable and extensive information on the value and composition of commodities transported since these data are derived from systems designed for the application of Customs regulations and tariff assessments. Geographically, trade statistics are concerned with the flow from country of export or origin to the point of customs clearance or country of destination.

The model presented in this paper seeks to combine the respective advantages of these two sources. While minimizing the loss or deterioration of transport variables, the Marine/Trade model aims to substitute some of the "pure" transport data elements by those derived from trade documents.

Recognizing, however, that international shipping statistics must reflect all transport flow, the model incorporates data on transshipments at national ports thereby overcoming a serious limitation in deriving transport statistics solely from trade sources.

The production of marine statistics in this manner reduces duplication of reporting and data capture efforts, improves timeliness and increases the utility of the statistics to transportation analysts and policy makers.

Finally, while the proposal outlined in this report relates to the marine transport mode, a similar database, comprising integrated transport and trade variables could be envisaged for trucking as well. Such a model would address a data gap in regards to transborder traffic flows which, although recognized for a number of years, is becoming increasingly critical in view of the pending implementation of a new National Transportation Act in Canada emphasizing competition and market forces and the anticipated impact of a free trade agreement.

Acknowledgements

The author wishes to acknowledge the contributions of B. Penner, Chief, Surface & Marine Transport, Transportation Division and S. Mozes, Chief, Data Development, International Trade Division (Statistics Canada) in the conceptualization of the model. Nevertheless the views and opinions presented in this paper are those of the author and do not necessarily reflect Statistics Canada policy.

Notes & References

1. See "Investigation into the feasibility of establishing a uniform system for the collection of international trade and marine shipping statistics: Final Report of the Working Group," 1983, Statistics Canada.

2. Changes resulting from the introduction of the new Customs Act in November 1986 and the implementation of new procedures are discussed in "Canadian Transportation & Distribution Management", February 1987 pp. 20-22.

3. The Harmonized Commodity Description and Coding System, normally referred to as the Harmonized System, denotes an international system for the classification of goods. While standardizing trade documentation for the purposes of tariff assessment, the Harmonized System provides a basis for greater correlation of trade and transport statistics (as derived from Customs documents) and facilitates international comparisons of data. The Harmonized System, to be implemented in Canada effective January 1988, has been in use in Europe since 1950.

4. A.A. Walters, "A Method for Collecting Economic Statistics of Shipping", Journal of the Royal Statistical Society series A volume 134, 1971 pp 440-448.

5. Han-Son Chu, "Organizing an Information System of Maritime Transport Statistics for Developing Countries", Research Seminar Series (Fall 1981) Canadian Transport Commission pp 13-30.

6. John M. Munro, Trade Liberalization and Transportation in International Trade, University of Toronto Press, 1969, p. 31. Similarly, Canadian Transport Commission Research Report International Liner Shipping and Canadian Trade (No. 20-79-02) noted that the analysis contained in that report would have been "... greatly enhanced if it could be based on the value of commodities carried, and not only on the tonnages involved" (p. 17).

7. Lloyd's Maritime Information Services Ltd., London, U.K. are represented in North America by Lloyd's Maritime Data Network Inc., Stamford, Connecticut.

8. The United Nations Statistical Paper "International Trade Statistics Concepts and Definitions" (Series M No. 52, 1970), recommended that "it would be of value if countries would record and tabulate statistics of direct transit trade preferably by commodity"; this would "improve comparability of statistics of trading partners ... and provide a good picture of the movement of goods entering into world trade" (p. 25).

PORT STATE CONTROL: DEVELOPING A CANADIAN POSITION

Mary R. Brooks and Wade Elliott[1]

INTRODUCTION

The harsh competitive environment created by tonnage overcapacity in all international shipping markets in recent years has created fundamental changes in the nature of vessel ownership, registry and management, in the seafaring labour market and in the politics of shipping.

In the early 1980s, surplus shipbuilding capacity, cheap yard credits and easy access to government subsidies and ship finance lured more players into the shipowning arena and by 1985 surplus capacity was estimated at 24.3 percent of the total merchant fleet.[2] More and more of the traditional maritime fleets are flagging out in an attempt to cut costs and survive in this era of severely depressed freight rates. The ensuing result has meant that links between ownership/management and the flag state are frequently less well defined as many of the open registries have neither the intention nor the resources to exert greater control.[3]

Concurrently, increasing competition amongst open registries, crew-supplying nations (predominately Third World), classification societies and underwriting syndicates have abetted a further deterioration of crew welfare and safety standards. Perhaps at the root of the problem is the inevitable rogue owner who, one step ahead of his creditors, runs his ships to the ground.

A direct result of these changes has been a considerable increase in the operation of substandard unsafe ships, and the consequent problems of ship-generated marine pollution, strandings, founderings, collisions, and human rights abuses at sea. Any list of defects, deficiencies or infractions which might be generated to identify

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[2] Maritime Transport 1985. Paris: OECD,p.ix

[3] The United Nations Convention on Conditions for Registration of Ships produced in February 1986, makes an attempt at strengthening the "genuine link" between ships and their flag states in areas of ownership, management and crewing. However, many of these provisions are vague and flexible and a genuine link may be difficult to establish.

such ships would be enormous, and include such factors as inoperable (or non-existent) fire fighting and life saving equipment, the refusal to pay back wages or to repatriate crew, and the absence of certificated personnel or oil pollution prevention certificates. The objective of Port State Control (PSC), which seeks to redress some of these problems, might best be summed up in the phrase "safe ships and clean seas".

Where once the establishment and maintenance of standards on merchant ships was largely the responsibility of the country of ship's registry, coastal states and host ports are increasing their efforts to prevent the problems caused by substandard ships. In July 1985 the Paris Memorandum of Understanding (MOU) was signed by 14 European nations, and articulates the principle of Port State Control (PSC) in which the host country accepts the responsibility for enforcing internationally-accepted standards of shipboard operation regardless of the flag of registry and the maritime practice of that registry. Under this principle, deficient ships can be detained until remedial action is taken. Japan, and more recently Korea, have begun implementing PSC based on the European model and other developed nations, like Australia, are showing increasing interest in the concept. In the tanker trades, the US has already unilaterally instituted a measure of port state control through its US Coast Guard Tanker Boarding Program and this move is supported by the American shipowning community.[4] The US has begun talks with the European MOU states and Japan about possible future implementation of full PSC. This paper will address the question: What should be the Canadian position on Port State Control?

THE DEVELOPMENT OF PORT STATE CONTROL

On March 17, 1978, the heavily laden VLCC Amoco Cadiz grounded on the Brittany coast of France, spilling 230,000 tonnes of crude, and focussing world attention on the issue of marine pollution. The ship was owned by Amoco International Oil Company, a subsidiary of the American multinational Standard Oil, and Amoco was subsequently found negligent in the maintenance and repair of the vessel, and in the failure to adequately train its crew.[5] It was this disaster which served as the final incentive for the adoption of PSC principles in January of 1982 through the adoption of the Memorandum of Understanding on Port State Control. Those countries initially party to the MOU are listed in Exhibit 1.

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[4] Philip J. Loree, Chairman of the Federation of American Controlled Shipping, remarks at Port State Control Conference, New York, April 4, 1986.

[5] Seatrade, May 1984, p. 3.

EXHIBIT 1
PARTIES TO THE MOU ON PORT STATE CONTROL

Belgium	Denmark
Finland	France
Federal Republic of Germany	Greece
Ireland	Italy
The Netherlands	Norway
Portugal	Spain
Sweden	
United Kingdom of Great Britain and Northern Ireland	

While the Amoco Cadiz disaster played a predominant role in the accelerated acceptance of Port State Control, the concept itself is by no means a new one, having been firmly founded in maritime law during the time of the Roman Empire and its modern basis can be traced to the Digest accompanying the Justinian Code.[6] The concept of PSC has been furthered by the general adoption of the Plimsol mark and the 1930 Loadline Convention, the 1914 and the 1929 Safety Conferences arising from the loss of the Titanic, and the 1948 Conference which adopted the first modern Convention on Safety of Life and Sea. In more recent times, the 1969 Civil Liability Convention placed the onus on its contracting parties to apply its measures to tankers of non-contracting states. The move from the Grotian principle of freedom of the seas to one of national management was most evident in the inclusion of this concept in Articles 216, 218, 220 and 226 of the 1982 Law of the Sea Convention.[7]

The objective of the Memorandum is to assist in securing compliance of ships with international standards regarding the safety of life at sea, the prevention of marine pollution, and the working and living conditions on-board ship. The standards are those established by the conventions listed in Exhibit 2 and are referred to as the 'relevant instruments' of the MOU.

A significant feature of the Memorandum lies in its concept of 'no more favorable treatment' whereby Port States can enforce even those relevant instruments to which the flag state may not be a party. However, a Port State can apply only those relevant instruments which are in force **and to which it is a party.** It is this which would prove to be the primary hurdle in gaining Canadian implementation of PSC as it exists in Europe.

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6 Frank Wiswall, President and Chief Counsel of Liberian Services Inc., remarks at Port State Control Conference, New York: April 2 - 4, 1986.

7 Tsuneo Akaha, Japan in Global Ocean Politics, University of Hawaii Press, 1985, pp. 8-9.

EXHIBIT 2
INTERNATIONAL CONVENTIONS AND AMENDMENTS ENFORCED THROUGH PORT STATE CONTROL

International Convention on Load Lines, 1966
International Convention for the Safety of Life at Sea, 1974 as amended by the Protocol of 1978 (SOLAS 1974/78)
International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 1973/78) *
International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978. (STCW 1978) **
Convention on the International Regulations for Preventing Collisions at Sea, 1972. (COLREG 1972)
Merchant Shipping (Minimum Standards) Convention, 1976 (ILO Convention No. 147) *

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* Ratified by all MOU parties but Portugal and Ireland
** Ratified by all MOU parties but Italy, Netherlands and Portugal

IMPLEMENTATION AND EFFECTIVENESS IN EUROPE

The parties to the MOU practice PSC by means of the inspection process. Each country is committed to inspecting 25 percent annually of individual foreign flag merchant vessels which enter its ports. The inspector is qualified and authorized by the port state concerned, and the inspection consists of a preliminary examination of certificates and documents relevant to the conventions of importance to the MOU. A detailed inspection of the ship is only conducted in those cases where the documents are not in order, and there are clear grounds for believing that the ship does not comply with the standards.

In the United Kingdom, during the first two years of PSC enforcement, 62 substandard ships were detected and detained.[8] Overall, the MOU reports that 428 ships were detained or delayed due to serious deficiencies in 1984-85, down only slightly from the 436 detained in 1983-84.[9] PSC can only be considered effective if evidence of a

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[8] Captain R. L. Newbury, "Implementation of Port State Control", Proceedings: The Legal Rights of Seafarers, 5-6 June 1985, Cardiff, Wales, p 124.

[9] Only 271 were delayed or detained in the first year of implementation, but it would only be fair to say that in the first year, the member countries were not yet "up to speed" in their inspection process.

declining detention rate exists, and the number of minor deficiencies uncovered drops.

EXHIBIT 4
DEFICIENCY RECORD

MAJOR DEFICIENCIES[10]	PERCENTAGE OF TOTAL 1982-83	1983-84	1984-85
Ship's Certificates	6.93	9.53	13.11
Life Saving Appliances	29.69	25.81	23.68
Fire-fighting Appliances	16.89	18.83	16.87
Safety in general	12.09	10.38	10.58
Load Lines	6.27	5.32	4.94
Navigation	11.39	13.51	12.13
Subtotal	83.26	83.38	81.31
Other	16.74	16.62	18.69
Total	100.0%	100.0%	100.0%
TOTAL NUMBER OF DEFICIENCIES	**8352**	**13436**	**14002**

SOURCES: Annual Reports, MOU, various years.

As can be seen in Exhibit 4, the effectiveness to date has been questionable given these particular criteria. To quote the Third Annual Report on the implementation of the MOU: "The number of deficiencies and of substandard ships have not yet declined significantly ... an unflagging effort will remain necessary."[11] However, to be fair, neither has the magnitude of the substandard shipping problem been determined nor has the target inspection rate been met.[12]

The principles of PSC must also be more universally adopted if they are to be effective in a global sense; we cannot rely solely on the MOU states to promote the principles of "safe ships and clean seas" for all, and certainly more time is needed to determine if PSC will be effective in achieving its intent.

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[10] A deficiency is considered to be a major one if it constitutes 5 percent or more of the total number of deficiencies reported in that year.

[11] From page 2.

[12] The target inspection rate of 25% has not been reached and has tended to stabilize at around 20% mainly because of a shortage of personnel in the national shipping inspection services of MOU members. This essentially means that 60% of all ships plying the region are inspected, rather than the 90% coverage which would occur if the 25% target were reached.

THE CANADIAN EXPERIENCE WITH SUBSTANDARD SHIPS

On January 27, 1985 the Colombian - registered general cargo vessel Monica B limped into Halifax harbour with a 15 to 20 degree list under the watchful eye of Canada Customs, which had suspected the vessel of carrying drugs. After pumps were put aboard to lighten the ship, it was soon apparent that the cargo the vessel was to load was non-existent. The Halifax Port Corporation held the ship but became frustrated in its efforts to trace the owner. The crew were owed back wages and were living in unsanitary conditions without heat or adequate food and water. Efforts to trace the owner(s) were unsuccessful and the vessel was eventually sold. In the meantime the crew of the Monica B were stranded in Halifax for over nine months.

In a similar case, the Panamanian registered Devon III ran aground 50 nautical miles south of Halifax on November 17, 1983 but was soon refloated and towed to a local shipyard. Its owner vanished after receiving more than $500,000 in insurance claims, and the ship was arrested for debts to the salvage and drydock companies, a Saint John shipping agent, and the motel which accommodated the crew after the rescue effort. The crew of Guyanese, Filipinos and Grenadians, some of whom had not been home for more than two years, were owed more than seven months of back wages and sought to be repatriated. After another year and a half sitting in dock accumulating more bills, the Devon III was sold at a sheriff's sale for $6,000 and six months later was towed out to sea and sunk by the Navy.

In a more recent incident, a Charlottetown pilot experienced difficulty in docking a Panamanian - registered bulk carrier because of problems with the ship's electrical power supply. The pilot reported the incident to Canadian Coast Guard's Ship Safety Branch (SSB). Subsequent Coast Guard inspections later revealed a host of defects: an inoperable generator and another with operating difficulties created an unreliable supply of power; defective wires and inoperable brakes on derrick winches made cargo handling dangerous; severe corrosion of decks, bulwarks, hatch openings and hatch covers as well as problems with hatch securing devices jeopardized the watertight integrity of the ship; and many more.

The vessel was declared unseaworthy and detained; Canada Customs clearance withheld until the defects were corrected. Both the Panamanian Consulate and the vessel's classification society were informed. Repairs were undertaken and the ship eventually permitted to sail with a cargo of pulpwood destined for Europe.

It is difficult to ascertain the extent and degree of foreign flag substandard shipping activity in Canadian waters. When incidences are identified, we are left to wonder how much activity goes undetected, the potential costs of which may be quite staggering. Besides local

port, repair, salvage and other charges, elusive owners often avoid the costs of relief, repatriation and medical treatment of their abandoned crews. Furthermore, if substandard shipping activity escalates, the costs of pollution clean-up and search and rescue activity will likely increase.

At present, responsibility for monitoring foreign flag shipping activity primarily rests with the Ship Safety Branch of the Canadian Coast Guard (SSB). Its responsibilities are derived from the international conventions and domestic legislation in Exhibit 5.

EXHIBIT 5
THE BASIS FOR EXISTING PORT STATE CONTROL POWERS IN CANADA

Regulation 19 of Chapter I of SOLAS 1974/78;
Article 21 of the 1966 Load Line Convention;
Non-Canadian Ships Compliance Certificate Regulations;
Non-Canadian Ships Safety Order;
Navigation Appliance Regulations;
Ships Deck Watch Regulations;
Safe Manning Regulations;
Charts and Publications Regulations;
Certain Provisions of COLREG, 1972;
Oil Pollution Prevention Regulations.

Involvement can be initiated in one of two ways: (1) as a result of a routine inspection by a Coast Guard surveyor to verify that there are valid certificates on board; or (2) as a result of a complaint or report which can come from any individual with an interest in the safety of the ship, its crew and passengers. For example, a crew member might bring his concerns about defective life-saving equipment on board his ship to a local representative of a seafarer's welfare/religious organization who in turn passes this information along to the SSB. Or a local port authority employee might inform SSB of a pool of oil surrounding a berthed ship. It is only when suspicion of a decline in standards exists that an inspection of the vessel can take place. Otherwise, certificates are accepted at face value.

However, because Canada has not ratified MARPOL 1973/78, STCW 1978 or ILO 147, the Coast Guard is frustrated in its efforts to enforce these conventions on foreign flag vessels visiting Canadian ports. In particular, not having adopted ILO 147, Canada is especially restrained in preventing abuses of basic human rights regarding working and living conditions. Furthermore, Canada does not have access to the data bank employed by MOU members and therefore has only very limited information on the trading activities of substandard ships. A

key to successful implementation will be an information link with other PSC authorities.

THE ISSUES AFFECTING THE CANADIAN POSITION

1. The position on PSC taken by our trading and continental partners

EXHIBIT 6
WATERBORNE EXPORTS - MERCHANDISE TRADE
(millions of dollars)

	1985		1980	
REGION	**BY WATER**	**%**	**BY WATER**	**%**
Western Europe	6272	24.8	9122	35.8
Eastern Europe	1872	7.4	2051	8.0
Middle East	889	3.5	625	2.5
Africa	933	3.7	949	3.7
Asia	8884	35.1	6676	26.2
Oceania	590	2.3	678	2.7
Central/South America	1716	6.8	2710	10.6
North America	4173	16.5	2678	10.5
Total	25329	100%	25490	100%

Note: Numbers may not add due to rounding error.
Source: Exports Merchandise Trade, Statistics Canada (65-202), 1980, 1985.

As can be seen in Exhibit 6, although the total value of our exports moving by water has not grown, there has been a shift away from Europe towards greater trade with Asia, which has generally not adopted PSC measures. Import patterns show a strengthening of our trade with Asia as well, although not at the expense of our European partners. (See Exhibit 7.)

EXHIBIT 7
IMPORTS - MERCHANDISE TRADE
(in millions of dollars)

REGION	1985 (SHARE)	1980 (SHARE)
Western Europe	12554 (12.0)	7006 (10.1)
Eastern Europe	296 *	307 *
Middle East	371 *	3027 (4.4)
Africa	1035 (1.0)	538 *
Asia	11218 (10.7)	5030 (7.3)
Oceania	604 *	696 (1.0)
Central/South America	4455 (4.2)	4048 (8.4)
North America	74380 (70.9)	48475 (70.1)
Total	104914 (100%)	69128 (100%)

Note: Numbers may not add due to rounding error.
* = less than one percent
Source: Imports Merchandise Trade, Statistics Canada (65-203), 1980, 1985.

It is in our trade with Europe, for example, that the Greek flag has been prominent after OECD flags, and it is the Greeks who have been shown to be among the more notorious owners and operators of substandard vessels.[13] Fully one-third of vessels flying the Greek flag in 1980 were manned by foreign nationals from developing countries.[14] In 1982, flag of convenience vessels carried 35 percent of Canada's deep-sea trade.[15] (It must be said, however, that flags of convenience and substandard shipping are not synonymous.)

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13 C.V.D. Smith Trends and Patterns in Human Rights Violations at Sea, M.Sc. thesis, Plymouth Polytechnic, 1986, p. 93.

14 Task Force on Deep-Sea Shipping, Ottawa: Supply and Services (T22-68/1985E), April 1985, p.37.

15 Ibid. p. 23.

EXHIBIT 8
EXPORTS - TOP 15 BULK COMMODITIES 1978
(in millions of tons)

FLAG TO	GROUP OF 77	OECD	COMECON	OTHER	TOTAL
OECD	4.7	55.0	1.4	1.8	62.9
Greek share	2.5	3.5	0.9	0.8	7.7
Group of 77	4.3	19.3	0.5	1.5	25.6
Liberian share	2.2	15.6	0.3	0.6	18.7
COMECON	0.2	0.5	3.3	—	4.1
Other	0.4	0.8	0.2	2.4	3.7
TOTAL	9.6	75.6	5.4	5.8	96.4

Source: Maritime Transport of Bulk Commodities in Canadian Trade, CTC Research (1982/OE7), p.17.

Therefore, Canadian concern should focus not so much on the vessels involved in regular liner service to Canadian ports as on those engaged in tramp activity, as this the least controlled of the shipping sectors and the core activity of many an unscrupulous owner. This is particularly true when insurance rates are low, sale and scrap markets are poor, and owners are awaiting better prices.

2. Canada's record on environmental issues, safety of life at sea, and human rights

In December 1981, Ted McDorman documented Canada's position on marine environmental issues in a very interesting paper, Record of an Environmental Nation: Canada 1967-1982.[16] In this paper he indicates the Canadian interest in marine environmental affairs at the international level to be marginal at the beginning of the period, and that this interest abruptly grew after the 1969 voyage of the Manhattan and the resultant 1970 Arctic Waters Pollution Prevention Act (AWPPA). It was at this time that Canada emerged as a strong advocate of expanded coastal state control over vessel-source pollution. It appears that the hidden agenda was to gain support for the AWPPA and Canada's radicalism was seen by some as an effort focussed on jurisdictional gain, particularly as Canada has failed to ratify the IMO Conventions that were developed to address marine pollution during this period. It is the lack of Canadian support for these conventions which may hinder any formal Canadian adoption of port

[16] Published by the Dalhousie Ocean Studies Programme, Dalhousie University, Halifax, N.S. Canada in December 1981.

state control principles although Canada has clearly little difficulty with the concept itself.

Canada boasts a proactive role in the protection and promotion of human rights throughout the world and evidence shows that it has become a cornerstone of Canadian foreign policy.

A recent study has shown that abuses of human rights at sea are on the increase and are intimately connected with substandard shipping and flag of registry.[17] ILO Convention 147[18] focusses on the prevention of human rights abuses but has not received support from the Canadian quarter.

Insofar as existing Canadian procedures for control of foreign registered substandard ships (based on our obligations under SOLAS 1974/78 and the 1966 Load Line Convention) provide for the inspection of certificates to ensure compliance with minimum ship construction, safety equipment and emergency procedures, foreign seafarers do receive some protection but these focus on technical inadequacies. By ratifying ILO Convention 147, Canada would be able to provide more effective control over working and living conditions on foreign flag ships, major "human causes" of casualties and accidents at sea.

3. Administrative Issues

Should Canada decide to strengthen its commitment to the control of substandard shipping by implementing PSC procedures, certain organizational, administrative and legislative issues first need to be addressed.

Coast Guard's existing Ship Information Reporting System should be modified to reflect the data requirements of PSC procedures and a data link between the Coast Guard and the MOU for the exchange of data on substandard shipping activity and ship inspections activated. Canadian ship inspectors will also need to be trained in accordance with the syllabus for training of European inspectors.

In order to implement PSC, Canada should then ratify MARPOL 1973/78 and STCW 78, after the passage of Bill C-39 (amendments to the Canada Shipping Act). In addition, the ratification of ILO Convention 147 requires compliance with the various conventions listed in its appendix and which set other minimum standards of living and working conditions. Because much of Canadian law relating to the

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17 C.V.D. Smith Trends and Patterns in Human Rights Violations at Sea, M.Sc. thesis, Plymouth Polytechnic, 1986

18 This convention sets standards for the placement of seafarers' articles of agreement, minimum age of employment, medical examinations, wages, hours of work and manning, health and welfare, food, catering and accommodation, sanitation, repatriation and social security.

internal order and economy of vessels under the Canadian flag is at least substantially equivalent to, and often supercedes, the standards proposed by the appended conventions to ILO 147, some may only need to be cross-referenced. The guidelines for inspections laid down in IMO Resolutions 466, 481 and 542 must also be adopted.

SHOULD CANADA ADOPT PORT STATE CONTROL?

There would obviously be costs involved in the implementation of full Port State Control. However, the Coast Guards's existing efforts towards curbing substandard shipping activity mean that much of the personnel, organizational infrastructure and computer requirements is already in place. The costs of prevention must be weighed against the costs of cure.

To be most effective, Canada should establish an integrated PSC network with the US and Europe. This will require consultations amongst the three to harmonize procedures and data formats and create uniformity of inspection standards.

This effectiveness would be diminished if Canada were not to ratify a number of the necessary conventions. If Canada is to reaffirm its moral leadership as a nation dedicated to the protection and promotion of human rights in the international political arena, ratification of ILO Convention 147 would be an important first step.

The names Devon III and Monica B are but a tiny sample of Canadian experience with substandard shipping in recent years but there are fears that if we do not follow the lead of the Europeans (and especially if the Americans become members of the MOU), these types of vessels will become even more familiar sights; indeed, Canadian ports could become "ports of convenience" with cargoes and substandard ships diverted to them. But at what price?

Determining Economic Maintenance Frequency of a Transport Fleet

by

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1.0 ABSTRACT

In this paper a total cost model has been developed for a transport fleet consisting of groups of vehicles. The total cost model considers two types of costs: (1) operating cost, and (2) maintenance cost. The operating cost is assumed to increase with elapsed time since the last maintenance on the vehicles. The maintenance cost is assumed constant for each vehicle. However, a fixed cost must be incurred at the start of a maintenance cycle. The objective is to determine the operating and maintenance policy for each vehicle that minimizes the total of the operating and maintenance cost of the transport fleet.

2.0 INTRODUCTION

The problems of determining economic operating and maintenance schedules for transport fleets have received very scant attention from researchers. In a transport fleet environmental setting that consists of a group of vehicles, a vehicle may be on the road or in the maintenance shop or available but not on the road. During the time a vehicle is not in the maintenance shop, it is assumed to be available. However, the proportion of time the vehicle is actually utilized during the period it is available depends on the utilization factor for the group of vehicles to which a particular vehicle belongs. The cost of operating a vehicle depends on the time the maintenance work was carried out on the vehicle and it is assumed to increase linearly with respect to time since the last maintenance on the vehicle. The cost of carrying out maintenance varies with different groups of vehicles. However, for same group of vehicles it is assumed to be constant.

A fixed cost of maintenance setups is incurred at the start of each basic maintenance cycle. The total cost of the system is obtained on adding the relevant maintenance costs and the operating costs. The problem facing the managers is to determine the basic maintenance cycle interval and the frequency of maintenance for vehicles in each group.

In the following section, we will determine each component of the total cost of the system and hence determine the total cost of the system. We will then determine the basic maintenance cycle time and the frequency of maintenance of vehicles in each group that minimizes the total cost of the system.

3.0 DEVELOPMENT OF THE TOTAL COST MODEL

3.1 Notations

Z	total cost per unit of time,
m	number of groups of vehicles,
T	basic maintenance cycle time,
S	fixed cost incurred in each maintenance cycle. For the i th group of vehicles:
$f_i(t)$	operating cost per unit of time at "t" time units after the last maintenance,
a_i	fixed operating cost per unit of time,
b_i	increase in the operating cost per unit of time,
S_i	fixed cost of maintenance for the group of vehicles,
s_i	cost of an individual maintenance,
n_i	number of vehicles in the group,
χ_i	time required for maintenance work on a vehicle,
k_i	an integer which when multiplied by the basic maintenance cycle time "T" gives the maintenance cycle time for the vehicles in the group,
y_i	utilization factor of a vehicle on the road,
z_i	total cost per unit of time for vehicle.

3.2 Assumptions

(1) The operating cost per unit of time at "t" time units after the last maintenance for a vehicle of a group is given by

$$f_i(t) = a_i + b_i t \qquad (1)$$

(2) The time required for maintenance for each vehicle in a group is assumed constant.

(3) The maintenance work on a group of vehicles is carried out at equal time intervals.

(4) A vehicle can be sent for maintenance not more than once in a basic maintenance cycle interval. However, if the basic maintenance cycle interval is too long then we need

to consider the alternative of sending a vehicle for maintenance more than once in the basic maintenance cycle interval. In general, the basic maintenance cycle interval will be short and the decision problem will be to determine the number of basic maintenance cycle intervals after which a vehicle should be sent for maintenance. The vehicles in the i th group are sent for maintenance once in k_i basic maintenance cycles. The operating and maintenance schedule for a vehicle in group i can be shown as follows:

Operation	Maintenance	Operation
$\longleftarrow (Tk_i - x_i) \longrightarrow$	$\longleftarrow x_i \longrightarrow$	
$\longleftarrow Tk_i \longrightarrow$		

The vehicle is available for operation in a cycle for a time interval equal to $(Tk_i - x_i)$. As the utilization factor is y_i, so the actual period during which a vehicle will be operated is equal to $y_i(Tk_i - x_i)$. Therefore, the total operating cost for a vehicle in group i is given by

$$\int_0^{y_i(Tk_i - x_i)} f_i(t)dt = \int_0^{y_i(Tk_i - x_i)} (a_i + b_i t)dt \qquad (2)$$

$$= Tk_i y_i(a_i - 2b_i x_i y_i) + b_i T^2 y_i^2 k_i^2 - x_i y_i(a_i - b_i x_i y_i)$$

Hence the total of maintenance and operating cost for a vehicle in group i equals

$$z_i = \frac{1}{Tk_i}\left[S_i + Tk_i y_i(a_i - 2b_i x_i y_i) + b_i T^2 y_i^2 k_i^2 - x_i y_i(a_i - b_i x_i y_i)\right]$$

$$z_i = y_i(a_i - 2b_i x_i y_i) + \frac{(S_i - x_i y_i(a_i - b_i x_i y_i)) + b_i Tk_i y_i^2}{Tk_i} \qquad (3)$$

The total of operating and maintenance cost for group i vehicles equals

$$\sum_{i=1}^{n_i} z_i .$$

As maintenance work is carried out at intervals of T and a fixed cost equal to S is incurred, so the total cost per unit time of the transport fleet can be evaluated as follows.

$$Z = \frac{S}{T} + \sum_{i=1}^{m} n_i z_i \qquad (4)$$

At a particular value of "T" the economic value of k_i is obtained on equating the first derivative of z_i with respect to k_i equal to zero. We get

$$k_i = \frac{1}{Ty_i} \left[\frac{(S_i - x_i y_i (a_i - b_i x_i y_i))}{b_i} \right]^{\frac{1}{2}} \qquad (5)$$

As the value of k_i as obtained from the above model may not be an integer, so we choose the nearest integer value greater than zero as the value of k_i.

On substituting the z_i value in the total cost model given in (4) and on equating the first derivative of Z with respect to T equal to zero, we get the economic value of T for a particular set of k_i values given by
$k = (k_1, k_2, \ldots, k_m)$.

$$T(K) = \left[\frac{S + \sum_{i=1}^{m} \left(n_i \frac{(S_i - x_i y_i (a_i - b_i x_i y_i))}{k_i} \right)}{\sum_{i=1}^{m} n_i b_i k_i y_i^2} \right]^{\frac{1}{2}} \qquad (6)$$

It may be pointed out that for determining T, we need to know $k = (k_1, k_2, \ldots, k_m)$ and for determining k_i we need to know T. As k_i can not be determined without prior knowledge of T which in turn can not be determined without prior knowledge of k_i, so we adopt a search procedure.

3.3 Search Procedure for Determining Economic Policy

(1) For the first iteration assume $k_i = k_i^{(0)} = 1$ for $i = 1,2,\ldots,m$ and obtain the first estimate of $T = T^{(1)}$ from (6). At $T = T^{(1)}$, determine $k_i = k_i^{(1)}$ from (5) for $i = 1,2,\ldots,m$. If $k_i^{(1)}$ values are not integer then select the nearest non zero integer.

(2) At $k_i = k_i^{(1)}$ for $i = 1,2,\ldots,m$, obtain $T = T^{(2)}$ from (6) and then $k_i = k_i^{(2)}$ from (5) using $T = T^{(2)}$. Repeat the process till the rth iteration and stop when $k_i^{(r)} = k_i^{(r-1)}$ for $i = 1,2,\ldots,m$. The economic policy will be obtained at $T^* = T^{(r)}$ and $k_i^* = k_i^{(r)}$.

4.0 CONCLUSION

A search procedure was presented for determining the economic maintenance frequency of vehicles in a transport fleet. The model will be tested in the near future.

THE DESIGN OF AN OPTIMAL CRUISE SHIP SCHEDULE

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THE DESIGN OF AN OPTIMAL CRUISE SHIP SCHEDULE

PURPOSE:

The operator of any passenger transportation service, must periodically design a new schedule. Ideally, such a schedule should deploy the operator's vehicles over the departures scheduled on each route in such a way as will maximize net operating revenues. Numerous methods have been developed to assist in this design for airlines and other complex multi-vehicle services. This paper discusses the design of a simpler schedule using, as examples, two cruise boat operations in Ontario. Hopefully, the simplicity of these cases will better illustrate the hypotheses underlining the model and its possible uses in other situations.

THE MODEL:

The model is based on two premises. The first states that the actual passengers are only a proportion of a larger number of prospective passengers, all of whom would travel with the "ideal schedule", that is, one offering each type of cruise every day. The second premise applies in usual circumstances when there is less than daily service. It hypothesizes that each prospective passenger for a particular type of cruise goes through the following decision making process in order to decide whether or not to travel.

(1) A prospective passenger for a particular type of cruise, selects one of the seven days of the week as his "Desired Day of Travel". The probability of any one day being chosen is given by the "Choice of Day" distribution for the relevant cruise.

(2) If the desired cruise is scheduled that day, the prospective passenger travels. If the cruise is not scheduled, the prospective passenger consults the timetable and chooses one of the available days as being his "Preferred Day".

(3) The prospective passenger finally decides whether or not he is prepared to accept the necessary inconvenience to travel on the "Preferred Day". The probability was defined to be "p" of a prospective passenger advancing or delaying his cruise by one day. However, in our two cases,

involving at most six or seven hour cruises, the corresponding probability of advancing or delaying his cruise two or more days was taken to be zero.

The fraction of the prospective passengers who are willing to travel with any specified schedule is denoted as the "Quality Index" for that schedule. The reciprocal of this Quality Index indicates the increase in traffic which could be expected with the adoption of the "ideal schedule".

The estimation of these Choice of Day distributions and other probabilities is challenging since these numbers apply to prospective passengers about which there are no data. Clearly, the available data apply only to the actual passengers who have chosen to accept any relevant inconvenience with the schedule. Thus the required probabilities have to be estimated using subjective methods, based on the collective experience of the operator's marketing/sales personnel and, where possible, data and experience of other cruise lines. Fortunately, it has been found possible to check the validity of these estimates. Experience indicates that the numeric value of a Quality Index is most influenced by "p", the probability of a prospective passenger being willing to advance or to delay his sailing. Therefore, one can ask the experienced marketing/sales people to estimate "p" and then, a bit later and independently, to estimate the likely increase to be expected if the current schedule were to be replaced by the ideal schedule. If the second estimate approximates the reciprocal of the Quality Index, calculated with the previously estimated "p", then these two estimates have been made consistently. Similarly, the Choice of Day distribution affects the expected distribution of the passengers over the various sailings. If this expected distribution corresponds both to what "makes sense" to informed personnel and to past experience, then its use seems reasonable for forecasts with proposed schedules.

Exhibit 1 shows the calculation of a Quality Index for a schedule with five sailings a week, that is daily except Mondays, and Fridays. The Choice of Day distribution, in common with many for tourist-oriented cruise boats, has Tuesdays, Wednesdays and Thursdays as peak days with Mondays and Fridays as lighter days. This pattern reflects the tourists driving to and from the tourist area on the weekends. Mondays and Fridays are adjustment days, while the tourists are particularly looking for things to do on the three midweek days. Sundays and Saturdays can be light or heavy depending on the amount of patronage from the local community and the degree to which the service attracts weekend tourists.

The prospective passengers are assumed to select the nearest available sailing day as their Preferred Day and, in the case of a tie, to divide evenly between the two adjacent days. In this example, the probability, "*p*", of a prospective passenger being willing to advance or to delay his sailing, was taken to be 0.30. In this way, the Sunday sailings on Exhibit 1 should receive their 13.6 percent of the week's traffic plus 15 percent of Monday's 9.4 percent making a total of 15.0 percent of the week's total. The remaining calculations yield a Quality Index of 0.843; that is 84.3 percent of the week's prospective passengers should travel with this schedule. The reciprocal of this Quality Index is 1.186 thus indicating that an increase of about 19 percent in passengers should be expected with the adoption of daily sailings.

The use of this model is shown with two cases involving Ontario tour boats. The first case involves M.V. "Chief Commanda II", a modern cruise boat operating between North Bay on Lake Nipissing and several small resort communities on the French River. The second case involves the S.S. "Segwun", a classic coal-burning steamboat built in 1887. While, originally, it provided essential passenger and package freight service on the Muskoka Lakes, it is now used only for cruise travel (Exhibit 2).

CASE ONE: M.V. "Chief Commanda II"

The principle decision with M.V. "Chief Commanda" is the choice of sailing days. Because of both scenery and local traffic constraints, the "Chief Commanda II" is limited to six hour cruises. Traditionally, it has sailed from North Bay at 11:00 a.m. to return at 5:00 p.m., daily except Tuesday.

The question thus arises "Why not Tuesdays"? When the service started in the late 1940's, there seemed to be insufficient business for a seven-day operation. Tuesday became the slack day because the lack of a Monday sailing would have forced the patrons to go two days, Sunday and Monday, without being able to receive supplies. This reason weakened with more road accessibility to the French River area and, in 1986, the "Chief Commanda II" did operate daily except Monday. Therefore, for purposes of this study, the model was calibrated using data for 1985 and earlier years and then tested with that of 1986.

This calibration started with the estimating of "*p*", the probability of a prospective passenger advancing or delaying his cruise by one day. Passenger surveys, conducted between 1976 and 1984, indicated that 30 percent of the actual passengers resided in or near North Bay. While this 30 percent would be a smaller percentage of the larger group of prospective passengers, the *p*-

value was set at 0.30 on the premise that these locals and at least some of the others would accommodate themselves to the ship. The resulting Quality Index was 0.884 and its reciprocal of 1.13 implied what was considered to a reasonable 13 percent in traffic were the daily except Tuesday schedule to be replaced by daily service.

The required Choice of Day distributions was developed, in the manner shown in Exhibit 3, so that the expected fraction of passengers on each of the six operating days was the average of that experienced from 1982 to 1985. Using these averages as a base reduced the bias which could result from the inevitable random fluctuations of anyone year. These calculations were facilitated by the advice of another tour boat operator that the Tuesday demand approximates that of Thursday with the provision of daily service. (While several other relationships were tested among these days, the assumption of their being equal provided the best estimates of past traffic.)

The model, calibrated in the above manner, was tested for its ability to predict the experienced traffic distribution of 1986 with its daily except Monday schedule. (Exhibit 4) The use of the Chi-square test showed there to be adequate correspondence. The Quality Index of 0.934, or 5.7 percent higher than that of 0.884 with the daily except Tuesday schedule, indicated a corresponding expected increase with this change in slack days. Also, as shown in Exhibit 1, the Quality Index would be 0.843 with a daily except Friday and Monday schedule. That is, there should only be an 11 percent decrease in traffic with the withdrawal of the Friday sailing.

CASE TWO: S.S. "Segwun"

Introduction:

S.S "Segwun" is based at Gravenhurst at the south end of the Muskoka Lakes system, about 160 kilometers north of Toronto. Here, the steamer has access to about 200 kilometers of waterway which encompass Lakes Muskoka, Rosseau and Joseph and their connecting channels; all these provide many attractive cruise itineraries.

Therefore, scheduling the "Segwun" involves both the developing of two or more cruise itineraries and then of choosing the days to operate each one. Since 1981 two basic itineraries have evolved. (Exhibit 5) Itinerary A, involves an all-day cruise leaving Gravenhurst at 9.30 a.m. returning at 6.30 p.m. and featuring a two-hour lunch stop at one of the Lake Rosseau resorts. While the Gravenhurst passengers are ashore for lunch, the "Segwun" does

a two-hour cruise for the resort guests. This all-day cruise is followed by a 3.5 hour evening cruise featuring a buffet dinner in the ship's dining room. Itinerary B involves a series of three two-hour cruises from Gravenhurst through the nearby islands; these cruises are also followed by the 3.5 hour dinner cruise. While in 1985 and in 1986, Itinerary A has been offered on Mondays and Thursdays and Itinerary B on the other five days, the question still remains as to how often should each of these itineraries, be offered. To answer this question, the following five sets of *p*-values and Choice of Day distributions were needed:

(i) The 3.5 hour evening dinner cruises from Gravenhurst,

(ii) The two hour cruises on Lake Muskoka out of Gravenhurst,

(iii) The all-day Lake Rosseau cruise from Gravenhurst as part of Itinerary A,

(iv) The four hour Lake Rosseau cruise from Port Carling as part of Itinerary A,

(v) The two hour Lake Rosseau cruise from the Lake Rosseau resort as part of Itinerary A.

The Calibration of the Model:

The required calculations for the evening dinner cruises were simplified since they have operated daily since 1984. Therefore, the Choice of Day distribution for these cruises was taken to be the average distribution of passengers for 1984 and 1985. The Chi-square test was used to show that these averages of the 1984 and 1985 distributions were comparable with those of 1986. While the use of a *p*-value was not needed for this paper, the local sales people estimated that it would approximate 0.20 on weekdays and 0.10 for Saturday and Sunday evenings.

The Choice of Day distributions and the corresponding Quality Indices for the two hour cruises from Gravenhurst were calculated for a *p*-values of 0.10, 0.20 and 0.30. As with Case One, the individual probabilities were calculated so that the expected distribution of the passengers corresponded to the averages experienced in 1984 and 1985. (Exhibit 6) In this case, with five operating days a week, the calculations involved solving four equations in six unknowns. To permit a solution, the Tuesday and the Thursday probabilities were again taken to be equal. Also, the Monday probability

was taken to be 0.10; this followed from experience with several cases where Monday was the lightest day of the week. It was concluded that a *p*-value of 0.10 was most reasonable with its implication that a 30 percent increase could be expected by increasing operating daily (Exhibit 7). Again, the Chi-square test was used to show the correspondence between the estimated and the observed numbers on the various days in 1986. .

As for the all-day cruises from Gravenhurst, the *p*-value was taken to be 0.30 and the Choice of Day distribution was taken to be that developed for the six hour "Chief Commanda II" cruise. This *p*-value implies a Quality Index of 0.44 or that the numbers of passengers should increase by a factor of 2.27 if daily instead of twice weekly service were to be provided. The ability of this model to predict the distribution among the operating days was tested with the observed data for 1984, with its three cruises a week, as well as for each of 1985 and 1986. (Exhibit 8) Again, the Chi-square values were well within an 80 percent confidence interval.

It was first hypothesized that the probability distributions for the four hour cruises from Port Carling and the two hour cruises from the Lake Rosseau resorts would be those for the two hour cruises from Gravenhurst. This hypothesis was rejected when there were found to be disappointing loadings at both Port Carling and the resort when Itinerary A was operated on Sundays in 1984. Therefore, in recognition that many prospective passengers for these cruises could be otherwise involved on the weekends, a new Choice of Day distribution was developed subjectively with the bulk of the demand being in the middle of the week. Again, several possible p-values were considered, but a value of 0.20 was adopted. The resulting Quality Index of 0.42 was considered reasonable with its implication that the total number of passengers could increase by a factor of 2.38 with the provision of daily service. The Chi-square test showed the expected and the actual distributions to be compatible for the tri-weekly sailings from Port Carling in 1984 and for twice weekly sailings from both Port Carling and the resort in each of 1985 and 1986. (Exhibit 8)

Some Conclusions from the Model:

In summary, four sets of Choice of Day distributions and *p*-values were estimated to represent the reaction of five sets of prospective passengers to a particular "Segwun" schedule. (Exhibit 9) Tests were made to indicate that these demand patterns, although developed with 1984 and 1985 data, were also applicable to 1986. That is, there seemed to be a common pattern

to the demand over a number of years. The resulting probabilities may be compared to permit the following general observations which can provide a theoretical base for future scheduling:

(i) The p-values increase with the length of the cruise; that is prospective passengers are more likely to depart from their desired day of travel with a longer than a shorter cruise.

(ii) The demand for the dinner cruises is light at the beginning of the week but increases towards the end of the week with the peak on Saturdays.

(iii) The two hour cruises have the peak midweek days of Tuesdays, Wednesdays and Thursdays with moderate demand on both Sundays and Fridays and then another peak on Saturdays. The latter is caused by weekend tourists.

(iv) The all day cruises have the peak midweek days of Tuesdays, Wednesdays and Thursdays with Monday being a slack day and moderate demand on each of Sundays, Fridays and Saturdays.

(v) The four hour and the two hour cruises from Port Carling and the Lake Rosseau Resorts have their demand concentrated in the three peak midweek days.

The Use of the Model:

The use of the model is demonstrated in determining the mix of Itinerary A and Itinerary B which will produce the maximum operating revenues after allowance for relevant costs. To this end, the average weekly number of prospective passengers and the prospective revenue were calculated for each type of cruise in each itinerary. (Exhibit 10) (The evening dinner cruises were excluded from these calculations since they are common to both itineraries.) Quality Indices were calculated for each cruise for each possible set of sailing days for Itinerary A with it being operated once, twice or three times a week. Each of these Quality Indices for a particular cruise was then multiplied by the relevant prospective revenue to produce the corresponding expected actual revenue. These expected revenues, in turn, were summed to produce the total expected revenue for this set of Itinerary A sailing days.

Exhibit 11 shows these expected weekly revenue for the five most remunerative schedules with Itinerary A being operated zero once, twice and three times a week, but not on consecutive days. (An exception to the latter

is the inclusion of the Sunday, Monday and Thursday sequence which was operated in 1984.)

If Itinerary A were abandoned, the expected weekly revenue would be $19364, the prospective revenue for the two hour cruises from Gravenhurst. This amount could be increased to $20507 with the operation of Itinerary A on Wednesdays. While this amount must be reduced by $400, the cost of the required extra 2.5 hours of sailing time, an improvement still results. (Exhibit 12) Similarly, a further improvement results by operating Itinerary A twice a week, that is on Mondays and Fridays. (In practice, the adopted schedule of Mondays and Thursdays is almost as remunerative and was adopted again for 1987 because of operating convenience.) However, the adoption of Itinerary A for three days a week, would decrease the expected contribution. Clearly, it would not worthwhile to operate Itinerary A more than twice a week.

CONCLUSIONS

The paper has described a model for measuring the quality of a cruise ship sehceule in terms of the days in which it is operated. The paper has also shown, in the cases of the "Chief Commanda II" and the "Segwun" that there is stability in the factors affecting cruise demand over a period of years. Hence our model can measure the relative attractiveness of two or more competing schedules.

EXHIBIT 1
The Calculation of a Quality Index

Day	Choice of Day Distn.	Sailing	Probability of Travel	Expected Distribution
Sun.	0.136	Yes	0.150	0.178
Mon.	0.094	No	nil	nil
Tues.	0.166	Yes	0.180	0.214
Wed.	0.182	Yes	0.182	0.216
Thurs.	0.166	Yes	0.1855	0.220
Fri.	0.130	No	nil	nil
Sat.	0.126	Yes	0.1455	0.172
Total	1.000		0.8430	1.000

EXHIBIT 2
Comparison of Vessels
Case One and Case Two

	Case One	*Case Two*
Vessel:	Chief Commanda II	Segwun
Gross Registered Tonnes	347	308
Length	28.68 metres	36.82 metres
Year Built	1975	1887
Rebuilt	—	1925, 1980
Place Built	Gananoque, Ont.	Glasgow, U.K.
Place Assembled	North Bay, Ont.	Gravenhurst, Ont.
Propulsion	Diesel	Steam (burns Coal)
Passenger Capacity	335	99
Crew	10	11

Source: Canadian Transport Commission, Canadian Merchant Fleet, 1985 Annual Lists.

EXHIBIT 3

The Calculation of a Choice of Day Distribution: Case 2
(given observed data for a daily except Tuesday schedule)

Day	Observed Distn.	Initial D's	Revised D's	Probability of Travel	Expected Distn.
Sun.	0.1540	0.1540Q	0.136	0.136	0.154
Mon.	0.1346	0.1064Q	0.094	0.119	0.134
Tues.	nil	0.1877Q	0.166	nil	nil
Wed.	0.2337	0.2055Q	0.182	0.207	0.234
Thurs.	0.1877	0.1877Q	0.166	0.166	0.188
Fri.	0.1474	0.1474Q	0.130	0.130	0.147
Sat.	0.1426	0.1426Q	0.126	0.126	0.143
Totals	1.0000	1.1313Q	1.000	0.884	1.000

Let D_1, D_2, D_3, ..., D_7 be the probability of a prospective passenger wishing to travel on Sunday, Monday,...,Saturday respectively.

Let $p = 0.30$ be the probability of a prospective passenger being willing to advance or to delay his sailing by one day.

Since the proportions of the passengers, observed for Sundays, Thursdays, Fridays and Saturdays were affected only by the demands of the prospective passengers on those days, it follows that D_1, D_5, D_6 and D_7 can be represented by the observed proportions multiplied by the unknown Quality Index "Q".

If $D_3 = D_5 = 0.1877Q$

Therefore for Mondays: $D_2 + (0.30/2)(0.1877Q) = 0.1346Q$

Similarly for Wednesdays: $D_4 + (0.30/2)(0.1877Q) = 0.2337Q$

Whence $D_2 = 0.1064Q$ and $D_4 = 0.2055Q$

Since $D_1 + D_2 + D_3 + D_4 + D_5 + D_6 + D_7 = 1.1313Q = 1.00$

Therefore, the Quality Index: $Q = 1/1.1313 = 0.884$

The D-values are restated in Column 4 and these are used in Column 5 to recalculate the probabilities of sailing on each of the six days and in Column 6 to show again the expected proportion of the passengers on each day.

EXHIBIT 4

A Comparison of the Expected and the Actual Allocation of Passengers among the Days with the 1986 Schedule

Days	*D* Values	Probability of Travel	Expected Allocation	Actual Allocation
Sun.	0.136	0.150	16.1%	17.9%
Mon.	0.094	nil	nil	nil
Tues.	0.166	0.180	19.3	19.6
Wed.	0.182	0.182	19.5	20.1
Thurs.	0.166	0.166	17.8	15.7
Fri.	0.130	0.130	13.9	15.0
Sat.	0.126	0.126	13.4	11.7
Totals	1.000	0.934	100.0	100.0

The value of Chi-square was calculated to test the degree of correspondence between the expected and actual numbers of passengers. This value was 8.15; the corresponding critical value is 9.236 for a 10 percent level of significance.

EXHIBIT 12

Comparative Economic Results with Changing Frequency of Itinerary

	Expected Revenue	Marginal Cost	Expected Contribution
No Itinerary A Trips	$19364	nil	$19364
One Trip: Wednesdays	20507	$ 400	20107
Two Trips: Mon.,Fri.	21314	800	20514
Three Trips: Mon.,Wed., Fridays	21170	1200	19970

EXHIBIT 5
Basic Schedule Patterns S.S. "Segwun"

Itinerary A (All-Day Cruises)	Itinerary B (Three Two-hour Cruises)	
Lv. Gravenhurst 9.30 a.m.	Lv. Gravenhurst	12.00 noon
Ar. Port Carling 11.59 a.m. (ship passes through lock)	Ar. Gravenhurst	2.00 p.m.
Lv. Port Carling 12.15 p.m.	Lv. Gravenhurst	2.15 p.m.
Ar. Lake Resort 12.55 p.m. (Gravenhurst passengers disembark for lunch)	Ar. Gravenhurst	4.15 p.m.
Lv. Lake Resort 1.00 p.m.	Lv. Gravenhurst	4.30 p.m.
Ar. Lake Resort 3.00 p.m. (Gravenhurst passengers reboard)	Ar. Gravenhurst	6.30 p.m.
Lv. Lake Resort 3.10 p.m.		
Lv. Port Carling 4.00 p.m.		
Ar. Gravenhurst 6.30 p.m.		
Dinner Cruise	Dinner Cruise	
Lv. Gravenhurst 7.00 p.m.	Lv. Gravenhurst	7.00 p.m.
Ar. Gravenhurst 10.30 p.m.	Ar. Gravenhurst	10.30 p.m.

Note: The above schedule patterns prevail in July and August but the Dinner Cruise and the 4.30 p.m. two-hour cruise are deleted during June, September and October.

EXHIBIT 6

Calculation of Choice of Day Distribution
Two Hour Cruises from Gravenhurst

Day	Initial D's	Probability of Travel	Observed Allocation	Revised D's	Final D's
Sun.	0.13	0.135	0.170	0.1635Q	0.13
Mon.	0.10	nil	nil	0.1300Q	0.10
Tues.	0.16	0.165	0.220	0.2095Q	0.16
Wed.	0.18	0.188	0.233	0.2225Q	0.17
Thurs.	0.16	nil	nil	0.2095Q	0.16
Fri.	0.13	0.138	0.167	0.1565Q	0.12
Sat.	0.14	0.140	0.210	0.2100Q	0.16
Totals	1.00	0.766	1.000	1.3015Q	1.00

From reasoning of Exhibit 4, $D_7 = 0.210Q$

And if $p = 0.10$ and if Q approximates 0.766

$D_1 + (0.05)D2 = 0.170Q$ $D_4 + (0.05)D5 = 0.233Q$

$D_3 + (0.05)D2 = 0.220Q$ $D_6 + (0.05)D5 = 0.167Q$

From the above there are 4 equations in six unknowns;

To permit a solvable system let $D_3 = D_5$

Also let $D_2 = 0.10$ or let $D_2 = 0.10/0.766 = 0.1300Q$

The remaining values of D_1, D_3, D_4, D_5 and D_6 are determined as in column (5) in terms of Q. Since the sum of these terms equals both 1.3015 Q and unity, then $Q = 1.00/1.3015 = 0.768$

The final D's, in column 6, are determined by multiplying the corresponding term of column 5 by the Quality Index.

EXHIBIT 7
Testing of Probability Distributions
Two Hour Cruises from Gravenhurst

p-value	Quality Index	Reciprical
0.00	0.740	1.35
0.10	0.768	1.30
0.20	0.792	1.26
0.30	0.818	1.22

The validity of this chosen *p*-value and the resulting Choice of Day distribution was tested by using them to predict the distribution of passengers over the five operating days in 1986 with the following results:

Day	Predicted Percentages	Actual Percentages
Sun.	17.1	18.8
Mon.	nil	nil
Tues.	22.0	21.4
Wed.	23.7	22.5
Thurs	nil	nil
Fri.	16.4	16.7
Sat.	20.8	20.6
Totals:	100.0	100.0

The value of Chi-square was calculated to test the degree of correspondence between the expected and the actual number of passengers. This value was 3.06; the corresponding critical value is 5.99 for a 20 percent level of significance.

EXHIBIT 8
Testing the Predictive Ability of the Model
With Itinerary A

	1985		1985		1986	
	Predicted	Actual	Predicted	Actual	Predicted	Actual
All Day Cruises from Gravenhurst						
Sun.	31.2%	30.4%	nil	nil	nil	nil
Mon.	24.3	24.7	41.6%	32.0%	41.6%	43.5%
Thurs.	44.5	44.9	58.4	68.0	58.4	56.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
Chi-square		0.04		2.85		0.16
Four Hour Cruises from Port Carling						
Sun.	23.1%	24.9%	nil	nil	nil	nil
Mon.	31.5	35.4	43.8%	33.4%	43.8%	37.5%
Thurs.	45.4	39.7	56.2	66.6	56.2	62.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
Chi-square		1.09		2.74		0.85
Two Hour Cruises from the Lake Rosseau Resort						
Sun.	23.1%(a)	5.7%	nil	nil	nil	nil
Mon.	31.5	38.5	43.8%	45.2%	43.8%	47.5%
Thurs.	45.4	55.8	56.2	54.8	56.2	52.5
Totals	100.0	100.0	100.0	100.0	100.0	100.0
	Chi-square (not applicable)			0.07		0.74

Note (a): There were almost no passengers available on Sunday from the relevant resort in 1984.

EXHIBIT 9
Comparison of Probability Distributions
by Type of Cruise S. S. "Segwun"

	From Gravenhurst			From Lake Rosseau
	Dinner	Two Hours	All Day	Four and Two Hours
Sun.	0.13	0.13	0.140	0.10
Mon.	0.10	0.10	0.090	0.13
Tues.	0.14	0.16	0.165	0.17
Wed.	0.14	0.17	0.180	0.20
Thurs.	0.14	0.16	0.165	0.17
Fri.	0.16	0.12	0.130	0.13
Sat.	0.19	0.16	0.130	0.10
Totals	1.00	1.00	1.000	1.00
p-value	0.20	0.10	0.30	0.20

EXHIBIT 10
Calculation of Weekly Prospective Revenue
For Each Cruise

	From Gravenhurst		From Lake Rosseau	
	All Day	Two Hours	Four Hours	Two Hours
No. of Actual Passengers	111.7	1255.1	51.8	130.9
Quality Index	0.44	0.77	0.42	0.42
No. of Prosp. Passengers	253.9	1630.0	123.3	311.7
Average Fare	$34.20	$11.88	$20.90	$11.88
Prospective Revenue	8683	19364	2577	3703

Notes: (1) The average fare is 95 percent of the adult fare.
(2) To permit confidentiality, the above traffic data are a multiple of the actual.

EXHIBIT 11
Comparison of Possible Schedule Combinations
Itinerary A and Itinerary B

	Itinerary A		Itinerary B	
	All Day	Lake Rosseau	Two Hours	Total
No Itinerary A Trips per Week	$ nil	$ nil	$19364	$19364
One Itinerary A Trip per Week				
Mondays	1576	1156	17621	(2) 20353
Tuesdays	2136	1482	16576	(5) 20194
Wednesdays	2423	1683	16401	(1) 20507
Thursdays	2240	1482	16576	(4) 20298
Fridays	1897	1156	17273	(3) 20326
Two Itinerary A Trips per Week				
Sun.,Wed.	4211	2600	14136	(4) 20947
Mon.,Wed.	3569	2625	14659	(5) 20853
Mon.,Thurs.	3816	2638	14833	(2) 21287
Mon.,Fri.	3473	2311	15530	(1) 21314
Tues.,Fri.	4033	2638	14484	(3) 21155
Three Itinerary A Trips per Week				
Sun.,Mon.,Thurs.	$ 5006	$ 3266	$12567	(2) $20839
Sun.,Tues.,Thurs.	5462	3467	11522	(5) 20451
Sun.,Tues.,Fri.	5249	3266	12219	(4) 20734
Sun.,Wed.,Fri.	5340	3416	12044	(3) 20800
Mon.,Wed.,Fri.	5036	3567	12567	(1) 21170

AUTOMATING THE CANADIAN FORCES MATERIEL MANAGEMENT SYSTEM

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AUTOMATING THE CANADIAN FORCES MATERIEL MANAGEMENT SYSTEM

INTRODUCTION

The Canadian Forces (CF) are presented with a unique and massive logistic challenge in the area of physical distribution. An extraordinarily wide and diverse range of line items must be dispersed to bases and stations situated not only throughout Canada, but in Europe and other overseas commands. The full range of transportation modes, both military and civilian, are utilised to effect the necessary materiel movement. Experience and research suggest that transportation represents the biggest single expenditure among the variety of activities which, collectively, are encompassed within the term "physical distribution". The Director General Transportation (DGT) at National Defence Headquarters (NDHQ) in Ottawa is currently sponsoring a National Materiel Distribution System (NMDS) project, with the aim of coordinating and more effectively managing the transportation element. Attempts in early years have failed because of high costs, or overwhelming competition from other Departmental projects.

BACKGROUND

General. The Canadian Forces Supply System controls in excess of 1.6 million centrally managed items of supply, worth between 9 and 12 billion dollars. The number of issues made through the Supply System has increased by about 10% per year over the last ten years. Arrangements for physical distribution are made by the Department through its Materiel Traffic System (MTS), the purpose of which is to plan and arrange for the delivery of DND-authorized materiel to the right place, at the right time, in serviceable condition, and in the most cost-effective manner. In addition to integral CF transportation resources, DND expends some $130M annually on commercial transportation services. The totally non-automated nature of the MTS renders the extraction of comprehensive management information data virtually impossible, due to the transaction volume generated at each location. Personnel responsible for materiel distribution therefore lack the fundamental information tools necessary for system planning and control, at both the local and national levels.

System Overview. Within DND, authority and responsibility for the selection of materiel movements resources is delegated by the NDHQ Director Transport Operations (DTO) to the local Transportation Agent (TA). The efficiency of existing operations depends largely upon the experience of the individuals shipping the freight, who, in the main, do not routinely communicate with neighbouring CF Bases and Stations. In addition, the TA has no larger system to call upon, and little meaningful workload or resource planning information, except for the CF Scheduled Road Freight Service (SRFS), to assist in his decision making. All document production is manual, and the movement of materiel is almost exclusively reactive to a consignor's request.

Transaction Volume. MTS TAs annually produce in excess of two million materiel traffic documents using, at best, electric typewriters. The information generated normally lies dormant, and is exceedingly difficult to make available for management use. Present manning is insufficient to retrieve and collate information quickly. For example, a Departmental study of the MTS western region took over eight months to obtain, assemble, and only partially collate the massive amounts of raw data available on only three months of materiel traffic operations in that one region.

Current Method. An NMDS Context Diagram is shown at Figure 1 below, and a brief overview of the actions undertaken by the major role-players in the distribution system is as follows:

a. Consignor. The consignor prepares a consignment to a specific consignee, and initiates a Consignment Authorization and Receipt Form (CARF). The CARF and goods are then physically handed over to the Origin TA for movement;

b. Origin TA (OTA). The OTA receives the consignment from the consignor, and consolidates it with other goods for similar geographic destinations, in accordance with the required delivery date (RDD). The OTA then prepares the shipment for movement, creates a Waybill/ Straight Bill of Lading (WSBL), and arranges movement by either DND or commercial common carrier;

c. In-Transit TA (ITA). When shipments are routed through an intermediary destination, for further consolidation and/or carrier transfer, an ITA receives the shipment and completes the appropriate receiving documents. He then marshals, and when possible consolidates, incoming shipments, completes the shipping documents, arranges movement, hands over the shipments to a carrier, and finalizes ITA documentation. This process is repeated for any number of subsequent ITAs;

d. Carrier . The carrier representative receives the shipment(s) and corresponding documentation from the OTA/ITA, and transports the materiel to the specific destinations annotated on the WSBL;

e. Destination TA (DTA). The DTA receives the shipment from the carrier, inspects it for losses or damage, and completes the carrier's documentation as required. This may include claims action. The DTA then deconsolidates the shipment into individual consignments, completes the documentation, hands over the materiel to the consignees, and obtains a signature on the CARF;

f. Consignee. The consignee receives the consignment from the DTA, and unless transportation-related discrepancies exist, the materiel movement is considered completed; and

g. NDHQ. DTO is charged with the overall management of the MTS, including the creation and promulgation of materiel traffic policy. He is also responsible for the budgetting and auditing functions connected with commercial freight movements.

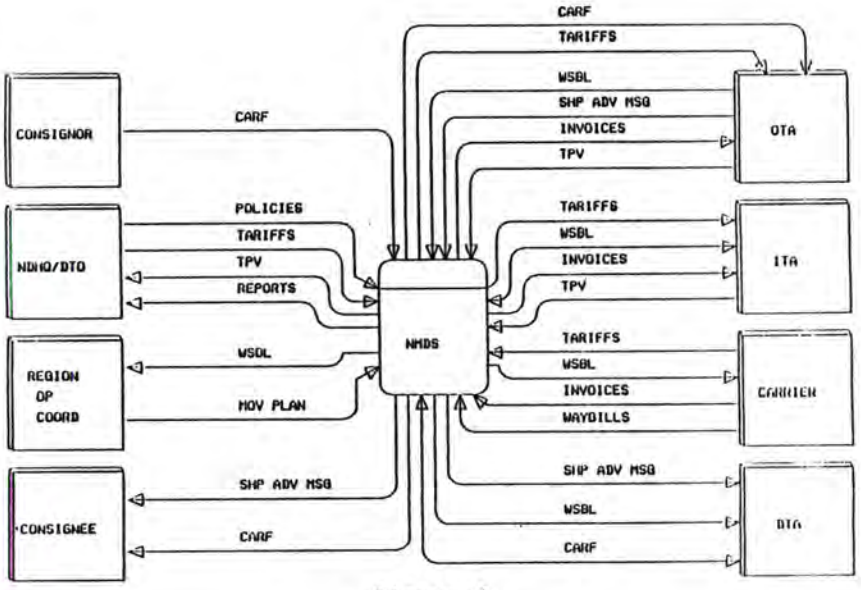


Figure 1
NMDS Context Diagram

Deficiencies. The current system has two major deficiencies - Management Information and manpower intensiveness. Information concerning materiel transit times, costs, carrier performance, volume over given routes, etc, is not practically retrievable. This means that both local and NDHQ MTS managers lack the fundamental data required to proactively control the system. It also means that any attempt at system effectiveness reporting would represent a dysfunctional level of resource commitment. Although the recent introduction of standard documentation reduced the number of DND forms within the MTS, manual production of the number of forms currently generated is time consuming, prone to error, and manpower intensive. In short, the personnel responsible for materiel distribution lack the basic information tools necessary for system planning and control at all levels, with the result that DND is getting less for its transportation dollars than it could or should do.

SYSTEM STRUCTURE

The needs and shortfalls of current MTS arrangements and procedures emphasize the requirement for a more structured approach, with decision making being supported by a sound Management Information System. Conceptually, two principal components of NMDS emerge - Management and Operational.

Management. The management element generates the information needs of the system. It gives DTO a new dimension in materiel traffic management since he will be able to develop policy and make decisions on contracting transportation services on both a national and a regional level. Creation of the management system will be a product of meeting the three principal objectives; namely, ensuring that the CF operational needs are met, optimising the purchasing power of funds expended on transportation, and implementing meaningful policy which will enhance effectiveness and cost efficiency. This must be based on accurate and full information from the field.

Five principal areas of information requirement are identified:

a. Volume/Frequency/Carrier Flow Pattern. This will enable DTO at NDHQ to monitor the relative intensity of movement activity between locations by both volume and weight, and by the number of transactions, (as OTA, ITA and DTA), over the same period. This information will be coupled with the transportation mode, and name of carrier, and will identify primary and feeder routes, seasonal trends, carrier utilisation and TA workload. This provides the core information needed for rate negotiations, and to formulate policy regarding the levels at which such negotiations should take place;

b. Carrier Cost-Effectiveness. This is needed to allow DTO and TAs to gauge relative common carrier costs over the same routes, and to monitor total expenditures on each carrier. Identification of the most economic carriers will also help with rate negotiations;

c. Operational Effectiveness. The intention here is to determine the effectiveness of the NMDS network by measuring the ability to meet the Required Delivery Date (RDD). Where there are shortfalls, the efficiency of individual carriers can be examined. It will also help in the development of a point-to-point transit time model, by mode, for subsequent use in movement planning;

d. Financial Package. This is to enable DTO to forecast expenditures; and

e. Rate Agreement File. This will provide a ready reference source for users at all levels to

access the most cost-effective carriers, and notify rate changes as they occur. It will also serve to identify and minimise tariff errors.

Operations. The operations component deals with those aspects of NMDS which concern the routine functional operations of materiel traffic movement, and are premised on the existence of interactive, on-line communications facilities. It is anticipated that the DND Integrated Data Network (IDN) system will become operational in late 1988. Included in this part of the system structure is the need for line personnel and staff to have the necessary hardware, software and ancillary equipment to do their job and to furnish the system with the appropriate MIS inputs. Also included is the specific requirement for shipment tracking.

The most significant operational requirement, however, is movement coordination. The principal aim of the system is to maximise consolidation and optimize transportation mode selection. In the long term it could be advantageous to establish a number of geographic regions within the country, each with a coordinating manager responsible for the movement of materiel from all the TAs in his catchment area. In effect this would take the form of a freight booking system, with materiel movements requirements being sent by electronic data transmission to the regional TA. RTA staff, assisted by a consolidation software programme, would assess the feasability of load consolidation and formulate a movement plan based on selection of optimum mode and carrier. The bidding, planning and execution phases would form a constant cycle, and would be based on the most economic "just in time" delivery. Account would therefore be taken of known in-transit times and carrier costs, already determined from the MIS, and RDDs. The movement plan would be transmitted from the RTA to his own OTAs, ITAs and DTAs, and to those appropriate in the other regions through parent RTAs.

System Hierarchy. The main role players in the system will continue to be DTO, as the system manager, CF Command Headquarters and then the whole range of Depots, Bases and Stations. Creation of the movement coordination system represents a new dimension, and raises a number of practical problems which will need to be resolved during the course of project development. Firstly, without visibility over the physical distribution patterns which exist, it is not known where the regulating, or coordinating focal points of the NMDS matrix should be. Second, it may lead to some change in the existing overall transport management structure. Such changes would only

be founded on the best possible financial evidence that savings would accrue, and/or that substantially increased effectiveness, if required, would result. Thirdly, there could well be a requirement for additional manpower to supplement RTA staffs.

Identification of the boundaries for this regional matrix requires consideration of four main contributing factors:

a. Geography. Canada's physical characteristics present unique time and distance problems in the transportation field. Commercial traffic movement is strongly influenced by the predominantly east-west route network, and many commercial carrier companies are organized along provincial or regional lines;

b. CF Locations. A number of concentrations, or groupings of Bases and Stations can be identified in various parts of Canada;

c. Materiel Sources. The benefits of transportation resource coordination are most evident when they are directed at the largest sources of materiel which must be moved. It therefore follows that the Department's four supply depots will be important focal points in the network; and

d. Command and Control. The right balance of control levels within the system has to be struck. Any temptation to use the management information made available by ADP for fully centralized control must be weighed against the need to remain inside the bounds of operational practicality. At the same time, the operation of the network must not be allowed to impinge on the prerogatives of the CF command structure.

PROJECT DEVELOPMENT METHODOLOGY

There are a number of practical and financial constraints which impact upon the scope, implementation and timing of projects initiated from within DND. Some practical considerations which must be addressed early on in the planning stages include training requirements for both initial equipment deployment and follow-on phases, site selection, whether there might be any benefits derived from running an initial pilot project, identification of any procedural changes which the new system will precipitate and the like. Most, if not all, of these matters can be resolved with sensible advance planning,

early notification by management of the changes envisaged, and by identification and inclusion on the management team matrix of those line staff and field personnel whose operational function or specific areas of expertise require their active participation as role players in development of the project.

Far less amenable to this application of sound and proven management practise is the question of project funding. There is, of course, strong competition between NDHQ branches and divisions for limited financial resources. The structure of resource allocation within DND is based on the establishment of a number of brackets, or ceilings - for example under $20K, $20K-$0.5M, and so on. The level at which approval must be given is, predictably, commensurate with the amount required.

The practical and financial constraints encountered in development of NMDS both supports and dictates the three-phase approach which is currently being taken in project implementation. Phase 1 will entail the establishment of telecommunications links, development of elementary local and central MIS software, and the acquisition and development of computer hardware resources throughout the core of the system. Phase 2 will be the refinement and expansion of MIS capabilities, and Phase 3 will be the eventual realignment of the MTS using ADP resources. This approach has a number of advantages. First, it will provide for a field testing period, to determine to what degree system hardware and software resources can be standardized. Second, the experience gained in installation and operation will build the expertise needed for subsequent expansion of the system, and thirdly the data collected will help to identify where further system development should be directed in the future.

IMPLEMENTATION

The initial deployment of equipment will be restricted to about six sites, and this will form a prototype for the main system. The aim is to provide a representative cross-section of users, in terms of both functionality (for example, a Supply Depot and an Air Movements Unit) and parent Command (Air Force, Army, and so on), so that all the system applications are as fully exercised as possible. The trial will also be contained

in an area reasonably close to Ottawa where the project team is based. Equally it is desirable that field testing should, where possible, cover the densest areas of movement activity, and south eastern Ontario does indeed meet this need.

A number of exclusions from the automated NMDS have been identified. These consist of some locations which are due closure by 1988, and others which will not be included on the IDN. There are also a number of stations and installations which, because of their relatively small materiel volume throughput, or the fact that materiel movement is already well consolidated and controlled, have a lower priority, and will only be included in the automated system if funds are sufficient. The trial will be conducted during the winter of 1988/89, and it is planned that the full system will start up in September 1989.

MANAGEMENT SUMMARY

There can be no doubt that the deployment of an automated decision support system will have an unparalleled impact on transportation operations in the CF. Quite apart from the potential benefits which have been discussed in this paper, there is the added advantage that provision of modern equipment, with all its inherent capabilities, will stimulate professional interest in transportation oriented ADP systems generally, so providing a dynamic platform for further system enhancements. However, the imposition of a fixed financial ceiling poses an interesting dilemma. It is likely that funding will not be sufficient to meet all of the perceived needs. Therefore senior staffs will almost inevitably be faced with a trade-off situation, and decisions will be needed regarding the relative advantages of system functionality against the number of sites to be automated. It is arguable that the provision of full functionality over, for example, 20% of the MTS nodes provides the biggest value for money return if, proportionally, those particular sites account for the largest volumes of materiel traffic movements. An alternative view is that the single most important deficiency in the existing system is management information, and that therefore the overriding application must be provision of visibility over as wide a spread of the network as possible, even at the expense of losing some degree of "operational" capability. It is axiomatic that incremental changes, made in manageable steps over the whole MTS would be less complicated to organise and operate, and would facilitate a more evenly balanced training requirements package. It is probable too that an equitable spread of the limited resources available will yield the greatest support from the users - an important consideration in implementation of new systems.

MODELLING THE EFFECT OF PASSENGER/FREIGHT INTERFERENCE ON RAILWAY COSTS

By

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1.0 INTRODUCTION

The purpose of this paper is to investigate the potential application of railway capacity and cost models to the estimation of incremental costs incurred by interaction between passenger and freight trains. In addition to the use of existing models, this study also develops computer models to aid in computations of the interference cost. These models are designed to examine the route specific impact on the cost of freight service of different options for rail passenger service, including the removal of passenger trains and the incremental expansion of passenger train service.

Both the cost and the capacity implications of running freight and passenger trains on the same track have been subjects of much interest in various railway studies. However, they are usually dealt with separately, with costing studies examining passenger service costing methodologies and railway capacity models trying to determine the impact of passenger trains on the average train trip time and required improvement in existing plant. The present study attempts to combine the methodologies that have been developed in these two fields to examine delay-induced increases in costs of freight services at different levels of passenger traffic.

Although passenger/freight interference currently exists in railway operations, the traditional railway costing methodology does not specifically deal with capacity issues nor interference costs. Rather, these costs are hidden costs included in annual actual expenditures, and they are accounted for in the calculation of system average unit costs.

The concept of interference cost associated with passenger trains is one of current importance. Since VIA acquired the railway passenger operations in Canada, freight and passenger services have become two separate services offered by different firms. While the traditional method of railway costing in Canada is considered as satisfactory in costing freight and passenger services on a system basis, it lacks flexibility in dealing with the problem of allocation of costs for individual passenger services, e.g. the corridor, regional and remote passenger services. This is

particularly true in the allocation of indirect cost because the cost is prorated to each service based on output units and system average unit costs.

As the cost effect of passenger/freight interference is dependent on the railway line capacity, its significance could vary from one rail segment to the other. Thus, the interference cost analysis could provide useful information supplemental to the traditional costing method.

In this paper, freight train delays are calculated with the railway capacity model developed by the Canadian Institute of Guided Ground Transport (CIGGT). Two different approaches are used in the estimation of interference costs. One follows the concept of railway costing as normally applied in Canada where unit costs of delay affected railway service units are calculated and applied. The other adopts largely the method of the World Bank's Rail model in the interference cost analysis.

2.0 INTERFERENCE ANALYSIS

2.1 Railway Line Capacity Analysis

The CIGGT's LINE Model is used to investigate the impact of passenger trains on the capacity of the railway line to provide freight train services. LINE is an analytical model that calculates the expected transit time for each train type at given traffic levels on a specific line segment.[2] The expected transit time is estimated from the free running time plus the interference delays. The length of interference delay is influenced by the frequency of meets and overtakes, which is, in turn, affected by a number of factors in railway systems and operations. The following is a list of factors that affect interference delay; correspondingly, a list of input requirements to the model is also provided.

Factors Affecting Train Delays	Inputs to the LINE Model
1. Traffic level and mix	-Trains per day by train classes in each direction.
2. Track configuration	-Single or double trackage, mileages.
3. Train speed	-Free running speed for each type of train in each direction.
4. Signal System	-e.g. Automatic Train Control (ATC), Centralized Train Control (CTC). Number of intermediate signals, etc.

5. Train priority	-Train priority matrix indicating the relative priority between a pair of trains.
6. Switch time	-Switch delays for each priority class.
7. Safe stopping distance	-Minimum headway between trains.
8. Changes in traffic level	-The class of trains for which traffic can be increased for capacity measurements.

At the start of the analysis, it is necessary to define line capacity. Depending on the constraints set by the analyst, capacity can be defined in various ways. For the purposes of this study, the capacity is considered reached if any of the following conditions hold:

1. Average total delay reached 50% of free running time.
2. Average total delay for any class of train reached 60% of that class' free running time.
3. Any train or class of trains had a transit time that exceeded 10 hours.[3]

A case study is established based on railway operations on the CN tracks between Kamloops and Hydro in British Columbia. This rail segment is 227 miles in length. The signal system is CTC. This route is chosen partly because traffic density on this rail segment is relatively high and partly because detailed data are available in a recent study of joint-track usage in this area.[4]

In order to measure delays due to interference between passenger and freight trains, the daily frequencies of freight trains are held constant while the number of passenger trains per day is varied.

The base case assumes 17.2 freight and 2 passenger trains per day. The freight traffic level represents the railway's 1984 operations; the daily run of passenger trains on this CN route did not start until the middle of 1985. Thus, the traffic level in the base case is hypothetical, but not unlike the actual operation in the middle of 1980's. The alternative cases include the removal of passenger trains and the incremental increase in the number of passenger trains, two at a time (one in each direction) until the capacity is reached.

The results of the rail line capacity analysis is summarized in Table 1. The table contains two parts. The first part shows transit times and speeds of freight trains when there is no passenger train. It is noted that even without passenger trains,

there could be interference delays due to interaction between different freight trains. This is shown in the last two columns. In this paper, the freight train interference delay is held constant.

The second part of the table shows train transit times when passenger trains are added. The first column shows the number of passenger trains per day in each alternative case. Based on the CIGGT model, the capacity as above defined will be reached at the level of 12 passenger trains (including both directions) in addition to the daily freight trains. The columns numbered 1 to 10 represents the five classes of trains in each direction as listed in the first part of the table.

2.2 Analysis of Train Delays

Interference delays are reflected in the changes in transit times of freight trains at different passenger service levels. The interference delays represent the first order delay resulting from more frequent meets and overtakes. A second order delay may also be generated due to increased track maintenance times at higher traffic levels. Work program slow orders may in turn affect first order delays. However, in this study, only the interference delay is estimated.

To obtain yearly delay due to passenger/freight interference, changes in average freight train trip times are multiplied by the total number of freight trains per day and by 365 days for a given traffic level as compared to the base case.

Delays in train hours can be directly converted to car-days and locomotive hours based on the average number of cars and locomotives per train respectively. Train equipment and traffic of the route studied are estimated based on CN 1984 operating statistics. In Table 2, the interference delays measured in train hours, locomotive hours and car days are presented.

3.0 THE COST OF INTERFERENCE DELAY

Two approaches are used in the cost estimation. One is based largely on the traditional railway unit cost method; the other estimates the interference cost based on delay effect on equipment cycle time and productivity.

3.1 The Railway Unit Cost Approach

This approach involves three steps: firstly, the cost items affected by the train delay are determined; secondly, a set of unit costs related to train delay measurements is developed; and finally, interference costs are calculated by multiplying the quantities of delay time units by the appropriate unit costs.

Cost Items Affected by Train Delay

In Table 3, major cost items associated with delay time units are identified. This table is constructed based on the unit cost system adopted by Canadian railways. Train interferences and delays are considered to have a direct impact on costs associated with the following five groups: train control and communication, crew wage, freight car, locomotive and fuel.

Traditionally, crew wages are computed on a train-run (or distance) rather than on an hourly basis. However, in the long run, unions negotiate for income levels would probably press for an increase in mileage rates should hours per train-run rise. Ultimately, it is hourly income that matters. Therefore, in this analysis, hourly crew wages are applied to train delay and included in the determination of the total interference cost.

In the traditional railway unit cost development, most operations and maintenance expenditures are related to output units, by either direct analysis or regression analysis. In addition, many of the indirect expenses including administration, supervisory and overhead expenses are related to other sets of expenses. For example, a part of the maintenance of shops and engine houses is explained by freight car maintenance expenses which is, in turn, related to car days and car miles. This process is known as "cost pyramiding". Thus, one work unit may be directly and indirectly linked to a number of expense accounts in the railway system.[5]

Unit Cost Development

In estimating interference costs, some distance or other physical units have to be converted to time-related units. These include the conversion from train miles to train hours, from diesel unit miles to locomotive hours and relating gallons of fuel consumption to delay in locomotive hours.

An average speed of 12 miles per hour is used to convert distance to hours. This speed is derived based on an analysis of the train acceleration profile produced by the AAR's Train Energy Model. The speed represents the average train speed during the first 10 minutes after the starting of a train, on level track.

Accordingly, the unit costs of train miles and diesel unit miles calculated from costing models are adjusted to unit costs of train and locomotive hours respectively.

The fuel consumption per locomotive hour of delay is also determined based on the Energy Report of the AAR model which calculates fuel consumption of a locomotive unit at a given notch position or speed. As train delay in each meet or overtake involves train slow down, speed up and wait time, fuel consumption in interference delay is calculated assuming 25% acceleration time

and 75% train idle time. The results show that fuel consumption per locomotive hour of delay is approximately 58% of fuel consumption (in gallons per hour) at normal speed. The unit cost of fuel per locomotive hour is adjusted accordingly for interference cost estimation.

Results of the Unit Cost Model

Results of the unit cost model are summarized in Table 4. The table shows the total interference cost and breakdowns by the five cost groups. The case with 0 passenger trains can be interpreted from two points of view. On the other hand, it represents the interference cost that can be saved by removing the passenger trains. On the other hand, it represents the hidden cost borne by the freight service because of the existence of the passenger train runs.

3.2 The Productivity Approach

Train delay results in longer car and locomotive trip times. Thus, it increases the rolling stock cycle (turnaround) time and reduces the annual mileages that can be generated per car and per locomotive. In other words, to carry the same traffic level of ton-miles, more rolling stock is required. The relationships, between average train speed and equipment cycle time, and between cycle times and rolling stock requirement, can be calculated with the World Bank's RAIL Model.

The RAIL model was designed in the late 1970's to investigate alternative investment policies for developing nations. The RAIL is a large scale and multi-function model by construction. It permits the user to define parameters of eight basic ELEMENT types in a railway system. The types of elements are Project, Locomotive, Wagon, Route, Service, Traffic by service/route, Line and Yard. Furthermore, RAIL provides a range of analysis types which represent varying levels of complexity.

The model calculates the locomotive and car turnaround times using the following two formulae.

$$LTURN = (TIME + WKDEL + LOCDEL)/24$$
$$CTURN = (TIME + WKDEL + DELSHN + NSHUNT)/24 + CDEL$$

Where
- LTURN = locomotive turnaround time in days
- TIME = average road time over route
- WKDEL = average working delay
- LOCDEL = locomotive terminal delay per trip
- CTURN = car turnaround time in days
- DELSHN = average delay per shunt
- NSHUNT = number of shunts en route
- CDEL = car delays at rail terminals per trip in days

In the above formulae, train interference delay is included in the average road time (TIME). In order to measure the effect of train interaction on locomotive and car turnaround times, the other delay components are held constant. Specifically, based on CN freight operating data and train schedules, average work program delay and locomotive and car terminal delay are estimated. These delay components are assumed unchanged in the interference analysis.

For the first formula, an average locomotive terminal delay of 40 hours and a work delay of 8 hours are assumed. Thus the total delay for these two components is assumed 2 days.

In the second formula, terminal delay is the most important component affecting car turnaround time. The terminal delay includes car loading and unloading. For the purpose of this study, a terminal delay of 4 days per trip is assumed. Car shunting delay is also a major factor that affects car cycle time; however, it is not affected by train congestion on the main line. A total of 1 day in car shunt and working delay per trip is assumed.

The requirements for rolling stock are calculated using:

```
        LSERV (I)     =  (NTR/DAYS) * NLOC * LTURN
        LSTOCK (I)    =  (LSERV(I) * 100) /LAVAIL
        CSERV (I)     =  (NTR/DAYS) * NTCAR * CTURN
        CSTOCK (I)    =  (CSERV(I) * 100) /CAVAIL

where   LSERV (I)     =  Number of locomotives required in
                         service of Case I
        LSTOCK (I)    =  number of locomotives required in stock
        CSERV (I)     =  number of cars required in service
        CSTOCK (I)    =  number of cars required in stock
        NTR           =  number of train runs in a year
        NLOC          =  number of locomotives per train
        LAVAIL        =  percent of time locomotive available for
                         service
        DAYS          =  number of days per year service operates
        NTCAR         =  number of cars per train
        CAVAIL        =  percent of time car available for
                         service
```

Inputs to the World Bank Model are presented in Table 5. To demonstrate the methodology, the base case and three alternative cases are analyzed. The latter include the case with passenger trains removed, and the cases with 4 and 6 passenger trains per day respectively. It is noted that among the inputs, only two variables, average speed and average transit time, are different in each case.

The Rail Operations Report shown in Table 6 includes annual freight traffic statistics and rolling stock requirement estimated by the model.

Cost Estimation from the Productivity Approach

Under this approach interference cost is analyzed from the point of view of costs incurred due to reduced productivity. Train delay increases the number of rolling stock units required in service, the cost implication is investigated here.

The World Bank Model has built-in mathematical equations to calculate revenues and costs based on route specific cost and traffic data. In this analysis, the World Bank Model method is used wherever possible. In addition, a method of calculating the incremental costs in train control and rail operation administration is proposed.

Four major cost groups are identified for the interference analysis; they are rail operation costs, maintenance costs, depreciation and capital charges. Data on cost components are presented in Table 7.

(1) Rail Operation Costs

In the World Bank's LINE model, line haul costs are the variable cost of operating a train and include crew wages, fuel and oil. The crew labour cost is assumed to be distance rather than time related. Oil cost is estimated as a percentage of the fuel cost. The equation used to calculate fuel cost per train is of interest in estimating inteference delay cost; it is specified as:

```
FUEL C (I) = FCON * FCOST * HORSEP * NLOC *
((.15 + .85 * AVSPD (I)/MXSPD) * FRTIME + .15 * (WAIT (I)/60 -
FRTIME + .25 * LOCDEL))
```

A detailed description of this equation and its variables can be found in reference.[6] Essentially, this equation specifies fuel cost per train as a function of the free running time (FRTIME), train speeds (AVSPD and MXSPD), road time (WAIT) which includes delays, and other variables related to locomotive characteristics. With some mathematical operations, the equation can be reduced to show that the fuel cost per unit of delay time can be calculated as 15% of the cost for free running time. This ratio is a low estimate compared with the factor of 58% developed in the unit cost approach. The fact that this formula gives lower estimates of fuel consumption in delay time than a previously used formula is considered unimportant, because the main purpose of this study is to investigate alternative methods for the estimation of interference costs.

In this paper, a set of formulae is developed to estimate the possible changes in the other rail operation cost, i.e. administration and train control. These formulae are described below.

First, it is assumed that total annual gross ton miles are not affected by interference delay, only the requirement for new rolling stock. Thus:

$$(1)\ GTM = GTM_{oj} + GTM_{nj}$$

where GTM is annual gross ton miles, GTM_{oj} represent the GTM carried by existing equipment (including cars and locomotives) and GTM_{nj} represents the GTM carried by added equipment at a given traffic level j. In the base case:

$$GTM = GTM_{oj} \text{ and } GTM_{nj} = 0.$$

the unit cost per gross ton-mile for a given traffic level is adjusted as:

$$RCGTM_j = RCGTM_o * (GTM/GTM_{oj})$$

where $RCGTM_j$ and $RCGTM_o$ represent rail operation costs per GTM at traffic level j and the base case o respectively. The interference cost is calculated as:

$$IRC = (RCGTM_j - RCGTM_o) * GTM = RCGTM_j * GTM_{nj}$$

where IRC represents the incremental railway operating cost.

(2) Maintenance Costs

In the World Bank Model, maintenance costs for rolling stock are specified as a combination of fixed annual cost per unit plus per mile travelled. The delay induced rolling stock maintenance costs are calculated based on number of new locomotives and cars required in each alternative case.

(3) Depreciation Costs

In this analysis, depreciation is calculated on rolling stock usage and replacement value. Thus, the delay induced increases in equipment depreciation are calculated as a function of new rolling stock requirement, annual mileage per equipment, replacement cost and equipment life in distance.

(4) Capital Charges

Capital charges are defined as the opportunity cost of the undepreciated capital invested in rolling stock.

The annual capital charge is the average book value (equal to half the replacement value) times the required rate of return. The interference costs are calculated based on new equipment requirement in each alternative case.

Results of the Productivity Approach

Under this approach, train delay times are built into equipment cycle times and the incremental costs associated with the resulted new equipment requirement are calculated. The results of interference costs based on the simulated operation on CN Kamloops segments are presented in Table 8.

It is noted that for two reasons, the general expense group e.g. overhead and other expenses is not included in the productivity approach: First, it is debatable whether this cost group should be included in the incremental cost analysis, and second, it would require further analysis to develop functional relationships between the overheads and the interference delay. Consequently, the total interference costs presented in Table 9 are lower than those estimated under the unit cost approach where system overheads are allocated to output units.

However, the lower cost estimates are also attributable to the different mathematical equations adopted in the two approaches. In particular, fuel costs estimated in the previous section are about three times higher than those presented here; this is due to the use of different fuel consumption formulae rather than the unit cost of fuel, i.e. cost per gallon. Furthermore, the crew cost is included in the unit cost approach based on a long term perspective, while in the World Bank Model, crew wage is assumed not changed in short-run marginal cost calculations.

4.0 CONCLUSIONS

The preliminary modelling effort made in this study indicates the feasibility of estimating the interfernce cost for individual train services. However, further development effort would be necessary to make use of the methodology as alternative costing approach. The following is an evaluation of the two cost models illustrated here.

Firstly, the advantage of the unit cost approach is that the "pyramiding" unit cost method provides a link between train delays and the cost items directly and indirectly affected by the delays. The major difficulty of this approach is that most of the unit costs currently adopted by the railways were developed based on system total costs. These unit costs may lead to an overestimate of incremental or marginal cost. Thus, to develop more precise interference costs it would be necessary to review and reconstruct the unit costs in the railway costing system.

Secondly, the World Bank Model is found very useful in analyzing the effect of interference delay on rolling stock requirement and costs. Furthermore, the Model's ability to analyze the marginal cost on a route or service basis is particularly useful for the route-specific interference analysis. However, more

case studies are required to draw conclusions on its cost estimates.

Overall, the interference cost approach may provide useful information supplementary to the traditional railway costing method. It is an aspect of importance to a railway for its internal investment evaluation and traffic development purposes. Moreover, it may be of potential use in service contract negotiations between passenger and freight railways. However, it remains to emphasize that this is a research project which concentrates on methodologies. Further studies are required to deal with their practical applications in railway costing systems.

Footnotes

1. The views expressed in this paper are those of the author and do not reflect the views of the Transport Canada.

2. English, G.W. and C. Schwier (1986) "User Analyst Guide CIGGT Linemodel V. 2.1" Canadian Institute of Guided Ground Transport, Queen's University, Kingston.

3. The ten hours limit on train-run is based on crew shift specified in industry labour agreements. See Spector, A.N. "An assessment of railway line capacity models available to the CTC", Canadian Transport Commission, 1986.

4. Delcan, Deleun Chather, Canada Ltd., "Joint Track Usage Study, Kamloops -Mission, B.C." Report No. 32-1727, November, 1985.

5. Hariton, G., "Railway Costing - A Review", Research Branch, Canadian Transport Commission, 1984, WP 60-84-04.

6. Taborga, P.N., "Railway Analysis Interactive Language, Rail User's Manual" The Work Bank, March, 1986.

7. Table 1, the trains per day are inputs to the Model. They are annual averages derived from train schedules. For local trains, the average number of daily trips was weighted by the proportion of the line that was traversed. The passenger train inputs were .001.

TABLE 1

EFFECT OF PASSENGER TRAINS ON FREIGHT TRAIN TRANSIT TIMES
KAMLOOPS - HYDRO BASED ON CIGGT CAPACITY MODEL

I. FREIGHT TRAIN TIME AND SPEED - WITHOUT PASSENGER TRAINS

Train Code	Dir.	Type of Trains	Trains* per day	Free Running Time		With Interference	
				Time (hr)	Speed (ml/hr)	Time (hr)	Speed (ml/hr)
1	EB	Slow Freight	3.4	7.28	31.2	8.92	25.5
2	EB	Solid/Unit	3.7	7.10	32.0	8.38	27.1
3	EB	Fast Freight	1.4	7.03	32.3	7.88	28.8
4	EB	Local	.2	6.85	33.2	8.43	26.9
5	EB	Passenger	.0	6.13	37.0	6.42	35.4
6	WB	Passenger	.0	6.03	37.7	6.25	36.4
7	WB	Local	.2	6.87	33.1	8.32	27.3
8	WB	Fast Freight	1.8	7.03	32.3	7.63	29.8
9	WB	Solid/Unit	3.8	7.38	30.8	8.70	26.1
10	WB	Slow Freight	3.1	7.55	30.1	8.95	25.4

II. TRANSIT TIME IN HOURS - WITH PASSENGER TRAINS

Passenger Trains/Day	Train Code									
	1	2	3	4	5	6	7	8	9	10
Free Time	7.28	7.10	7.03	6.85	6.13	6.03	6.87	7.03	7.38	7.55
2	9.28	8.69	8.13	8.77	6.52	6.30	8.67	7.83	9.07	9.34
4	9.67	9.05	8.38	9.14	6.62	6.36	9.01	8.01	9.44	9.69
6	10.11	9.40	8.60	9.51	6.71	6.44	9.38	8.24	9.84	10.16
8	10.59	9.83	8.93	9.91	6.83	6.54	9.82	8.42	10.31	10.61
10	11.13	10.25	9.26	10.37	6.89	6.66	10.26	8.67	10.78	11.15
12	11.67	10.71	9.56	10.91	7.02	6.76	10.80	8.90	11.33	11.69

* See Footnote 7.

TABLE 2

MEASURES OF INTERFERENCE DELAY
IMPACT OF PASSENGER TRAINS ON FREIGHT OPERATIONS

KAMLOOPS - HYDRO

Psg. Trn Per Day	Annual Increase in		Increase in Car Days by Train Type				
	Freight Trn Hrs	Loco Hrs	SL Frt	Unit	Fast Frt	Local	Total
0	-2 103	-4 838	-3 727	-3 848	-844	-44	-8 464
2							
4	2 146	4 935	3 666	4 117	820	43	8 646
6	4 537	10 435	8 114	8 409	1 688	89	18 301
8	7 193	16 544	12 725	13 524	2 621	143	29 014
10	10 078	23 180	18 060	18 640	3 735	201	40 636
12	13 072	30 065	23 396	24 342	4 717	269	52 725

TABLE 3

COST ITEMS AFFECTED BY TRAIN DELAY

Train Delay	Cost Directly Affected	Cost Indirectly Affected	Service Units* Associated with Cost
Train Hours	- Signals, Communication and Train Control, Maintenance, and Ownership	- Overhead	Train hour (CP), Train mile (CN)
	- Crew Wages		Train hour
Car Days	- Freight Car Maintenance and Ownership	- Shop Machine and Equipment Maintenance and Ownership	Car days
		- Overhead	
Locomotive Hours	- Locomotive Maintenance and Ownership	- Shop Machine and Equipment	Diesel Unit Miles
		- Overhead	
	- Fuel	- Fuel Station Maintenance and Ownership	Gallons

* The service or output units are for Directly Affected Cost Items; the unit costs of indirect cost items are normally associated with the expenditure of direct costs.

TABLE 4

THE UNIT COST APPROACH
ESTIMATED INTERFERENCE COSTS

KAMLOOPS - HYDRO

Yearly Estimates in 1983 Costs
Dollars

Passenger Trains/Day	Signal & Comm.	Loco	Freight Cars	Fuel	Crew Wages	Total
0	-67266	-159652	-50824	-253760	-102669	-634170
2						
4	68620	162865	51874	258867	104736	646962
6	145092	344367	109899	547357	221457	1368171
8	230027	545955	174183	867773	351094	2169031
10	322298	764956	244029	1215867	491930	3039081
12	418022	992150	316598	1576982	638035	3941787

TABLE 5

OPERATING STATISTICS - INPUTS

KAMLOOPS - HYDRO

DESCRIPTION	INPUTS*	PASSENGER TRAINS PER DAY			
		2	0	4	6
System Trackage	ML	227	227	227	227
Length of Haul	ML	227	227	227	227
Annual Traffic	TONS (000)	26591	26591	26591	26591
Average Car Load	TONS	78	78	78	78
Loaded Cars/Train	CARS	54	54	54	54
Empty/Loaded Ratio		0.784	0.784	0.784	0.784
Average Speed	ML/HR	25.65	26.58	24.70	23.74
Average Road Time	HRS	8.85	8.54	9.19	9.56
Locomotives/Train	LOCOS	2.31	2.31	2.31	2.31
Loco. Availability**	%	95	95	95	95
Locomotive Weight	TONS	180	180	180	180
Empty Car Weight	TONS	28	28	28	28
Car Availability**	%	90	90	90	90
	INTERMEDIATE OUTPUTS				
Car Cycle Time	DAYS	9.58	9.55	9.60	9.63
Loco. Cycle Time	DAYS	2.37	2.36	2.38	2.40

* Estimated based on CN 1984 operating data.

** The availability figures in the table apply to existing equipment only. For new equipment, a 100% availability is assumed.

TABLE 6

FREIGHT OPERATION REPORT

KAMLOOPS - HYDRO

DESCRIPTION	PASSENGER TRAINS PER DAY			
	2 (Base Case)	0	4	6
Number of Trains	6313	6313	6313	6313
Locomotive Miles (000)	3310	3310	3310	3310
Train Miles (000)	1433	1433	1433	1433
Net Ton Miles (000)	6036157	6036157	6036157	6036157
Gross Ton Miles (000)	10497651	10497651	10497651	10497651
Car Miles (000)	138058	138058	138058	138058
Equipment Required in Service				
Locomotives	94.6	94.1	95.2	95.8
Freight Cars	8945.7	8924.2	8969.3	8995.0
Equipment Required in Stock				
Locomotives	99.6	99.1	100.2	100.8
Freight Cars	9939.7	9918.2	9963.3	9989.0
Increase in Rolling Stock Requirement				
Locomotives		-0.52	0.57	1.18
Freight Cars		-21.52	23.61	49.29
Annual Miles per Locomotive	34978	35170	34770	34576
Annual Miles per Car	15433	15470	15392	15348
GTM/Locomotive	6296106	6330626	6258674	6218443
GTM/Car	1106873	1109542	1103959	1100807
Train Hours	55871	53914	58018	60354

TABLE 7

COST DATA

COST COMPONENTS	VAR OR FX	UNIT	COSTS $*
Crew	V	Trn-HR	48.81
Fuel	V	Trn-HR	208
Other Rail Operation	V	GTM	0.0015
Maintenance			
Locomotive	V	Loco-ML	1.3534
	F	Annual/Loco	79838
Freight Car	V	Car-ML	0.0750
	F	Annual/Car	807
Way and Structure	V	Trn-ML	10.2834
	F	Annual/ML	4123
Depreciation			
Locomotive	V	Loco-ML	0.7153
Freight Car	V	Car-ML	0.0219
Way and Structure	V	GTM	0.0007
Capital Charges**			
Loco	V	Locomotive	10%
Wagon	V	Car	10%
Way and Structure	V	ML	10%

* Derived based on CN system data from the 1983 Railway Financial and Traffic Statistics. Statistics Canada Report 52-215.

** The opportunity cost of capital is assumed at ten percent.

TABLE 8

THE PRODUCTIVITY APPROACH
ESTIMATED INTERFERENCE COSTS

KAMLOOPS - HYDRO

Yearly Estimates in 1983 Costs

	Remove Passenger Trains	Add Two Passenger Trains	Add Four Passenger Trains
RAIL OPERATING COST			
Fuel	-61061	66970	139849
Other	-40517	44646	93476
MAINTENANCE			
Locomotive	-41203	45190	94367
Freight Car	-17369	19049	39780
DEPRECIATION			
Locomotive	-12983	14078	29209
Freight Car	-7307	7974	16604
CAPITAL CHARGES			
Locomotive	-25804	28301	59099
Freight Car	-32284	35408	73940
TOTAL	-238528	261616	546324

COOPERATION IN TRANSPORT MANAGEMENT EDUCATION: THE BEES AND THE HONEY

by

Barry Prentice, Paul Belisle, John Hare, & Bill Wilson[1]

INTRODUCTION

The principles of transport management can be related through lectures, seminars, case studies, computer simulations, and other pedagogical techniques. Each method has its merits and can be effective in transferring received knowledge. The major weakness of these approaches to transport management education is the learning environment; classrooms cannot replicate the real world. This paper outlines a joint project that involved university, business and government participation in providing an MBA student with summer job experience in transport management. The purpose of the paper is to identify some of the potentials and pitfalls associated with this form of logistics management training.

The project was initiated in February 1986, through the Transport Institute of the University of Manitoba. Discussions were held with representatives of Agriculture Canada and local agri-business firms to obtain agreement in principle for the development of two pilot projects. Also, the Transport Institute applied to the "Careerstart" program of the Province of Manitoba which provides partial support for summer student employment.

Proposals for joint funding were prepared and submitted concurrently to the participating firms and to Agriculture Canada through the Canada-Manitoba Subsidiary Agreement on Agri-Food Development. Both proposals were accepted and graduate students were employed from May 1 to August 31, 1986. The remainder of this paper discusses the experience of one of these projects which was undertaken in cooperation with Bee Maid Honey Ltd.

The results of this experience will be presented from

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the perspectives of the individual parties involved. The first section of the paper contains a descriptive summary of the project and the principal findings. This is followed by four separate assessments of the project from the point of view of the student, the government representative, the general manager of the business, and the professor. A summary and discussion of the concept is provided in the final section.

THE BEE MAID HONEY STUDY

Bee Maid Honey Ltd. is owned jointly by the Alberta Honey Producers Cooperative Limited (AHPC) and the Manitoba Cooperative Honey Producers Ltd. (MCHP). The two honey cooperatives are responsible for the assembly and storage of raw honey and for the processing and packaging of honey products. Bee Maid Honey Ltd. is responsible for the sales and distribution of finished products from both cooperatives. The purpose of this study was to evaluate the efficiency and costs of the established distribution network, and to explore the implications of re-organizing the existing system from a transportation cost point of view.

The Alberta and Manitoba cooperatives operate as parallel, but autonomous business organizations. The AHPC is owned by honey producers in Alberta, while the MCHP is owned by honey producers in Manitoba and Saskatchewan. The AHPC has a processing plant in Edmonton, and the MCHP has a processing plant in Winnipeg. Bee Maid Honey Ltd. maintains staff in both Edmonton and Winnipeg and shares space with the cooperatives.

In order to equalize the two cooperatives' costs of processing, Bee Maid Honey Ltd. has a policy of balancing the level of shipments from the plants at Edmonton and Winnipeg. In most years, these plants operate on a single shift and the entire production could be processed by either Winnipeg, or Edmonton facilities. The cooperatives recognize that a rationalization of their activities might be mutually beneficial. Operating two plants creates some duplication of staff and services, while excess capacity at both plants generates higher unit fixed costs of processing. What services or operations should be rationalized, and at which location centralization should occur however, is a more contentious issue.

Scope, Objectives and Method

The scope of the study was circumscribed to a partial analysis of the physical distribution system for final products. As a partial analysis, certain aspects of the

logistics system were constrained. For example, changes in the warehousing system for raw materials and final products were considered outside the terms of reference.

The objectives of the study were to establish the least cost routing system for processed honey using two plants and to determine which plant was better located, from a transportation cost perspective, if all processing were to be consolidated at one location.

To analyze the alternative shipping scenarios a transportation formulation of a linear programming (LP) model was constructed. Initially, the model was designed to simulate the current shipping routes and costs. Subsequently, certain model constraints were relaxed and parameters were changed to evaluate optimal plant/shipping configurations.

Model Development

Bee Maid Honey Ltd. ships processed honey across Canada and to twenty-five countries around the world. The domestic packaged market accounts for approximately half of Bee Maid's processed honey sales. Warehouses containing the finished product for Canadian distribution are located at both the Edmonton and Winnipeg plants and contract warehouse space is used in Vancouver, Toronto and Dartmouth. All of these destinations are included in the model, as well as direct shipments to customers in Saskatchewan.

Direct truck load shipments elsewhere in Canada were treated as shipments to that customer's nearest outlying warehouse. For example, a truck load shipment of processed product to a customer in London, Ontario, was assumed to have the same costs as shipping to the Toronto warehouse. The remainder of Bee Maid's brand name consumer packs are shipped to various export markets including the United States, Europe, Japan and several other offshore countries. Most offshore shipping is done in container load quantities.

Processed honey is also packaged in bulk containers for shipment to industrial customers e.g. candy manufacturers. Processed bulk product is shipped to eastern Canada, to several U.S. customers, and to one overseas customer situated in Europe. All of these bulk processed destinations are included in the model.

All cost data were expressed in Canadian dollars per unit of shipment. In general, these data reflected truck load/container load shipping rates, except for those instances in which less than full load shipments are the rule. Costs for loading and unloading are not included

in the shipping charges. As a result, product which is shipped F.O.B. the plant is assumed to have zero cost.

The following general assumptions were employed in constructing the model:

(i) Regional Honey Production and Quality: It was assumed that the required grades and quantities of honey were equally available to both processing facilities and at equal cost. The exception to this rule is the origin of coloured honey for bulk processed sales which is only available at Winnipeg.

(ii) Warehousing costs of Raw Materials and Supplies: It was assumed that both plants have equal warehousing capabilities for raw materials and supplies. Also the costs of incoming processing supplies (eg.containers) were assumed to be equal for both plants.

(iii) Processing Capability, Capacity and Efficiency: No consideration was given to differences in processing capabilities, capacities or efficiencies between the two production plants. Both plants were assumed to have similar production systems and to be capable of producing all products at equal costs. Further, volume through-put capacities were not considered as a differentiating criteria. That is, both production locations were assumed to have equal and unlimited capacity.

(iv) Bulk Raw Honey Sales: The distribution of unprocessed honey was not considered in the study. The volume of raw honey sold varies widely from year to year and this market is used primarily as an outlet for excess stocks. Moreover, sales are made essentially on a break-even basis, with little regard to long term market development.

(v) Package Type: No consideration was given to the weight, durability and/or ease of handling and shipping different package types. All calculations represent pounds of honey (except for Bee Maid Domestic Brand which includes weight of packaging materials) and were derived from sales records and projections as provided by Bee Maid Honey Ltd.

(vi) Freight Rates: Where volume dictates, freight rates were calculated on the basis of full truck or container loads. Back haul rates were

included where applicable. This information was provided by the staff of Bee Maid Honey Ltd. and not independently researched.

(vii) Outlying Warehousing and Distribution Costs: The freight costs analyzed include only those from the processing plant to outlying warehouses and direct shipments from plant to customer. Costs of distribution of product from individual outlying warehouses to specific customers were not included.

Results

The transportation costs of the existing network in which shipments from the Edmonton and Winnipeg plants were equalized was $452,000. The optimised results have a total cost of $380,000 and $389,000 for the unbalanced and balanced scenarios, respectively. That is, with no consideration given to equalizing shipments between the two plants there is an optimum freight cost of $380,000. When shipments are balanced as well as optimised, total cost rises to $389,000. The potential gain from reorganizing the shipping pattern is between $63,000 and $72,000. The extra transportation cost of balancing plant outputs was $9,000 per year.

The results of the model suggest that all product being shipped within and east of Winnipeg should originate in that city, and all honey sold west of Winnipeg should be processed and shipped from Edmonton. The exception to this is bulk processed coloured honey for the Edmonton market which is only available at the Winnipeg plant.

Consideration was given to the potential impacts of closing one processing plant and conducting all processing at the other. The optimal least costs of shipping all processed product from Edmonton were $548,000, while the least costs of shipping all products from Winnipeg were $566,000. In terms of final distribution costs, it would cost $52,000 more to close the Winnipeg plant than to close the Edmonton plant.

A further consideration when evaluating the closure of one plant was the increased cost of shipping raw unprocessed honey from producers to the remaining plant. If it is assumed that equal amounts of raw honey were produced in both of the Edmonton and Winnipeg catchment basins, it would be necessary to ship approximately, 8 million pounds of raw honey from one region to the other depending on which plant remains open.

The shipment of raw honey between plants is complicated by the re-cycling of the drums which are used for farm to plant raw honey deliveries. The honey co-operatives supply these 45 gallon drums to their members for bringing the raw product in for processing. These drums remain the property of the co-operatives and are re-used as often as possible. Each full drum has a gross weight of approximately 690 pounds with a net honey weight of 645 pounds. The closing of one plant would require the shipment and return of 12,403 drums.

A standard semi-trailer can load 68 full or 260 empty drums. To ship 8 million pounds of raw honey would require 183 truckloads of full drums. The return of empty drums would require the use of 48 more full (by volume only) truckloads. Traffic imbalances between Winnipeg and Edmonton make west-east shipments less expensive than east-west shipments. Trailer load rates from Edmonton to Winnipeg are $830.00, while similar shipments from Winnipeg to Edmonton cost $1350.00.

Using the above figures, the cost of moving raw product from Edmonton to Winnipeg and the subsequent return of empty drums to Edmonton is $217,000 per year. Consequently, if processing is done only in Winnipeg it would cost $217,000 more to move the raw product from the Edmonton region to the Winnipeg processing plant. Alternatively if the Winnipeg plant were closed and all raw honey from this region had to be shipped to Edmonton, it would cost an additional $287,000 annually. Also, the plant not being used for processing would still be required for receiving raw honey from it's region. The cost of keeping the plant in operation as a collection, storage, and shipping depot would have to be included when deciding the net benefits of consolidating processing at one plant.

Combining the added shipping costs of raw honey to the cost of distributing processed honey from a single plant, total shipping costs would be $835,000 if all product were packaged in Edmonton, and $783,000 if all product were processed in Winnipeg. Given the choice between the two processing plants, Winnipeg would be favored by $52,000. Compared, to the optimum shipping costs, however, it is evident that closing either plant would increase annual transportation costs by more than $400,000. Unless cost savings from better processing equipment utilization and rationalization of services could exceed $400,000, it would be more economical to operate both plants and optimize shipping patterns, rather than consolidate processing at one plant.

PERSPECTIVES ON LEARNING EXPERIENCE

In the following pages, the participants relate their views on the process and the learning experience.

Student's Perspective:

Upon meeting Dr. Prentice and learning of the proposed study, I was both interested and skeptical. The project interested me because I had just completed a course in Operations Research, where the subject of transportation problems had been covered. I was skeptical, however, due to my previous business experience where academic methods of problem solving seemed dependent on too many assumptions to be of practical value.

The original project mandate was to determine the least cost routing of honey from the two Bee Maid Honey Ltd. processing plants located in Edmonton and Winnipeg, to their various customers situated in some 26 countries around the world. As a result of my original skepticism and hence desire to make the study of practical value, I was determined to include the details of all variables. You can imagine my frustration in trying to combine all shipping variables (including warehousing, handling, package type, processing capabilities, capacities and efficiencies of the two plants, freight rates, etc.) from two processing plants to several hundred customers located in over 25 countries. Throw in the differences in the type of honey produced at each plant which results from variations in local crop types and climate, plus the internal politics involved because of Bee Maid's ownership structure, and you can understand the eventual necessity to introduce the various assumptions outlined in the report. I credit Dr. Prentice for pushing me through this bit of compromising in our model construction. Although these assumptions meant that the results of our study would not be 100% accurate, they would at least give direction for decision making on the part of Bee Maid's management.

The results of the study indicated that there could, in fact, be a transportation cost saving through the redirection of some of Bee Maid's output. A further revelation and one not originally sought, was the application of the linear programming model's results to the question of processing honey from only one plant. As in the case with many innovative ideas, their development is the result of a search for something altogether different. Such was the case with Bee Maid where we know they were considering the idea of closing one plant for efficiency reasons. Our study therefore included the

scenario of using only one plant, analyzed from the perspective of shipping costs only. In the end, it was determined that the savings from closing one plant would have to be substantial in order to offset the resulting increase in freight costs that would be associated with plant closure.

From a personal viewpoint, I considered the project a success especially since it went further than originally planned and as a result possibly helped in the development of future strategic planning for Bee Maid Honey Ltd. It was also personally rewarding in that it allowed the opportunity to apply operations research techniques in a practical and beneficial manner. This was something about which I had been very cynical during my previous years in business and also while taking the aforementioned course.

Finally, I enjoyed working as a link between the business oriented approach of Bee Maid Honey Ltd. and the academic thoroughness of the Transport Institute. These two fundamentally different perspectives can work well together given a common problem or goal.

Businessman's Perspective:

When Bee Maid was first approached by Dr. Prentice, I was a little surprised since we had not solicited his help or suggested a transport management study. I believe that there was little probability that we would have initiated this study in-house, since we had neither the time, expertise, nor equipment for this type of work. My second concern once I had accepted the idea of doing a study of this type, was the choice of a graduate student, who would actually carry out the project. My uneasiness was unfounded since the student chosen had some ten years-plus of experience in a business setting, and he fit easily into our organization.

From our point of view, the greatest demand on us was for time. It was necessary for us to explain our distribution patterns, and to expand upon our operation so that the student could incorporate this information into his model. Again, John Hare's prior experience made this easy going. If this is the caliber of student enrolled at the University of Manitoba, I would not hesitate to recommend that future studies be carried out for Bee Maid or for my business associates.

The study results relating to plant closure were surprising, since it was always felt intuitively, at least, that one plant operating at full capacity would be better than two operating at one shift per day. This discovery alone was sufficient to make the entire study

worthwhile. Secondly, that some $50,000 to $60,000 could be saved by changing the distribution pattern between the two producing plants has precipitated us to make changes to take advantage of these economies. Since there were good reasons why the distribution patterns had evolved in the first place, usually to maximize plant efficiencies, our current changes will require some additional investment of capital and relearning at the plant level to make production more flexible.

Of continuing importance is that our organization will have access to the computer model developed during this study. This will allow us to examine our distribution patterns as markets change, as demands increase or decrease, as costs change, and as new markets are contemplated. All-in-all, the experience was positive and, hopefully, was beneficial from the point of view of the University, the student and Agriculture Canada.

I believe that organizations of our size can benefit greatly from this type of cooperation with the University personnel. We do not have the assets or the budgets to maintain departments or hire staff to answer some of the logistical questions which are asked of and by us on a daily basis. Many times, these questions are answered with a minimum of information and data. When time permits, we should make use of this type of University student based study to allow us to make better transport management decisions.

Technocrat's Perspective:

I have spent a significant proportion of my professional career within academia and because of this exposure I am, somewhat atypical of a government manager, conversant with the operative stimuli within this milieu. The Canadian academic environment is much less driven by professional peer reviewed research publications than in some other countries, such as the United States. This diminution of research demand has both negative and positive aspects. A significant loss, I would argue, is that without a career enhancement incentive, the oft-witnessed response is to avoid doing research. It is a reasonable response to an activity which intrinsically includes a considerable commitment of the academic's basic marketable assets--time--along with the frustration and anxiety endemic to research.

The Canadian research *modus vivendi* is, however, not without a driving force. A cadre of domestic academics is heavily involved in research and there is a considerable dedication of public sector resources to the

research effort. Despite the lack of institutional demand, this group is motivated, productive and internationally competitive.

Allowing for the extant quality research capability within the agricultural discipline, a remaining challenge is to define an acceptable linkage between academic pursuits and the information demands of government policy and programming.

The government programming regime can be characterized within four facets: growth, efficiency, distribution and stability. Clearly, not all of these facets can be maximized simultaneously. The artistic, some would claim the voodoo, element enters the decision-making process through the trade-offs inherent to this matrix. The process is further complicated by a national commitment to social equity across regions.

The Bee Maid Honey project was an interesting response to providing necessary information to answer a corporate question on the economics of the regional location of processing. The opportunity to apply the standard transportation algorithm to a non-contrived location/distribution case analysis was a successful drawing force for the researcher. Government support for the project was predicated on project consistency with established sectoral objectives of improving value-added magnitudes, and efficiency-based or market-driven production. In addition, the project is a complementary adjunct to an ongoing Agri-Food[2] initiative designed to enhance production efficiencies of regional honey producers. Any improvement in the methodological skills of the researchers, through the application and rigors of in vivo analysis, must be viewed as an ancillary bonus.

Government programs such as the Agri-Food development agreement deal with a wide array and a large volume of options which are competing for the limited program resources. Invariably, each option will contribute a benefit. However, the task is to identify a configuration of options which will secure the best contribution to sectoral performance. The Bee Maid Honey project is an example of a company, academics, and government each providing a modest input toward a product which services the identified needs of each.

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[2]This is the working term for the Canada-Manitoba Subsidiary Agreement on Agri-Food Development, a $38.3 million multi-year programming package designed to improve production technology, transfer this technology, improve producer skills and enhance resource maintenance options.

Professor's Perspective:

Using the tools of management which are taught in the academic setting on applied business problems has direct and tangible benefits for instructors. When a theory can be illustrated with a practical example, the students are more likely to grasp the idea and to remember the concept. One reason for initiating this project was to develop source material for preparing case studies for teaching transport management concepts in agribusiness. Although some case studies on logistics management have been published, they are often out-of-date, not directly applicable to the Canadian context and/or related to inappropriate subject matter. This research demonstrates the value of the transportation formulation of linear programming models as an effective tool for logistics planning for a Canadian agribusiness firm and illustrates several important management concepts which are being prepared in a teaching case for next year's course.

Three important logistics management concepts are demonstrated in this study: 1) there is an economic trade-off between transportation costs and warehousing, 2) the need for re-cycling must be considered in the partial analysis of a logistics system, and 3) the factors affecting the location of processing operations may be more complex than they appear. Generally speaking, if processing causes a commodity to lose weight, the location of the processing plant should be relatively close to the source of supply. Alternatively, if weight or volume is gained in processing, the plant should be located close to the final consumer. As a result, it is typical to find cheese plants located close to dairy farms, while bakeries are located in the cities. When a product, such as honey, neither gains nor loses significant weight or volume in processing, it may seem unimportant whether processing is located close to producers or close to consumers. As demonstrated by this study, however, the re-cycling of specialized containers may alter the general rule for processing plant location. In this particular case, amalgamating processing at one plant on the basis of a simple trade-off between production/warehousing costs and transportation costs of final products could have resulted in a sub-optimal and higher cost logistical system. This also serves as a reminder of the dangers inherent in partial systems analysis.

As a learning experience, the co-operative university/business approach sensitized both the student and the professor to the difficulties that firms have in researching complex economic issues. These difficulties became apparent when the researchers attempted to define

the real problem, assemble the correct data, and deal with anomalies in firm policy and practices which were political in origin.

The one aspect of co-operative university/business research projects that may be negative from the academics' point of view, is the narrow scope for publication of the research findings. Obviously, the researcher cannot prepare an article for publication which contains information that might impair the competitive position of the host business. On the other hand, publications in referred journals are an important consideration in academic promotion and tenure. Clearly, it is essential for the academic to develop an understanding with the firm that selected information will be available for pedagogical use and publication in professional journals following the completion of the study.

Discussion:

There are many positive educational aspects associated with the summer employment of graduate students to work on case studies in transportation management. As demonstrated by the perspectives of the various participants, the educational process was not confined solely to the student. Clearly, the education of both the professor and the businessman were furthered by this project. Moreover, the education of future students may be enhanced as they study the teaching case based on this experience.

The comments of the participants also demonstrate, that the educational component of summer research projects must be considered as an implicit joint product, rather than the principle objective of the undertaking. At the same time, if the public and private sector can be convinced of the potential for an economic payoff, they are willing to risk their financial and time resources on projects which may in the end have only educational benefit.

Transport management is both science and art. The science involves such topics as statistical analysis and operations research, while the art is found in the application of these techniques. Universities are well suited to teaching the science of management, but the art is best developed using "learning-by-doing" techniques. We hope that the results of this experience encourages others to experiment with summer case studies as an approach to teaching transport management.

BULK MINERAL COMMODITY TRANSPORTATION COSTS IN CANADA

by
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Energy, Mines and Resources Canada

ABSTRACT

This paper presents the interdependency of mineral and transport industries, particularly railways on which the transportation of bulk mineral commodity depends. It illustrates the difficulties faced by the bulk mineral commodity producers, such as decrease in world market prices and increase in rail transportation costs. The paper also gives an account of the recent trends in rail rate innovation, and calls for greater cooperation between the two industries.

INTRODUCTION

Canada is one of the world's leading producers and exporters of bulk mineral commodities. These commodities are produced in many relatively remote regions and usually thousands of miles from markets, for example, potash is produced in Saskatchewan and shipped to the U.S. midwest, British Columbia and Alberta coal to Japan, and Quebec iron ore to the United States and Europe. The major bulk commodities are coal, potash, sulphur, iron ore, and copper, lead and zinc concentrates. In 1985, these commodities accounted for almost 5.2 per cent of Canada's total exports.

Since the early 1980's, Canada's producers of bulk mineral commodities have been facing increasing competition in world markets from producers in other countries, which has driven down the prices of some commodities. While Canadian producers have decreased their operating costs by increasing productivity, mineral commodity transportation costs have increased. The net result is that the competitiveness of Canadian bulk commodities at the point of delivery has decreased, thereby causing decreased sales, lower production, layoffs and reduced resource development.

Transportation costs can make the difference between a company's operating profit and loss. On average, transportation represents 6 per cent of the total cost of Canadian products at the point of delivery. For mineral commodities, the average is much higher ranging from 20 to 30 per cent for potash to almost 50 per cent for coal. Lower world mineral commodity prices since 1980 have added pressure on companies to reduce costs. Canada's railways today are amongst the most productive in the world as judged by most statistical measures, despite operating difficulties posed by rugged terrain and harsh climate. Mineral producers are fortunate to have the lowest cost per ton-mile for rail transportation. However, they are faced with the highest total costs for shipment of bulk commodities such as coal, potash and sulphur due to the long distances that these commodities generally must be hauled.

Because of the wide dispersion of the numerous mineral producing areas in Canada, a complex network of roads, railroads and waterways are essential to enable the mineral producers to transport their products to foreign markets. For example, mineral commodities are shipped to U.S. by road, rail and waterway, and to offshore through many ports.

INTERDEPENDENCY OF MINERAL AND TRANSPORT INDUSTRIES

Minerals constitute both the highest tonnage and volume of all goods moved in Canada. In 1985, the movement of all minerals, unprocessed and processed, accounted for about half of all rail traffic and a third of all domestic shipping.

During the past five years, as mineral prices fluctuated widely, transportation systems that are dependent on the mineral industry have been adversely affected. Reciprocally, the economic viability of mineral development and production has been affected by transportation costs.

Mineral producers facing increased competition are seeing transportation costs become an important factor in their survival, which is causing a shift away from the high bulk, low value commodities to low bulk, high value commodities, particularly gold and precious metals.

Transportation cost can be a major determinant in the decision of exploring for and exploiting mineral deposits. The most obvious example is exploration in

frontier areas. The more remote the region, the more likely companies would reject mineral exploration opportunities because in some cases transportation costs would be over 50 per cent of the total exploration budget.

MINERAL TRAFFIC

The Canadian mineral industry is a major contributor to rail and Seaway traffic. In 1984, unprocessed and processed mineral commodities and products amounted to 159 million tons of railway traffic, making upto about 50 per cent of total revenue of rail freight of Canadian railways. Unprocessed minerals alone, including coal, amounted to 78 million tons or 43 per cent of the total traffic on the Canadian National Railways and CP Rail systems in 1985. The ton-miles was 44 billion or 35 per cent of the total. Transportation of minerals represents an even larger proportion of traffic on some other Canadian railways, such as the Quebec and Labrador Railway and the Algoma Central Railway built specifically to haul iron ore.

During 1985, mineral products, mainly iron ore, accounted for 13.8 million tons or 33 per cent of the total traffic on the Montreal-Lake Ontario Section of the St. Lawrence Seaway. The traffic on the Welland Canal Section for the mineral products, mainly iron ore and coal, accounted for 18.9 million tons or 41 per cent of total traffic. These amounts do not include processed products such as iron and steel, which amounted to 3.6 million tons on the Montreal-Lake Ontario Section and 3.0 million tons on the Welland Canal Section of the Seaway.

MINERAL TRANSPORTATION RATES

The Canadian mineral industry is almost totally reliant on railways for shipping bulk mineral commodities to domestic markets or to ports for exports. Intra or inter-modal competition is rarely a factor in determining transportation rates.

CN and CP rail transportation rates and revenue per ton-mile have steadily increased over the years even when commodity prices have dropped, as shown in Tables 1 and 2. Table 1 shows that the rail revenue per ton-mile from 1974 to 1985 has increased by 262 per cent for coal, 217 per cent for potash and 234 per cent for sulphur. The corresponding increase for all unprocessed mineral commodities was 187 per cent.

Table 1.
Rail Revenue per Ton-Mile, 1974-1985
CN and CP Combined Canadian All-Rail Traffic
(cents per ton-mile)

Year	Coal	Potash	Sulphur
1974	0.76	0.89	0.94
1975	1.05	1.04	1.14
1976	1.33	1.29	1.48
1977	1.55	1.43	1.64
1978	1.62	1.52	1.79
1979	1.64	1.63	1.94
1980	1.92	1.85	2.17
1981	2.19	2.16	2.44
1982	2.44	2.70	2.76
1983	2.56	2.61	2.98
1984	2.64	2.63	3.00
1985	2.75	2.82	3.14

Source: CTC Commodity Flow Analysis.

Table 2.
Rail Rate, 1971-1985
CN and CP Combined Canadian All-Rail Traffic
(dollars per short ton)

Year	Coal(1)	Potash(2)	Sulphur(1)
1971	3.65	7.80	5.96
1972	3.58	8.81	6.05
1973	3.76	9.30	6.35
1974	4.61	9.85	7.24
1975	6.62	11.41	8.48
1976	8.72	13.80	11.96
1977	10.30	15.49	13.42
1978	11.16	16.30	14.58
1979	12.11	17.12	15.86
1980	13.78	19.11	18.05
1981	15.75	21.25	20.76
1982	18.37	25.02	23.70
1983	18.47	24.89	24.78
1984	18.63	25.87	25.42
1985	19.14	26.76	26.81

Source: Canadian Transport Commission.

(1) Average rail rate for transportation from Alberta to a port facility in British Columbia.
(2) Average rail rate for transportation from Saskatchewan to a port in British Columbia.

Table 2 shows that rail rate from 1971 to 1985 has increased by 424 per cent for coal, 243 per cent for potash and 350 per cent for sulphur. For example, rail rates for potash from Saskatchewan to Vancouver have increased from $9.30 per ton in 1973 up to the current level (1986) of $27.22 per ton or by almost three times. Selling prices of potash have fluctuated during this period reflecting world market forces, and are currently only 50 per cent higher than in 1973. Thus, rail rates have increased much more rapidly than potash selling prices.

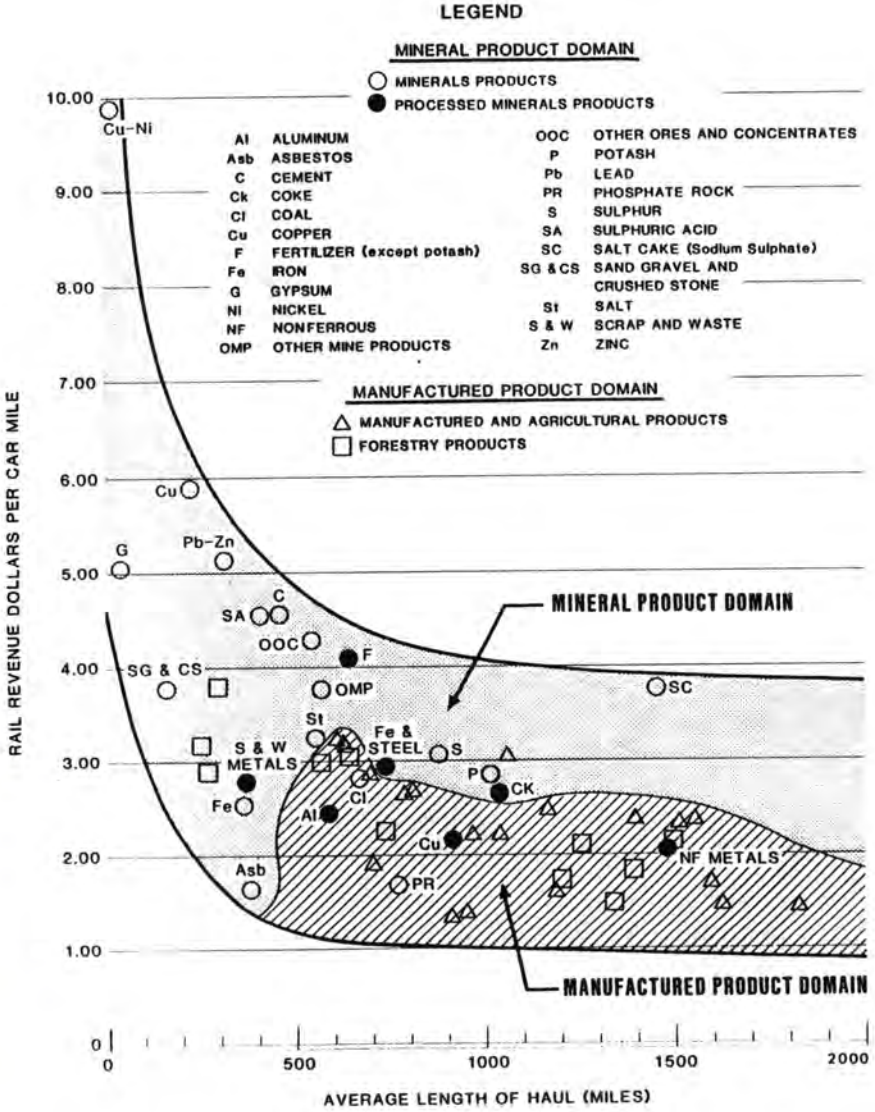
On the other hand, ocean freight rates for bulk commodities have gone up and down to respond to changes in market demand and the supply of shipping capacity. Comparison of the ocean freight rates with the rail rates shows that rail rates over the years have increased in real terms while ocean freight rates have decreased.

Other observations indicate that, in general, excessively high rail freight rates compared to what would be expected under a highly competitive situation can discourage the development of new mines and mineral processing facilities. They could also cause the premature closure of existing operations, particularly during long periods of depressed commodity prices.

It is generally believed that significant distortions have developed in rail rates for bulk mineral commodities captive to this mode. Bulk mineral traffic has made substantial contribution to increasing the productivity of Canadian railway freight operations, e.g., through the use of unit trains, solid trains and multiple cars. As a result, average revenue per car mile for mineral product carload traffic, as shown in Diagram 1, is higher than that of all other types of carload traffic. Diagram 1 also shows that the rail revenue from mineral products is almost double that from the manufactured, agricultural and forestry products which is about $2.00 per car-mile. This may be because the average length of haul for the latter is higher than that for the mineral products. Even where the haul distance is similar, mineral products appear to provide more rail revenues per car-mile when compared to other products. At the extreme, the average haul length for copper-nickel ores and concentrates is only 32 miles but the rail revenue is substantially high at $0.88 per car mile. Thus, rail revenue from mineral products rather than other traffic makes a substantial and proportionately greater contribution to the recovery of railway overhead costs.

Diagram 1.

RAIL REVENUES PER CAR MILE BY COMMODITY BASED ON COMMODITY FLOW ANALYSIS OF CANADIAN CARLOAD ALL-RAIL TRAFFIC (CTC) 1985



MINERAL TRANSPORTATION HAUL DISTANCES

Transportation haul distances greatly affect the competitiveness of Canadian mineral industry in the world market.

Canada is at a distinct disadvantage in the international coal trade when considering the average mine to port rail haul distances in each country. The average haul distance for coal in South Africa is 533 kilometres, in Australia 199 kilometres, in the United States 700 kilometres and in Canada 1066 kilometres. Similarly, Canada's major competitors for sulphur are Mexico, Saudi Arabia, the United States and Poland. The average haul distance for sulphur in Mexico is 45 kilometres, in Saudi Arabia 208 kilometres, in the United States 288 kilometres, in Poland 500 kilometres and in Canada 1371 kilometres. These haulage routes in Canada are also over rugged terrain and through harsh climates. Nevertheless, Canadian producers pay lowest cost per ton-mile for rail shipment but have relatively the highest total cost due to the length of the haul. Despite these relatively high costs, Canadian producers have maintained their competitive position by providing quality products with high degree of reliability and service, which is partly due to two of the relatively best run railways in the world. Currently, it is the quality of service which is crucial for the Canadian mineral industry.

THE IMPACT OF THE NEW NATIONAL TRANSPORTATION ACT

In keeping with its deregulation initiatives, on November 4, 1986, the Government of Canada tabled Bill C-18, designed to reduce economic regulation and thereby permit greater reliance on market forces within the transportation sector. The changes provided under the new legislation should be of considerable benefit to rail shippers by eliminating collective rate-making and thus giving shippers more flexibility to negotiate rates and services through the use of confidential contracts; by providing competitive rail access as well as dispute resolution mechanisms for captive shippers; and by allowing confidential contracts which should permit railways to compete more effectively for transborder traffic. In particular, the Government believes that the new transportation legislation addresses the needs of shippers of bulk mineral commodities, especially in remote locations. The Government also believes that one of the effects of the new legislation will be to assist in reducing rail freight rates although the amount is uncertain.

The mineral industry hopes that the new transportation legislation will provide the mechanism to obtain the balance between the desirable quality of rail transportation service and low freight rates.

RECENT TRENDS IN THE TRANSPORTATION OF BULK MINERAL COMMODITIES

Recent trends in the transportation of bulk mineral commodities have focused on the innovation of rate, route, equipment and short line railway. All these innovations eventually affect the rail transportation rates.

The railways have in recent years provided innovative freight rates to suit shippers' special needs. For example, in 1985, CP Rail quoted a developmental rate, which is lower than market rate, to facilitate initiation of potash into the California market. Developmental rates have also been quoted to help ship potash via the Mississippi barge system through the Port of New Orleans to Caribbean and South American markets.

The railways also have provided innovative solutions to distribution problem. For example, since 1986 CNR is shipping potash to Europe by a new route via unit train to Thunder Bay instead of Montreal, and then by ocean vessel through the St. Lawrence to Europe. This system was designed in cooperation with CNR and Fednav Ltd. It reduces shipping distances by rail in favour of increased distances by water. The establishment of this route required adaptation of Canadian National's Valley Camp terminal at Thunder Bay and Fednav's bulk carriers which can operate on both the Seaway and the Atlantic Ocean.

Presently, CP Rail is developing a super unit train for coal made up of four 30-car minitrains coupled with one power unit for each of the four minitrains. New coal cars are being developed for increased aerodynamics and reduced tare weight. They will have a new interior lining that will help prevent coal from sticking to the bottom of the cars during dumping.

Another recent innovation was the establishment in November, 1986 of the first short line railway in Canada consisting of unused trackage. The new operation, Central Western Railway Corporation of Calgary bought 173 kilometres of CNR's branch line in southeastern Alberta for about $2.5 million. Central Western's intention is to offer low cost service to

farmers on trackage that would otherwise be abandoned as uneconomical by the national railways. Short line railways have proliferated in the U.S. following deregulation in 1980, therefore, it is anticipated that this concept may set a precedent in Canada for the movement of mineral commodities.

It is through such innovativeness that both mineral and transport industries will continue to prosper. Competitiveness of bulk mineral commodities is greatly affected by the transportation costs while the transport industry itself relies on the revenue from the bulk mineral commodities. Accordingly, both the mineral and transport industries will have to continue to cooperate.

MATERIEL TRAFFIC WITHIN THE CANADIAN FORCES - TRANSPORTATION ROUTE ANALYSIS

by

Major T.J. Gardener

Major M.B. Turnbull

and

Kevin Y.K. Ng

INTRODUCTION

The Directorate of Transportation Resources and Plans (DTRP) is conducting the National Materiel Distribution System (NMDS) Study in order to validate the operation of the current Materiel Traffic System (MTS). The results of the study will ascertain the ability of the MTS to meet the requirements of the Canadian Forces in the future and thus the need to fine tune, modify, or replace it to meet the aim of the system, in the context, economically and technologically, of the 1980s and to meet the approved system objectives. That aim is "to delivery materiel safely, on time, and at the lowest cost to its destination".

The aim of this report is to describe the materiel movements in the Western Region, with particular emphasis on the use of military transport vehicles for the movement of low priority traffic. An analysis of the data will illustrate whether or not there is a need for greater control of transport resources and if a significant increase in military vehicle usage can be expected through the consolidation of certain shipments.

METHODOLOGY

The first attempt to define the activity of the MTS

in the Western Region produced a series of computer outputs identifying:

a. the shippers;

b. what was shipped in terms of weight, volume and number of shipments; and

c. where they were shipped.

There were over 43,000 shipment records from the two data collection periods: 1 Nov 83 to 15 Dec 83, and 15 Jan 84 to 29 Feb 84. Starting with 43,024 shipment records, we eliminated 3,446 Materiel Priority Code OX and 5,970 MPC 01 records. Of the 33,608 remaining, exact duplicates (when compared character by character) were removed which left 32,427 shipping records to be analyzed. Of course some of these represented either out of region or local shipments which are not subject to regional analysis. After the removal of these particular records, 16,292 TCNs (Traffic Control Numbers) remained for the analysis of the Western Region.

The route program required a pre-determined trunk corridor. This was established by summing the shipments at each location, sorting the results in descending order, and then selecting the top bases accounting for 80% of the total activity. These bases were then identified on a map of the Western Region, Figure 1, in an attempt to draw a physical route between them. Additional bases were added to the route that the trunk would pass through. Only in one case were two bases considered to be mutually exclusive along the route. Both Wainwright and Cold Lake had substantial activity justifying their inclusion, but it was geographically inefficient to have the route go between them. It was decided, therefore, that for the purpose of analysis, only one would be considered to be on the route, but that the actual operation of the route could alternate between them. Having slightly greater activity, Cold Lake was chosen to be included. Penhold, Kamloops, and Portage La Prairie were added to the route because it appeared that they could logically be serviced without major deviation. This should provide a more efficient flow of materiel along the Scheduled Road Freight Service (SRFS) route.

It had been noted in analyzing the route traffic records that certain inefficiencies were appearing. For example, shipments from Portage to Shilo were being directed through Winnipeg because the SRFS did not service Portage. Other shipments from Suffield to Penhold were going via Calgary, onto the SRFS to Edmonton, and then back to Penhold by different means because the SRFS did not service Penhold. Similar routing practices were

observed throughout the Western Region. It was evident that those smaller units not located on the established route(s) were forced to make awkward arrangements in order to use the SRFS. The inclusion of as many of these smaller units as possible along the SRFS would avoid the noted anomalies.

Cold Lake has a great deal of business with the Repair and Overhaul (R&O) facilities in Winnipeg but currently ships via Edmonton. The theoretical route would have Cold Lake shipping directly to Winnipeg. From these various examples, it can be seen that the reported activity required some modifications when applied to the structured route. Arrows from the smaller bases indicate how they would feed to the Main Transportation Corridor.

BASE CLOSURES

When initially analyzed, it was understood that the smaller bases, mainly radar stations, would require separate handling. However, the record-by-record review mentioned above showed that these locations are extensively using the SRFS through transshipments. This means that the activity along the trunk corridor more closely reflects the actual situation than first supposed.

Many of these smaller locations, however, are scheduled for closure in the near future, with the expected closure dates reflected on the attached map (Figure 1). Additionally, the radar function at CFB Penhold will be terminated, further reducing the materiel traffic activity there. Once these locations are no longer serviced, the traffic requirement will be primarily concentrated on the trunk corridor, allowing a better opportunity for control.

SCHEDULED ROAD FREIGHT SERVICE

Before examining the trunk corridor in detail, it is beneficial to review the current infrastructure which has been designed with the needs of the SRFS truck drivers in mind.

The SRFS operates a fleet of tractor/trailer units throughout the Western Region using integral resources of the Canadian Forces. The routes are established to cycle in and out of Moose Jaw through Shilo to Winnipeg, and through Edmonton to Calgary. This allows the drivers to maximize their time at home but restricts the number of stops in between. Support to other bases along the route, such as Penhold, Suffield, and Portage La Prairie, requires other resources at the unit level. Support to the west coast and Wainwright is provided by transshipment to vehicles operating from Edmonton. Traffic amongst

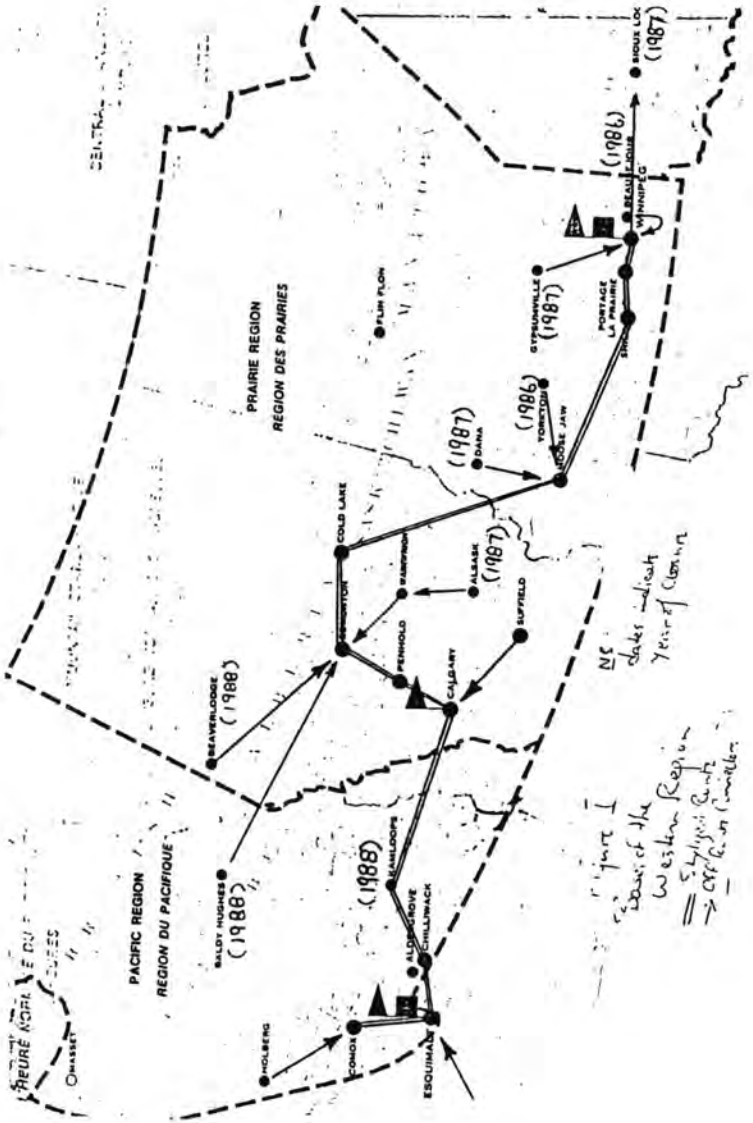

PACIFIC REGION
RÉGION DU PACIFIQUE
PRAIRIE REGION
RÉGION DES PRAIRIES
(1988)
(1987)
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(1986)
(1987)
BEAVERLODGE
BALDY HUGHES
HOLBERG
COMOX
ESQUIMALT
ALDERGROVE
CHILLIWACK
KAMLOOPS
EDMONTON
WAINWRIGHT
COLD LAKE
ALSASK
SUFFIELD
PENHOLD
CALGARY
DANA
TORNTON
LODGE JAW
PLUM PLOW
STEINHAMLLE
PORTAGE LA PRAIRIE
BEAULIEU
WINNIPEG
SIOUX LOC

Figure 1

Chilliwack, Esquimalt and Comox is provided locally. The overlapping routes, which provide twice weekly service to each location, are shown in Figure 2 below.

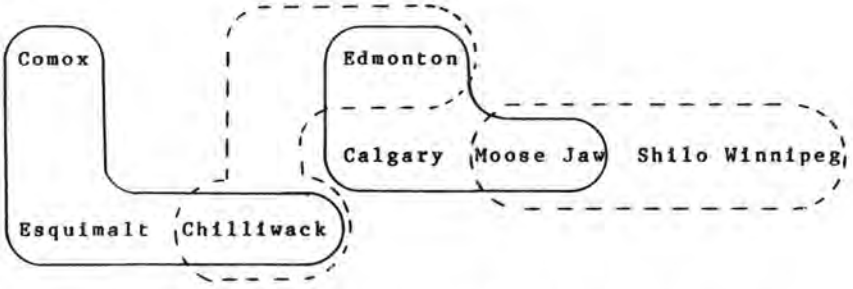


Figure 2 - Current Scheduled Road Freight Service

An objective of this report is to illustrate how individual units are using the MTS and to what extent within the Western Region, so that a comprehensive appreciation of the region's materiel traffic can be made, from a traffic flow perspective.

The traffic flows of low priority materiel will be highlighted in the following discussion. The data has been filtered so that a representative regional picture is illustrated. The resulting tables which summarize the average "weights" moved along the trunk corridor between the various units should be considered a lower bound for actual SRFS traffic because:

a. out of regional traffic is not included in the totals; and

b. MPC OX and O1 traffic is also excluded.

RESULTS

As explained above, the thirty-two thousand plus records examined in this part of the study included many shipments which did not both start and finish within the Region. For the purposes of the route analysis, only those 16,292 records exclusive to the Western Region were used.

Table I provides a breakdown, in descending order, of the number of low priority TCNs handled by each shipper in Western Region, regardless of the destination. As would be expected, the major bases dominate the activity, shipping almost 95% of the TCNs. Further, the depot at Lancaster Park, which is the main source of supply, creates almost 60% of the TCNs.

TABLE I

NUMBER OF TCN's PER SHIPPER
UNDER MPC's 02, 03, 04
WITHIN THE WESTERN REGION

SHIPPER		QUANTITY	CUMULATIVE	PERCENT	CUMULATIVE
Lancaster Pk	*	19173	19173	59.78%	59.78%
Cold Lake	*	1798	20971	5.61%	65.39%
Edmonton	*	1780	22751	5.55%	70.94%
Chilliwack	*	1479	24230	4.61%	75.55%
Moose Jaw	*	1290	25520	4.02%	79.57%
Winnipeg	*	1143	26663	3.56%	83.13%
Esquimalt	*	970	27633	3.02%	86.16%
Calgary	*	965	28598	3.01%	89.17%
Wainwright	**	777	29375	2.42%	91.59%
Comox	*	745	30120	2.32%	93.91%
Shilo	*	246	30366	0.77%	94.68%
Alsask		240	30606	0.75%	95.43%
Penhold		230	30836	0.72%	96.14%
Baldy Hughes		200	31036	0.62%	96.77%
Portage	*	194	31230	0.60%	97.37%
Dana		173	31403	0.54%	97.91%
Gypsumville		125	31528	0.39%	98.30%
Alert/Y'knife		123	31651	0.38%	98.68%
Beaverlodge		97	31748	0.30%	98.99%
Kamloops	*	87	31835	0.27%	99.26%
Dundurn		79	31914	0.25%	99.50%
Yorkton		75	31989	0.23%	99.74%
Masset		42	32031	0.13%	99.87%
Suffield		42	32073	0.13%	100.00%

Note: * On the prescribed route
** Alternate to Cold Lake on prescribed route

The other side of the activity is the reception of TCNs at the destination. Table II lists, in descending order by number of TCNs, those destinations provided by shipper. Just over 50% of the shipments are destined for the Western Region, including those for regional R&O facilities.

TABLE II

NUMBER OF TCN's PER DESTINATION
UNDER MPC's 02, 03, 04

DESTINATION		QUANTITY	CUMULATIVE	PERCENT	CUMULATIVE
Edmonton	*	3245	3245	10.13%	10.13%
Esquimalt	*	1880	5125	5.87%	16.00%
local		1821	6946	5.68%	21.68%
Winnipeg	*	1652	8598	5.16%	26.84%
Cold Lake	*	1639	10237	5.12%	31.96%
Calgary	*	1448	11685	4.52%	36.48%
Chilliwack	*	1134	12819	3.54%	40.02%
Comox	*	1090	13909	3.40%	43.42%
Moose Jaw	*	927	14836	2.89%	46.31%
Toronto		780	15616	2.43%	48.75%
Trenton		752	16368	2.35%	51.10%
Shilo	*	714	17082	2.23%	53.32%
Wainwright	**	618	17700	1.93%	55.25%
Halifax		600	18300	1.87%	57.13%
Ottawa		535	18835	1.67%	58.80%
Penhold	*	449	19284	1.40%	60.20%
Portage	*	433	19717	1.35%	61.55%
Alsask		423	20140	1.32%	62.87%
USA		398	20538	1.24%	64.11%
Others		11496	32034	35.89%	100.00%

Note: * On the prescribed route.
** Alternate to Cold Lake on prescribed route.

Others includes 1.8% R&O facilities in Region
10.1% R&O facilities elsewhere.

Table III provides the detail of the traffic flow program output, and illustrates the net traffic along the route by number of shipments, volume and weight in both directions. The net traffic along the route is defined as "the sum of that which arrives at a location plus that which is added at the location, minus that which is delivered to that location".

TABLE III

SUMMARY OF ACTIVITY UNDER MPC'S 02, 03, 04 ALONG THE MAIN CORRIDOR IN THE WESTERN REGION

Summary of Route Data Westward				Summary of Route Data Eastward		
Frequency	Volume	Weight	Location	Weight	Volume	Frequency
413	9,917	212,406	Winnipeg	---	---	---
469	10,251	215,801	Portage	336,791	32,467	1,567
559	10,837	222,862	Shilo	377,761	35,657	1,909
868	13,352	247,728	Moose Jaw	486,832	44,606	2,485
2,060	26,886	364,268	Cold Lake	629,519	56,038	3,286
5,220	94,442	1,236,858	Edmonton	876,705	77,309	4,616
4,891	90,276	1,158,659	Penhold	314,400	19,567	1,444
3,740	62,747	802,006	Calgary	301,641	18,890	1,351
3,511	60,991	777,839	Kamloops	191,952	12,864	861
2,789	41,252	591,059	Chilliwack	193,517	13,039	873
1,059	11,805	188,308	Esquimalt	185,533	13,675	801
---	---	---	Comox	82,723	6,407	364

Note: Shipments beyond Esquimalt are delivered to Comox. Similarly, those beyond Portage are delivered to Winnipeg.

Ignoring all constraints except route capacity, it can be seen from Table III that the total activity at any point away from Edmonton is greater than the total at the same point towards Edmonton. Further, Table IV shows that capacity on the route out using MSE, is significantly greater than the requirement for transport towards Edmonton. Therefore, almost all materiel towards the depot could, theoretically, utilize MSE. This was partially confirmed by examining individual records which indicated that at least 89%, by weight, of the shipments towards Edmonton from Winnipeg use MSE. The exception arises with the high use of road express by Cold Lake. This is probably in support of the CF-18 maintenance activity in St Louis, the most practical and expedient means of shipment being road express to Edmonton and commercial air to and from St Louis. From Comox towards Edmonton, the standard is almost 97% by weight shipped via MSE. Out from the depot, again MSE is used predominantly, with some reliance on rail and commercial road.

TABLE IV

SUMMARY OF USE OF MSE CARRYING MPC'S 02, 03, 04 THROUGH CORRIDOR LOCATIONS IN THE WESTERN REGION

Summary of MSE Data Westward				Summary of MSE Data Eastward		
Frequency	Volume	Weight	Location	Weight	Volume	Frequency
248	8,961	189,041	Winnipeg	---	---	---
281	9,270	192,385	Portage	326,107	31,899	1,367
316	9,787	199,138	Shilo	360,801	34,826	1,632
610	12,293	224,116	Moose Jaw	455,176	43,282	2,127
1,422	21,696	311,909	Cold Lake	575,765	53,675	2,819
4,522	88,797	1,103,952	Edmonton	829,188	75,444	4,216
4,204	84,627	1,025,495	Penhold	306,903	18,885	1,116
3,064	57,261	674,307	Calgary	294,447	18,243	1,045
3,032	57,088	672,288	Kamloops	187,505	12,426	636
2,345	37,424	491,139	Chilliwack	187,668	12,430	637
852	10,011	138,916	Esquimalt	181,776	13,318	626
---	---	---	Comox	80,338	6,254	278

Note: Shipments beyond Esquimalt are delivered to Comox. Similarly, those beyond Portage are delivered to Winnipeg.

Considering that the data being reported represents only priority codes 02, 03 and 04, there would appear to be space for improvements in the consolidation of shipments via MSE from points east of Edmonton. Further, the capacity of the MSE fleet returning towards Edmonton can probably handle must of the traffic to locations beyond the Western Region which has not been included in Tables III and IV; (some 16,000 records were dropped by the filtering process). Certainly some of these shipments could be moved to Edmonton for consolidation and furtherance. We shall consider the total requirement once we have fully dealt with capacity.

Route capacity is further determined by the capability of the SRFS to service the requirement. Table V provides this view of the situation. The actual average pounds per week is the total weight (low priority materiel) by all modes through each location (from Table III) divided by the twelve weeks of the study. The planning capacity is based on:

a. the twice weekly service provided by the SRFS using,

b. 45-foot trailers at various load weights per linear foot.

The industry standard is a planning load of 1,000 pounds per linear foot. There is enough disagreement, however, amongst the experts in the industry that other planning levels are presented to allow for a comparison of various bulk loads. It is noted that the 45-foot trailer is listed in the transportation documentation as a 30 ton vehicle. Nonetheless, it is commonly believed that a trailer load will "bulk-out" prior to its reaching maximum weight.

It can be seen that the standard planning capacity utilization of the trailers (i.e. 1,000 lbs per foot), for low priority traffic within region, would not be great going towards the depot in Edmonton. Also, moving towards Winnipeg, the actual utilization is only half of capacity once the vehicle leaves Moose Jaw. This would indicate that a vehicle of lesser capacity might be used or that the SRFS might operate less frequently than published in current instructions. Table VI was produced using the same formulation as Table V, but included only MSE records from Table IV. This gives a much more accurate picture of the utilization of the SRFS, but it must be remembered that unscheduled MSE service is also recorded under this category and that OX and O1 traffic is excluded. During the period of this study, OX and O1 traffic accounted for 9% (477,854/5,284,820) of total MSE traffic by weight.

Tables VII and VIII were produced using all shipment records from the study. It can be seen that MPCs 02, 03, and 04 comprise 78% of the activity by number of TCNs and 86% by weight. MSE carries only 55% by number and 58% by weight of the total traffic, yet the regional analysis shows 85% and higher by weight. This would indicate that TAs in the Western Region are making a very good effort to use MSE and the SRFS whenever possible for low priority traffic within region, and would suggest that this area of activity offers only limited potential to significantly improve overall MSE/SRFS usage.

TABLE V

WEIGHT PLANNING SCHEDULE
USING ACTUAL PHYSICAL DATA
FOR ALL SHIPMENTS HAVING
AN MPC OF 02, 03, OR 04

ROUTE UTILIZATION AT PLANNING CAPACITY

LOCATION	AVERAGE LBS/WEEK ACTUAL	800 lbs/ ln ft PLANNING CAPACITY 72,000 lbs	1000 lbs/ ln ft PLANNING CAPACITY 90,000 lbs	1200 lbs/ ln ft PLANNING CAPACITY 108,000 lbs
		WEST TO EAST		
Comox	6893.58	9.57%	7.66%	6.38%
Esquimalt	15461.08	21.47%	17.18%	14.32%
Chilliwack	16126.42	22.40%	17.92%	14.93%
Kamloops	15996.00	22.22%	17.77%	14.81%
Calgary	25136.75	34.91%	27.93%	23.27%
Penhold	26200.00	36.39%	29.11%	24.26%
Edmonton	73058.75	101.47%	81.18%	67.65%
Cold Lake	52459.92	72.86%	58.29%	48.57%
Moose Jaw	40569.33	56.35%	45.08%	37.56%
Shilo	31480.08	43.72%	34.98%	29.15%
Portage	28065.92	38.98%	31.18%	25.99%
Winnipeg				
		EAST TO WEST		
Winnipeg	17700.50	24.58%	19.67%	16.39%
Portage	17983.42	24.98%	19.98%	16.65%
Shilo	18571.83	25.79%	20.64%	17.20%
Moose Jaw	20644.00	28.67%	22.94%	19.11%
Cold Lake	30355.67	42.16%	33.73%	28.11%
Edmonton	103071.50	143.15%	114.52%	95.44%
Penhold	96554.92	134.10%	107.28%	89.40%
Calgary	66833.83	92.82%	74.26%	61.88%
Kamloops	64819.92	90.03%	72.02%	60.02%
Chilliwack	49254.92	68.41%	54.73%	45.61%
Esquimalt	15692.33	21.79%	17.44%	14.53%
Comox				

TABLE VI

WEIGHT PLANNING SCHEDULE
USING ACTUAL PHYSICAL DATA
FOR MSE SHIPMENTS HAVING
AN MPC OF 02, 03, OR 04

ROUTE UTILIZATION AT PLANNING CAPACITY

LOCATION	AVERAGE LBS/WEEK ACTUAL	800 lbs/ ln ft PLANNING CAPACITY 72,000 lbs	1000 lbs/ ln ft PLANNING CAPACITY 90,000 lbs	1200 lbs/ ln ft PLANNING CAPACITY 108,000 lbs
		WEST TO EAST		
Comox	6694.83	9.30%	7.44%	6.20%
Esquimalt	15148.00	21.04%	16.83%	14.03%
Chilliwack	15639.00	21.72%	17.38%	14.48%
Kamloops	15625.42	21.70%	17.36%	14.47%
Calgary	24537.25	34.08%	27.28%	22.72%
Penhold	25575.25	35.52%	28.42%	23.68%
Edmonton	69099.00	95.97%	76.78%	63.98%
Cold Lake	47980.42	66.64%	53.31%	44.43%
Moose Jaw	37931.33	52.68%	42.15%	35.12%
Shilo	30066.75	41.76%	33.41%	27.84%
Portage	27175.58	37.74%	30.20%	25.16%
Winnipeg				
		EAST TO WEST		
Winnipeg	15753.42	21.88%	17.50%	14.59%
Portage	16032.08	22.27%	17.81%	14.84%
Shilo	16594.83	23.05%	18.44%	15.37%
Moose Jaw	18676.33	25.94%	20.75%	17.29%
Cold Lake	25992.42	36.10%	28.88%	24.07%
Edmonton	91996.00	127.77%	102.22%	85.18%
Penhold	85457.92	118.69%	94.95%	79.13%
Calgary	56192.25	78.04%	62.44%	52.03%
Kamloops	56024.00	77.81%	62.25%	51.87%
Chilliwack	40928.25	56.84%	45.48%	37.90%
Esquimalt	11576.33	16.08%	12.86%	10.72%
Comox				

TABLE VII

ACTIVITY REPORTS
BY MODE AND MPC BY NUMBER OF TCN'S

Mode	Frequency	Cumulative Occurences	Percent	Cumulative Percent
MSE	23,934	23,934	55.636%	55.636%
Parcel Post	4,839	28,773	11.249%	66.884%
Comm Air	3,674	32,447	8.540%	75.425%
Rail	3,619	36,066	8.413%	83.837%
Road Express	1,941	38,007	4.512%	88.349%
Comm Road	1,878	39,885	4.366%	92.715%
Air Express	1,730	41,615	4.021%	96.736%
Svc Air	1,281	42,896	2.978%	99.714%
Bus	123	43,019	0.286%	100.000%

MPC	Frequency	Cumulative Occurences	Percent	Cumulative Percent
03	14,417	14,417	33.513%	33.513%
04	9,765	24,182	22.699%	56.212%
02	9,421	33,603	21.900%	78.112%
01	5,970	39,573	13.878%	91.990%
0X	3,446	43,019	8.010%	100.000%

TABLE VIII

ACTIVITY REPORTS
BY MODE AND MPC BY WEIGHT

Mode	Weight (lbs)	Cumulative Weight	Percent by Weight	Cumulative Percent
MSE	5,284,820	5,284,820	57.932%	57.932%
Comm Road	1,490,702	6,775,522	16.341%	74.273%
Rail	1,374,476	8,149,998	15.067%	89.341%
Road Express	615,965	8,765,963	6.752%	96.093%
Comm Air	168,615	8,934,578	1.848%	97.941%
Svc Air	112,580	9,047,158	1.234%	99.175%
Air Express	45,932	9,093,090	0.504%	99.679%
Parcel Post	25,827	9,118,917	0.283%	99.962%
Bus	3,479	9,122,396	0.038%	100.000%

MPC	Weight (lbs)	Cumulative Weight	Percent by Weight	Cumulative Percent
03	4,211,031	4,211,031	46.161%	46.161%
04	2,437,365	6,648,396	26.718%	72.880%
02	1,248,253	7,896,649	13.683%	86.563%
01	932,835	8,829,484	10.226%	96.789%
0X	292,912	9,122,396	3.211%	100.000%

TABLE VIII

IN MATRIX FORM (BY WEIGHT)

MODE MPC	03	04	02	01	OX
MSE	2,609,735	1,299,268	897,963	389,309	88,545
POST	14,281	4,800	4,838	1,599	309
COMM AIR	2,651	13,197	34,322	52,055	66,390
RAIL	486,810	756,108	91,356	23,375	16,827
ROAD EX	107,139	186,548	83,530	177,418	61,330
COMM RD	963,558	152,833	110,189	242,177	21,945
AIR EX	165	1,718	2,039	17,402	24,608
SVC AIR	26,285	22,647	22,892	27,947	12,809
BUS	407	246	1,124	1,553	149
TOTAL	4,211,031	2,437,365	1,248,253	932,835	292,912

TOTAL REQUIREMENT

Realistically, the total requirement for the transportation of goods in the study should be expanded to include all the shipping records submitted by the various bases in the Western Region. This view of the need for transportation resources extends beyond the stipulation of shipments starting and finishing along the main corridor. Here we see a fundamental need for some form of centralized control which would place these shipments onto the SRFS for consolidation and transshipment to other destinations. However, this study does not address the actual feasibility of introducing extensive consolidation procedures, which may include issues such as:

a. packing and re-packing materiel,

b. changes in manpower requirements,

c. handling and storage facilities, and

d. administrative coordination.

The Transportation authorities need to assess these as well as other pertinent areas which would impact on the MTS.

TABLE IX

DESTINATIONS OF ALL TCN'S BY FREQUENCY AND WEIGHT FOR ALL MPC'S

Location	Frequency	Percent by Freq	Cummulative Percent	Weight (lbs)	Percent by Wt	Cummulative Percent
CFSD Lancaster Pk	1072	2.492%	2.492%	345925	3.792%	3.792%
CFAD Rocky Point	22	0.051%	2.543%	12833	0.141%	3.933%
CFAD Dundurn	15	0.035%	2.578%	5634	0.062%	3.994%
local	2152	5.002%	7.579%	525828	5.764%	9.759%
Comox	1406	3.268%	10.847%	210706	2.310%	12.068%
Esquimalt	2311	5.371%	16.219%	503709	5.522%	17.590%
Chilliwack	1333	3.098%	19.317%	288187	3.159%	20.749%
Baldy Hughes	259	0.602%	19.919%	26510	0.291%	21.040%
Kamloops	342	0.795%	20.714%	80056	0.878%	21.917%
Namao	237	0.551%	21.265%	22130	0.243%	22.160%
Holberg	274	0.637%	21.902%	15953	0.175%	22.335%
Alert/Yknife	434	1.009%	22.910%	120946	1.326%	23.661%
Calgary	1865	4.335%	27.245%	523091	5.734%	29.395%
Wainwright	812	1.887%	29.133%	323268	3.544%	32.938%
Penhold	501	1.164%	30.297%	81903	0.898%	33.836%
Edmonton	4224	9.818%	40.115%	669024	7.334%	41.170%
Cold Lake	2436	5.662%	45.777%	527790	5.786%	46.956%
Moose Jaw	1197	2.782%	48.559%	171166	1.876%	48.832%
Shilo	792	1.841%	50.400%	662643	7.264%	56.096%
Portage	540	1.255%	51.655%	49262	0.540%	56.636%
Dana	334	0.776%	52.431%	31416	0.344%	56.980%
Winnipeg	2782	6.466%	58.897%	582159	6.382%	63.362%
4N - DUNDURN Det	44	0.102%	59.000%	4018	0.044%	63.406%
Yorkton	328	0.762%	59.762%	34420	0.377%	63.783%
Gypsumville	238	0.553%	60.315%	20015	0.219%	64.003%
Beausejour	193	0.449%	60.764%	12007	0.132%	64.134%
Sioux Lookout	177	0.411%	61.175%	10765	0.118%	64.252%
Beaverlodge	248	0.576%	61.752%	15239	0.167%	64.420%
Alsask	444	1.032%	62.784%	26895	0.295%	64.714%
Suffield	297	0.690%	63.474%	32268	0.354%	65.068%
5A	405	0.941%	64.415%	30538	0.335%	65.403%
5C	12	0.028%	64.443%	1383	0.015%	65.418%
5D	166	0.386%	64.829%	8536	0.939%	66.357%
5E	279	0.648%	65.477%	27549	0.302%	66.659%
5F	682	1.585%	67.063%	214638	2.353%	69.012%
CFSD Downsview	434	1.009%	68.071%	100988	1.107%	70.119%
CFAD Angus	31	0.072%	68.143%	912863	10.007%	80.125%
5J	1217	2.829%	70.972%	213690	2.342%	82.468%
5J	1	0.002%	70.974%	43	0.000%	82.468%
5K	2	0.005%	70.979%	31	0.000%	82.469%
5L	64	0.149%	71.128%	1149	0.013%	82.481%
5M	333	0.774%	71.902%	41099	0.451%	82.932%
5Q	49	0.114%	72.016%	2900	0.032%	82.964%
Ontario	1985	4.614%	76.629%	289915	3.178%	86.142%
6A	400	0.930%	77.559%	56101	0.615%	86.757%
6C	64	0.149%	77.708%	5835	0.064%	86.821%
6D	407	0.946%	78.654%	32552	0.368%	87.188%
6E	547	1.271%	79.925%	48613	0.533%	87.721%
6G	31	0.072%	79.997%	636	0.007%	87.728%
6J	47	0.109%	80.106%	1507	0.017%	87.745%
6K	45	0.105%	80.211%	1006	0.012%	87.757%
6L	57	0.132%	80.344%	1490	0.016%	87.773%
6M	52	0.121%	80.464%	641	0.007%	87.780%
6N	1032	2.399%	82.863%	123362	1.352%	89.132%
6P	14	0.033%	82.896%	487	0.005%	89.138%
6R	534	1.241%	84.137%	185121	2.029%	91.167%
6W	34	0.079%	84.216%	3450	0.038%	91.205%
6X	121	0.281%	84.497%	5414	0.059%	91.264%
6Z	16	0.037%	84.534%	746	0.008%	91.272%
CFSD Montreal	291	0.676%	85.211%	98408	1.079%	92.351%
Quebec	1774	4.123%	89.334%	236958	2.598%	94.949%
7A	206	0.479%	89.813%	14167	0.155%	95.104%
7B	66	0.153%	89.966%	8627	0.095%	95.199%
7C	295	0.686%	90.652%	76157	0.835%	96.033%
7D	8	0.019%	90.670%	24	0.000%	96.034%
7E	35	0.081%	90.752%	5778	0.063%	96.097%
7F	42	0.098%	90.849%	1197	0.013%	96.110%
7G	40	0.093%	90.942%	1013	0.011%	96.121%
7H	926	2.152%	93.095%	104154	1.142%	97.263%
7J	316	0.734%	93.829%	18773	0.206%	97.469%
7K	257	0.597%	94.426%	11242	0.123%	97.592%
7L	126	0.293%	94.719%	3741	0.041%	97.633%
7M	405	0.941%	95.661%	32484	0.356%	97.989%
7N	48	0.112%	95.772%	955	0.010%	98.000%
7R	39	0.091%	95.863%	1924	0.021%	98.021%
7S	15	0.035%	95.898%	280	0.003%	98.024%
CFSD Moncton	125	0.291%	96.188%	18584	0.204%	98.227%
CFAD Bedford	5	0.012%	96.200%	687	0.008%	98.235%
Maritimes	139	0.323%	96.523%	5635	0.062%	98.297%
9B	217	0.504%	97.027%	24189	0.265%	98.562%
9D	2	0.005%	97.032%	16	0.000%	98.562%
9E	3	0.007%	97.039%	514	0.006%	98.568%
9F	521	1.211%	98.250%	58031	0.636%	99.204%
9G	17	0.040%	98.289%	1718	0.019%	99.223%
9K	29	0.067%	98.357%	808	0.009%	99.232%
USA	691	1.583%	99.940%	68073	0.746%	99.978%
Unknown	26	0.060%	100.000%	2030	0.022%	100.000%
totals	43024			9122396		

Table IX presents a summary by destination, by number, and by weight of shipment, of all materiel shipped during the period of the study. It is readily apparent that a large volume of business is destined outside of the region. Approximately 35% by weight, 37% by TCN, is delivered beyond the regional support area of 7 CFSD, Lancaster park. It must be noted, however, that a large amount of the out of region traffic was destined for the ammunition depot at CFAD Angus, fully 10% of the overall weight and almost 30% of the out of region weight. These shipments predominantly originated from CFB Wainwright, likely stemming from RV 83 activity. Normal materiel traffic destined out of region might therefore be more accurately estimated as approximately 27.7% (i.e. 2,273,767/8,209,533) of total weight.

As an originator, Lancaster Park itself distributed 504,941 lbs, representing 15.6% of its total shipment weight, to out of region locations. Table X summarizes the sample data by destination either within the Western Region or out of region. 7 CFSD is differentiated as an originator and as a shipper. Lancaster Park acted as the shipping agent for 665,345 lbs of the low priority traffic destined out of region. If CFAD Angus weight is removed, this represents 39.7% (665,345/1,676,099) of the low priority, out of region weight. This suggests that the majority of out of region traffic is originated by the other bases and that the potential for consolidation is significant. It is also acknowledged that TAs in the West are in fact currently performing this consolidation process to some extent by transshipping portions of their eastern traffic to Edmonton.

TABLE X

(A) TOTAL WEIGHT DISTRIBUTION: ALL MPCs

	Western Region	Out of Region	Total Weight
7 CFSD as Originator	(2,735,751 lbs)	(504,491 lbs)	(3,240,692 lbs)
7 CFSD as shipper	3,145,259	783,154	3,883,413
All other Units	2,790,507	2,448,476	5,238,983
Total Weight shipped	5,935,766	3,186,630	9,122,396

TABLE X (Cont'd)

(B) TOTAL WEIGHT DISTRIBUTION: MPCs 2, 3, 4

	Western Region	Out of Region	Total Weight
7 CFSD as Originator	(2,574,162 lbs)	(435,286 lbs)	(3,009,448 lbs)
7 CFSD as shipper	2,298,730	665,781	3,594,511
All other Units	2,378,957	1,923,181	4,302,138
Total Weight shipped	5,307,687	2,588,962	7,896,649

(C) TOTAL WEIGHT DISTRIBUTION: MPCs 2, 3, 4
(LESS CFAD ANGUS WEIGHT OF 912,863 lbs)

	Western Region	Out of Region	Total Weight
7 CFSD as Originator	(2,574,162 lbs)	(434,857 lbs)	(3,009,019 lbs)
7 CFSD as shipper	2,298,730	665,345	3,594,075
All other Units	2,378,957	1,010,754	3,389,711
Total Weight shipped	5,307,687	1,676,099	6,983,786

SUMMARY AND CONCLUSIONS

This analysis has shown that the shippers of low priority materiel within the Western Region make very good use of CF resources, especially towards the Edmonton area, but that those same resources have excess capacity on certain legs. With the additional transportation requirements for shipments outside of the region, particularly the 1,010,754 lbs of low priority materiel from the various bases other than Edmonton and area, an increased concentration of effort may be possible towards consolidation and furtherance through Lancaster Park. This amount of weight averages 84,230 lbs per week, some of which may be suitable for consolidation. By using the excess return capacity of the SRFS towards the depot, more economically sized commercial loads could be prepared for transshipment through the other regional depots.

Although Table VI reflects an accurate picture of the use of MSE/SRFS of low priority traffic within the Western Region, it should be considered as a lower bound of total actual usage. Higher priority items are often shipped via MSE; previous analysis has indicated that the percentage of weight shipped under MPCs OX and O1 via MSE could be expected to be approximately 30% and 41% respectively. Further, recent informal discussions with selected traffic officers during the fall of 1986 indicated that they are making a concerted effort to utilize military resources if at all possible.

The significant number of shipments outside the regional boundaries is somewhat larger than might be expected. A separate study which identifies exactly what materiel is shipped across regional support areas would be required to determine what is an expected and acceptable level of out of region shipments.

Lastly, it is emphasized that this study is primarily descriptive, with the purpose of identifying those areas which impact on the actual and potential usage of the SRFS. It is concluded that there is potential for further consolidation of shipments which can provide savings in resources through economies of scale, and it is acknowledged that such procedures already exist to a certain extent. A detailed feasibility analysis of the physical implications of such a process was not within the scope of this study. Nevertheless, a centralized or regional coordination authority would be an appropriate agency to more effectively control the consolidation of materiel traffic, and this in turn should be supported by a suitable information and control system.

The views presented in this paper are solely the opinion of the authors and do not represent the official views of ORAE and the Department of National Defence, Canada. Finally, the authors gratefully acknowledge ORAE's permission to publish this work.

THE ALBERTA CONTAINER TRAIN

by

F.H. HOWARD

THE ALBERTA CONTAINER TRAIN

I am going to describe to you something about Alberta Intermodal Services Ltd. and I am going to tell you what we are and we do.

We are a private corporation whose stock is all owned by the Government of Alberta. We are a for-profit corporation with a Board of Directors to whom we deliver regular financial reports. In these ways, Alberta Intermodal Services Ltd. resembles a Crown Corporation, autonomous from the Government and with a clear mandate. This mandate is to serve Alberta exporters and, naturally to a great extent, Alberta importers by making available the lowest possible rates for full container loads to and from the Pacific Coast, destined for on-carriage by water.

We are the result of many months of deliberation, calculation and investigation by Alberta Government economists, transportation philosophers, politicians, and consultants, all performed with considerable imagination and brought into being by an act of no little political courage. Alberta is a province, dedicated, perhaps more than any other province, to non-government participation in areas where the private sector is performing adequately but, as is sometimes the case with government-sponsored initiative, it had been observed that there was no agency in the transportation market place that was going to provide this transportation advantage, deemed necessary for the diversification of the Alberta economy from its traditional reliance on petroleum and agriculture. Petroleum and agriculture are, as we speak, not enjoying the height of economic benefits so it is currently all the more important to encourage employment in other fields.

Now it was discovered several years ago that there was a significant discrepancy between the published tariffs, measured by the container-mile, between Alberta and the Pacific Coast and similar tariffs between Montreal and Toronto to Halifax and Saint John on the Atlantic Coast. This was taken up with the two transcontinental railways, who explained that the Atlantic ocean carriers had at their disposal these low container rates because they were able to guarantee to the railways certain annual volumes spread evenly throughout the year and in both directions. The Province of Alberta then naturally proceeded to the next step, which was enquire whether significant improvements in their rates to the Pacific Coast could be expected if roughly similar guarantees were made. This is when the many months of investigation began, followed by lengthy and agreeable discussions with CP Rail. The result was a unique contract between the Government of Alberta and CP Rail guaranteeing certain volumes in return for certain rates. They are now much lower than anything offered before. This contract lasts for a number of years and the minimum annual guarantee is to escalate over the first three.

Certain logical terms and conditions and concessions were applied. AISL is barred from participating in Western Grain Transportation Act traffic; that is reserved to the railway and in any event is scarcely amenable to container transport. The contract covers movement between Alberta and generally the Vancouver area for export and import only, not to anywhere else in Canada or to the United States. The contract states specifically that we are permitted to engage in domestic traffic in otherwise empty containers in order to achieve a balanced load movement.

We are to lease cars from the railway for the first two years and then provide our own cars thereafter. CP Rail will perform terminal services at both ends of the system at the same tariff rate available to all other intermodal customers.

We resemble a railway in that we sell railroad transportation. When asked directly what we do I sometimes, in feeling jocular, say we are a railroad; we don't own any locomotives; we don't own any track; we do have cars but we usually don't know where they are. This is because the cars we lease from CP Rail are quite naturally returned into the CP Rail pool which gives us access to several thousand cars and, most importantly, absolves us from having to manage a mini-fleet of a few score container cars between five terminals and four line hauls. Maintenance charges are covered in the monthly lease payments. We are incidentally not subject to Canadian Transportation Commission overview.

But in further answer to just what we are and what we call ourselves, we have been compared to an NVOCC; I guess we are that equivalent on land, although we don't yet know what the initials would be in our case. This description is not completely accurate however; and we resemble more what the Americans have started to call "third parties" or in other words, shipper's agents. We are not a forwarder and in fact the Workmen's Compensation Board doesn't know yet exactly what to call us. One supposes that we could be called a sort of Plan IV piggyback operator, if there were any such in this country.

In short, I suppose that we could say that, just as with American shippers' agents who move principally by piggyback, although recently with some of the Pacific Ocean carriers by container, we buy space from the railway on a wholesale basis and we retail it to our customers.

We have in Edmonton and in Calgary storage space for empty containers immediately adjacent to CP Rail's intermodal yards, in fact their container-moving machinery has free access to our property. These yards are paved, fenced and flood-lit and we store ocean carriers' containers there free as long as we have participated in a preceding or following movement. One result of this provision of storage space in Calgary and Edmonton is an ample supply of empty containers for the Province and an incentive to move them to the Coast loaded.

It is interesting to note that we have frequently been referred to locally as the "container port"; actually our "port" terminal activity is minor and we are preoccupied with moving containers, which we think we do effectively and promptly, enjoying, as we do, excellent daily service from CP Rail between all points. Therefore, we don't waste any time in correcting the press when they call us the "container port". The publicity is useful and supportive and in fact we have a small flag flying at each inland terminal saying "Port of Calgary" or "of Edmonton".

Our head office is in Calgary which is where we carry on accounting functions and general administration. In Calgary, Edmonton and Vancouver we have marketing and operational people, but so far have not had to acquire real estate in Vancouver because containers generally are stored on the waterfront or, if not, in compounds under the control of the carriers themselves. In Vancouver, our office is downtown located in the heart of the steamship industry. There we have contacts with some 40 steamship lines, most of them calling at one of the Vancouver terminals, although some very important of our customers call in Seattle/Tacoma and our access to that Port is through CP Rail's intermodal terminal in Coquitlam, whence the ocean carriers provide onward service, usually by truck, to the State of Washington. If you will have concluded that Alberta exports are principally to Pacific Rim countries, you should now know that some few North Atlantic carriers call direct at Vancouver, so we have now begun to enjoy some traffic to North-West Europe and likewise to South America.

On the inland side we have contact with some 200 customers, large and small, import and export. Our traffic naturally includes a significant proportion of petrochemicals and we seem to have become important in the rather complicated hide trade as well. Our traffic is concentrated more in 40' containers than in 20', and, like all intermediate carriers, we have no control over how our business is divided between container sizes. All of these containers obviously belong to or are leased by ocean carriers and, depending on the structure of the Bill of Lading, much of our container movements are paid for by ocean carriers; the rest by the exporter or importer. Our Alberta marketing people stay in touch with all exporters, regardless of who eventually pays the freight bill.

There is a considerable amount of empty movement ordered by the ocean carriers, a circumstance which they no doubt deplore and we will try to mitigate. These empties are both inbound to load export and outbound to be loaded in Vancouver for export. It is clearly desirable that we try to match a loaded inbound move to a loaded outbound move but this requires considerable skill and the ocean carrier that has solicited the outbound move may simply not have an inbound customer. We therefore have the spectacle of empty containers westbound passing empty containers eastbound on adjacent tracks, but our attempts to mitigate this have had some small success, especially in certain refrigerated movements.

Now all transportation companies, and we are no exception, are burdened with distressing amounts of directional imbalance. This is especially distressing to us because our contract with our railway hosts is on a round-trip payment basis, and it behooves us of course to exercise whatever managerial skills we have to reduce the imbalance. Normally one would expect that inbound containers would generate corresponding outbound loads, or else where would inbound containers disappear to or where would the outbound loads find space? However, there are considerable westbound empty containers coming into Alberta from Eastern Canada and the centre of the United States seeking loads which we, of course, are anxious to move, but whose corresponding eastbound movements we have not seen. Nothing that we know of can be done about this and we assume that both railways have this same problem. On the other hand, some of our import/inbound containers, when made empty, disappear into the WGTA stream, small as it is, consisting of mostly of hay cubes, and this makes some meagre contribution to restoring the state of balance.

This is the time to point out that AIS has introduced one-way import rates for the first time which seems to have been greeted with approval by importers. The standard railway tariff provides for loaded import combined with empty westbound movement, whether or not it actually moves westbound.

Our rate structure, as is the railways', is quite simple: just loaded FAK and empty, 20' and 40', eastbound and westbound, to any seaboard point on CP Rail. However, our pricing philosophy may have broken new ground in that we have skewed our rates such that export prices are about ten percent lower than import prices for similar movements. We realize, naturally, that competition provides the ceiling on all our rates and probably we provide the ceiling on all our competition's rates. It is quite possible that, as a result of AISL rate activity in the marketplace, that our competitor friends have adjusted theirs very closely to ours, but notwithstanding, all this is to the benefit of the Alberta economy in the search for costs which would make its products competitive on the Pacific Rim.

Several other services are performed by AISL, not necessarily foreseen during the conceptual period; pick up and delivery has turned out to be an important part of our activity. Virtually all exporters and importers in Alberta depend on AIS to identify a drayage operator, to communicate with him to come and pick up an empty or a load and in nearly every case pay his bill. This charge is passed on to the line-haul customer as soon as reasonably possible, and this is done at no profit to AIS. Similarly, special charges that are levied by the railway, such as for protective service and overweight, are paid for by us - after all, we are the only customer recognized by the railway - and passed on to the shipper or consignee.

Now and again a container has to be positioned between Calgary and Edmonton at the call of the ocean carrier and special arrangments are available for this.

While discussing all the things that we do, it is important to describe what we do not do. We are not in the trucking business, although we do a lot of business with truckers and are prepared to move containers to and from the Coast, if necessary, by truck. We do not stuff or strip containers as there is plenty of capacity for doing that already in business in Alberta; likewise we do not repair containers, nor clean them.

We are well into becoming completely E.D.P. with an IBM/36 computer in our Calgary office and screens available to the majority of our personnel. All bookings of new business, including the names of the billing parties, container sizes, container numbers, tariffs, direction of movement, as well as pick-up and delivery instructions, terminal service charges, and overweight charges, both to be passed through. Any special instructions are entered. This booking immediately generates a waybill and an invoice as well as being entered on various accounts. The accounts payable file can be matched against the invoice received from CP Rail and from the various truckers. The accounts receivable file is maintained similarly, with provision for credit follow-up. A general ledger is of course kept up to date this way, with financial statements and marketing statistics being generated periodically, accurately and without any human input. This is no doubt quite familiar to many transportation managers but it is a source of extreme interest and even fascination to the relatively few people working with AIS, many of whom took part in the design of the system. As one would expect, we are alert to the possibilities of E.D.I., especially with CP Rail and possibly even with some of our larger ocean carrier clients.

Double-stack container cars are much in the news these days and of course AIS keeps a watchful eye on this technology and especially participation in it by CP Rail. Many Western United States railways, as we all know, provide this service, in dedicated trains out of at least five ports, usually weekly in conjunction with vessel calls, but sometimes daily. It is significant that the majority of these double-stack cars, coupled together in solid trains, are committed for, possibly even owned, by the steamship line providing the lading and exclusively so. It is not known whether any steamship lines calling at Vancouver are prepared to undertake this sort of operation, but no doubt this will become evident before too long. It is noticeable that the activity in the Eastern United States doesn't seem to be the same; the rail haul of course is only half as long as to and from the West, and the Atlantic Ocean carriers have not indicated any prepensity for double-stack container train investment. The double-stack concept seems to have made a reality of the first micro-bridge concept to the inland continent, and also the mini-bridge concept between Coast and Coast. As John Kneiling would say, containers are now carried on the iron ocean about as much as they are carried on the water ocean front.

For those who want to know how our first year of operation has been, which was the whole of 1986, we are pleased to say that we have attained our minimum guarantee without undue exertion and feel confident that we shall do the same in 1987.

AN ALTERNATIVE MECHANISM FOR PAYMENT OF THE CROW SUBSIDY: THE WESTERN GRAIN STABILIZATION PROGRAMME

by

Paul D. Earl & Edward W. Tyrchniewicz[1]

Introduction

The case for subsidizing freight rates for Western grain and grain products is a complex one, resting more compellingly on historic factors than on economic ones. These historic factors go back to before the turn of the century when farmers in the West felt themselves discriminated against by the railways, and most notably, the CPR. This discrimination was alleged to be of several varieties: rates in Western Canada which were higher than for similar distances in the East; the so-called "monopoly clause" which protected the CPR from the construction of competing lines; preferential treatment to elevators over loading platforms in the allocation of boxcars; and finally, the abiding (albeit arguable) belief of Western farmers that they are the only shippers who are compelled "to pay the freight both ways": on the grain moving out, and on the manufactured goods moving in. These grievances of course do not constitute grounds for subsidization of freight rates; but they were instrumental in creating the Crow's Nest Pass Agreement which is the institutional and legal starting point for the situation we are now in.

The Crow's Nest Pass Rates have developed a rich and complex web of myth and misinformation since their inception in the Agreement. But myth (leaving aside the question of misinformation) is the stuff from which political realities are spun. It is widely believed by Western grain producers that the freight rate provisions of the Western Grain Transportation Act protect them from burdensome transportation charges. This belief that the producer benefits from subsidized rates has received acceptance outside the agricultural community. The Turgeon Royal Commission of 1949 spoke of three great pillars of national transportation policy: the Maritime

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Freight Rates Act for the East, water competition for the Central region, and the Crow Rates for the West. Of course, economists can show that whatever benefit the rates might have provided is now capitalized into land values. But the historic and hence political justification for grain transportation subsidies means that they are here to stay, and that being so, the debate in recent times has turned on the issue of how they ought best be paid. As the focus of this paper is the question of the method of payment, we will first review the current state of this debate.

The Method of Payment Debate

Two competing methods occupy the field: firstly, that favored by the three Prairie Wheat Pools and the Provinces of Quebec and Manitoba and now incorporated into the WGTA: to pay the subsidy to the railways; secondly, that favored by United Grain Growers, livestock interests, the Western Wheat Growers Association, various commodity groups, the Province of Alberta and in the reports from three major investigations into the matter (Gilson and the two reviews carried out under Section 62 of the Western Grain Transportation Act): to pay the subsidy to farmers. The pros and cons of these two competing methods should be understood because they form the evaluative basis for the third way to be explored in this paper. The Report of the Committee of Inquiry on the Crow Benefit Payment contains a thorough summary of the matter (pp. 7-9), of which the following is a precis.

The advantages of the "pay the railways" approach are:

a) it is administratively simple;
b) the benefit accrues to the actual shippers of grains;
c) when combined with the inflation protection and "safety net" provisions of the WGTA, it moderates freight rate increases; and,
d) it provides direct accountability to the government for railway performance.

The disadvantages are:

a) it perpetuates incentives for the production of statutory grains, rather than encouraging other, possibly better, uses of prairie agricultural resources;
b) it perpetuates disadvantages against western livestock production and processing (this is the so-called "livestock hurt" issue);
c) it creates a competitive disadvantage for modes of transportation other than rail; and

d) it masks real transportation costs to the producer, and reduces incentives for efficiency..

The "pay the producer" approach has the following advantages:

a) it would be "resource neutral";
b) it would remove farm gate grain price distortions discouraging livestock production and processing;
c) it would make full transportation costs visible to producers, thus creating market accountability and incentives for efficiency in the transportation system.

Paying producers on an acreage basis would have the following disadvantages:

a) it would dilute the benefit to actual shippers because the payments would be spread over all land capable of producing statutory grain;
b) it would not recognize individual farm management practices;
c) it could work to the disadvantage of agriculture in other parts of Canada by providing payments, which would be available only in the West, on crops other than grain;
d) it was seen as administratively difficult; and
e) it would be difficult for producers to understand.

The Committee was careful to ascribe the alleged disadvantages of paying the subsidy to the producer specifically to an acreage based system. However, the disadvantages which they identify would, to a greater or lesser degree, apply to any "pay the producer" scheme.

The Committee's criteria for evaluating different method of payment proposals were as follows:

a) conduciveness to agricultural development in Canada;
b) resource neutrality;
c) provision of equity;
d) encouragement of efficiency both in grain handling and transportation and in allocation of agricultural resources in general; and
e) administrative feasibility.

Criterion a) is contained in the Western Grain Transportation Act (WGTA); criteria b) through d) were

provided to the Committee by the then Minister of Transport, Don Mazankowski.

The Grain Transportation Agency (GTA) was charged with conducting the more general review of the WGTA provided for under Section 62 of the Act. This required a further examination of the method of payment issue. Section 62 required that specific attention be paid to the inflation sharing provisions of the Act, having regard to the relationship between the price of grain and the producers' transportation costs. The Minister emphasized the importance of this section, suggesting that the producers' "ability to pay" was to be considered the most important criterion for recommendations relating to the method of payment.

Both the Committee of Inquiry and the GTA recommended variations on the "pay the producer" option. The Committee's recommendation was for a Grain Transportation Refund to be paid to producers on the basis of their net sales of eligible grain. The Agency's recommendation was for a one time "payout" of the net present value of the government commitment direct to producers.

Neither of these two systems has proven acceptable to the federal government. Although the government has never made clear precisely what its objection to either system is, no doubt the continued opposition of the Prairie Wheat Pools and the Province of Quebec have been important factors. Whether the proposal put forward in this paper would fare any better remains to be seen. It does, however, have some inherent advantages over these two systems.

Let us first look at the conceptual framework for what is proposed.

The Conceptual Framework

A. Definition of Terms

It is necessary to have a clear understanding of some of the terms that will be used in this paper. These are as follows:

Eligible cost is defined in the WGTA and means the total cost in dollars of moving statutory grain by rail in Western Canada. The average eligible cost per tonne is this total divided by the total tonnage moved. In this paper, when the term full freight rate is used, it may be taken for practical purposes to be the same as the average eligible cost per tonne. In 1986/87, this was approximately equal to $31. On some 30 million tonnes, the total eligible cost is close to $1.0 billion.

The producer share of the freight rate is that portion of the full freight rate (or the average eligible cost per tonne) paid by the grain farmer. In 1986/87, this was approximately equal to $6 per tonne, or about 19% of the total. The government share is the remainder, about 81% of the total, or $25 per tonne.

The Crow Benefit is a term defined in the WGTA, and is approximately equal to the railway losses on grain in 1981/82. It is a fixed dollar amount established in the WGTA at $658.6 million.

The WGTA provides for increases in the cost of moving grain by rail to be shared between the producer and the government. The term cumulative share of the cost increase is defined in the WGTA and is the government's accumulated portion of these cost increases. It is a per tonne figure, and its current value is approximately $2.30 per tonne.

The government commitment is the total amount of the subsidy which the government will provide for grain transportation in any one year. It is equal to the sum of the Crow Benefit plus the cumulative share of the cost increase multiplied by the total tonnes which move in that year. For example, if 34 million tonnes of grain move by rail to the designated destinations in the crop year 1986/87, the government commitment will be approximately:

$$658.6 + (2.30) \times (34) = \$736.8 \text{ million} \qquad (1)$$

The Freight rate multiplier is approximately the factor by which the old Crow Rate (or what is called in the Act the base rate scale) must be multiplied in order to calculate the full freight rate. If the average level of the old Crow Rate is taken to be $4.89 per tonne, then the multiplier for 1986/87 is approximately $31 divided by $4.89, or 6.3.

It will be important to understand these terms clearly when we come to describing how the subsidy might be administered through the Western Grain Stabilization Programme.

B. The Proposal

The proposal is as follows:

1. Grain producers would pay the full freight rate as calculated under the WGTA. This would include both the producer share and the government share of the rate.

2. The federal government would continue to calculate the government commitment to Western grain transportation in the same way that it now does.

3. Each year, the government commitment would be placed into the Western Grain Stabilization Fund, and would be used for stabilization payments as required under the Western Grain Stabilization Act. (The Fund, and the operation of the Stabilization Programme are described below).

Since this would represent an enrichment of the Stabilization Fund, some changes would have to be made to the payout provisions of the Stabilization Programme for producers to receive the full benefit. In order to describe these changes, it is first necessary to understand how the Programme works, and how the operation of the Fund would be altered by a change in the freight rate.

C. The Operation of the Stabilization Programme

Table 1 illustrates, using a simplified model with hypothetical numbers, how the Stabilization Programme works. Basically, it is intended to smooth out the grain producers' net cash flow (NCF). NCF is approximately equal to producers' gross returns from grain sales less the costs of production. The programme is designed to ensure that NCF in any one year does not fall below the average NCF in the preceding five years. When the calculated NCF is below the preceding five year average, payments are triggered out of the Stabilization Fund to augment farmers' incomes. This is illustrated in the first five columns of Table 1. In years 1 to 3, and in years 9 to 11, NCF exceeded the preceding five year average. Farmers would not receive a stabilization payment in these years. However, in the other years (4 to 8, and 12) farmers would receive payments equal to the deficits shown in Column (5)). (It should be noted that in actual practice the farmers' income is not fully stabilized as this simple model indicates, and accordingly the payments would not cover the full deficit.)

The Stabilization Fund is sustained from two sources: a check-off from producers' gross receipts, and a government payment approximately equal to double the producers' check-off. To be actuarially sound, the amounts paid into the Fund must be equal to the amounts paid out. In the example shown in Table 1, a total of $6960 million was paid out of the Fund over the twelve years. If this were representative, approximately $580

million would have had to be paid into the Fund each year, approximately $190 million from producers, and $390 million from government. (In fact, the check-off is approximately 2% of producers' gross receipts, and the government levy is 2% over the farmers', or about 4%. These levels were chosen after extensive analysis as those which would make the Fund actuarially sound.)

The only other thing to note at this point is that over the long term, assuming there is no long term trend up or down in NCF, the sum of the surpluses (Column (4)) must equal the sum of the deficits (Column (5)).

Now let us look at the impact of the producer paying higher freight rates.

D. The Impact of the Farmer Paying Higher Rates

It is assumed in Table 1 that the increase in producer freight rates is an even $1000 million annually (Column (6)). The producers' "new" net cash flow is shown in Column (7) as $1000 million less than Column (2). Now it is clear that, in this simple example, a corresponding "new" five year average column (not shown) would also be $1000 million less than Column (3) and the surpluses and deficits would be equal to those shown in Columns 4 and 5. Hence increasing the freight rate to the farmer (ignoring the phasing in of the increase) would have little impact on the Stabilization Programme.

E. Impact of Paying the Government Commitment into the Stabilization Fund

It was noted above that the Stabilization Fund is considered to be actuarially sound under the present arrangements. Thus the payments out of the Fund are sustained by the payments in. Therefore, if the payments into the Fund were increased by the amount of the government commitment, unless there were a corresponding increase in payments out, the Fund would grow over time at an average annual rate equal to the amount of the government commitment. Accordingly, if the producers are to be paid what is owing to them, the payout provisions of the Stabilization Programme would have to be made more generous.

How then ought the payout provisions to be altered so that the producers receive the full amount of the freight rate subsidy? At first glance, it might be supposed that this could be accomplished by stabilizing producers' income at the "old" five year average: i.e. by bringing producers' incomes up to the level of the "new" five year average plus the government commitment. This is illustrated in Columns 8 and 9 of Table 1. These columns

TABLE 1

Illustrating Stabilization Programme and Proposal Using Hypothetical Figures

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		5 Yr.	Difference		Inc. in	"NEW"	Difference		"Stab."	Difference	
Year	NCF	Ava.	Surplus	Deficit	Freight	NCF	Surplus	Deficit	Level	Surplus	Deficit
	(_____	_____	_____	_____	_____	$ millions	_____	_____	_____	_____	_____)
1	3,800	3,200	600	—	1,000	2,800	—	400	3,780	—	990
2	3,800	3,240	560	—	1,000	2,800	—	440	3,820	—	1,020
3	5,400	3,360	2,040	—	1,000	4,400	1,040	—	3,940	460	1,020
4	3,400	3,800	—	400	1,000	2,400	—	1,400	4,380	—	1,980
5	3,600	3,840	—	240	1,000	2,600	—	1,240	4,420	—	1,820
6	1,800	4,000	—	2,200	1,000	800	—	3,200	4,580	—	3,780
7	2,000	3,600	—	1,600	1,000	1,000	—	2,600	4,180	—	3,180
8	1,000	3,240	—	2,240	1,000	—	—	3,240	3,820	—	3,820
9	2,600	2,360	240	—	1,000	1,600	—	760	2,940	—	1,340
10	3,600	2,200	1,400	—	1,000	2,600	400	—	2,780	—	180
11	3,200	2,200	1,000	—	1,000	2,200	—	—	2,780	—	580
12	2,200	2,480	—	280	1,000	1,200	—	1,280	3,060	—	1,860
			5,840	6,960	12,000		1,440	14,560		460	26,550

represent the difference between the "new" NCF (Column (7)) and the old five year average (Column (3)). The deficits are more frequent and larger, and the payout from the Fund are greater.

Columns 5 and 6 show what is owed to the producers. The total to be paid out over the twelve years is $6960 million in stabilization monies, plus $12,000 million in government commitment. However, the sum paid out in Column (9) is only $14,560 million. The reason for the difference can be seen by comparing year 1 with year 4. In year 4, the producers are owed the government commitment of $1000 million plus the stabilization payment of $400 million (Column (5)) plus Column (6)), and that is indeed what they get. But in year 1, although they are owed $1000 million, they only get $400 million. Thus it can be seen that in years such as year 1, the payout is reduced by the amount of the surplus.

Hence, in order to pay out to producers the full amount owing to them, their NCF would have to be stabilized at a slightly higher level than the "old" five year average. How much higher? By an amount approximately equal to the sum of the surpluses. However we noted two things earlier in this paper: first, that the sum of the surpluses is equal to the sum of the deficits; second, that the sum of the deficits is equal to the sum of the levies. Accordingly, if producers' NCF were to be stabilized at the level approximately equal to:

a) the five year average NCF as it would be under subsidized rates;
b) plus the amount of the levies (which in the simple example illustrated here was calculated to be about $590 million annually).

Then the producers would receive the full amounts due to them under the two programmes. This is illustrated in Columns 10 to 12 of Table 1.

This then is the conceptual framework for paying the grain transportation subsidy - legally known as the government commitment - through the Stabilization Programme. Let us now turn to the practicalities of implementing it.

The Practical Aspects of Using the Stabilization Programme

A. In Respect of the WGTA

The proposal seems to present no problems from the point of view of the Western Grain Transportation Act.

The calculations which are now done to determine the cost of moving grain, the cost increases, the apportionment of cost increases between the producer and the government, could all be done as they now are. The differences in procedure would arise only in the last few steps. The Freight Rate Multiplier would be calculated as it now is, but the farmer would pay the full freight rate thus calculated instead of only a portion. The government commitment would be paid into the Stabilization Fund instead of to the railways. (This is not quite true. The CN adjustment portion of the government commitment would presumably be paid directly to CN as it now is. The remainder of the government commitment would then go into the Fund).

The WGTA rate setting process would in fact be simplified somewhat. The most troublesome aspect of the present rate setting procedure lies in the need for a forecast to be made of the volume to be moved in the upcoming year. Since the Crow Benefit portion of the government commitment is a fixed dollar sum; its value per tonne varies with volume, and since the volume cannot be forecast with precision, the government portion of the rate can never be set correctly before the beginning of the crop year. The result is that the government always either overpays or underpays its commitment and some provision must be made for subsequent correction. Under this proposal however, there would be no need to determine the government commitment prior to the beginning of the crop year. It could be done after the end of the year when the volume is known and it is time to calculate the payout under Stabilization.

B. <u>In Respect of the Stabilization Programme</u>

From the point of view of the mechanics of the Stabilization Programme, there would appear to be no difficulty. The Western Grain Stabilization Administration would have to calculate the new level to which farmers' NCF would be stabilized. As analyzed above, this new level would be equal to actual NCF plus the average of the previous five years of government commitments plus a further augmentation approximately equal to the levies or premiums paid into the Stabilization Fund. This would be a straightforward calculation.

There are however four minor and two major difficulties. The minor ones are as follows:

First, some phase-in provisions would have to be worked out. In the simple model illustrated in Table 1, NCF under subsidized rates was compared with NCF under compensatory rates. But in fact, there would be a

transition procedure for moving from Column (2) to Column (7) of Table 1. This however should not pose a major difficulty, and would be a one-time calculation. It should be noted that the Stabilization Administration's practice for introducing major changes such as this one is to recalculate previous years' NCF as if the change had been in place.

Second, the Stabilization Programme is a voluntary one, and not all farmers are covered by it. Farmers may have any number of reasons for staying out of Stabilization at the present, but it is unlikely they would wish to stay out if their Crow subsidy were at stake. There would have to be provisions made for those who are currently out of the Programme to get in without penalty.

Third, in moving from Column (2) to Column (7), there would be a decrease in farmers' gross receipts, but not much change in the stabilization payments. This may require an increase in the check-off levels in order to keep the Fund actuarially sound.

Fourth, and the most significant of the minor problems, would be the need to calculate the added differential above the "old" five year average to which the producers' income would have to be stabilized. The analytical approach shown above, suggesting that this differential is approximately equal to the sum of the levies, gives only a starting point, and to be certain that the plan would be actuarially sound, and that farmers would be getting their due, a thorough analysis, probably entailing the development of a simulation model, would have to be undertaken.

The two major problems are of course much more severe. The first, and probably the lesser, is that the Stabilization Programme places an upper limit on the level of income which can be stabilized. Gross receipts over $60,000 p.a. are not subject to a levy, and no stabilization payments are paid in respect of them. If this provision were left unchanged under this proposal, the producer would not receive his share of the Crow subsidy on grain generating gross income over the $60,000 level. This excludes about 20 to 30% of receipts.

Procedurally, the easiest way to remedy this problem would be to remove the ceiling on eligible receipts. This would, however, involve changing a major feature of the Programme. A procedurally more difficult approach would be to divide the payout into two portions: one related to Stabilization alone, and one related to the Crow subsidy portion. This, however would seem to defeat one of the major benefits of this proposal, namely its

administrative simplicity (see the discussion below under pros and cons).

The second, and more serious major practical difficulty is that the Stabilization Programme covers different grains than does the Crow subsidy. This has two parts to it. First, some grain eligible for a stabilization payment is not eligible for the statutory freight rate. Feed barley moving to the lower mainland area of British Columbia is an example. Second, certain grains eligible for the statutory rate are not part of the Stabilization Programme. Corn, Alfalfa and sunflower seeds are probably the most important of these. The first part of this problem is the more general one of dilution (see the Committee of Inquiry's discussion of disadvantages of "pay the producer" methods of payment, above); the second part is unique to this proposal. One element of the solution to the second part of this problem could be to bring all primary products now eligible for statutory rates within the Stabilization Programme. For the most part this could be done under existing legislation because the Stabilization Act allows for grains under the Canadian Grain Act to be included. However, Commodities like alfalfa which are not grains would pose a problem.

These then are the practical problems of greater or lesser severity which would be encountered in implementing the proposal. Now let us turn to the pros and cons of the proposal.

Pros and Cons

This proposal can be evaluated under various headings, most of which are implicit in the findings of the Committee of Inquiry and in the instructions given to the Committee and the GTA by the Minister.

A. Resource Neutrality

Under this heading can be included the issues of the "livestock hurt", equity, and agricultural production across Canada. The livestock hurt arises from the artificial increase in grain prices on the Prairies caused by the low freight rate on grain. As the producer, under this proposal, would pay the full freight rate, the livestock hurt issue would be resolved.

The Committee of Inquiry defined the equity criterion in terms of the livestock problem, and in terms of identifying all losses and benefits arising from policy changes, and providing compensation for losses. In relation to their own proposal they suggested that the equity criterion would be met because of the benefits to

the livestock sector, and because the GTR would keep the transportation subsidy within the grain sector. Finally, they suggested that the criterion relative to agriculture across Canada would be best met by removing "constraints to non-grain agricultural production and marketing activities such as livestock production and other forms of processing in the western region of Canada". As the proposal made in this paper has some similarities to the GTR in its bottom line effects on the producers, these conclusions can be extended to the present proposal.

B. Dilution

As noted above, the Stabilization Programme covers grains which do not qualify for the statutory rates. This means that, if paid out through Stabilization, the government commitment would be spread among a larger number of recipients. This effect has become known as "dilution". This proposal therefore, in common with other "pay the producer" schemes, dilutes the subsidy benefits for the current beneficiaries.

C. Administrative Simplicity

This proposal is administratively the simplest proposal advanced to date. As discussed above, virtually no substantive changes would be required in the administrative procedures under either the WGTA or the Stabilization Programme to put this proposal into effect. The price of this administrative simplicity is the problems referred to earlier.

D. Comprehensibility to Producers

Although the conceptual framework for making this proposal work takes some careful thought, the basic idea is straightforward. The producers would pay the full freight rate, and the government would pay its share into the Stabilization Fund. The payout provisions would be altered to that the producers get the full transportation subsidy.

One of the criticisms has been levelled at various proposals relative to the statutory rates has been that they are too complex for producers to understand. Since this present proposal involves only a modification to a programme which is familiar to producers, it should be acceptable under this criterion.

E. Efficiency

The essence of the efficiency argument is that because the present arrangements mask the full costs of transportation, a less than optimal allocation of

resources in the transport sector is achieved. Only if producers are aware of the full freight costs, it is argued, will they seek to maximize efficiency in the grain handling and transportation system. As this proposal would have the producers pay the full rate, the efficiency issue would be dealt with.

F. Ability to Pay

An examination of Table 1 will show that one effect of this proposal is to provide a further stabilization of producers' NCF. Comparing Column (5) with Column (12), it can be seen that the producers would receive payout far more frequently under this proposal than they do under the present Stabilization Programme. This means that producers' final income for the year (NCF plus deficit payment from Stabilization) would more frequently follow a relatively more stable five year average line than a relatively more erratic annual NCF line.

It follows that the proposal in this paper better satisfies the criterion of ability to pay. The producers would receive the largest payout from the funds in those periods of lowest NCF, and their income would be stabilized at a higher level than it would be with just the Stabilization Programme alone. The price of this higher level of stabilization of course is lower peak NCFs.

G. Freight Rate Stability

A matter closely related to the ability to pay issue is that of freight rate stability. One of the more contentious issues in the freight setting process under the WGTA is the fact that the producers' share of the freight rate varies erratically from year to year. The reason for this is that the Crow Benefit portion of the government commitment does not vary with volume. Its per tonne value therefore varies up and down, causing the producers' share of the rate to fluctuate accordingly. This has an inherently destabilizing impact on producers' income.

Under this proposal, the per tonne variation of the Crow Benefit does not affect either the freight rate or the Stabilization payout. This is a further stabilizing effect of the proposal on producer income.

H. Railway Accountability

This proposal as outlined above, in common with all other pay the producer schemes, would not provide any specific mechanism for ensuring railway accountability. However, a simple modification to the proposal would

allow for this. Instead of having the producers pay the full rate, they could pay some amount less than the full rate. For sake of illustration, this might be in the order of $2 per tonne. At the end of the year when the government commitment is calculated, the deficit in railway revenues (which, at the $2 level would amount to some $60 million) could be paid as a lump sum to the railways on the condition that their performance had been satisfactory.

I. The Stabilization Proposal Compared with the GTR and the GTA Payout

The proposal in this paper has a strong similarity to the GTR proposal made by the Committee of Inquiry. Hence, it has most of the strengths of that scheme. It is however superior to the GTR in two ways:

a) it is administratively much simpler;

b) with the modification suggested above, it could easily be made to provide for railway accountability.

It is not as good as the GTR in paying the Crow subsidy to the "right" producers. This is because of the second major problem identified above, that the Stabilization Programme and WGTA cover different grains. In particular, it is not as good as the GTR in respect of the dilution factor. The Committee of Inquiry recommended that the GTR be paid to an individual producer on his net grain sales (sales less purchases) thus inhibiting any tendency for a livestock producer to sell his grain into the market and buy back his feed requirements. This proposal does not have the same netting out provision, and grain could be forced into the market in order to qualify for the stabilization payout.

The GTA payout proposal is widely held by economists to be the most desirable way to pay the Crow subsidy. It would pay the subsidy out once and for all, and would remove all distortions from the transportation market. Unfortunately, it has two major drawbacks that were not addressed by the GTA report:

a) it provides no simple way to provide for inflation sharing; any effective inflation sharing formula would likely entail maintaining all the administrative machinery now in place for the rate setting procedure, and having an ongoing program of subsidization which would tend to offset the benefits achieved by the payout;

b) it provides no straightforward way of ensuring railway performance; again, some modification of the payout idea, tending to offset some of its inherent advantages, would be necessary to implement penalties for poor performance.

The proposal presented here resolves the inflation sharing problem, and could be modified to resolve the railway accountability problem, as described above.

J. Shift from Volume Base to Value Base

One of the effects of this proposal which would require careful further examination is its potential impact on individual payout. At present, the producer receives his individual proportion of the government commitment on the basis of the volume of grain he ships. Under this proposal, the individual payment would be influenced by the value of the grain, and the kind of margins which exist between production costs and prices. No work has been done on this particular matter.

K. International Trade Issues

One final matter that would also have to be addressed is the implication of this proposal under the GATT. To date, the Stabilization Programme has not been considered a violation of the GATT; however, the United States has continually claimed that the subsidization of freight rates is. The impact of this proposal could either be a pro or a con, depending how the matter might come to be viewed internationally. It could either jeopardize the Stabilization Programme or neutralize the grain freight rate subsidy. At this point, the issue is simply noted. Further analysis would have to be done to determine the implications for these trade arrangements.

Illustration Using Actual Figures

Let us finally take a look at how the actual Stabilization figure would look under this proposal. Table 2 shows actual net cash flow figures as determined by the Western Grain Stabilization Administration. The second column, which contains the actual NCF figures for the years shown, corresponds to Column (2) on Table 1. Column (3) is the preceding five year average, corresponding to Column (3) in Table 1. The fourth column is the difference between the actual NCF and the preceding five year average. When this column shows a negative number, a payout could be triggered from the Stabilization Fund. However, unlike in the simple model described above, the full deficit is not made good because of the eligibility restriction which sets the maximum grain sale proceeds at $60,000 annually. Column

(5) shows the actual payouts from the Fund, and these can be seen to be substantially less than the calculated shortfall in Column (4). It should be noted that the Stabilization Programme used to operate on a calendar year rather than crop year, and this makes comparisons between actual payout and NCF shortfalls calculated on a crop year basis difficult.

TABLE 2

Actual Net Cash Flow Figures:
1966/67 - 1984/85

(1) Year	(2) NCF	(3) 5 Year Avg. NCF	(4) Diff.	(5) Actual Payments
	($'000,000)			
1966/67	868	611	+ 257	
1967/68	670	714	- 44	
1968/69	229	736	- 507	
1969/70	273	634	- 361	
1970/71	539	548	- 9	
1971/72	849	516	+ 333	
1972/73	1225	512	+ 713	
1973/74	1848	623	+2225	
1974/75	2345	1147	+1198	
1975/76	2282	1561	+ 721	
1976/77	1551	1910	- 359	115 (1977)
1977/78	1875	2050	- 175	253 (1978)
1978/79	1949	2180	- 231	
1979/80	2802	2000	+ 802	
1980/81	4613	2092	+2521	
1981/82	3322	2558	+ 764	
1982/83	3633	2912	+ 721*	
1983/84	3177	3264	- 87*	223 (Jan-Jul/84)
1984/85	2530	3509	- 739*	522
1985/86	2002	3455	-1453*	Not Available

NOTES:
1. Column (2) corresponds to Column (2) on Table 1
2. Column (3) corresponds to Column (3) on Table 1
3. Column (4) equals Column (2) - Column (1)

SOURCE:
Figures for Columns (1), (2) and (3) provided by Western Grain Stabilization Administration, and quoted in the Review of the Western Grain Transportation Act (except 1985/86 provided directly from WGSA); figures of Column (5) from the WGSA Annual Report, 1984/85.

* COMPARE WITH COLUMN (7) TABLE 4.

TABLE 3

Net Cash Flow Figures
At Compensatory Freight Rates
1981/82 - 1984/85

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year	NCF	Volume Moved	Total Rate	Prod's Rate	Dec. in NCF	"New" NCF	"New" 5yr.av.
	$ m.	m.t.	$/t	$/t	$ m.	$ m.	$ m.
81/82	3322	30.4	22.05	4.89	522	2800	2200
82/83	3633	33.1	23.08	5.66	577	3056	2560
83/84	3177	33.9	25.00	5.72	653	2523	2880
84/85	2530	27.2	25.90	7.70	495	2053	2990
85/86	2002	27.5	28.42	6.00	605	1397	2919

SOURCES AND CALCULATIONS:

1. Column (2) is from Table 2.
2. Column (3) is from the CWB Annual Report, except for the 1985-86 figure which was provided by the GTA.
3. Columns (4) and (5) are re-constructed from CTC data.
4. Column (6) equals Column (3) x [Column (4) - Column (5)].
5. Column (7) equals Column (2) - Column (6), and corresponds to Column (7) in Table 1.
6. To calculate the five year averages in Column (8), the total freight rate in Column (4) was decreased by 5 percent per annum from 1981/82 back to 1975/76. Column (7) for these years was calculated using these approximations for the total rate, CWB data for Column (3), $4.89 for the producers' rate in Column (5) and calculations described for Columns (2) and (7).

Table 3 shows approximately how the NCF figures would alter if the producers were to pay full statutory rates. The calculations are shown in the notes to the Table, and basically involve deducting from the annual NCF figures shown in Table 2 the approximate amount of additional freight which producers would pay. The "new" NCF figures are shown in Column (7), and the "new" preceding five years average NCF is shown in Column (8). Column (7) corresponds to Column (7) in Table 1.

The calculations in Table 3 start with the NCF figures as calculated by the WGS Administration and work to the "new" NCF figures in Column (7). In fact, if the proposal contained in this paper were implemented, the Administration would have Column (7) from its own data, and would have to have Column (1) reconstructed from CTC data on freight rates and volumes moved.

TABLE 4

Augmented Five Year Average NCF
To Which Producers' NCF is Stabilized

(1) Year	(2) NCF	(3) Levies	(4) 5 Year Av.NCF	(5) Stab. Level	(6) "New" NCF	(7) Difference
	($'000,000)					
81/82	3322	168	2558	2726	2800	+ 74
82/83	3633	184	2912	3096	3056	- 40*
83/84	3177	174	3264	3438	2523	- 915*
84/85	2530	152	3509	3661	2053	-1628*
85/86	2002	120	3455	3575	1397	-2218*

SOURCES:
1. Column (2) from Table 2.
2. Column (3) from WGSA Annual Report, 1984/85. Figure for 1985/86 provided directly by WGSA.
3. Column (4) from Table 2.
4. Column (5) = Column (3) + Column (4); this column corresponds to Column (10) on Table 1.
5. Column (6) from Table 3.
6. Column (7) = Column (6) - Column (5).

* COMPARE WITH COLUMN (4) TABLE 2.

In Table 4 the new level of NCF from which the stabilization payments must be determined is calculated. As discussed above, the "old" five year average NCF must be augmented by the amount of the premiums paid into the Fund in order to determine the level to which the producers' income must be stabilized. Column (5) in Table 4 corresponds to Column (10) in Table 1. Column (7) is the difference between:

a) the Producers' actual "new" NCF as it would be under compensatory freight rates, and,

b) the sum of: (i) the "old" preceding five year average NCF as it would be under the subsidized rate, and (ii) the levies paid into the Stabilization Fund.

The key figures to compare are the last three figures in Column (7) of Table 4 and the last three figures of Column (4) of Table 2. As expected, the Table 4 figures are larger, and are larger by more than the additional freight charges paid by the producers as shown in Column (6) of Table 3.

Concluding Comments

The payment of the Crow subsidy through the Stabilization Programme has been shown to have certain advantages over the existing system of "pay the railway" contained in the WGTA and over the previously recommended methods of paying the producer viz., the GTR recommended by the Committee of Inquiry and the "payout" recommended by the Grain Transportation Agency. It also has some problems which these other methods do not possess. The proposal seems to be administratively feasible, and a rough calculation of its effects using actual WGSA data does not indicate any problems in its application.

This paper is put forward in the hope that the idea might receive some critical public comment. Should the idea be found acceptable, further work would have to be done to determine whether the difficulties described earlier could be resolved and to develop an implementation plan.

THE ECONOMIC COST OF TRANSPORTING GRAINS FROM FARM TO MARKET

By: N.Meyer and G.Sparks Department of Civil Engineering, University of Saskatchewan.

I Abstract:

The impact on producers of adjustments in the Canadian grain collection system depends heavily on how the system evolves. If the system maintains the numerous delivery points which presently exist, producer transport distances will be relatively short but the benefits of system rationalization will elude them. However fewer assembly points mean generally longer hauls, although not necessarily higher transport costs for producers. Economies of size and scale in grain delivery can actually reduce total and variable transport costs for producers assembling their grain. The net result could be higher net margins to producers for grains.

Modifying the grain assembly system can bring about a number of changes which are beneficial to producers. First, because they have adequate on farm storage, they can deliver their grains to market throughout the year. Using larger trucks, producers can actually reduce the per unit cost of moving grains to the assembly points even if the distance is up to four times farther. This is because more use of transport capacity reduces per unit fixed costs. In cases where custom or commercial trucking is used costs per unit decline even more because equipment has more annual use.

II Introduction :

Many of the most recent innovations in grain handing have not been incorporated into the Canadian grain handling system. Rationalization of the Canadian grain handling system would be very likely to incorporate many of these innovations. That action has important implications for several different groups in Canadian society. These changes are likely to bring some costs and some changes in rural lifestyles to different segments of society. Therefore, there are strong vested interests in any change of the system.

Producer's perspective: Producers often envision two different aspects from the rationalization of the grain handling system. The first thought in

many producer's mind is the additional distance to haul grains if local elevators are closed. That means additional expenses and time to transport grain. It may mean upgrading and resizing a truck or it may mean constructing additional on-farm storage to be able to keep combines running during harvest. Additional traffic on rural roads may also mean higher maintenance costs to rural municipalities and thus higher taxes. All of these imply additional costs. Producers want to know specifically what are the benefits to the individual producer of the proposed changes in the system? If producers receive some of the gains from efficiency, they may support changes in the system, if not they will oppose changes.

Grain firms perspective: The grain firms also have potential gains and costs associated with changes in the system. Presently they have a system setup for collection, processing and storage of grains. To change the system renders some of the facilities obsolete with few alternative uses. In addition, what about labor contracts and the need for fewer managers of a smaller number of high thru-put facilities. These firms have the potential of greatly increasing efficiency but at a cost of reduced facility values and labor contract settlements. Both can have a significant impact on the firm's profitability in the short run.

Rural municipalities perspective: A major concern of rural municipalities in system rationalization is abandoning branch lines. The concern is for additional traffic on roads causing increased maintenance costs. Abandoning rail lines could reduce the property tax base in some rural municipalities while increasing the tax base in communities where the assembly facilities are maintained or expanded. Reducing the service levels at elevators on lines to be abandoned could result in the transfer of visits to town by rural residents to the community retaining the assembly point. Rural municipalities are concerned that revenue to support additional road maintenance demands will not be available from the tax base. The net result could be inadequate revenue to meet additional expenses.

Province's perspective: Research has shown that the majority of the additional traffic resulting from hauling grain additional distance will be on the provincial highways leading to the rail sites where rapid loading of grains is possible (Calkins

and Meyer). Maintenance and improvement of these roads is the responsibility of the province. Their concern is: will they end up with additional costs and no additional revenues?

National perspective: Grains are an important earner of foreign exchange for Canada. With the depressed grain prices each extra dollar of cost to get grains to tidewater inhibits Canada's ability to compete in world markets with out government subsidies. Extra costs in the system reduce the price which can be paid to producers, shifts production out of these crops and puts additional financial pressure on them. A related national question is: could the funds being put into the grain handling system be used in another manner and improve the overall economy of Canada?

III Literature Review:

Sparks,G."Investment Options Related to Rail Line Rehabilitation",CANADIAN TRANSPORTATION RESEARCH FORUM,1985 pp334-358. First, rehabilitation of branchlines may actually cost more than the value of the grain being moved. A second issue is raised concerning can a duplicate system be afforded in a time of scarce resources? The problem is presented as the provinces providing the roads, therefore being reluctant to encourage activities which increase traffic without some form of compensation. The rural municipalities are also reluctant because they expect additional costs without compensation. The costs for branchline upgrading are paid by the federal government. Branchline abandonment could mean additional costs to rural municipalities and provincial governments and no compensating revenues. That is why local and provincial governments tend to oppose it.

Irwin,N.A.,L.S.Sims and E.E.Hopkin,"The Role of Trucking in The Grain Industry",CANADIAN TRANSPORTATION RESEARCH FORUM,1985,pp359-378. This report is an overview of changes likely to occur in transporting Canadian grains by 1990/91. They assume elevator numbers will continue to decrease while throughput per facility continues to increase. Farm to elevator tramsport costs are estimated at $2.35/tonne (Authors' note: our analysis indicated that only with producers working for zero wages could grain be transported for $2.30 per tonne), elevation charges at $6.50/tonne and rail charges are estimated to be $22.52/tonne for a total estimated transport cost of $31.37/tonne to an export point 1200 km

distant. Farm to elevator costs are estimated to be 8%of total transport costs;elevation charges are 21 %; and rail charges are 72 % of transport costs for 1990/91.

Chaudhary,G.N.,"Impacts of Reforms in the Statuary Rates on Trucking",CANADIAN TRANSPORTATION RESEARCH FORUM,1986,pp14-25. Farmers are replacing their 2 axle(6,000 kg) trucks with 3 axle(14,000 kg) in Alberta.The number of 3 axle increased from 1% to5.4% of registered trucks from 1976/77 to 1983/84. During the same period 2 axle trucks decreased by 7.7 %. Commercial truckers can generally move grain for lower rates because the annual capital costs are spread over more annual miles and tonnes. However because the Western Grain Transportation Act pays the railroads rather than the producers, the is no incentive for the changes necessary to gain the benefits to occur.

Sparks,G.A.,PRODUCTIVITY/OPERATIONAL IMPLICATIONS OF VEHICLE WEIGHT AND DIMENSION REGULATIONS, Clayton Sparks & Associates Ltd. Saskatoon ,Sask. July, 1986. Sparks research points out that the variables of capacity(weigh or volume),distance wage rate and annual use have the greatest effect on cost variation in transporting commodities. In the case of bulk commodities, fuel consumption was also an important variable affecting cost per unit for transportation. Sparks developed a probabilistic model for estimating costs. He then goes on to show the efficiency gains to be derived by service suppliers if axle and gross vehicle weight restrictions were removed. Vehicle configuration (5 axle vs. 7 axle vs. 8 axle) also had a strong influence on productivity. The type of truck (flat bed ,bulker or tanker) did not particularly effect productivity. A and B trains showed efficiency gains of 15 to 25 percent over 5 axle semi's. Axle and gross vehicle weight restrictions are given in the appendices.

Calkins,B.L. and N.L.Meyer ADOPTION OF NEW MARKETING METHODS BY IDAHO GRAIN PRODUCERS, Bulletin 636, Ag. Experiment Station, Univ. of Idaho,1985. Based on survey data, the adaptations of Idaho producers to the introduction of 3-5 and 25-26 car rail rates and barge traffic to Lewiston Idaho are described. When multicar rates were introduced, facilities were upgraded and new facilities constructed to load trains within the required loading time. The benefits of lower rates were shared among those providing transportation, handlers,and producers. Producers adapted to the

new environment by transporting grain greater distances to take advantage of the higher bid prices being offered for grain. In North Idaho, with ready access to the Snake River, the average transport distance from on farm storage to market was 38 miles. The average transport distance for those selling to points capable of loading barges or multicar trains was 104 miles which was 66 miles greater in distance. South Idaho producers,who are dependent on rail and truck transport,shipped grains an average of 34 miles to traditional markets while those marketing to locations capable of loading multicar trains transported grains an average of 85 miles one way, a distance 51 miles farther. In spite of the greater distances, by using larger trucks which traveled greater distances annually, the total and variable cost of getting grains to locations capable of loading rail cars decreased on a per unit basis as compared to 2 axle farm truck deliveries.

Karadininis,K. & G.G.Storey WESTERN CANADIAN GRAIN HANDLING AND TRANSPORTATION SYSTEM;THE IMPACTS OF VARIABLE FREIGHT RATES, Dept of Ag. Economics, Univ of Sask. Saskatoon, Sask. July,1986. A model is developed to simulate the introduction of 20,40, and 100 car variable freight rates for grain. The discounts are respectively 1.50, 1.75, and 3.00 dollars per tonne. The effect of these rate breaks was to concentrate deliveries to fewer points. Alternative one resulted in an additional 31% of the delivery points being closed . Alternative two resulted in 20 more delivery points being closed.Efficiency gains come from reducing the number of miles of track to be maintained and from increases in volumes handled by existing elevators. Farmers greater distances from delivery points would be required to haul grains greater distances thus enduring additional transportation costs. The authors do not make adjustment for technical change in producer delivery of grains in this study. Lack of cost information from the railroads also makes the estimation of gains to the railroads somewhat speculative.

IV Methodology:

Objective: To estimate the producer's cost of delivering grains to assembly points under alternative assumptions. Thus permitting evaluation of the impacts resulting from rail line and assembly elevator rationaliza ion.The

following cases were used as a basis for estimation.

1) base case - two axle farm truck,
2) three axle truck,
3) three axle tandem pulling a pup,
4) five axle semi and
5) A-train.

Three systems of service provision were evaluated: a producer hauling his own grain, a producer hauling his own grain plus that of six other producers, and commercial service.

Theory: Costs of transporting grain from farm to assembly point can be classified into fixed costs and variable costs. Fixed costs refer to costs having a constant annual value unrelated to the level of utilization. Variable costs refer to those varying with the quantity of use. Total cost is the summation of fixed and variable costs as shown in equation 1.

1) TC = FC + VC
TC = total cost
FC = fixed cost
VC = variable cost

2) FC = D + In + L + I + T
D = annual depreciation
In = annual insurance
L = licenses
I = interest on average investment
T = annual cost for tarps

Fixed costs (2) are divided by the annual kilometers of truck use to determine the per kilometer cost. Grain transports part of the total cost are then estimated by the number of kilometers traveled to deliver the producer's annual grain sales.

3) VC = L + Ti + RM + F
L = labor cost to transport grain
Ti = annual tire cost for grain transport
RM = repairs and maintenance costs for grain transport
F = fuel cost to transport grain

Variable costs (3) increase or decrease with the level of use. Labor is based on the time required to load, transport to the delivery point, unload, and return to the loading point. In the commercial operation an additional fee is paid to the driver

for loaded tonne kilometers. Tire cost is based on the return kilometers covered in delivering grains to assembly point and a per kilometer cost. Repairs and maintenance are also based on a per unit rate and the distance covered hauling grain. Fuel is the efficiency (km/l)times the return distance traveled transporting grain and the cost per liter of fuel.

Economies of scale theory indicates there are gains from specialization. Free trade theory is based on the assumption that the maximum of scale economies can be gained with each producer specializing in what he can do best. Economies of size refers to individual long run average cost curves. Each average cost curve has a minimum cost point for production. This analysis deals with economies of size for individual Prairie grain producers as well as well as economies of scale in permitting some to specialize in grain production and others in custom or commercial grain transport.

Scale economies dictate that a given service can be provided in alternative ways but there is usually a least cost method at each level of output. In the physical movement of grains, the most efficient tool depends on several factors. Distance, capital investment, operating costs and flexibility are important factors to evaluate. As capital investment increases, the utilization rate becomes more important. As operating costs increase, it becomes more important to control the increases. This is particularly true in the cases of fuel and labor costs for the transport of farm grains to market. Theory tells us that larger loads, more productive kilometers per year, and more rapid traveling speeds help to increase the efficiency of trucks transporting grains.

The movement of grain from on-farm storage to the assembly point for loading unto rail cars can be divided into three parts. The first part is the loading of grains from farm storage to trucks. The second part is the movement by truck from the farm storage location to the assembly point. The third part is the unloading of grains at the assembly point. A fourth part of domestic transportation is from the assembly point to export or domestic utilization location. This last part of the transportation may be entirely by rail, truck or a combination of rail,truck and water transportation. This paper deals with the assembly of grains, the first three parts.

Farm storage to delivery point shipping requires loading the truck at the farm. The time required for this operation depends on the equipment used. Larger trucks are assumed to require more time to load. Loading of grain is assumed to be on a units per time period basis. Loading includes setting augers, opening bins, loading and cleaning up complete.These values differ for the quantity of grain shipped, the number of different types handled and size of the storage facility. Total cost and variable cost per unit would be expected to change with the situation.

Transporting grains to the assembly point involves movement from the farm on a grid road to the provincial highway and then transport on the highway to the assembly elevator. This distance will vary for deliveries to local elevators and to more distant multicar loading sites(Calkins & Meyer). Travel distance from farm storage points to the assembly points will likely be greater to larger assembly points than to the local assembly locations. This travel distance will generally be covered at highway speeds. The additional distance on provincial highways can be covered much more rapidly and the additional cost is only the cost of moving down the road, no waiting, loading or unloading time.

Transporting grains involves fewer trips if the trucks are larger for transporting the same quantity of grain. These larger trucks are less likely to have overloaded axles because they have more axles under them. Load on roads per square inch of tire is likely to be less because larger trucks must pass over scales and are more likely to travel on main roads. Larger loads require fewer trips over the road, therefore fewer vehicles to meet. Costs to the producer may also be less depending on the haul distance and truck size.

The third portion of the cost is the unloading cost at the assembly point. Because many of the locations accepting greater quantities of grain have larger capacity facilities,the required unloading time will be less. These are the reasons : the larger trucks are of bottom dump design which unload faster; because of larger loads fewer trucks need to be unloaded; and larger capacity pits and legs permit faster handling of grains. These factors translate into potentially increased capacity and lower costs for grain handling.

V Analysis:

To analyze the options which producers have for moving their grains under alternative arrangements five vehicles were evaluated under assumptions of delivery to assembly points 10 km. up to 160 km distance from the farm. These alternatives were evaluated with respect to different wage rates for the driver and with different levels of vehicle utilization. The impact of fuel efficiency on the cost of grain assembly was then evaluated. Combining all the options defines a decision tree which can help policy makers, as well as producers decide which alternatives are best for a given situation.

A decision tree is an outline of the different steps in making a decision (Howard). It notes the alternatives available at each decision point. The number of variables at any decision point as well as alternative outcomes entered into the decision model. Figure 1 outlines a decision tree for a producer deciding how to deliver his grain to an assembly point. First he has the options of doing it himself with his present equipment or hiring it done. If he decides to hire, then it is a matter of who is available to provide the service, what quality of service is likely to be offered and what the cost will be. If the producer decides to do it himself, then he must decide if it should be done with his current equipment or with different equipment. If the producer decides different equipment is needed, should it be new or used? What size should it be? What is the cost trade-off versus the probability of breakdown with new versus used equipment? Is there enough volume to warrant the addition of a pup to the main trucking unit to increase capacity? Should custom work for neighbors be done to increase utilization and reduce per unit costs? Each of these alternatives is a potential answer to the producers question of what is the best for my overall situation?

Base Case

A basic model was set up to evaluate the costs of delivering grain various distances in alternative transport units. The traditional two axle farm truck was used as a base. (The basic assumptions and data are available from the authors upon request). For comparison, producers were assumed to deliver their grain 10,20,40,80,and 160 km. to the assembly elevators. Each farm was assumed to have 353 tonnes of grain to transport annually to market. Data from the University of Saskatchewan Top Management Program indicate each farm had an average of 1.6 trucks

being used to deliver grain in 1985. Based on the assumptions in the model, if the average delivery distance is 10 km.(6.2 mi.), the producer's estimated variable and total delivery cost would be respectively $4.54 and $7.90 per tonne (Table 1.). Converting to a used tandem would reduce a producer's total cost $2.45 per tonne to $5.45 for the same distance haul. Adding a pup behind the 3-axle truck would permit hauling over 20 kilometers for less than is presently being paid. A neighbor hauling with a used semi or a used A-train could transport the grain up to 40 kilometers for less than the present cost of transporting with a two axle truck. The most economical for the producer would be to use a commercial A-train or hire custom transport from a neighbor. Both of these could transport his grain up to 80 kilometers (50 mi.) for less than the present estimated total cost for transporting grain. A producer choosing not to be paid for his labor could transport grain the 10 kilometers for a total cost of $5.67/tonne and a variable cost of $2.30/tonne. Custom service could deliver it 20 km. in a 3 axle truck plus pup or a 5 axle semi for less than the cost of delivering it 10 km. in a 2 axle unit.

The total cost, variable cost and variable cost without labor cost show the decision points for a producer with a two axle truck (Figure 2). Decisions start with the current equipment and variable cost. That is compared with total costs for all other alternatives.

Considering total costs and a producer paying himself $10 per hour for his labor, all alternatives considered reduce per unit transport costs. Compared to producer per tonne variable costs, the custom and commercial total transport costs were lower for delivering grain equal distances. The greatest reduction is with a commercial A-train which could transport the producer's grain over 40 kilometers for less than he would expect to pay in variable costs doing it himself.

Examining the producer's total transport cost for grain (Table 2) shows that total costs could be reduced by adapting other trucking alternatives over the present predominant 2-axle truck system. Doubling transport distance to 20 km while purchasing a used 3-axle or hiring custom service could actually reduce transport costs. In the case of a custom 3-axle with pup or a custom A-train, it could be by almost half.

In all cases using a larger truck reduced the per tonne transport costs for the same distance and in certain cases for additional distances. Figures 3 and 4 show cost reductions were greatest when trucks are used for custom work or commercial service (high km annual usage example). In that case the estimated costs per tonne for delivery were lower even though distances were up to four times greater. In the cases of custom 3-axle plus pup and commercial A-train the distance up to eight times greater cost less per tonne to deliver to the assembly point. The differences tended to get larger as the delivery distance increased. Even in cases where the producer did not charge a labor cost for transporting his own grain, the commercial and custom services cost less than he presently spends to transport his grain to the assembly point 10 km from his present grain storage.

The majority of producers have at least one truck, therefore the decision criteria for an individual producer is the variable cost which must be covered. If the variable cost of delivering grain to the assembly point in the producers truck is less than the commercial or custom rate, it pays the producer to haul his grain with his present unit. Table 3 shows the additional cost of moving grains by alternative size trucks additional distances. Larger trucks reduce the transport costs for all distances. Use of custom or commercial services permits hauling grains up to four times greater distance for less cost. If a new or different truck is needed, then full costs must be used as a basis for decision making rather than variable cost because new unit costs must be paid.

Sensitivity

Solution sensitivity to various parameters was tested to determine how changes in various factors effect the per tonne cost of transportation. Subjectively, to estimate sensitivity to changes in parameters, a 20 percent over and under variation in each variable was tested. The most important factor was truck capacity for 2-axle and 3-axle units hauling 40 kilometers. This resulted in a 42 percent cost per tonne kilometer variation for a 2-axle truck, and a 39 percent variation for a 3-axle truck, both hauling 40 kilometers (Tables 4 and 5). The next two most important variables

for both units were the annual kilometers driven and the purchase price of the unit.

As can be expected commercial truck operations were most sensitive to annual kilometers, delivery distance, truck capacity and drivers wages. A plus or minus twenty percent variation in each of these resulted in a 28.6 percent variation in cost per tonne kilometer (Table 6).

Sensitivity to increasing or decreasing the fuel efficiency was small. It effected total delivery cost per tonne 7.9 percent for the two axle, 3 percent for the 3-axle and insensitive for the commercial A-train.

One option simulated was to have a producer do commercial work for six additional producers. This was called a custom operator. This increased the volume over which the fixed costs were allocated and reduced per kilometer costs. Figure 3 shows the effect of having more units over which to allocate the fixed costs. Doing custom work for others reduces the per unit cost of transporting the producer's grain because it reduces per unit fixed cost. Certainly a question to consider is, does the individual have adequate labor to begin another business. If so, it could be a viable part time employment for a producer. Certainly in all cases the costs per unit transported were reduced by hauling greater volumes with the same unit.

Trips

For many producers the second thought concerning grain assembly point consolidation is that of road maintenance and expected higher taxes associated with longer hauls. One result of using larger trucks is fewer loads are required to transport the same quantity of grain. As shown in Table 7, It takes 10 A-trains to move the same quantity of grain as 63 2-axle farm trucks. Traffic on roads could be reduced by 84 percent by switching grain transport to larger trucks. However there would still be traffic concentrations near larger capacity assembly points. Road damage rates would be expected to decline rapidly a few miles distant from the assembly point.

VI Summary and policy implications:

The above factors reduce the marginal per unit cost of moving grain the additional distance to higher capacity loading sites. The net result is

that under certain circumstances the cost of delivering grain can decrease permitting a greater net return to the producer despite the greater transport distances. Trucks transporting the grain may be commercial or custom operations or producer owned. The key to greater efficiency and lower per unit cost is higher annual volumes to spread fixed costs over a larger number of units to be moved.

Hauling grains greater distances does not necessarily cost more. It depends totally on how the producer hauls the grain the additional distance. If the producer is expected to change the manner in which he is doing business and be exposed to new risks, he must receive compensation for his efforts. If he does not, he will not willingly change. Presently producers have little incentive to change. Will the efficiencies to be gained by elevator rationalization be shared with producers to an extent they are more than compensated for their extra transport expense? This analysis indicates that the additional cost to producers of transporting grain varies widely depending on the assumptions used for equipment and transport distance. Larger equipment with adequate volume reduces total transport cost for the producer. The cost reductions more than compensate for the additional transport distances. This analysis does not consider road maintenance costs but does point out that the larger trucks with more axles require fewer trips to move the same quantity of grain. That means fewer vehicles on the road.

VIII Needs for further research: This paper reports on estimates of additional costs to producers of transporting grains greater distances under several assumptions. This research needs to be evaluated in conjunction with other parts of the grain handling system to access the impact system rationalization will have on producers and how the benefits need to be allocated among participants in the system for equitable treatment.

Appendix

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APPENDICES (Methods of data development, copies of the data and the model used for this analysis are available from the authors.

Table 1 Total and Variable cost per tonne for grain assembly

Equipment	Costs	Kilometers 10	20	40	80	160
2-axle	total	7.90	11.16	15.34	21.75	38.26
	variable	4.54	6.42	9.38	14.77	27.03
3-axle	total	5.45	8.70	13.21	18.83	27.86
	variable	2.84	4.32	6.61	9.95	16.12
3-axle	total	5.15	7.39	11.57	15.96	22.19
/pup	variable	3.45	4.30	5.91	7.96	11.32
5-axle	total	5.25	8.94	14.70	22.45	31.61
	variable	2.52	4.01	6.42	9.94	14.79
A-train	total	3.69	6.47	11.15	18.16	27.17
	variable	1.76	2.84	4.70	7.60	11.68
Custom						
3-axle	total	2.96	3.93	5.35	7.79	13.37
+pup	variable	1.68	2.14	2.98	4.76	8.47
5-axle	total	3.88	5.21	7.58	12.16	20.19
	variable	1.98	2.66	3.99	6.80	12.00
A-train	total	2.86	4.11	5.58	8.71	15.17
	variable	1.47	2.04	2.81	4.62	8.47
Commercial						
A-train	total	**	**	3.55	5.60	9.60
	variable	**	**	2.65	4.40	7.83

** A commercial operator could not generate adequate revenue to cover cost transporting these short distances.

Table 2. Total cost to deliver 353 tonnes to assembly points

Equipment	Units	Kilometers				
		10	20	40	80	160
2-axle	total cost	2789	3940	5415	7678	13507
(5.6)	cost/tonne	7.90	11.16	15.34	21.75	38.26
3-axle	total cost	1922	3070	4464	6646	9834
(12)	cost/tonne	5.45	8.70	13.21	18.83	27.86
3-ax+pup	total cost	1818	2608	4083	5632	7833
(24)	cost/tonne	5.15	7.39	11.57	15.96	22.19
5-axle	total cost	1854	3157	5188	7925	11156
(22)	cost/tonne	5.25	8.94	14.70	22.45	31.61
A-train	total cost	1303	2283	3937	6411	9592
(35)	cost/tonne	3.69	6.47	11.15	18.15	27.17
Custom						
3-ax+pup	total cost	1045	1387	1889	2749	4721
(24)	cost/tonne	2.96	3.93	5.35	7.79	13.37
5-axle	total cost	1368	1859	2677	4292	7129
(22)	cost/tonne	3.88	5.27	7.58	12.16	20.19
A-train	total cost	1008	1452	1969	3076	5353
(35)	cost/tonne	2.86	4.11	5.58	8.71	15.17
Commercial						
A-train	total cost	400	605	1013	1816	3409
(35)	cost/tonne	1.13	1.72	2.87	5.15	9.66

Table 3. Additional total cost of transporting 353 tonnes of grain additional distances over base cost of $2789.

Equipment	Base	Kilometers			
	10 km	20	40	80	160
	($)	($)	($)	($)	($)
2-axle	0	1151	2626	4889	10718
3-axle	-867	-282	1876	3857	7045
3-axle+pup	-971	-181	1294	2843	5044
5-axle	-935	368	2399	5137	8368
A-train	-1486	-506	1148	3622	6803
Custom					
3-axle+pup	-1744	-1402	-900	-39	1932
5-axle	-1421	-930	-112	1503	4340
A-train	-1781	-1337	-821	287	2565
Commercial					
A-train	N/A	N/A	-1776	- 973	621

Table 4. Deterministic sensitivity for operating costs of a two axle farm grain truck hauling 40 kilometer (24miles).

Inputs	Typical value			Associated productivity			
	-20%	most likely	+20%	costs/tonne kilometer min	expected	max	%
Tonnes haul annually	282	353	424	.38	.38	.38	0.0
Annual travel	5424	6780	8136	.44	.38	.35	23.6
Delivery distance	64	80	96	.41	.38	.37	10.5
Delivery time(min)	104	130	156	.36	.38	.43	18.4
Truck cap(tn)	4.5	5.6	6.7	.48	.38	.32	42.1
Plates & Ins	118	147	176	.38	.38	.39	2.6
Truck cost	13920	17400	20880	.34	.38	.43	23.7
Service life	8	10	12	.42	.38	.36	15.8
Salvage value	2088	2610	3132	.38	.38	.38	0.0
Tarp cost	800	1000	1200	.38	.38	.38	0.0
Tarp service	8	10	12	.38	.38	.38	0.0
Fuel cons(km/l)	1.7	2.1	2.5	.40	.38	.37	7.9
Fuel cost/l	.27	.34	.41	.37	.38	.40	7.9
Tire cost($/)	202	252	302	.39	.38	.38	2.6
Tire life(km)	64000	80000	96000	.38	.38	.38	0.0
Interest rate	.09	.11	.13	.37	.38	.39	5.3
Drivers wages/hr	8.00	10.00	12.00	.36	.38	.40	10.5

Table 5. Deterministic sensitivity for 3 axle farm grain truck delivering 40 km.(24 mi).

Inputs	Typical values			Associated productivity			
	-20%	expect	+20%	min	expect	max	%var
Tonnes /year	282	353	424	.33	.33	.33	0.0
Km/ year	3792	4740	5688	.39	.33	.29	30.3
Del dis (ret)	64	80	96	.34	.33	.32	6.1
Del time (min)	112	140	168	.32	.33	.34	6.1
Truck cap tn	9.6	12	14.4	.41	.33	.28	39.4
License& ins.	120	151	181	.33	.33	.33	0.0
Price truck	24000	30000	36000	.28	.33	.38	30.3
Service life	8	10	12	.37	.33	.30	21.2
Salvage value +	3600	4500	5400	.33	.33	.33	0.0
Tarp cost	800	1000	1200	.33	.33	.33	0.0
Tarp ser-yrs	8	10	12	.33	.33	.33	0.0
Fuel con(km/l)	1.7	2.1	2.5	.34	.33	.33	3.0
Fuel cost/l	.27	.34	.41	.32	.33	.34	6.1
Tire cost	298	373	448	.33	.33	.33	0.0
Tire life	96000	120000	144000	.33	.33	.33	0.0
Interest rate	.09	.11	.13	.32	.33	.34	6.1
Driver wages	8.00	10.00	12.00	.32	.33	.34	6.1

Table 6. Deterministic sensitivity for high annual use A-train grain truck delivering 40 km(24mi)

Input	min	expect	max	min	exp	max	var
Tonnes yearly	282	353	424	.07	.07	.07	0.0
Km/ year	80000	100000	120000	.08	.07	.07	28.6
Delivery dist	64	80	120	.08	.07	.06	28.6
Delivery time(min)	152	190	228	.07	.07	.07	14.3
Truck cap(tonne)	28	35	42	.08	.07	.06	28.6
License& ins	2758	3448	4138	.07	.07	.07	0.0
Truck price	104000	130000	156000	.07	.07	.08	14.3
Service life	8	10	12	.07	.07	.07	0.0
Salvage value	15600	19500	23400	.07	.07	.07	0.0
Tarp cost	2000	2500	3000	.07	.07	.07	0.0
Tarp life	8	10	12	.07	.07	.07	0.0
Fuel con(km/l)	1.7	2.1	2.5	.07	.07	.07	0.0
Fuel cost/l	.25	.31	.37	.07	.07	.07	0.0
Tire cost	385	481	577	.07	.07	.07	0.0
Tire ser	149000	187000	224000	.07	.07	.07	0.0
Pup tire cost	184	230	276	.07	.07	.07	0.0
Pup tire ser	104000	130000	156000	.07	.07	.07	0.0
Interest rate	.09	.11	.13	.07	.07	.07	0.0
Driver wages	15.07	18.84	22.61	.06	.07	.08	28.6

Table 7. Trips required to transport 353 tonnes of grain with different capacity trucks.

Truck axles	Net capacity tonnes	Trips	Axle trips
2	5.6	53	126
3	12	30	90
3+pup	24	15	75
5	23	16	80
6	35	10	70

Figure 1 Decision tree for a producer concerning grain transport from farm to assembly point

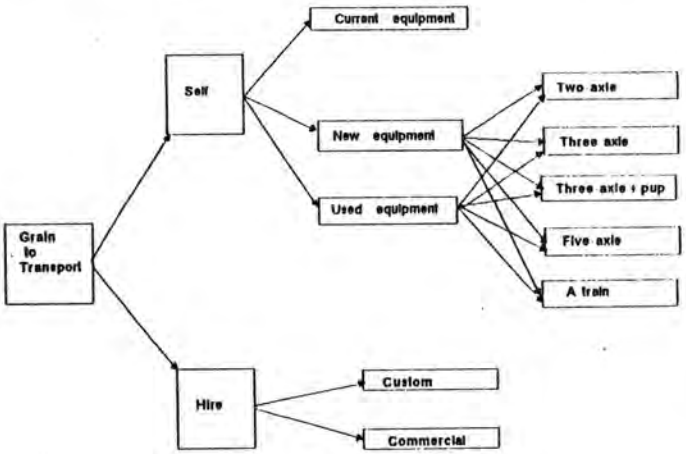


Fig. 2 Two axle farm truck grain

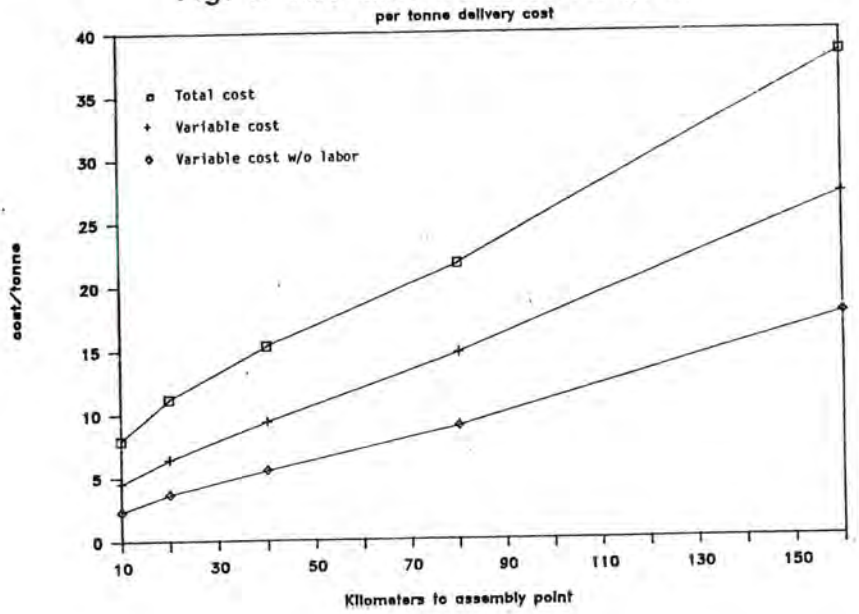


Fig. 3. Two axle variable cost versus

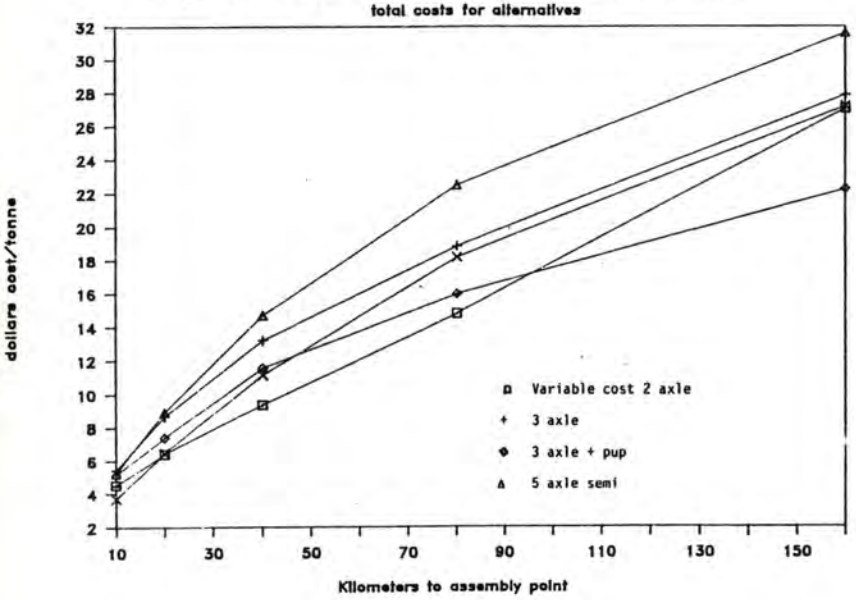
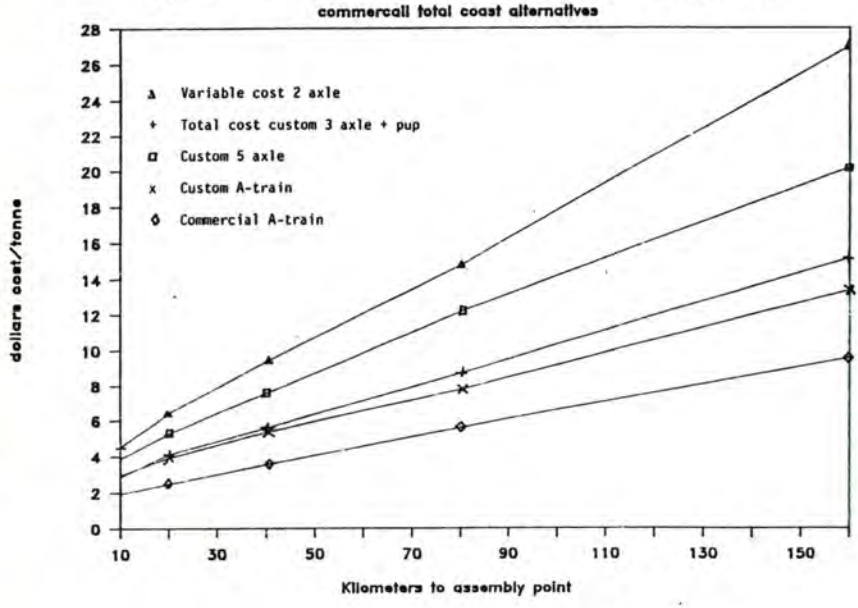


Fig. 4 Two axle variable versus custom/



PRODUCTIVITY IMPLICATIONS OF VEHICLE WEIGHT AND DIMENSION REGULATIONS IN THE TRANSPORTATION OF PETROLEUM PRODUCTS

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1.0 Introduction

There has been considerable interest in the issue of vehicle weight and dimension regulations in Canada as well as in other parts of the world in recent years. This interest is primarily motivated by the increased productivity/efficiency of larger trucks. While it is intuitively obvious that there are potential cost savings associated with the use of larger trucks in any particular haul, it is not obvious as to the magnitude of these potential savings. It is therefore of interest to analyze the costs associated with operating trucks of different sizes. This is of particular interest in the context of variable (and changing) regulations governing the size and weight of trucks permitted to operate on Canadian roads. Understanding the implications of changing vehicle size and permitted weights is an obvious first step in determining the potential benefits associated with changing vehicle weight and dimension regulations.

2.0 Measure of Productivity

Productivity of a transportation system can be measured in a number of different ways. One of the most common and probably the most useful when considering the motor carrier industry is in terms of costs per unit of useful output. This is usually measured in terms of cents/tonne km of payload or for a particular vehicle, in terms of $/loaded km or $/running km. (If the vehicle cubes-out, a more useful measure of output may be cents per cubic metre km. This involves essentially "re-scaling" the measure of useful output by the relative density of the

commodity involved. For example, if the density of the commodity is such that the vehicle can haul only 1/2 of its weight capacity, then it costs twice as much per tonne km as it would if weight governed rather than cube.)

3.0 Cost Model

In order to determine the productivity of a particular haul situation or compare the productivity of one method versus another, it is necessary to have an analysis framework or methodology. Numerous models have been developed with most falling into what would be considered a general category of costing models. Most such models are deterministic in nature and draw heavily upon methods of engineering economics. One such model is illustrated in Figure 1. (1)

As illustrated in Figure 1, the productivity (as measured in cents/tonne km) is a function of a large number of inputs and/or assumptions about a relatively large number of variables. This results in a situation wherein the productivity as determined by the model can be highly variable depending upon the value of inputs and/or basic assumptions made. This is indeed a reasonable representation of the real world. This high variability in results does however present a difficult situation for those attempting to make general comments about productivity. The usual approach has been to determine the productivity (cents/tonne km) for a number of typical situations to provide a "feel for" the various situations. This approach is clearly helpful however it does have its limitations because of the large number of variables and the large range in potential values for many of these parameters. (This point will be illustrated in the examples later in the paper.)

There is another approach which is possible which can contribute to a more complete understanding of the relationships between the various parameters and productivity. This is a three stage approach which involves the use of a deterministic model to carry out a deterministic sensitivity analysis as the first stage, the development of a probabilistic model as the second stage and a stochastic sensitivity analysis as a third stage. This approach is described and illustrated in the following sections.

4.0 Deterministic Sensitivity

In order to determine the relative importance of various variables in determining productivity as measured by cents/tonne km, a sensitivity analysis is undertaken using the deterministic model illustrated in Figure 1.

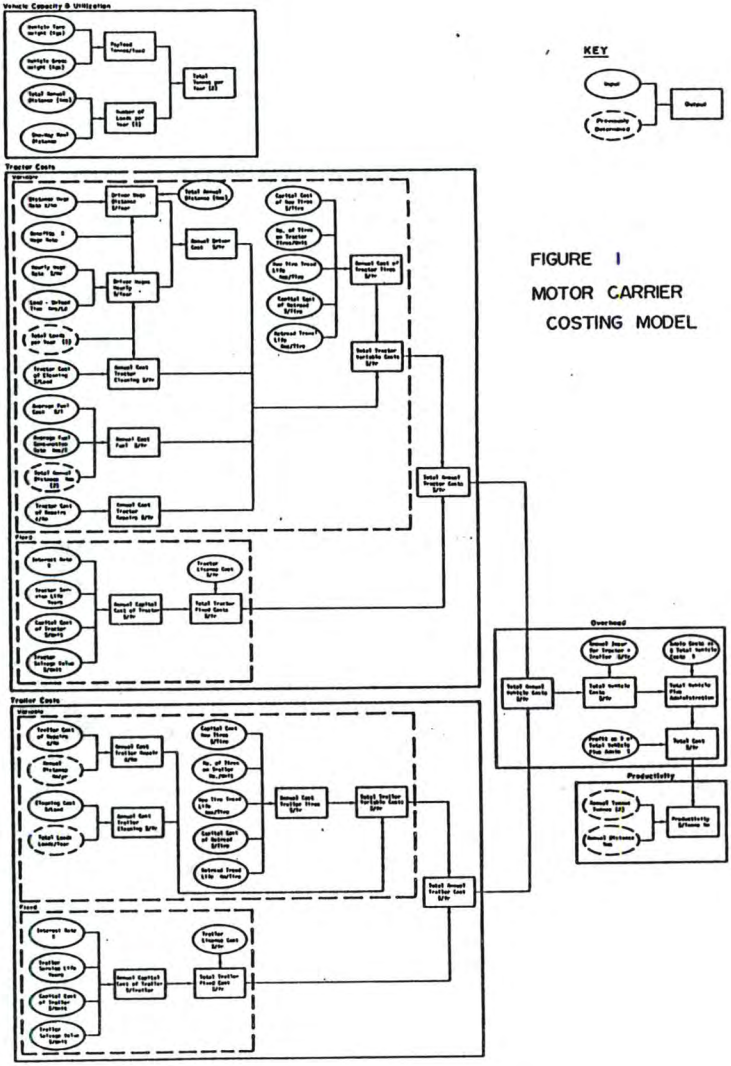


FIGURE 1
MOTOR CARRIER
COSTING MODEL

This is done as illustrated in Table 1 for a 5 axle tanker unit by specifying three values for each parameter. These values represent a minimum value, a maximum value and a most likely value for each parameter. (Observed values would be expected to fall inside the range defined by the minimum and maximum values about 98% of the time, i.e. ± 2 standard deviations from the mean.) The deterministic model is then used to evaluate the sensitivity of productivity to individual parameters by setting the value of all parameters equal to their most likely value except for one which is evaluated at its maximum and minimum value. The results of such a sensitivity analysis for a 5 axle tanker using the deterministic costing model illustrated in Figure 1 are summarized in Table 1 and illustrated in Figure 2. (Note: No allowance has been made for administration costs and profits. The analysis therefore allows for only vehicle operating costs as opposed to total operating costs. This is appropriate for our purposes herein because we are primarily concerned with the impact of changes in VWD regulations on vehicle productivity.)

From Figure 2 it is noted that the various parameters can be generally categorized relative to the senstivity of productivity to changes in values of their individual parameters (i.e. % variation column in Table 1). They might be generally classified as relatively insensitive, moderately sensitive and very sensitive. (The parameters to which productivity is highly sensitive are identified in Table 1 by **).

Given the results of the sensitivity analysis it is possible to conclude that issues related to productivity will be primarily determined by the values of parameters to which productivity is very sensitive, to a lesser extent to those to which productivity is moderately sensitive and largely unaffected by those to which productivity is relatively insensitive.

For the example illustrated in Table 1 and Figure 2 it is possible to conclude that productivity is:

1) highly sensitive to:

   - vehicle capacity and utilization as measured by vehicle tare weight and total annual distance
   - tractor cost as measured by distance wage rate

2) moderately sensitive to:

TABLE 1

DETERMINISTIC SENSITIVITY 5 AXLE-TANKER

INPUT PARAMETER	TYPICAL VALUE - INPUTS			ASSOCIATED PRODUCTIVITY (CENTS/TONNE KM)				
	MINI(1)	MAXI(1)	MOST LIKELY	MINI	MAXI	MOST LIKELY	I VARIATION	SENSITIVITY
VEHICLE CAPACITY AND UTILIZATION								
VEHICLE GROSS WEIGHT (KGS)	37500	37500	37500	2.58	2.58	2.58	0	
VEHICLE TARE WEIGHT (KGS)	11500	14500	13000	2.43	2.75	2.58	12	**
PAYLOAD (KGS PER LOAD)	23000	26000	24500	NA	NA	NA		
TOTAL ANNUAL DISTANCE (KMS)	90000	240000	170000	2.42	3.08	2.58	26	**
ONE WAY HAUL DISTANCE (KMS)	500	900	700	2.54	2.65	2.58	4	
TOTAL LOADS	186.9	340.0	242.9	NA	NA	NA		
TOTAL TONNES PER YEAR	4344.4	8840.0	5950.0	NA	NA	NA		
AVERAGE SPEED (KMS/HR)	80	100	90	2.58	2.58	2.58	0	
TRACTOR COSTS								
VARIABLES								
DISTANCE WAGE RATE ($/KM) (2)	0.12	0.18	0.15	2.42	2.74	2.58	12	**
HOURLY WAGE RATE ($/HR) (2)	6.5	12.5	9.75	2.53	2.62	2.58	3	
BENEFITS AS % OF WAGE RATE (%)	25	40	32	2.53	2.64	2.58	4	
LOAD-UNLOAD TIME (HRS/LOAD)	0.5	1.5	1	2.5	2.55	2.58	2	
AVERAGE FUEL PRICE (C/L)	25	35	30	2.49	2.67	2.58	7	
AVERAGE FUEL CONSUMPTION RATE (KMS/L)	2.6	1.8	2.2	2.49	2.7	2.58	5	
TRACTOR COSTS OF REPAIR ($/KM)	0.02	0.06	0.04	2.5	2.66	2.58	6	
TRACTOR COST OF CLEANING ($/LOAD)	1	5	3	2.57	2.59	2.58	1	
NO. OF TIRES ON TRACTOR (TIRES/UNIT)	10	10	10	2.58	2.58	2.58	0	
CAPITAL COST OF NEW TIRES ($/TIRE)	260	460	360	2.57	2.59	2.58	1	
NEW TIRE TREAD LIFE (KMS/TIRE)	100000	320000	200000	2.56	2.6	2.58	2	
CAPITAL COST OF RETREAD ($/TIRE)	240	330	280	2.57	2.59	2.58	1	

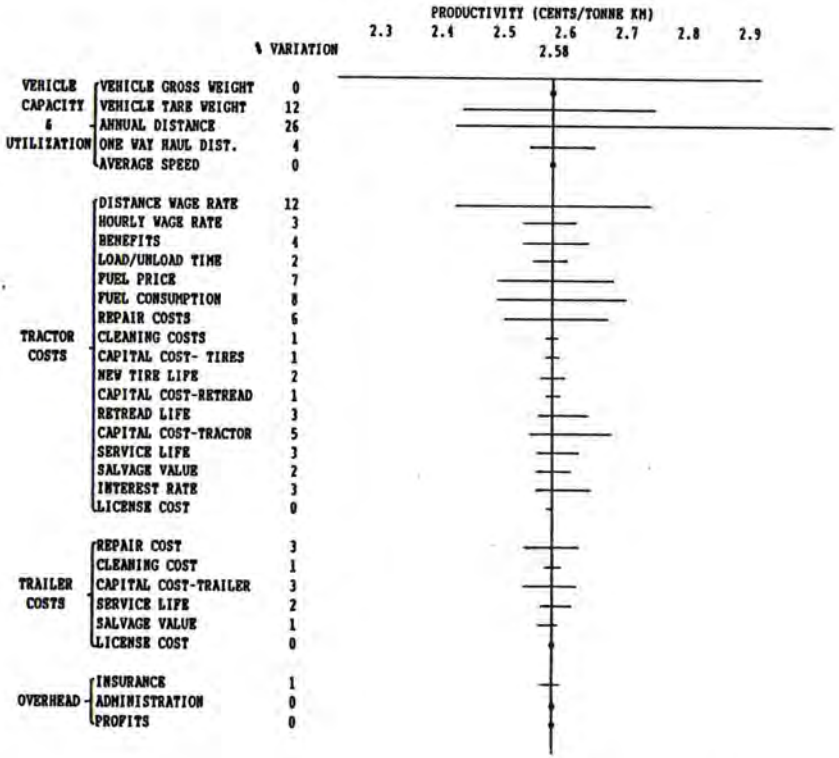
TABLE 1 (CONTINUED)

DETERMINISTIC SENSITIVITY 5 AXLE-TANKER

INPUT PARAMETER	TYPICAL VALUE-INPUTS			ASSOCIATED PRODUCTIVITY (CENTS/TONNE KM)				
	MINI(1)	MAXI(1)	MOST LIKELY	MINI	MAXI	MOST LIKELY	% VARIATION	SENSITIVITY
TRACTOR COSTS (CONT'D)								
RETREAD TREAD LIFE (KMS/TIRE)	160000	600000	360000	2.55	2.63	2.58	3	
FIXED								
CAPITAL COST OF TRACTOR ($/UNIT)	80000	110000	90000	2.54	2.67	2.58	5	
TRACTOR SERVICE LIFE (YRS)	7	10	8.5	2.55	2.62	2.58	3	
TRACTOR SALVAGE VALUE ($/UNIT)	20000	33000	27000	2.55	2.61	2.58	2	
INTEREST RATE (%)	8	14	10	2.55	2.64	2.58	3	
TRACTOR LICENSE COST ($/YR)	1500	2200	2000	2.57	2.58	2.58	0	
TRAILER COSTS								
VARIABLE								
TRAILER COST OF REPAIRS ($/KM)	0.04	0.07	0.055	2.53	2.62	2.58	3	
CLEANING COST ($/LOAD)	1	5	3	2.57	2.59	2.58	1	
NO. OF TIRES ON TRAILER (NO./UNIT)	8	8	8	2.58	2.58	2.58	0	
FIXED								
CAPITAL COST OF TRAILER ($/UNIT)	30000	50000	40000	2.53	2.62	2.58	3	
TRAILER SERVICE LIFE (YRS)	6	10	8	2.56	2.61	2.58	2	
TRAILER SALVAGE VALUE ($/UNIT)	5000	13000	10000	2.56	2.59	2.58	1	
TRAILER LICENSE COST ($/YR)	22	22	22	2.58	2.58	2.58	0	
OVERHEAD								
ANNUAL INSURANCE - TRACTOR & TRAILER ($/YR)	3300	4400	3900	2.56	2.59	2.58	1	
ADMIN. COSTS % OF TOTAL VEHICLE COSTS (%)	0	0	0	2.58	2.58	2.58	0	
PROFITS AS % TOTAL VEHICLE PLUS ADMIN. (%)	0	0	0	2.58	2.58	2.58	0	

(1) VALUES WOULD BE EXPECTED TO FALL OUTSIDE THE RANGE DEFINED BY THE MINIMUM AND MAXIMUM 2% OF THE TIME.
(2) IN SOME CASES DRIVERS ARE PAID A MILEAGE RATE FOR DRIVING AND AN HOURLY RATE FOR LOADING / UNLOADING / WAITING.

FIGURE 2 DETERMINISTIC SENSITIVITY
5 AXLE TANKER



- benefits as % of wage rate
- fuel price
- fuel consumption rate
- tractor repair costs, and
- capital cost of tractor

3) relatively insensitive to all other parameters.

From the above, it can be seen that the critical parameters in terms of productivity/economic viability are the relative magnitudes of vehicle capacity, utilization and labor costs.

It is important to note that this analysis represents a particular operating scenario. This scenario is described by the values assigned to the costing variables. The costs (productivity) would be substantially different if the scenario changed. To illustrate, it has been assumed that a new tractor costing between $80,000 - $110,000 with a service life of 7-10 years and a salvage value of $20,000 - $33,000 was used on the haul. If a used tractor with a capital cost of $25,000 were used the cost incurred and therefore the productivity would be substantially different. It is for these reasons that it is very difficult to generalize when dealing with costing and therefore productivity measures.

5.0 Probabilistic Model

The deterministic model detailed in the previous section indicated that the productivity (vehicle costs) of a "typical" 5 axle tanker operation is in the order of 2.58 cents per tonne km (given the assumptions used). It was further illustrated how these costs could vary up to 2-26% by varying any one of a number of parameters to which productivity is sensitive.

The deterministic sensitivity analysis summarized in the previous section is very informative in terms of identifying individual important parameters. It would also be of considerable interest to determine the combined effect of varying a number of sensitive parameters at one time as opposed to varying them one at a time as was done in the previous section. This type of analysis is possible if the previous deterministic model is extended to include a probabilistic structure.

Such a probabilistic model is conceptually illustrated in Figure 3 for those parameters for which the deterministic model was determined to be very sensitive. (2) In effect, the probabality distributions for the highly sensitive parameters are combined (as per the costing model) to provide a probability distribution for

FIGURE 3
PROBABILISTIC MODEL
5 AXLE TANKER

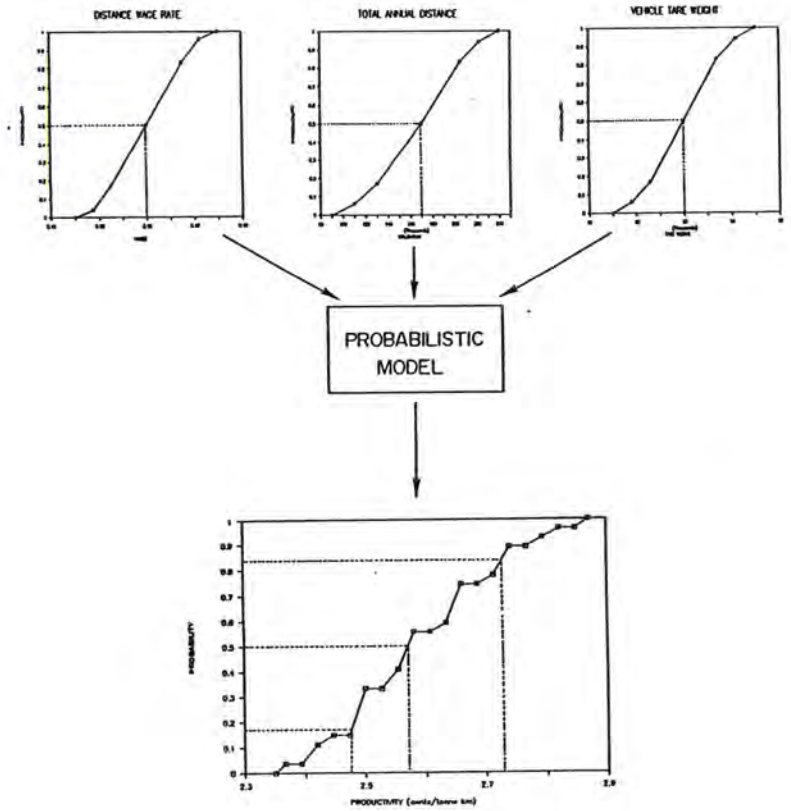
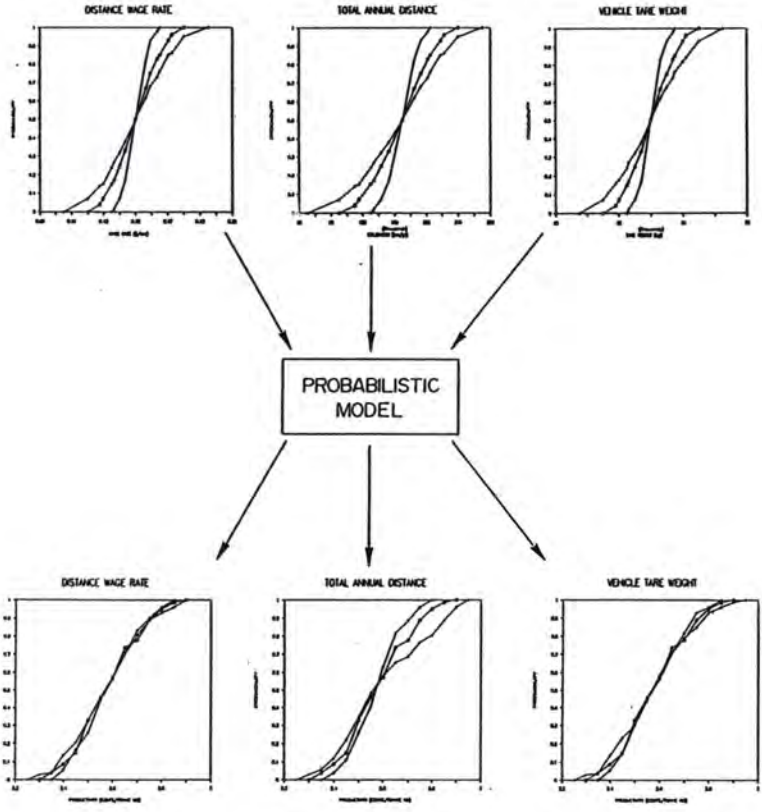


FIGURE 4
STOCHASTIC SENSITIVITY
5 AXLE TANKER



productivity as measured by the cost per tonne km. The expected value as provided by the probabilistic model is equivalent to the value provided by the deterministic model when the most likely values for all parameters are used. The probability distribution for productivity as provided by the probabilistic model gives a measure of uncertainty in this measure of effectivess (as measured by the variance of the probability distribution). This uncertainty in the measure of productivity is the result of the (combined) uncertainties of the input parameters. As noted from Figure 3, for the given case (i.e. 5 axle tanker), the expected cost would be 2.58 cents per tonne km and the range (i.e. ± one standard deviation) would be 2.5 - 2.7 cents per km. (Note: There are some minor discrepancies between the deterministic model and the stochastic one because of descretness of the data input into the stochastic model.)

6.0 Stochastic Sensitivity

Another issue that is of potential interest is the question of how does the probability distribution of productivity vary as the probability distribution for a given parameter varies. This is in effect a measure of the stochastic sensitivity. The result of such an analysis for the 5 axle tanker is illustrated in Figure 4.

From Figure 4, it can be noted that the distribution of productivity is not very sensitive to changes in the distribution of any one of the parameters analyzed. From this, one would conclude that little is to be gained from improved information about these parameters.

7.0 Model Applications

The previous sections have presented the details of two models (one deterministic and one stochastic) which illustrate the functional relationship between the parameters which determine motor carrier productivity.

These models and the associated analysis result in a good understanding of productivity and the parameters that affect it. The primary issue of concern here is however how do changes in vehicle weight and dimension regulations affect productivity. The use of the previous models in analyzing these types of questions might be illustrated by the following example.

Suppose current regulations (and other considerations) dictate that a particular haul be undertaken using a 5 axle semi-trailer tanker at a maximum gross vehicle weight of 37,500 kgs. (The operation is described by the data in Table 1). Suppose a regulator is considering changing the

VWD regulations so that the haul under consideration could be carried out using a 7 axle A-Train at 53,500 kgs. (The operation being described by the data in Table 2.) One might carry-out a deterministic sensitivity analysis similar to that illustrated in Table 2. One could also illustrate the results as per Figure 2, develop a stochastic model similar to that in Figure 3 and carry-out a stochastic sensitivity as per Figure 4. (Space does not permit so doing here.)

(Note that the three most sensitive parameters are now, annual distance, distance wage rate, and fuel consumption. That is fuel consumption has replaced vehicle tare weight in moving from the 5 axle semi to the 7 axle unit.) Similar calculations could be performed for 7 axle B-Trains, and 8 axle A and B-Trains. (See (3) for details.)

The implications of the proposed change in VWD regulations on productivity for each type of vehicle are illustrated in Figure 5. From Figure 5 it is noted that the expected productivity for the 5 axle unit is approximately 2.6 cents per tonne km with a standard deviation of about .1 cent/tonne km and for the 7 axle A-Train unit it is about 2.2 cents per tonne km, also with a standard deviation of about .1 cent/tonne km. Put another way, the productivity of the 5 axle unit would be expected to be approximately 2.6 cents/tonne km and lay in the range of 2.5 and 2.7 cents per tonne km 68% of the time (i.e. expected value plus or minus one standard deviation). Similarly the productivity of the 7 axle A-Train unit would be expected to be about 2.2 cents/tonne km and lay in the range of 2.1 - 2.3 cents/tonne km 68% of the time.

In short, the change in regulations would be expected to result in a change in vehicle productivity that would be detectable (i.e. the probability distributions for the 5 axle unit and the 7 axle A-Train in Figure 5 do not overlap very much - there is a high probability that there is a significant difference between the means). Put another way, the difference between the expected productivities for the two vehicles is large relative to the uncertainties associated with the expected values.

The previous example has illustrated how productivity might be enhanced within a particular jurisdiction by increasing allowable gross vehicle weights and thereby permitting the use of larger, differently configured vehicles. By moving from a permitted GVW of 37,500 kgs to 53,500 kgs, productivity could be increased by 15% (2.6 - 2.2 = .4; .4/2.6 = 15%).

It is of potential interest to also compare the

TABLE 2

DETERMINISTIC SENSITIVITY 7 AXLE-TANKER (A TRAIN)

INPUT PARAMETER	TYPICAL VALUE - INPUTS			ASSOCIATED PRODUCTIVITY (CENTS/TONNE KM)				
	MINI(1)	MAXI(1)	MOST LIKELY	MINI	MAXI	MOST LIKELY	% VARIATION	SENSITIVITY
VEHICLE CAPACITY AND UTILIZATION								
VEHICLE GROSS WEIGHT (KGS)	53500	53500	53500	2.17	2.17	2.17	0	
VEHICLE TARE WEIGHT (KGS)	16300	19300	17800	2.08	2.26	2.17	8	**
PAYLOAD (KGS PER LOAD)	34200	37200	35700	NA	NA	NA		
TOTAL ANNUAL DISTANCE (KMS)	90000	240000	170000	2	2.66	2.17	30	**
ONE WAY HAUL DISTANCE (KMS)	500	900	700	2.14	2.22	2.17	4	
TOTAL LOADS	188.9	340.0	242.9	NA	NA	NA		
TOTAL TONNES PER YEAR	6460.0	12648.0	8670.0	NA	NA	NA		
AVERAGE SPEED (KMS/HR)	80	100	90	2.17	2.17	2.17	0	
TRACTOR COSTS								
VARIABLES								
DISTANCE WAGE RATE ($/KM) (2)	0.13	0.19	0.16	2.05	2.28	2.17	11	**
HOURLY WAGE RATE ($/HR) (2)	6.5	12.5	9.75	2.14	2.19	2.17	2	
BENEFITS AS % OF WAGE RATE (%)	25	40	32	2.13	2.21	2.17	4	
LOAD-UNLOAD TIME (HRS/LOAD)	0.5	1.5	1	2.12	2.22	2.17	5	
AVERAGE FUEL PRICE (C/L)	25	35	30	2.1	2.25	2.17	7	
AVERAGE FUEL CONSUMPTION RATE (KMS/L)	2.3	1.3	1.8	2.07	2.35	2.17	13	**
TRACTOR COSTS OF REPAIR ($/KM)	0.02	0.06	0.04	2.12	2.23	2.17	5	
TRACTOR COST OF CLEANING ($/LOAD)	1	5	3	2.16	2.18	2.17	1	
NO. OF TIRES ON TRACTOR (TIRES/UNIT)	10	10	10	2.17	2.17	2.17	0	
CAPITAL COST OF NEW TIRES ($/TIRE)	260	460	360	2.16	2.19	2.17	1	
NEW TIRE TREAD LIFE (KMS/TIRE)	100000	320000	200000	2.16	2.19	2.17	1	
CAPITAL COST OF RETREAD ($/TIRE)	240	330	280	2.17	2.18	2.17	0	

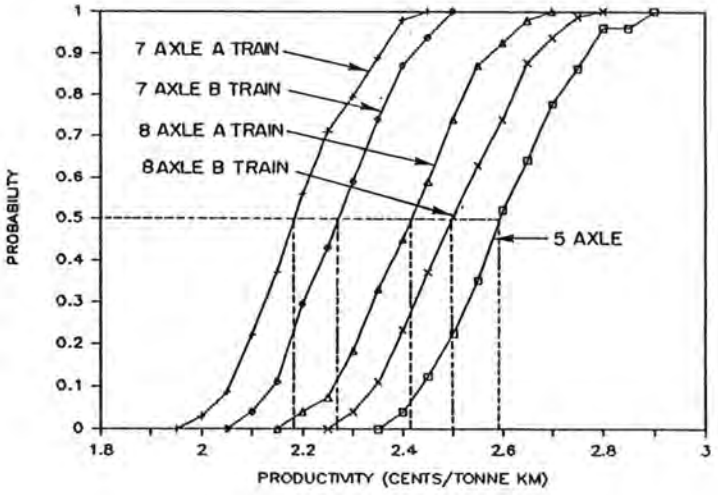
TABLE 2 (CONTINUED)

DETERMINISTIC SENSITIVITY 7 AXLE-TANKER (A TRAIN)

INPUT PARAMETER	TYPICAL VALUE-INPUTS			ASSOCIATED PRODUCTIVITY (CENTS/TONNE KM)				
	MINI(1)	MAI(1)	MOST LIKELY	MINI	MAI	MOST LIKELY	I VARIATION	SENSITIVITY
TRACTOR COSTS (CONT'D)								
RETREAD TREAD LIFE (KMS/TIRE)	160000	600000	360000	2.22	2.15	2.17	3	
FIXED								
CAPITAL COST OF TRACTOR ($/UNIT)	85000	125000	105000	2.11	2.23	2.17	6	
TRACTOR SERVICE LIFE (YRS)	6	10	8	2.14	2.23	2.17	4	
TRACTOR SALVAGE VALUE ($/UNIT)	22000	38000	30000	2.15	2.2	2.17	2	
INTEREST RATE (I)	8	14	10	2.14	2.24	2.17	5	
TRACTOR LICENSE COST ($/YR)	2500	3200	2900	2.17	2.17	2.17	0	
TRAILER COSTS								
VARIABLE								
TRAILER COST OF REPAIRS ($/KM)	0.06	0.105	0.08	2.12	2.24	2.17	6	
CLEANING COST ($/LOAD)	1	5	3	2.16	2.19	2.17	1	
NO. OF TIRES ON TRAILER (NO./UNIT)	16	16	16	2.17	2.17	2.17	0	
FIXED								
CAPITAL COST OF TRAILER ($/UNIT)	70000	100000	85000	2.13	2.21	2.17	4	
TRAILER SERVICE LIFE (YRS)	8	12	10	2.16	2.2	2.17	2	
TRAILER SALVAGE VALUE ($/UNIT)	13000	20000	17000	2.17	2.18	2.17	0	
TRAILER LICENSE COST ($/YR)	22	22	22	2.17	2.17	2.17	0	
OVERHEAD								
ANNUAL INSURANCE - TRACTOR & TRAILER ($/YR)	5000	7000	6000	2.16	2.19	2.17	1	
ADMIN. COSTS I OF TOTAL VEHICLE COSTS (I)	0	0	0	2.17	2.17	2.17	0	
PROFITS AS I TOTAL VEHICLE PLUS ADMIN. (I)	0	0	0	2.17	2.17	2.17	0	

(1) VALUES WOULD BE EXPECTED TO FALL OUTSIDE THE RANGE DEFINED BY THE MINIMUM AND MAXIMUM 2I OF THE TIME.
(2) IN SOME CASES DRIVERS ARE PAID A MILEAGE RATE FOR DRIVING AND AN HOURLY RATE FOR LOADING / UNLOADING / WAITING.

FIGURE 5
PRODUCTIVITY vs. VEHICLE CONFIGURATION
TANKERS



productivity of particular fleets operating in different regulatory environments across the country. Such a comparison is illustrated in Table 3 and Figure 6 for tankers transporting petroleum products in various jurisdictions across the country. As summarized in Table 3, different vehicle configurations operating at different axle and gross vehicle weights dominate the haul in various jurisdictions depending upon the regulatory environment in which they must operate. Figure 6 illustrates the implications of these various regulatory environments on vehicle productivity in fuel transportation. It is interesting to note that of the possible configurations analyzed, the tractor - semi trailer operating in New Brunswick is the least productive while the same vehicle configuration operating at higher axle and gross vehicle weights in Quebec is among the most productive (i.e. compare curve 1 and curve 2 in Figure 6). It is also interesting to note that the productivity of this fleet varies about 20% due to the difference in regulatory environments across the country.

8.0 Conclusions

Increases in productivity and efficiency are the primary motivating forces behind changes in vehicle weight and dimension regulations which permit larger and/or heavier vehicles to operate on Canada's public highway system.

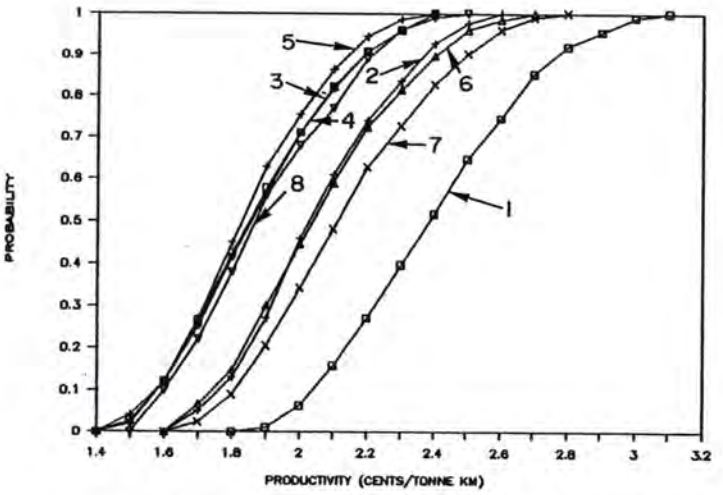
The methodology developed and illustrated herein illustrates that changes in vehicle productivity resulting from changes in vehicle weight and dimension regulations can be determined. Further if a probabilistic approach is used, it is possible to gain insight into the uncertainty in the measures of productivity as a function of uncertainty in input parameters. This can be an important consideration because a measure of uncertainty will enable an analyst to determine whether or not the expected impact on vehicle productivity would be expected to be detectable by fleet operators (i.e. noticeable changes) or whether the changes would be so small as to be "swamped" by the "noise" in the system.

The model used in this particular effort illustrates that vehicle productivity is a function of a very large number of identifiable parameters (seé Figure 1). Values for any one of these parameters can vary substantially (i.e. the capital cost of a tractor capable of pulling a semi trailer could vary from $120,000 for a new unit to $25,000 for an old one; the tare weight of a particular type of vehicle can vary by 15-25% depending on the design and the materials used). The high potential variability in values for various parameters necessitates the development of "typical" scenarios inorder to determine and compare the

TABLE 3 TYPICAL TRUCK CONFIGURATIONS FOR PETROLEUM PRODUCTS HAULING

DESCRIPTION	N.B.	QUEBEC	ONTARIO (1)	ONTARIO (2)	ONTARIO (3)	MANITOBA	SASK.	B. C.
CONFIGURATION	(TRACT-SEMI TRAILER) 3-S3	(TRACT-SEMI TRAILER) 3-S3	B-TRAIN 3-S3-S2	B-TRAIN 3-S2-S2	(TRACT-SEMI TRAILER) 3-S4	A-TRAIN 3-S2-2	A-TRAIN 3-S2-2	B-TRAIN 3-S3-S2
NUMBER OF AXLES	6	6	8	7	7	7	7	8
REGISTERED GVW (kg.)	50,000	54,203	63,500	62,100	61,230	54,875	53,500	63,500
TARE - TRACTOR (kg.)	9,000	8,618	8,810	8,810	9,000	9,000	9,000	9,072
- TRAILER (kg.)	9,000	8,437	11,100	10,150	9,600	6,833	6,833	11,453
- TOTAL (kg.)	18,000	17,055	19,910	18,960	18,600	15,833	15,833	20,525
PAYLOAD (kg.)	32,000	37,147	43,590	43,140	42,630	39,042	37,667	42,975
AXLE WEIGHTS (kg.)								
- 1 STEERING	6,000	6,258	7,005	7,500	6,500	4,675	4,500	5,500
- 2	17,000	18,960	17,055	18,500	18,310	16,000	15,750	17,000
- 3								
- 4	9,000				9,155			7,000
- 5		28,985	20,860	19,100	9,155	16,000	15,750	
- 6	18,000					9,100	8,750	17,000
- 7				17,000	18,310	9,100	8,750	
- 8			18,580					17,000

FIGURE 6 PROBABILITY DISTRIBUTIONS FOR PETROLEUM HAUL ACROSS CANADA FOR TYPICAL VEHICLE CONFIGURATION



LEGEND: 1. NEW BRUNSWICK, 3-S3 at 50,000 kg.
2. QUEBEC, 3-S3 at 54,203 kg.
3. ONTARIO (1), 3-S3-S2 at 63,500 kg.
4. ONTARIO (2), 3-S2-S2 at 62,100 kg.
5. ONTARIO(3), 3-S4 at 61,230 kg.
6. MANITOBA, 3-S2-2 at 54,875 kg.
7. SASKATCHEWAN, 3-S2-2 at 53,500 kg.
8. BRITISH COLUMBIA, 3-S3-S2 at 63,500 kg.

productivity of vehicles.

Using the scenario approach, it was possible to identify the parameters to which vehicle productivity are most sensitive. Further it was possible to compare productivity of various vehicle configurations within particular jurisdictions as well as across jurisdictions.

In general terms, vehicle productivity for a given permitted gross weight is most sensitive to:

1) vehicle tare weight,

2) annual utilization in terms of annual distance travelled,

3) wages in terms of distance wage rate, and

4) fuel consumption.

Vehicle productivity was found to be highly sensitive to allowable gross vehicle weights and vehicle configuration (i.e. 5 axle semis versus 7 axle A-Trains etc.). Combination units (i.e. 7 and 8 axle A and B-Trains) were found to be typically 15-25% more productive than 5 axle semis operating at the same axle weights but higher gross weights. Given the fact that gross vehicle weights are typically a constraint in existing regulations, 7 axle units were found to be in some cases more productive than 8 axle units. This is attributable to their lower tare weights (and therefore higher payloads) and somewhat lower capital costs.

Vehicle productivity is very sensitive to permitted axle weights. Increasing axle weights translates directly to increased payloads and therefore increased productivity. Increasing gross vehicle weights on the other hand usually translates into different vehicle configurations (i.e. more trailers and more vehicles) and while increasing payload, there is also an associated increase in tare weight. This increase in tare weight in part offsets the increase in payload relative to the increase in allowable gross vehicle weight.

To illustrate, it was found that the 5 axle configuration in the fuel haul is potentially one of the most inefficient vehicles used (i.e. under New Brunswick's allowable axle weights) and potentially one of the most productive (i.e. under Quebec's allowable axle weights).

In conclusion, vehicle weight and dimension regulations do have an important impact upon vehicle productivity. These differences in productivity are associated primarily with

allowable axle weights which directly affect payloads and allowable gross vehicle weights that affect vehicle configurations which in turn affect payloads. Within existing regulatory regimes in Canada, productivity differences of 15-25% are observed over various vehicle configurations (i.e. 5 axle versus 7 and 8 axle) and over various jurisdictions (i.e. for the same vehicle in different provinces).

FOOTNOTES

1. This model draws heavily in a structural sense upon one prepared by Trimac Consulting Services Ltd. for Transport Canada. The report is entitled: "Operating Costs of Trucks in Canada".

2. This draws heavily upon a probabilistic motor carrier costing model developed at the University of Saskatchewan, Saskatoon.

3. "Study of Vehicle Weights and Dimension Regulations and Canada's Trucking Industry: Background Paper #5, Productivity Implications of Vehicle Weight and Dimension Regulations". Prepared for the Transportation Development Centre, Transport Canada, by Clayton, Sparks & Associates Ltd., November 1986.

Analysis of Managerial Practices of Medium-Sized For-Hire Trucking Firms

by

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Introduction

This paper presents selected findings of a research project undertaken in 1986 by the Transportation Management Center at Concordia University and the Centre de recherche en gestion of Université du Québec à Montréal.

This project was funded in part by a special F.C.A.R. grant under a research program on goods movement sponsored jointly by the Ministère de l'Education supérieure, des Sciences et de la Technologie and the Ministère des Transports du Québec. The overall objective of this program is to develop management aids and techniques for the trucking industry, so as to help it maintain and even improve its competitiveness in the context of deregulation(1,2).

Medium-size For-Hire trucking firms based in Québec were the object of this investigation. It was felt that those firms needed more help than larger firms, which generally benefit from highly professional management, because they can better afford the human and technical resources necessary to make the most effective use of recent developments in management principles, approaches, and techniques.

Also, sophisticated techniques developed for large firms are usually complex, often customized, and, as a result not applicable to or available to medium-size firms. It was felt finally that techniques and aids developed for medium-size firms could, in time, be applied to smaller firms.

The objective of the research project was to analyze the managerial practices of these firms, so as to identify their major strengths and weaknesses, and this, in order to establish priorities for the subsequent development of management aids and techniques designed specifically for medium-size for-hire trucking firms.

Ultimately, the use of such aids by these firms and the resulting improvement of their managerial practices should help them become more competitive as the trucking industry moves into a deregulated environment (3,4).

Methodology

The significant characteristic of this study resides in the *microscopic* approach to the subject. Rather than study the industry or whole segments of it, as is done for other purposes (5,6), the study focused on individual firms and their managerial practices.

In this research a medium-size firm was defined as employing between 50 and 300 persons. This corresponds to annual gross revenues in the order of 5 to 10 million dollars. Only firms headquartered in Québec were considered.

According to professional industry directories, 37 firms could be considered of medium size as defined above when the study was performed. Of those, 20 were selected for investigation. The selection of firms to be interviewed was partly random, but also took into account the willingness of the firms to be surveyed. To ensure a balanced geographic distribution, firms were surveyed across the province of Québec and not just in the Montréal Region.

Data on managerial practices were collected through personal interviews. A detailed interview guide was prepared, covering all aspects of the firm's management. The guide comprised over 250 questions, many of them open; the questions were grouped as follows:

corporate planning,
accounting,
finance,
marketing and sales,
operations management,
human resources management,
management information systems,
executive management.

Interviews were conducted by teams of two researchers. The respondent was normally the chief operating officer, who called in his key associates when needed. Interviews lasted on the average three hours and a half and cooperation obtained from the firms interviewed was always excellent.

Although no effort was made to draw statistical inferences from the survey data, it is felt that, by interviewing 20 firms out of a possible total of 37, a faithful representation of managerial practices of typical medium-size firms was obtained. The findings reported herein are necessarily amalgamated in order to maintain confidentiality of the responding firms.

Moreover, data collected in the survey was quite adequate, both in quantity and in quality, to fulfill the specific objective of the project, that is to establish priorities for the development of managerial aids and techniques developed specifically for medium-sized trucking firms.

Methodology

20 Firms selected out of an industry group of 37
Detailed interview guide (250 questions)
covering all aspects of the management of the firm
Average interview duration: three hours and a half

Selected findings from analyses of the survey data are presented below. Detailed findings were published elsewhere (7).

Major Strengths of the Firms

Major strengths of the medium-size firms were found to be in the speed of managerial reaction, the efficiency of operations management, and the quality of human resources management.

Executive management of these medium-size firms is often highly centralized. As a result, information on problems and opportunities is systematically channeled to top management, where decisions are taken rapidly. The firm is thus able to react fast to unexpected or unforeseen situations.

The management of day-to-day operations such as dispatching, tracing, billing, etc., appears to be quite efficient in the medium-size firms surveyed. This is not meant to imply that trucks are optimally dispatched or that tracing is faultless. Rather, what was observed is that operational functions are usually the object of careful planning, attentive direction, and rigorous control.

Computers are not frequently used to assist in the planning or control of operations, but detailed operational plans are prepared daily and carried out under strict control. Responsibilities are clearly divided between the various functions and levels of operations management.

Significant Managerial Strengths Observed

Firms react fast to unforeseen situations
Careful planning and control of operational functions
Good personnel relations, even with unionized labor

Despite the frequent absence of a Personnel Department, most of the firms interviewed appear to master the management of their human resources. Top management often knows most employees personally and is aware of their wants and performance. Labor relations appear good, even with unionized labor. Clearly, management perceives the importance of human resources and their contribution to the success of the firm, particularly in operations.

Major Weaknesses of the Firms

Major weaknesses are areas in which there appears to be a greater need for developing managerial aids to assist the medium-size trucking firms. Major weaknesses were found in the areas of corporate planning, sales and marketing, and the assignment of responsibilities to middle-level management.

Too often, no formal or systematic method is used for drawing up corporate plans in these firms, which, due to the lack of precise objectives, find it difficult to position themselves with respect to new situations as they occur. The lack of corporate planning is partly due to the absence of management reports that would serve as a basis for drawing up the plan.

Significant weaknesses were also observed in marketing and sales. Firms do not appear to be sales-oriented: sales targets are seldom precisely identified and sales objectives are not systematically formulated and assigned. Little marketing research is performed and even less used as a basis for formulating a marketing strategy.

There is no adequate method for measuring customer satisfaction; too often, no clear distinction is made between the real needs of (present and potential) customers and the requests received for services currently offered.

The third weakness observed is, in a way, the adverse consequence of a highly centralized management (which results in swift corporate reaction, a strength mentioned above): the responsibilities of middle managers are often limited in scope and, as a result, they are disinclined to take initiatives outside their immediate work scope.

Managerial Weaknesses Observed

Lack of corporate planning: too many unforeseen events
Organization oriented towards operations/rather than sales
Insufficient responsibilities and authority assigned to middle management

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The three weaknesses outlined above appear in the first analysis to be related to management style and organizational culture. And indeed they are, because present-day medium-size trucking firms are often young and still managed by the owner-founder with the help of his/her immediate family: management, in such a situation, is almost inevitably centralized.

But this is not the only explanation. Even in medium-size firms where professional management is present, it may be difficult to push responsibilities down to the middle levels of management.

Middle managers do not receive all the information that they would need to make a greater number of decisions on their own, and, as a result, can not easily be held accountable for all aspects of the operations under their authority.

This is due in large part to the absence of a management information system (computer-based in all likelihood) that would process the large amounts of operational data that is usually compiled for statistical purposes into management information in an appropriate form to serve as a basis for decision-making. More will be said on this later in this paper.

Determinants of Success

In the course of this research, 20 medium-size trucking firms were surveyed and analyzed in detail as to their managerial practices. In many cases, the researchers had access to their financial statements. In all cases, the researchers, given the benefit of the lengthy interview and their own observations on site, were able to obtain a fairly accurate evaluation of the firm's success.

As a result, they were thus placed in a good position to answer the following question. What determines the success of a medium-size trucking firm ?

As there often are economies of scale in the trucking industry, one would naturally think of size as a determinant of success. If this were true, the larger firms (in the sample of 20) should be more successful. Observations made in the course of that study do not confirm this.

To the contrary, the most successful firms are amongst the smallest; some of the largest firms showed very significant managerial weaknesses.

In fact, the most successful firms amongst those surveyed showed the following characteristics:

> they have defined a clear mission for themselves, and or have found a specific niche in the market (be it a geographic area or a specific product) in which they excel and do not fear competition;
>
> management is decentralized; middle managers have a clear perception of the firm's mission; they are assigned ample responsibilities and corresponding authority, and are expected to take initiatives;
>
> an efficient information system (computerized or not) ensures that every manager has the information necessary to make the decisions under his/her responsibility.

Determinants of Success

Clearly defined mission and/or market niche
Responsibilities and authority assigned to middle management
Efficient management information system (computerized or not)

The managerial aids to be developed in future projects under this research program should be designed to help medium-size firms create the above conditions in their corporate environment.

A first step in this direction is the establishment of a management information system as described below.

Management Information Systems

Questions in the interview guide helped draw a summary inventory of the computer hardware and software used by the firms, but their main intent was to help the researchers understand the circulation of management information through the firm. The questions also aimed at evaluating the application of structured information systems, thus measuring the importance of management information in the decision-making process and its patterns of circulation through the firm.

The survey revealed a wide range of situations, from the presence of a M.I.S. Department to the total absence of any computerized data processing; from micro-computers to super-minis. The largest amongst the firms surveyed use complex systems and maintain elaborate data banks, which respond to most needs of their managers.

Several firms have hired hardware suppliers to develop computerized accounting applications for them. As a result of using such a procedure, there is often no systematic analysis of all the firm's information requirements. In such a situation, one may

forget that all sectors of the firm have specific information needs and could benefit from computerized applications.

Computers are thus now used primarily for accounting applications: corporate accounting, general ledger, accounts payable and receivable, billing; some customer statistics are compiled. Consequently, the Comptroller is often responsible for the data processing function.

M.I.S. Situation of Medium-Size Trucking Firms
Quite variable from firm to firm
Primarily used for accounting applications
All firms favorable to increased use of computers
Managerial requirements of increased computerization are generally underestimated

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All firms interviewed are favorable to expanding their computer applications, often even very favorable. This is understandable. Large trucking firms are computerized. A considerable amount of expertise already exists: for instance, up-to-date directories of software applications for trucking firms (8), detailed guides for establishing management information systems (9). Medium-size trucking firms feel that computerization would help them also and several of them place high hopes in the introduction of a new computer.

Do they overestimate its potential for improvement ? Do they underestimate the scope of organizational changes that would result from the computerization process ? Probably, according to the survey.

As many trucking firms feel a favorable prejudice towards computerization, one should use this opportunity to help these firms first *systematize* themselves and then develop a computer-based management information system to be used effectively in the decision-making process. But how should this be done ?

Implementing an efficient and profitable management information system must be based on a correct evaluation of the firm's information requirements and careful planning, to ensure that the unavoidable organizational changes are brought about without any major difficulty. Significant steps in the computerization process must be clearly identified and taken one at a time.

More precisely, the following should be recommended to ensure a smooth computerization process yielding durable improvements:

a requirements analysis should be performed in each firm, to precisely identify the needs to be fulfilled by the computer system;

this analysis should make clear what the computerization process will imply: organizational changes, impacts on human resources, on administrative procedures, etc.

the computer solutions must be carefully adapted to the specific information requirements of the firm, rather than to available hardware and/or software;

computerization must be progressive, so that the firm can adapt to this fundamental change.

Requirements for Cost-effective M.I.S. Development

Information needs assessed with formal requirements analysis
Evaluate organizational and human implications
Hardware and software adapted to firm and not vice-versa
Progressivity to adapt to fundamental changes

A management information systems developed based on these principles will truly help the firm face new challenges, including those resulting from deregulation; for instance, facilitate accurate costing of various services and operational policies.

Survival of trucking firms will depend, in a large measure, on their ability to accurately estimate the cost of the services they currently offer or contemplate offering in the future. A computer-based management information system, tailored to the firm's specific needs, appears to be the best method to reach that goal.

In some cases, firms should regroup to find joint solutions to common problems: development, implementation and even operating costs for the system could be shared between several users of a common information system. There are thus advantages to striving for a high degree of harware and software compatibility.

As computerization will bring about profound changes in managerial policies, styles, and procedures, the most difficult problems involved in computerization will be associated with human and organizational changes. It will be necessary for top management to involve itself with the process so as to generate the necessary support in all departments. This is a requisite condition for successful systematization and computerization.

M.I.S. Implementation Guide

As a result of the foregoing, there appears to be a need for the development of a management guide to help medium-size trucking firms through the systematization and computerization process. That guide should help those firms formulate a computerization and systematization strategy adapted to their own needs. That strategy will help them obtain the maximum benefit from this process of change, in the context of their own operations.

Such a guide should help those firms to:

evaluate their situation with respect to the availability and circulation of management information, the efficiency of their management systems, and the adequacy of their data processing;

determine precisely their needs with respect to management information and computer systems and services, given the nature of their operations and their managerial style, and given also the available human, financial, and technical resources;

evaluate the impacts of systematization and computerization, and the changes to be expected in management procedures, systems, practices, and habits, given the new systems and procedures envisioned and the qualifications and experience of existing personnel; evaluate the profitability of computerization in their case;

As a result of the foregoing, the firm would obtain a clear and detailed systematization and computerization strategy adapted to its own needs and resources.

Conclusions

This paper has reported on an in-depth managerial analysis of medium-size for-hire trucking firms in Québec. Strengths and weaknesses were identified in order to help establish priorities for the development of management techniques and aids designed specifically for those firms. The development of an efficient management information system appears to be a priority. Such a system should be designed for each firm's needs and take into account its human, technical and financial resources. The implementation of the system should be carefully planned so as to minimize the adverse effects of organisational changes resulting unavoidably from systematization and computerization.

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Disclaimer

This paper represents the views of the authors and does not necessarily reflect the official position of the governmental agencies or universities mentioned.

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Ontario Owner-Operators

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ABSTRACT

This paper develops information on the characteristics of owner-operators in Ontario from data obtained from a 1983 roadside survey and from Statistics Canada's most recent trucking data.

1. Introduction

Each province and territory is responsible -- with some assumption of federal powers -- for its own regulation of trucking and its own vehicle-registration system. One of the consequences is that there is no common meaning for the term "owner-operator" (or "broker", "independent trucker", "lease-operator", etc.). The following situations may be thought of as owner-operators in certain cases and in certain provinces and/or territories:

- A person owning and operating a vehicle re-registered in the name of a for-hire or private carrier.
- A person owning and operating a vehicle where the registration is in the owner's name but a formal lease-agreement exists and is noted on the registration.
- A person owning a vehicle re-registered in a carrier's name with a lease agreement filed with a regulatory board.
- A person with an operating authority permitting the hauling of trailers of named carriers and/or shippers.
- A person owning a vehicle, hauling exempt commodities, and working for and/or contracting with an exempt-commodity carrier (no vehicle re-registration or authorities involved).
- A person residing in a province where there is no economic regulation (ie, operating authorities or licenses are available as long as the applicant meets certain minimal requirements) and operating a licensed for-hire vehicle under contract to some other enterprise (motor carrier, forwarder, transportation broker, shipper).

Without providing a precise definition, an owner-operator can be thought of as someone owning a truck -- straight truck, tractor, or tractor and semitrailers -- and operating that truck or using hired drivers to haul freight under someone else's authority. "Authority" is

used here to mean the specific authority contained in a for-hire trucking licence, the authority to haul goods on a private-carriage bases (in which case there is usually no operating licence), the authority to haul goods for-hire on an exempt-commodity basis, or the authority implicit under some other enterprise's service (eg, the enterprise that issues the bill of lading and/or that arranges the hauling contract). These details on the institutional setting affecting the use of owner-operators have been described in an earlier paper. [1]

The existence of owner-operators creates important policy issues for governments. First, as the regulatory control of for-hire trucking is relaxed, the use of owner-operators may increase. This is speculation as to-date no evidence has been found linking this growth with the changing regulatory environment in Canada. Second, and independent of the issue of the increasing use of owner-operators, their use may have important consequences for other regulatory programs. For-example, owner-operators may respond differently than company drivers to weight and dimension regulations, hours-of-work regulations, truck-route by laws, vehicle-safety regulations, dangerous-goods regulations, and so on. These possibilities are also speculative. Third, the use of owner-operators creates difficulties for both federal and provincial governments in terms of labour and/or social-welfare legislation (worker's compensation is the best known example): the issue being the difficulty of defining an employee versus a self-employed contractor.

The importance of these issues is difficult to gauge: there has been so little data available that quantitative analysis has been almost non-existent. (There has been extensive analysis in the U.S., some of which may have relevance for Canadian policies.) Previous attempts at describing owner-operators, using heroic assumptions, have estimated that (in 1981) as much as one-third of all long-distance trucking in Canada may be undertaken by owner-operators and that their use is on the increase [2], or that (in 1982) as much as 15% of the entire trucking industry (for-hire and private) and as much as 9% of total freight-transportation in Canada may be accounted for by owner-operators. [3]

In the present paper new and better data sources are used to develop information on owner-operators.

2. The Data Sources

Ontario conducts periodic roadside surveys to collect information about characteristics of trucks using its highways. The latest one, in the summer of 1983, was conducted at 43 roadside inspection stations, 8 international border crossings, and 3 interprovincial border crossings. There were a total of 13,213 interviews, representing 20.1% of the trucks passing through. After a number of adjustments (to correct for missed trucks and missed hours and to eliminate multiple counting of truck trips), estimates were made for average annual daily truck traffic. The final data base of 45,800 truck trips represents a typical day's activity on Ontario highways. Further information on methodology, limitations, and possible biases are discussed in the report produced from the survey. [4]

A problem with this source is the choices used to describe "driver employment" in the questionnaire. Drivers were asked to categorize themselves as follows, with the total response shown in parentheses:

broker	(5.5%)
company driver	(82.5%)
self	(8.0%)
driver agency	(2.5%)
don't know	(1.5%)

Given the difficulties with terminology, given the possible interpretations drivers might give to these terms, and given the survey's own lack of precise definitions, the accuracy of these responses is not known. For here, the assumption is made that all of the "broker" and some of the "self" -- those further categorized as "for-hire" self -- are owner-operators. This is not a perfect division of drivers into owner-operators versus other types, but it is the best that can be done with the available data.

Statistics Canada also collects data on the trucking industry. The latest information (1984) is used both to expand on the information contained in the Ontario survey and as a basis for comparison. [5] In terms of the for-hire industry, the only information collected is the amount spent by carriers in purchasing owner-operator services. As for the newer private-truck data, more specific information on the use of owner-operators is available (how many, how much equipment, distance driven, etc.); however, there may be problems with this data in the sense that it appears to blend point-in-time measurements of the number of owner-operators and the amount of equipment with annual figures such as owner-operator costs and distance driven.

The data collected by Statistics Canada has a different framework than the Ontario data making comparisons between the two sources difficult, although not impossible. Statistics Canada captures information according to the province of domicile of the carrier's head office (or reporting unit); the Ontario data captures trucks on-the-road irrespective of the domicile of their head office. Further, the two surveys employ quite different methodologies: Statistics Canada uses a census survey of all carriers (within certain categories) and collects what amounts to year-end financial and operating data; the Ontario survey uses a sampling technique at a number of roadside points and collects data based on relatively short interviews about particular trucks on particular trips -- supplemented to some extent with other vehicle-registration information.

The attempt here is to use these quite different sources to analyze the characteristics of owner-operators.

3. Analysis

In the following, the terms "broker" and "self" are used in the same manner as in the Ontario survey. [6] The term "owner-operator" is used to mean the sum of the "broker" and "for-hire-self" categories, even though some of the "for-hire-self" responses may not be owner-

operators and even though some of the "private-self" categories may be owner-operators. In terms of Statistics Canada's data, "owner-operator" means "broker" as defined in their publications. [7]

"Company driver" in the case of Ontario data means the total sample less the "broker" and "self" categories. This is a slight over-simplification of the survey's original five categories (ie, the 4.0% of the sample categorized as "driver agency" or "don't know" are being grouped with "company drivers"). "Total" in the case of Ontario data, means the total sample (45,800 trip observations); and in the case of Statistics Canada data "total" means the sum of for-hire and private carrier data, even though there are exclusions from this data base.

		1983 Ontario Data				
		Broker	Self For-Hire	Self Private	Company Driver	Total
1. total trips		2,534	1,670	2,015	39,578	45,797
	%	5.5	3.7	4.4	86.4	100
2. total RGVW	%	6.8	4.0	3.1	86.1	100
3. total load	%	7.7	4.9	3.7	83.6	100
4. total trip distance	%	9.6	3.7	4.5	82.2	100

		StatsCan Data: Owner-Operator Expenses as % of Total					
		1975	1980	1981	1982	1983	1984
For-Hire							
5. Canada	%	11.2	15.5	15.6	16.0	16.8	18.3
6. Ontario	%	9.9	13.1	13.3	13.6	14.8	15.6
Private							
7. Canada	%						6.2
8. Ontario	%						5.3
TOTAL							
9. Canada	%						13.8
10. Ontario	%						12.1

TABLE 1 Significance Of Owner-Operators

3.1 Importance of Owner-operators

The Ontario data indicates that owner-operators account for 9.2% of all truck trips -- 5.5% broker and 3.7% for-hire-self (Table 1). Other measures from this source indicate that owner-operators account for 10.8% of the total registered gross vehicle weight (RGVW), 12.6% of the total payload, and 13.3% of the total kilometres.

The data from Statistics Canada, although using a different framework, supports these Ontario figures. As shown in Table 1, 12.1% of total operating expenses are accounted for by owner-operators. Further (not shown in Table 1), for Ontario-domiciled private truckers, where

owner-operator expenses only account for 5.3% of total expenses, this 5.3% translates into one of every five road tractors being operated by owner-operators! The Statistics Canada data also indicates that the use of owner-operators has been increasing -- from 11.2% of for-hire operating expenses in 1975 to 18.3% by 1984 [8], but that the use of owner-operators by Ontario-domiciled carriers is less than in other parts of Canada (compare Ontario's 12.1% with the Canada-wide 13.8%). On this last point, that the use of owner-operators is less in Ontario than elsewhere, the private truck data indicates that 27% of the road tractors in all of Canada are operated by owner-operators whereas in Ontario only 20% are operated by owner-operators.

3.2 Use of Owner-Operators

The Ontario data indicates that owner-operators are used more extensively in for-hire trucking operations than in private: 17.3% of all for-hire truck trips are accounted for by owner-operators (9.1% broker and 8.1% self) versus 2.6% of the private truck trips. Another 8.0% of the private truck trips are classified as "self" but these private-self drivers appear to consist largely of small operators from sectors such as retail, farming, construction, and other trades (as is shown later). The Statistics Canada data (Table 1) also supports the observation that for-hire carriers use owner-operators more extensively than private carriers: in 1984, 15.6% of the operating expenses of Ontario for-hire carriers were accounted for by owner-operators versus only 5.3% for private carriers. [9]

The data from Ontario also suggests that owner-operators are used more extensively on extraprovincial hauls than on intraprovincial: owner-operators accounted for 12.3% of the trips crossing a provincial boundary versus 7.8% of the trips entirely within the province.

The 1984 Statistics Canada for-hire data may be disaggregated as shown in Table 2. The first six lines show the percent of total operating expenses spent on owner-operators by industry segment (general freight, dump, etc.) and by class of carrier. [10] On line 7, those carriers from line 6 classified as international are shown separately. On line 8, the household goods carriers (all three classes) are shown, and on line 9 the total industry is shown (the same figures as in Table 1).

The most notable point about the data in Table 2 is the absence in of owner-operators in "bulk-liquid" trucking. This low usage of owner-operators for bulk-liquid hauling is responsible for the relatively low total usage of owner-operators in the province in comparison with other regions. (Note in the last column that the use of owner-operators in other industry segments in Ontario is similar to the national figures.) A second point about the information shown in Table 2 is that the use of owner-operators is more pronounced in large firms than in small firms. A third point, even though the data is incomplete, is that the use of owner-operators by international carriers is higher than the industry average. Finally, in terms of industry segments, the use of owner-operators in Ontario is concentrated in the forest products, dump truck, and "other" segments.

Freight Carriers	Class 1		Class 2		Class 3		Total	
	Can %	Ont %	Can %	Ont %	Can %	Ont %	Can %	Ont %
1. gen. fr.	16.8	14.6	13.1	12.7	11.6	6.5	16.1	14.2
2. bulk liq.	16.8	1.7	18.3	1.2	3.3	1.2	14.8	1.5
3. dump	28.0	27.5	18.5	29.6	10.8	9.4	16.3	20.8
4. forest	35.8	34.0	18.6	22.2	5.5	6.9	17.8	23.2
5. other	30.7	24.1	19,0	17.1	11.4	8.3	26.2	21.8
6. TOTAL	20.7	16.6	16.9	15.5	9.0	7.2	18.7	15.9
7. international component	23.2	17.9	21.9	18.7	19.8	*		
Household Goods Carriers class 1,2,3							11.1	10.1
GRAND TOTAL							18.3	15.6

* not available

TABLE 2 For-Hire Trucking -- Use of Owner-Operators
(Statistics Canada, 1984, owner-operator expenses as % of total)

The Statistics Canada data on private carriers can also be used to show which sectors of the economy use owner-operators. For Canada as a whole, the following shows the cost of owner-operators as a percent of (trucking) operating costs for firms in the following sectors:

construction	7.5%
manufacturing	5.7%
other (mining, logging, fishing, etc.)	8.6%
government	5.1%
wholesale	6.9%
retail	0.8%

Another way of characterizing the use of owner-operators is shown in Table 3. [11] Here, from the Ontario survey, the distribution of drivers among Ontario's "carrier type" schema is shown in the top half of the table (ie, reading down the columns), and the distribution of driver categories within each industry segment is shown in the bottom half of the table (ie, reading across the rows). Driver categories are subdivided between for-hire ("f-h") versus private ("p"). To show the importance of various driver categories, all percentages 50% higher or more than the total industry distribution are in bold face. For example, the dump-truck segment of the industry accounts for 3.3% of all drivers; the 7.5% shown for for-hire brokers is in bold face as this is over double the industry-wide distribution. The bold faces in the bottom half of the table are interpreted in the same way (the industry-wide distribution is shown in this case in the row labelled "total") and the pattern of bold faces is identical to that shown in the top half of the table.

A) Distribution by Driver Category

	Broker		Self		Co. Driver	
	f-h %	p %	f-h %	p %	f-h %	p %
1. LTL general freight	6.7	4.5	4.0	3.6	14.7	8.2
2. TL general freight	24.1	32.1	15.1	22.0	22.8	25.9
3. local gen. freight	0.1	0.0	2.7	1.8	1.1	0.8
4. household goods	2.2	1.1	1.0	5.7	1.0	1.0
5. live animals	1.1	0.0	2.1	6.1	0.9	0.9
6. new & used autos	7.7	2.9	5.4	1.3	12.0	3.3
7. liquid bulk tank	1.0	1.1	1.4	1.5	4.6	6.3
8. dry bulk tank	0.5	0.0	1.5	0.7	1.2	1.3
9. dump	7.5	6.4	14.2	4.8	3.3	1.7
10. oversize	1.5	0.0	0.4	0.1	0.6	0.2
11. parcel/courier	0.0	0.5	0.1	0.8	1.0	0.9
12. lumber & wood pr.	9.2	10.9	9.3	16.4	8.0	11.6
13. non-bulk farm pr.	5.9	1.3	6.0	14.0	2.2	4.4
14. air freight	0.6	0.0	0.1	0.0	0.1	0.1
15. primary metal pr.	14.3	11.9	8.5	5.7	7.2	5.7
16. scrap metal & garb.	1.9	8.8	2.3	2.9	0.7	1.9
17. containers	1.9	1.1	4.3	2.7	2.2	2.9
18. other	13.7	17.5	21.6	9.8	16.4	23.0

B) Distribution by Industry Segment

	Broker		Self		Co. Driver	
	f-h %	p %	f-h %	p %	f-h %	p %
1. LTL general freight	2.8	0.5	1.5	1.5	55.4	38.2
2. TL general freight	4.4	1.6	2.4	3.9	36.6	51.2
3. local gen. freight	0.7	0.0	10.2	7.9	43.8	37.5
4. household goods	7.5	1.0	3.1	19.4	31.9	37.1
5. live animals	4.4	0.0	7.0	23.3	31.5	33.8
6. new & used autos	4.9	0.5	3.0	0.8	68.0	22.7
7. liquid bulk tank	0.9	0.3	1.0	1.3	36.2	60.3
8. dry bulk tank	1.9	0.0	4.9	2.4	40.2	50.7
9. dump	10.1	2.4	16.5	6.3	39.3	25.5
10. oversize	15.0	0.0	3.8	0.8	55.6	24.8
11. parcel/courier	0.0	0.8	0.4	3.8	43.6	51.5
12. lumber & wood pr.	3.9	1.3	3.4	6.8	30.2	54.3
13. non-bulk farm pr.	6.4	0.4	5.7	14.9	20.8	51.9
14. air freight	21.6	0.0	2.7	0.0	35.1	40.5
15. primary metal pr.	9.1	2.1	4.7	3.6	40.6	39.9
16. scrap metal & garb.	5.2	6.6	5.4	7.7	17.5	57.6
17. containers	3.2	0.5	6.2	4.4	32.6	53.1
18. other	3.1	1.1	4.2	2.2	32.8	56.6
TOTAL	4.3	1.2	3.8	4.2	38.7	47.7

TABLE 3 Ontario: Owner-Operators and Industry Segment

There are some possible anomalies between the data shown in this table and that shown later. In particular, 14.2% of the for-hire-self drivers are classified in the "dump" segment of the industry, whereas

later it will be shown that 27.4% of their equipment is classified as "dump." (The importance of this is that the heavy concentration of for-hire-self drivers within gravel hauling may help to explain some of their characteristics in comparison to the other owner-operators.)

	Industry Segment Accounting For Most of the Activity	Industry Segment Where Drivers Are Relatively Important
For-Hire Brokers	69.0% of all activity	
	TL general freight	air freight
	primary metal products	oversize (dimens.)
	"other"	dump
	lumber & wood products	primary metal prod.
	new & used autos	household goods
Private Brokers	81.2% of all activity	
	TL general freight	scrap metal/garbage
	"other"	dump
	primary metal product	primary metal prod.
	lumber & wood products	
	scrap metal & garbage	
For-Hire Self	68.7% of all activity	
	"other"	dump
	TL general freight	local general fr.
	dump	live animals
	lumber & wood products	containers
	primary metal products	
Private Self	68.3% of all activity	
	TL general freight	live animals
	lumber & wood products	household goods
	farm products	farm products
	"other"	local gen. fr.
	live animals	lumber & wood prod.
For-Hire Co. Drivers	73.9% of all activity	
	TL general freight	new & used autos
	"other"	
	LTL general freight	
	new & used autos	
	lumber & wood products	
Private Co. Drivers	75.0% of all activity	
	TL general freight	
	"other"	
	lumber & wood products	
	LTL general freight	
	liquid bulk tank	

TABLE 4 Ontario: Summary of Industry Segments Using Owner-Operators

To summarize the information shown in Table 3, the top five industry segments in terms of employment are shown for each driver category in Table 4. In addition, the relatively important industry segments (ie, 50% or more above the industry distribution) are also shown.

A first point to note, which helps explain the assumption made previously about which drivers are owner-operators, is the categories where the private-self drivers are relatively important: notice in particular the "live animals," the "household goods" -- presumably people who have rented a truck and who are moving their own goods, the "farm products," and the "local general freight." All of these industry segments suggest that private-self drivers tend to be the one-truck-one-person type of operation (tradesmen, farmers, retail operations, etc.).

A second point to note is that company drivers dominate every industry segment -- for-hire company drivers in six segments and private drivers in the remaining twelve. A third point is that owner-operators, any of the three driver categories, are used in all industry segments. In other words, the use of owner-operators is widespread throughout the trucking industry, but in no case do owner-operators constitute a majority of the drivers (at least in the industry segments defined in the Ontario survey).

While the use of owner-operators is widespread, there are areas of concentration. Actually, it is easier to first note those areas where owner-operators are not used much: LTL general freight is the most obvious area, followed by the automobile carriers, the liquid bulk tank carriers, and to a lesser extent the dry bulk tank carriers. The areas where the use of owner-operators stands out include the dump industry [12], the hauling of primary metal products, the scrap metal & garbage sector, and the forest-products haulers.

Although the Statistics Canada and Ontario data are quite different, particularly in the industry segments defined, they do support each other in several broad areas: owner-operators are not used much by bulk liquid carriers in Ontario (unlike elsewhere), but they are used extensively in the dump and forest-products sectors.

3.3 Fleet Characteristics

The Ontario data shown in Tables 5 and 6 provides information on fleets which helps further to characterize the various kinds of drivers. There are two points to note. First, there are minor differences in some of the distributions shown. This occurs because slightly different data sets from the total 45,800 were used in the compilations (some data records were incomplete and dropped out). Second, the information on energy-saving devices has to be interpreted with care as the percentages are obviously affected by the proportion of assorted body styles within the various fleets (eg, some body styles such as dump or flatbed tend not to use bubble or air deflector equipment).[13]

	Broker		Self		Company
	f-h	p	f-h	p	Drivers
1. RGVW - mean (kg)	46,275	43,603	40,896	27,417	37,019
2. tare - mean (kg)	8,406	8,041	8,471	6,687	7,994
3. model year of power unit	1978	1979	1978	1977	1979
4. energy-saving devices					
- bubbles (%)	6.2	8.2	2.3	5.1	8.5
- deflectors (%)	6.0	4.6	5.0	2.0	16.5
5. configuration					
- straight truck (%)	5.5	9.9	20.1	54.7	22.4
- truck + trailer (%)	2.4	3.5	6.8	4.7	4.8
- tractor (bobtail) (%)	3.1	6.4	0.7	0.4	1.2
- tractor-semitrailer (%)	82.4	76.5	67.7	36.9	67.1
- B-train (%)	3.1	3.5	2.2	1.6	1.9
- A-train (%)	3.2	0.3	1.7	1.4	1.9
- other (%)	0.3	0.0	0.3	0.2	0.7
6. body style					
- van (%)	43.1	42.2	26.9	44.5	49.3
- reefer (%)	8.5	9.9	10.4	6.5	8.5
- concrete mixer (%)	0.0	0.2	0.0	0.0	0.3
- stake (%)	5.5	7.8	10.2	13.5	5.0
- dump (%)	12.9	9.0	27.4	11.1	7.1
- tank (%)	3.5	4.0	1.9	2.5	10.0
- flatbed (%)	15.4	14.6	15.9	15.2	11.1
- car carrier (%)	2.5	2.6	3.2	0.4	2.9
- float (%)	1.6	0.3	1.3	0.3	0.6
- other (%)	6.5	9.6	2.9	5.9	5.2
7. number of axles					
- 2 (%)	2.5	5.5	9.6	43.4	17.1
- 3 (%)	3.7	11.1	12.0	10.3	7.5
- 4 (%)	1.6	3.8	3.8	3.7	5.8
- 5 (%)	67.8	59.9	50.0	29.7	54.2
- 6 (%)	13.4	9.1	14.3	7.0	10.0
- 7 (%)	2.9	4.2	6.6	3.0	3.1
- 8 (%)	6.4	5.0	3.4	2.4	1.9
- 9 (%)	1.1	1.7	0.1	0.4	0.3
- 10 (%)	0.0	0.0	0.2	0.0	*
- 11 (%)	1.0	0.0	0.1	0.0	*

TABLE 5 Ontario: Fleet Characteristics by Driver Category

The for-hire-broker fleet: For-hire brokers operate the heaviest trucks; the average registered weight (RGVW) is 24% higher than the sample mean. They tend to operate trucks that are slightly older than other drivers' trucks and that have somewhat fewer energy-saving devices. In terms of configurations, these drivers are highly concentrated in the tractor-semitrailer class (more so than any other group); they use few straight trucks; and, they are the relatively largest users of double-trailer combinations (A- and B-trains). They also have a significantly higher than average appearance in tractors

(ie, "bobtailing tractors" or tractors with no semitrailers) -- this higher than average figure being explained largely by the low incidence of straight trucks in this fleet compared to others. In terms of body style, for-hire brokers tend to have a higher than average number of dumps and floats and a lower than average number of tanks. While the use of 5-axle equipment is quite pronounced (more so than any other group), these drivers also have the highest concentration of equipment with more than five axles (24.8%).

More detail on the for-hire broker fleet is shown in Table 6. Tractor-semitrailers, which constitute 82.4% of the total, are primarily the standard 5-axle variety (78% of the 82.4) and most of the rest have 6 or more axles. If the "reefer" (temperature controlled) body styles are included, 57% of these tractor-semitrailers are vans. The next highest category (17%) is flatbeds. Trains, while not a large part of the fleet (6.3%), are relatively more concentrated in this fleet in comparison to any of the other driver classes. Most of these (61%) are 8-axle units, and the spilt between A- and B-trains is roughly equal. The most common body style for trains (57%) is the dump -- which tend to be A-trains. B-trains are more evenly distributed among vans, dumps, and stakes.

The private-broker fleet: Private brokers are similar to for-hire, only they tend to operate slightly lighter equipment, with slightly less concentration on tractor-semitrailers, more emphasis on straight trucks, and slightly fewer double-trailer configurations -- particularly B-trains. Even more so than for-hire brokers, these drivers are seen in an above average number of bobtailing tractors (again, explained in part by the low incidence of straight trucks). In terms of body style, the low incidence of tank and float equipment is all that is indicated in Table 5. In terms of axles, 20.0% of these configurations have more than five axles.

Considering the more detailed information in Table 6, the predominance of 5-axle tractor-semitrailers, primarily with van body styles, stands out -- although not quite to the extent as is the case for the for-hire brokers.

The for-hire-self fleet: These drivers operate equipment that tends to be lighter than that operated by brokers -- although the average RGVW is still higher than the industry average. The equipment also tends to be older than the average; and there is a low incidence of energy-saving devices. The figures shown in Table 5 suggest that there is nothing remarkable about the distribution of configuration types for the for-hire-self drivers: it is close to that of the industry as a whole (not shown). However, in terms of body styles, these drivers have a much higher use of stake, dump, and float equipment and a much lower use of tank equipment than the industry as a whole. As for the distribution by the number of axles, the higher than average appearance of 3-axle equipment stands out (20% of the fleet is straight trucks), as does the high incidence of 7-, 8-, 10-, and 11-axle equipment. Altogether, 24.7% of this fleet has more than 5 axles -- almost the same as the for-hire brokers and significantly higher than the industry average.

	Broker		Self		Company
	f-h	p	f-h	p	Drivers
A) Configuration X No. Axles					
# of axles					
1. straight trucks - 2	2.25	5.16	8.68	42.48	16.13
- 3	1.18	4.40	10.72	8.73	4.65
- 4 or more	1.93	0.30	0.78	3.52	1.63
2. truck + trailer - 4 or less	0.05	0.46	0.96	1.59	0.91
- 5	1.34	1.06	4.55	1.89	2.97
- 6 or more	1.18	1.97	1.26	1.24	0.92
3. tractor only	3.05	6.37	0.72	0.50	1.17
4. tractor-semitr. - 4 or less	1.61	3.64	2.93	2.58	6.91
- 5	63.92	58.57	44.49	26.10	49.27
- 6 or more	16.97	14.11	20.60	8.19	10.92
5. trains (A & B) - 5 or less	0.11	0.00	1.14	0.45	0.61
- 6	0.16	0.15	0.00	0.05	0.47
- 7	0.32	0.61	0.84	0.35	0.99
- 8	3.80	3.03	1.98	1.69	1.42
- 9 or more	1.82	0.15	0.00	0.45	0.26
6. other	0.32	0.00	0.36	0.20	0.76
B) Configuration X Body Style					
7. straight truck - van	2.78	6.68	6.41	29.38	11.39
- stake	0.27	0.00	1.98	9.28	1.55
- dump	1.87	2.43	9.40	7.39	2.18
- other	0.54	0.76	2.46	8.73	7.27
8. truck + trailer - van	1.02	0.30	3.05	2.08	2.37
- dump	0.54	1.37	1.86	0.50	0.28
- other	0.86	1.82	1.92	2.13	2.15
9. tractor-semitr. - van	38.38	35.05	16.29	13.00	34.62
- reefer	8.46	9.26	8.68	4.91	5.16
- stake	4.39	5.46	7.60	3.18	3.07
- dump	7.49	4.25	13.71	1.79	3.87
- flatbed	14.24	13.66	14.97	9.63	8.22
- other	9.48	8.80	6.77	4.37	12.16
10. trains (A & B) - van	1.07	0.00	1.08	0.00	0.87
- stake	0.80	2.28	0.30	0.40	0.23
- dump	3.59	1.21	2.22	1.49	0.81
- flatbed	0.48	0.00	0.30	0.79	0.60
- other	0.37	0.30	0.00	0.30	1.29
11. other (incl. tractor only)	3.37	6.37	1.02	0.65	1.89

TABLE 6 Ontario: Owner-Operators and Fleet Characteristics

The information shown in Table 6 confirms these observations: note, for example the 11% of the fleet which consists of 3-axle straight trucks. Since this driver category has the highest use of truck-plus-trailer configurations (almost 7%) it is interesting to look at these trucks in more detail. Most of these have 5 or more axles (ie, they are relatively large) and the most common body style is a

van. As with the two preceding groups, the largest single component of the fleet consists of 5-axle tractor semitrailers (44%); in this case, though, there is a more even distribution of body styles among vans, dumps, and flatbeds.

The private-self fleet: The information shown in Table 5 on private self-employed drivers is revealing. Their equipment is on average far lighter than any of the other driver categories. The mean of 27,417 kg is only 74% of the industry mean. The two most significant statistics shown are that 55% of this fleet consists of straight trucks and that 43% of this fleet has only 2 axles (recall the relative importance of this group in such industry segments as live animals, farm products, household goods, and local general freight).

3.4 Trip Characteristics

The available material on trip characteristics from the Ontario survey is shown in Table 7. For-hire and private brokers are clearly different than other drivers with their mean trip distance of 606 km and 587 km respectively (line 1). Notice that 21% and 23% respectively of their trips are 750 km or more (line 4). The low average trip distance (350 km) for for-hire-self drivers is surprising as it is more characteristics of the private-self or company drivers (and thereby jeopardizing the assumption that they belong with the owner-operator category). However, given that 27.4% of their equipment is dump, this low average trip distance is understandable: gravel is not hauled over long distances.

The information on "level of utilization" (line 2) and "type of trip" (line 3) is, it is believed, somewhat subjective. Possibly the only useful information it sheds on owner-operators is that they tend to have more completely full or completely empty trips than company drivers. Specifically, the percent of trips that were either full or empty (but not partially full) for each of the driver categories is as follows: for-hire brokers -- 81.6%, private brokers -- 83.6%, for-hire self -- 80.8%, company drivers -- 74.6%.

The distribution of trips by distance block (line 4) suggests that, as previously indicated, owner-operators are used on the long distance trips. Corroborating some of the earlier characteristics about private-self drivers, it can be seen that 41.4% of their trips are less than 100 km; these drivers tend to operate locally.

3.5 Commodities Characteristics

Although data from the Ontario survey has commodity detail down to the two-digit level of the Standard Commodity Classification Code, the only tabulation undertaken for this paper was the six broad classes shown in Table 7 (line 6). At this level of generality, there is little to note other than the apparent tendency for owner-operators to haul goods that are less finished than those hauled by company drivers. (This is the "gravel influence" on the data shown in Table 7.)

TRIP CHARACTERISTICS	Broker		Self		Company
	f-h	p	f-h	p	Drivers
1. trip distance - km (mean)	607	587	350	359	329
2. level of utilization					
- empty (%)	28.3	41.0	30.8	33.3	32.0
- one-quarter full (%)	2.9	9.4	4.2	10.6	9.1
- one-half full (%)	7.9	1.8	4.7	6.4	7.8
- three-quarters full (%)	7.6	5.2	10.3	7.3	8.4
- full (%)	53.3	42.6	50.0	42.4	42.6
3. type of trip					
- peddle run (%)	11.3	19.4	15.1	17.0	19.8
- TL (%)	32.2	25.9	23.5	22.8	20.9
- LTL (%)	2.6	4.9	3.0	1.4	2.3
- shuttle (%)	52.3	46.4	54.7	51.5	55.2
- local (%)	0.1	0.0	2.2	2.7	0.4
- other (%)	1.6	3.5	1.5	4.6	1.4
4. distance blocks					
- 1 - 99.9 km (%)	15.9	17.5	41.4	32.6	25.1
- 100 - 299.9 km (%)	29.1	31.3	27.0	39.7	42.3
- 300 - 749.9 km (%)	34.3	28.1	19.2	17.1	24.5
- 750 - plus km (%)	20.8	23.1	12.5	10.6	8.1
COMMODITY CHARACTERISTICS					
5. payload tne (mean, ex M/T)	19.9	21.2	19.5	13.0	14.3
6. commod. distrib. by driver	%	%	%	%	%
- animals, food/feed/bev./tobac.	41.6	51.5	43.5	49.2	45.7
- crude materials, inedible	9.6	16.9	18.0	19.1	6.8
- fabricated mat., inedible	27.5	22.6	20.0	14.5	21.0
- end products, inedible	7.1	3.2	4.9	10.9	9.6
- motor vehicles & parts	8.4	4.4	8.8	3.3	9.4
- misc. end products	5.8	1.4	4.9	3.0	7.4
7. commod. distrib. by commodity					
- animals, food/feed/bev./tobac.	3.7	1.6	3.5	4.7	86.5
- crude materials, inedible	4.9	3.0	8.2	10.5	73.4
- fabricated mat., inedible	5.4	1.6	3.5	3.0	86.6
- end products, inedible	3.1	0.5	1.9	5.2	89.3
- motor vehicles & parts	3.8	0.7	3.6	1.6	90.4
- misc. end products	3.4	0.3	2.5	1.9	91.9
8. commodity 1 - 2,400 kg	6.4	8.0	10.1	28.1	17.8
weight 2,401 - 5,000 kg	4.4	3.5	6.8	13.4	11.3
5,001 - 10,000 kg	10.7	13.6	11.5	16.9	15.9
10,001 - 15,000 kg	17.9	12.8	10.3	5.7	11.8
15,001 - 20,000 kg	14.0	15.0	15.0	7.8	15.6
20,001 - 25,000 kg	17.5	9.4	12.8	9.5	10.1
25,001 - 30,000 kg	8.2	9.9	7.6	6.4	5.6
30,001 - 35,000 kg	9.3	8.3	13.5	3.7	6.0
35,001 - 40,000 kg	5.1	8.6	8.8	4.6	2.8
40,001 - 45,000 kg	3.4	8.0	1.9	1.4	1.6
45,001 - 50,000 kg	0.3	1.6	0.8	1.3	0.5
50,001 - 55,000 kg	1.6	0.0	0.4	0.1	0.4
55,001 - plus kg	1.2	1.3	0.5	1.2	0.6

TABLE 7 Ontario: Owner-Operators: Trip and Commodity Characteristics

Of more significance is the information shown on commodity weight (line 5 for total payload, and line 8 for shipment weight). To simplify, the following are the percent of shipments hauled by each driver category weighing 10,000 kg or less versus those weighing 25,001 kg or more:

	10,000 kg or less	25,001 kg or more
for-hire brokers	21.5%	29.1%
private brokers	25.1%	37.7%
for-hire self	28.4%	33.5%
private self	58.4%	18.7%
company drivers	45.0%	17.5%

It is clear that owner-operators (the first three categories) tend to haul the largest shipments.

3.6 Annual Utilization, Productivity, Price/Cost

There is little data available to analyze some of the more interesting questions about owner-operators: how does their productivity compare with company drivers, what are their costs, etc.? Given the nature of the Ontario survey, little can be inferred from this source. Statistics Canada's data on for-hire carriers is limited to the amount spent on owner-operator services: this cannot be converted to a proxy for owner-operator price/cost as there is no associated measure of output. This only leaves the Statistics Canada data on private truckers, and this, it appears, is flawed.

The Statistic Canada data on private trucking gathered at least three measures that could be helpful: number of owner-operators (full and part time combined), number of tractors, total payments, and annual distance driven. It appears, though, either because of the combination of full and part time data or because the questionnaire used to collect the data had the effect of combining annual information (total payments) with averages or point-in-time data (number of owner-operators) that the data is less than perfect. Annual total earnings of $49,595 (Canada) or $55,000 (Ontario), and an annual average 49,230 km per tractor (Canada) or 55,358 (Ontario) seem unrealistic.

If, however, the "total payments" and "total distance" data does coincide (ie, if they are both annual figures), there may be some value to numbers listed below, showing 1984 annual average earnings (payments) per kilometre for a number of different divisions of the Statistics Canada data. In considering these numbers, it should be noted that the "government" sector accounts for 25% of all owner-operators and their $2.22 per km is obviously having a marked effect on the overall average of $1.74 per km. It is not known if the $2.22 is a data problem or if the government-employed owner-operators are some sort of special case (snow-plough operators?). But even ignoring the (possible) problem with the $2.22/km, the other figures shown also appear high. The one other source of information on the subject suggest -- on the basis of a small telephone survey of carriers -- that

for-hire owner operator rates in 1984 were more in the range of $0.45 to $0.55 per kilometre. [14]

	Payments per km
Total industry	$1.08
Ontario Carriers	$1.01
Canada-wide,	
predominantly local truckers	$1.61
predominantly intercity	$0.88
Canada-wide,	
construction	$1.42
manufacturing	$0.95
other (mine/fish/log)	$0.88
government	$2.22
wholesale	$0.76
retail	$0.90

4. Summary

The data analyzed here supports the following observations:

1) Owner-operators constitute a significant part of trucking in Ontario -- something in the range of 12.1% of total operating expenses (1984, Statistics Canada) or 9.2% of total truck trips (1983, Ontario survey) or 20% of the road tractors (1984, Statistics Canada, for private carriers only -- presumably the percentage is higher for for-hire carriers).

2) The use of owner-operators in Ontario, as in the rest of the country, is on the increase.

3) The Ontario trucking industry does not use owner-operators as extensively as the industry in other provinces. This is true for both the for-hire and private truck sectors.

4) Owner-operators are used more extensively by for-hire carriers than by private carriers; they are used more extensively on extraprovincial operations -- both inter-provincial and international -- than on intraprovincial; and, they are used more on long hauls than on short hauls.

5) Considering for-hire trucking only, large carriers make far more use of owner-operators than small carriers.

6) Considering private truckers only, the construction, mining, logging, fishing, (etc.) sectors of economy make the most use of owner-operators, followed by the manufacturing, government, wholesale sectors. The retail sector uses few owner-operators.

7) The use of owner-operators is spread throughout the entire trucking industry; while there are areas of concentration, there is no industry segment without owner-operators.

8) While owner-operators are used in all types of trucking, in no segment do they dominate: company drivers constitute the majority in all industry segments identified in the Ontario survey.

9) The following types of trucking operations in Ontario account for most of the activity of owner-operators:

TL general freight	-- 21.5%
"other" (not defined)	-- 17.4%
primary metal products	-- 11.6%
dump	-- 10.1%
lumber and wood products	-- 9.4%.

10) These same five types account for a large part (63%) of the activity of company drivers. The only real difference between the two groups is that owner-operators are noticeably absent in the LTL general freight business and in the hauling of bulk liquids. The situation concerning bulk liquids is different in Ontario than elsewhere; that is, in other provinces owner-operators are used to haul these commodities.

11) Owner-operators account for 9.2% of all truck trips in Ontario. The following shows the percent of trips accounted for by owner-operators within various sectors of the Ontario trucking industry (these are the "relatively" important percentages from Table 3 and 4):

dump	-- 29.0%
air freight	-- 24.3% [15]
(oversize) dimensional goods	-- 18.8%
scrap metal & garbage	-- 17.3%
primary metal products	-- 15.9%
agricultural products (excluding bulk)	-- 12.4%.

12) In terms of fleets, the most noticeable characteristics of owner-operators is that they tend to operate the largest trucks: their average RGVW is 43,755 kg (compared to 37,019 kg for company drivers); 59.4% of their fleet has 5 axles and 23.9% has 6 or more axles (the percentages for company drivers are 54.2% and 15.4%); and, 12.7% of their fleet consists of doubles -- either trains or truck-plus-trailer combinations (versus 8.6% for company drivers).

13) In terms of body styles, the following are the most common types in which owner-operators are found in Ontario: vans -- 36.5% (or 46.0% if temperature controlled are included), dump -- 18.3%, flatbed -- 15.5%, temperature-controlled vans -- 9.5%, and stake -- 7.7%.

14) Confirming some of the previous information on truck sizes and types, and industry sectors that use owner-operators, the available trip/commodity information suggests that (i) owner-operators tend to haul large shipments (32% being over 25,000

kg versus only 17% for company drivers); (ii) owner-operators tend to be either completely full or completely empty (at least to a greater extent than company drivers -- all of this being a logical outcome of the type of freight they haul and their low rate of participation in LTL business); and (iii) owner-operators tend to haul more of the raw or unfinished products in comparison to company drivers (this observation is heavily influenced by the amount of aggregates handled).

15) Finally, information on annual utilization, productivity, and costs (price) is scarce. The small amount that is available, and there are some questions about its reliability, suggest that owner-operators are paid (1984) anywhere from a range of $0.45 - $0.55 per kilometre to a range of $0.76 - $2.22 per kilometre.

While none of these observations resolves the policy issues that may surround owner-operators, they do add a more quantitative feel to the subject than has previously being available. However, it is important to bear in mind that most of the important questions remain unanswered: why is the use of owner-operators increasing? is the use of owner-operators related to the degree or type of regulation? do owner-operators react to other (non-economic) regulatory programs in the same manner as company drivers? are there issues between carriers and owner-operators that demand attention on the part of government? what is the use of owner-operators doing to the efficiency of the truck-transportation system?

ACKNOWLEDGEMENTS AND DISCLAIMER

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NOTES

1. Clayton, A.M., Nix, F.P., 1983, "Owner-Operators in Canadian Trucking: Their Role and Status and Implications of Their Use", Proceedings, Canadian Transportation Research Forum, 19th annual meeting, Jasper, pp. 130 - 157.
2. Ibid. p. 152.
3. Nix, F.P., forthcoming, "Owner-Operators: Analysis of Research, Issues, and Data", Transportation Forum.
4. Perera, M.H., Corupe, E.G., Ontario Commercial Vehicle Survey - 1983, Ontario Ministry of Transportation and Communications, TDF-84-05, Toronto.

5. Canada: Statistics Canada, annual, Trucking in Canada, Cat. #53-222, Ottawa. In addition to the published data, Statistics Canada provided one special tabulation for this paper.
6. "Broker" is defined as someone who "owns the truck and operates it himself, usually under contract with a carrier." The term "self" does not appear to be defined in the Ontario report, however its obvious meaning is a self-employed driver.
7. Statistics Canada defines "broker" in the following terms: "Broker operators (or lessor operators), by means of owned or leased vehicles, haul trailers or other equipment for a carrier."
8. The figures shown in Table 1 include both the freight carriers and the household goods carriers as defined by Statistics Canada. Some of the previously published figures only accounted for freight carriers; therefore, the percentages shown here for the earlier years are different than those referenced in other papers.
9. Operating expenses are not identical for for-hire and private truckers. In the case of private carriers, only those expenses associated with the trucking division of the firm are counted (ie, no overhead expenses included). The effect of this is that the use of operating expenses overstates the importance of owner-operators for private carriers in comparison to for-hire carriers -- the difference is greater than that suggested by the ratio 15.6:5.3
10. Class 1 has annual revenues over $2 million, class 2 has $500,000 to $1,999,999, and class 3 has between $100,000 and $499,999.
11. The data in Table 3 were developed with the empty truck trips and the missing-data entries excluded.
12. It is assumed that the "dump" segment of the industry includes hopper-bottom equipment so that "dump" is essentially synonymous with the gravel (or aggregate) haulers.
13. A third point might be added to these observations: the Ontario data shows quite clearly that owner-operators use straight trucks. That is, 16.4% of the combined fleet of brokers and for-hire-self drivers are straight trucks (this includes the truck + trailer class). Interestingly, the Statistics Canada data on private trucking, which is not discussed in the text, shows owner-operators owning no straight trucks.
14. op. cit., Clayton/Nix.
15. The sample size for this percentage is very small -- 28 truck trips.

GRAIN SHIPMENT ECONOMICS THROUGH THE PORT OF CHURCHILL

by

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ABSTRACT

The Port of Churchill, located in Northern Manitoba, has been used for exporting grain from the Prairie provinces for the past 57 years. The Port has had a relatively short shipping season of about 12 weeks, from late July until mid-October each year, although the season has recently been extended until the end of October. During this period typically 300,000-750,000 tonnes of grain are shipped through Churchill each year, using boxcars and drawing primarily on production in Northern Saskatchewan and Western Manitoba.

Churchill is controversial as a grain port. Its supporters point out that it is the cheapest route for grain moving to European destinations, in terms of rail rates and ocean shipping rates, because it is the closest salt water port for eastbound export grain. Others suggest that there are significant costs in moving grain through Churchill which are not reflected in the rates, and that the entire grain exporting system would be more economical if the Churchill grain program were cancelled. Lurking behind this question is the issue of Churchill's usefulness as Canada's only deep water sea port on the Arctic Ocean with a rail link to the south, in terms of Arctic development, sovereignty, defence and related national objectives.

The paper presents an economic comparison of moving grain exports through Churchill relative to their movement through Thunder Bay and the Great Lakes-St. Lawrence system, dealing both with actual rates charged for rail and marine transportation and dealing also with other relevant costs which may not be fully reflected in the rates. The analysis is carried out for a variety of levels of grain movement through the Port of Churchill (ranging from 0 to 1,500,000 tonnes per year) and an analysis of the throughput capacity of the port for grain is also presented. The economic comparisons are presented under two scenarios:

(1) Assuming that the Churchill rail line and port would be kept open even if the grain program were cancelled, in order to fulfill other national objectives; and

(2) Assuming that, if the grain program were cancelled, the rail line would be abandoned.

Conclusions are drawn, based on the economic analysis, in the context of each policy framework.

This paper draws upon and summarizes the results of an extensive study entitled "Port of Churchill: Grain Shipping Costs" which was prepared by IBI Group and associated firms on behalf of Transport Canada and the Manitoba Department of Highways and Transportation, which was published in November, 1986.

GRAIN SHIPMENT ECONOMICS THROUGH THE PORT OF CHURCHILL

by

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1. STUDY OBJECTIVES AND SCOPE

The study on which this paper is based was conducted on behalf of the Government of Canada, Transport Canada, and the Government of Manitoba, Department of Highways and Transportation, under the Canada-Manitoba Subsidiary Agreement on Churchill. It was part of an overall study of the Port of Churchill conducted in 1985/86 on an integrated basis by IBI Group and its associated consultants, with the following components:

- Study A: Season Extension;
- Study B: Additional Commodities;
- Study C: Resupply Operations;
- Study D: Grain Shipping Costs.

The paper provides a brief overview of the objectives, scope, major findings and conclusions of Study D.

Objectives

As stated in the Terms of Reference, the study objectives were as follows:

A. "to clarify and explain the costs, and the elements of such costs, of moving grain by sea from Churchill within existing seasonal limits to foreign destinations over the past five years. No other type of cargo movement is to be considered."

B. "to identify and analyze any cost advantages that may obtain through the use of Churchill."

C. "to recommend any courses of action which may be taken, from the marine transportation aspect, to increase the utilization of the Port during the existing season, for the export of grain."

Study Scope

It was agreed as the study was initiated that the scope as outlined above would be expanded to include an analysis of both rates and relevant costs which may not be reflected in current rates, for the export movement of grain by land to Churchill and by sea to typical overseas markets. The rates and costs for exporting grain through Churchill were compared with those of exporting grain through the alternate ports of Thunder Bay and typical lower St. Lawrence ports.

2. GRAIN MOVEMENT PATTERNS

During the 30 year period 1956-1985, movements of export grain through the Port of Churchill have averaged about 573,000 tonnes per year; the highest throughput was 755,200 tonnes in 1977 and the lowest was 308,800 tonnes in 1980. There has been a declining trend generally since 1977, and the average throughput over the period 1976-1985 was 545,000 tonnes per year. During the same period total grain exports from Canada to Atlantic destinations (Europe, Western and North Africa, the Mediterranean Coast of Asia and the East Coast of South America, the markets for grain that passes through Churchill), increased by about two-thirds. Most of this grain was exported through Thunder Bay and the St. Lawrence system.

During the period 1960-1973, 54 percent of the grain exported through Churchill went to the United Kingdom and 88 percent to Western Europe in total, with only 6.6 percent to Eastern European nations. During the period from 1974-1985, 56 percent of Churchill grain was shipped to Eastern Europe, compared to 24 percent to Western Europe; there was also a significant increase in shipments to Mediterranean and Persian Gulf destinations, from 3.7 percent in 1960-1973 to 15.8 percent in 1974-1985. In most years since 1971 the practice of the Canadian Wheat Board (CWB) has been to ship either wheat or barley almost exclusively in a given year through Churchill.

An examination of weekly grain receipts at the various export grain terminals in recent years indicates that, during the Churchill shipping season (normally about 12 weeks between the last week of July and the third week of October), the total movement of grain to all terminal elevators does not increase significantly and there is a reduction of grain flows through Thunder Bay while grain is being received at Churchill. No corresponding interaction is evident between Vancouver and Churchill flows.

The two main conclusions drawn from the analysis of grain movement patterns were as follows:

- grain exports to destinations served by Churchill are growing and are expected to continue to grow over the longer term in spite of current soft markets stemming from the EEC/US trade war in grain;

- during the Churchill navigation season, Churchill and the Thunder Bay/St. Lawrence route tend to be in competition for grain traffic with many of the same destination countries being served by both routes.

3. ANALYSIS OF RATES AND COSTS

In recent years, the majority of grain shipped to Churchill has originated from CN shipping blocks in Northern Saskatchewan and Northwest Manitoba which have a lower rail rate to Churchill than to Thunder Bay or the West Coast. The Churchill rail rate advantage area lies east of a north-south line slightly east of Lloydminster and north of an east-west line which passes between Saskatoon and Moose Jaw. The advantage in total rail rates (including the shipper's share and the federal government contribution) to Churchill versus to Thunder Bay in the 1985/86 crop year was 92¢ per tonne from Saskatoon and $3.70 from Melfort, Saskatchewan. During the period 1978-1982 an average of 78 percent of wheat and barley shipments to Churchill originated at delivery points within the Churchill rail rate advantage area; this percentage dropped slightly to 72 percent during the period 1983-1985. Saskatoon approximates the average source for grain shipped through Churchill in that the weighted average rail rate advantage achieved relative to grain moving through Thunder Bay is about 95¢ per tonne, including grain shipped from outside of the Churchill rail rate advantage area, whereas grain from Saskatoon has an advantage of 92¢ per tonne to Churchill compared to Thunder Bay. It is recognized that, while the Canadian Wheat Board experiences these rail rate savings for grain shipped via Churchill, there are other costs of shipping grain to Churchill which are borne by all grain shippers in Western Canada and which may counterbalance these rate savings. This is dealt with in Section 4 below.

An extensive analysis was carried out of ocean shipping rates from Churchill and other Eastern Canadian grain exporting ports to destinations in Western Europe, and detailed analyses of ocean shipping costs were also carried out for the same routes, including development and application of an ocean shipping cost model. Three alternate marine routes were subjected to this analysis:

- Churchill to Northwestern Europe (e.g., Rotterdam);
- Thunder Bay directly to Northwestern Europe with an ocean going vessel; and
- Thunder Bay by laker to a lower St. Lawrence port with transshipment there to an ocean going vessel to Northwestern Europe.

It was found that marine rates on these and other routes have been subject to substantial cyclical fluctuations, with recent peaks in 1974 and 1980, "medium" levels in 1975, 1979 and 1981, and low levels

in 1972, 1977 and 1983-1985. These trends are illustrated in Exhibit 1. Rates in years of strong ocean freight markets (reflecting high demand relative to the supply of vessels) are typically about twice as high as rates in years of low ocean freight markets (an oversupply of vessels relative to demand).

Ocean shipping costs (i.e., capital and operating costs experienced by the shipping companies as opposed to the shipping rates which they charge) were also examined to put the rate comparisons in perspective. They have been substantially more stable over the years. Typically, marine shipping costs between, for example, Baie Comeau and Rotterdam for grain, with a 50 percent backhaul, are estimated to be about three-quarters of the rate charged in a medium ocean freight market year; however, costs are significantly higher than rates charged in low ocean freight market years while profit margins are greater in high market years.

Comparisons were made of the total rates paid for moving wheat from Saskatoon, Saskatchewan to Northwestern Europe (e.g. Rotterdam) through Churchill and through Thunder Bay including full rail rates and terminal elevator charges as well as marine transportation rates and transfer elevator rates at a lower St. Lawrence port for grain moved by laker vessel from Thunder Bay. To reflect the effects of the cyclical fluctuations in ocean marine rates as noted above, these comparisons were carried out for low, medium and high ocean freight markets. The total rate via Churchill was found to be lower than the total rate via Thunder Bay direct (with an ocean going vessel) or via Thunder Bay and a laker vessel (with transfer at a lower St. Lawrence port), for all three ocean freight market scenarios.

During medium ocean freight market conditions the total rate via Churchill (in 1985 dollars) is about $14.00 less than via Thunder Bay direct and about $12.40 per tonne less than via Thunder Bay and a St. Lawrence port. During years of low ocean freight market conditions the total rate via Churchill is about $7.00 per tonne less than via Thunder Bay direct and about $17.00 per tonne less than via Thunder and a St. Lawrence port; during high ocean freight market years these differences are about $10.00 per tonne and $6.00 per tonne, respectively. Similar comparisons were carried out for other Prairie origins which show that when total rail, elevator and marine rates are taken into account (rather than simply the rail rates) the "Churchill total rate advantage area" is very much larger, including virtually all of Saskatchewan and a substantial portion of Western Manitoba, including Dauphin.

4. COST COMPARISONS

As has been pointed out in a number of recent studies, there are certain cost elements (e.g., rail line related costs), not currently reflected in the rate structure upon which the above findings were based, which should be taken into account in comparing the total grain transportation cost to Canadians and to overseas grain customers for grain shipped via the three routes described above. Because a number

of these cost elements contain fixed costs (which do not vary with the amount of grain handled), the cost per tonne of grain throughput varies with the level of throughput, with decreasing costs per tonne at higher throughput levels. In order to take this into account, the transportation cost comparisons for the three routes were carried out under six grain throughput scenarios for the Port of Churchill: zero throughput, 250,000 tonnes per year, 500,000 tonnes per year, 750,000 tonnes per year, 1,000,000 tonnes per year and 1,250,000 tonnes per year, with corresponding variations in the Thunder Bay grain throughput.

The Churchill study report presents an extensive discussion of various cost elements and the reasons for including some of these and not including others in the comparison. Among the elements discussed are those relating to the grain collection system, port and terminal facilities and the marine transportation system. Within each of these systems the possibility of there being costs that are not adequately reflected in the rates or which would change the rates for different magnitudes of Churchill shipping programs on the Churchill route or on the alternative routes is discussed.

Grain Collection System

It was concluded that within the grain collection system (including the primary elevator) there was no evidence that the Churchill shipping program incurred costs any higher than the movement of the same grain on an alternative route.

Rail Transportation System

The current rail rate structure is based on distance alone with no variation in the rates charged by origin area or by destination. It was concluded that the railway rates charged under the Western Grain Transportation Act (WGTA) reflect grain movement costs in an adequate manner in general but that it is not possible to attribute specific costs to particular movements without a very detailed enquiry into the costs of various routes which would have to be much more detailed than previous studies of railway grain movement such as the Hall and Snavely enquiries.

There are some railway volume related costs associated with conditions on the Churchill line which will be required to maintain service which are not required on other routes. Difficult soil conditions now require only boxcars to be used on this route. As described in substantial detail in the report, while the number of boxcars is sufficient currently and for the next few years, it is anticipated that there will be insufficient boxcars for this purpose by 1991-1992. In order to address this problem, one of three basic actions will be required to continue grain deliveries by rail to Churchill:

- o rehabilitate additional boxcars; in this case there will be an additional capital cost as well

as additional operating costs associated with movement of these boxcars;

- o purchase specialized equipment for the Churchill route such as the articulated hopper car that has been developed and a prototype of which is now being tested on the Churchill line by CN; again, there will be capital and additional operating costs associated with this option compared to the use of conventional hopper cars;

- o refurbish the Churchill line (through the use of "cryo-anchors" to avoid thawing of perma-frost sink holes during the summer which currently can cause road-bed problems sufficient to derail conventional hopper cars) in order that conventional hopper cars can move on the Churchill line.

More information on the three alternatives is expected to be available later based on current studies being carried out by CN under the Canada-Manitoba Subsidiary Agreement on Churchill and drawing on the results of the prototype articulated hopper car tests and other analyses. A preliminary assessment of the three alternatives, carried out as part of this study suggests that under certain assumptions the articulated hopper car approach may be the most cost-effective but that either of the other two approaches might prove more cost-effective depending on factors such as the useable life of rehabilitated boxcars, capital and operating costs of the new articulated hopper cars, and the actual cost of refurbishing the rail line. For purposes of this study, the additional annual costs of the articulated hopper car approach were used; as described more fully in Chapter 4 of the report the annualized costs associated with an articulated hopper car program are similar to the annualized costs estimated for a boxcar rehabilitation program.

There are also three existing line related costs associated with the use of the Churchill rail line which are significant to the comparison:

- o $680,000 for 1985/86 as a special subsidy paid to CN out of WGTA funds for additional line related costs of the line from Thompson Junction north to Churchill;

- o $2,281,000 for the basic line related costs of the Herchmer Subdivision (from Gillam to Churchill) as a grain dependent branch line which is included in the WGTA rate base and therefore paid by all grain shippers and the federal government unlike the line related costs of the routes to other ports; and

- o $1,657,000 for line related costs of the northerly section of the Thicket Subdivision (from Thompson Junction to Gillam) now paid by CN and other shippers.

If the Churchill line is maintained in operation these costs totalling about $4.6 million must be met by the grain shipper or by others.

Port and Terminal Facilities

Another set of cost elements relates to port and terminal facilities, including interest charges on capital facilities, terminal elevator costs, extra Canadian Grain Commission inspection costs at Churchill, extra costs of unloading boxcars, overtime charges for elevator use, and capital costs of future improvements. The conclusion of this part of the analysis was that there are certain additional costs associated with maintaining Churchill port and terminal facilities in operation which would not be reflected in additional costs at other ports if the route were no longer used for grain.

Marine Transportation System

The final set of cost elements considered relates to the marine transportation system, including items such as the St. Lawrence Seaway tolls, and additional Transport Canada and Canadian Coast Guard en route costs associated with operation of the Hudson Bay route in addition to the actual freight rates charged from the ports to the final destination overseas. The comparison indicates that there is a marine freight rate advantage for grain that is moved from Churchill, net of the impacts of the other factors. Including the full value of the marine freight rate differential in the comparison between routes makes the implicit assumption that the prices for grain that the Canadian Wheat Board realizes at each port will fully reflect the freight rate differentials of the alternative routes to the overseas destinations. The comparison uses the marine rates actually paid for voyages from Churchill, Thunder Bay and lower St. Lawrence ports to Northwestern Europe (Antwerp to Hamburg). These were used as representative of the rate differentials for the routes from Churchill ports to the actual destinations to which most Churchill grain is going.

Analysis of Results

Estimates were then made of the relative total cost advantages/disadvantages in grain transportation and handling that would be expected to result from the different levels of Churchill throughput referenced earlier. In each case, the comparison was with the option of moving no grain through Churchill. The analyses were carried out and the results presented for the 1986/87 crop year and for the 1991/92 crop year, that is with and without the costs associated with acquiring and operating new rail equipment for the Churchill service which will be necessary by the latter year. Because of the significance of the railway line related costs, the results are presented for each of the

two years with and without the additional line related costs. A summary of the results is presented in Exhibit 2.

If the Churchill line is not used for grain movement in future, an important question must be addressed: Will the line will be completely abandoned or will it continue to be used for carrying other traffic? If the line would be kept open even if no grain were carried on it, then the line related railway costs should not be included in the comparison, since these costs would still have to be borne by government, the railway or other shippers even though they would no longer be paid by grain shippers. On the other hand, if the rail line would be completely abandoned, then the line related costs should be included in the comparison since they would in fact be "saved" by the Canadian transportation system and shippers. There would, of course, be other cost implications of completely abandoning the Churchill line associated with disruption and dislocation of the other users of the line and the communities served by it as well as reductions in Canada's ability to achieve national objectives related to sovereignty, defence, Northern development and resupply of Arctic communities but these are among the considerations that are relevant to addressing the issue of complete abandonment of the Churchill line rather than the issue of use of the Port for grain exports.

The results of this analysis are also sensitive to the assumption that the prices for grain realized at the various Canadian ports reflect the actual freight rate differentials from the ports to the overseas destination. While it is reasonable to assume this, if a larger discount has to be offered at Churchill (relative to the lower St. Lawrence) then the benefits of shipping grain through Churchill would be reduced.

The following conclusions flow from the above cost comparisons:

1. There is a marine transportation advantage associated with the use of Churchill compared to Thunder Bay for grain moving to Northwestern Europe and other Atlantic markets.

2. This marine transportation advantage more than compensates for the total costs associated with using the Port and terminal facilities, for higher volumes of grain movement through Churchill.

3. To the extent that the CWB captures the marine freight advantage in the prices charged to buyers, these differences will represent a gain to Canada and to grain growers.

4. There are also railway system costs associated with the Churchill route which are not specifically reflected in the Churchill rates. These costs are associated with the need to have specialized cars for use on the Churchill line (volume related

costs) and with the cost of maintaining the line to Churchill (line related costs) which are currently charged to grain transportation.

5. The economic advantage of using the Churchill route for grain movement is reduced if the volume related additional rail costs are taken into account (e.g., to provide special rail equipment to operate on this line), but there would still be an advantage for Churchill grain throughput levels above about 600,000 tonnes per year by 1991/92.

6. When the costs of maintaining the Churchill line in operation are included as a cost of shipping grain through Churchill (and most of these are currently attributed to grain transportation), the Churchill route shows an overall advantage for movements over about 850,000 tonnes under the current railcar supply situation for average ocean freight rates. When new cars would be required for shipment through Churchill (by 1991/92) use of Churchill at annual throughputs would result in a cost penalty under about 1.25 million tonnes annually over the long run when the full range of ocean freight rate market situations are encountered.

7. It is not at all certain that the rail line from Thompson Junction to Churchill would be abandoned if grain were no longer shipped through Churchill. In this case these line related costs would not be actually saved by eliminating the Churchill grain program,and therefore the economic comparison should not include the cost of maintaining the Churchill line in operation. In this case there would be an economic advantage in using Churchill for higher throughput levels, even by 1991/92 when new cars would be required, for annual throughputs above about 600,000 tonnes.

8. It does not seem equitable to charge grain shippers for all of the line related costs of the Churchill route unless this line is maintained specifically for the movement of grain. If in fact the line would not be abandoned if grain were no longer shipped, then consideration should be given to paying some or all of the line related costs out of general government revenues, reflecting the importance of the Hudson Bay route for Canadian sovereignty, defence, Northern development and Arctic resupply as noted earlier.

9. If the Port of Churchill is kept open for grain exports, the greater the volume that is shipped the better off are the grain shipper and the overall grain transportation system. Higher costs occur when Churchill is kept open but only relatively small volumes of grain are shipped through the Port.

5. PORT CAPACITY ANALYSIS

Chapter 6 of the report presents an analysis of the grain throughput capacity of the railway system, elevator and ship loading facilities comprising the Port of Churchill grain transportation/handling system. It is important to understand the levels of throughput which can be achieved by the Churchill system under various operational and vessel arrival circumstances and the average vessel waiting time that would likely result at various levels of throughput, the components of the system which are the limiting factors on its capacity under various circumstances, and the implications of this in terms of improving the system and its economics.

In order to assess these questions systematically, a computerized model was developed to simulate Port operations including: train movement, railcar unloading, grain cleaning, vessel loading, and vessel movements at the Port. It was calibrated in terms of 1985 operations and was able to reproduce the operational features and vessel delays actually observed at the simulated throughput levels, within reasonable tolerances. As a further test, the model was operated for throughput levels and number of arriving vessels similar to those experienced in 1976 (a year of large grain throughput) and again the model was able to reproduce with reasonable accuracy the vessel delays actually experienced that year.

Some thirteen additional runs of the Port capacity model were carried out, to simulate operating conditions at annual throughput levels of 700,000 tonnes, 1,050,000 tonnes and 1,400,000 tonnes, respectively, under various conditions of: ship arrival patterns; number of hours per day worked for unloading railcars, cleaning grain and vessel loading; and the amount of available elevator capacity for storage.

the conclusions drawn by the study team from the simulation results were as follows:

- the practical capacity of the elevator, assuming the present configuration, is approximately one million tonnes per year during the current shipping season, or about 85,000 tonnes per week over 12 weeks; if the shipping season is extended to 17 weeks as recommended in Study A, the capacity would be about 1.45 million tonnes per year;

- if vessel arrivals could be made more uniform and grain arrivals coordinated with these vessel arri-

vals, the capacity in a 12 week season could be higher, in the order of 1.4 million tonnes per year;

- o on the basis of the spread of types of grain analyzed (three different types of grain were used in the simulation runs) the amount of storage provided by the elevator was found to be balanced with the handling rates;

- o the only practical basis to increase throughput would be to increase all three handling rates including unloading, cleaning and vessel loading. At 700,000 tonnes per year throughput, with 20 hours per day of operation for car unloading, grain cleaning and vessel loading, the estimated average vessel waiting time would be about 4.3 days; this would rise to about 8.1 days with only 10 hours per day of vessel loading. At 1,050,000 tonnes per year throughput, the estimated average vessel waiting time would be about 7.6 days with 20 hour unloading shifts, and this would drop to an estimated 6.9 days if the shifts were increased to a 24 hour per day operation. At 1,400,000 tonnes per year throughput, vessel waiting times would rise to over 10 days on average unless the number of grain types were reduced or the vessel arrivals are uniform rather than random; under the latter situation, the estimated average vessel waiting time would drop to about 3.7 days.

The results confirm that, with multiple shift operations, the Port and its rail and ocean interfaces are capable of handling one million tonnes in a 12 week season and 1.45 million tonnes in a 17 week season and, under controlled circumstances, this level could be exceeded.

6. CONCLUSIONS AND RECOMMENDATIONS

The economic analyses presented in this paper indicate that use of the Port of Churchill and the rail line serving it as a route for export grain is likely to be economically viable into the 1990's under medium or low ocean freight market conditions, and under medium or high world grain market conditions provided that the grain throughput levels are in the order of 600,000 tonnes per year or higher through the Port. This conclusion is based on the premise that the line related costs of the rail line (currently about $4.6 million per year) would be government-subsidized (in recognition of the Port's broader role and strategic significance) rather than being borne by the grain shipper and by CN.

The policy question to be addressed is whether the potential savings in grain transportation/handling costs and the other strategic reasons for continuing the Port and rail line in operation are sufficient to

decide in favour of their continuing operation, recognizing the subsidy requirement for rail line related costs. In addressing this question governments and other interested parties should consider the broader policy implications of ceasing the movement of grain through Churchill and abandoning the rail line. Among these policy implications (which are beyond the scope of analysis of this study), in addition to the immediate strategic and Northern development factors mentioned earlier, is the consideration that the rail line and the Port do exist, the marginal cost of maintaining them in operation for grain exports is relatively modest, they may be badly needed during the coming decades for strategic reasons and possibly for grain exports, and their future replacement costs if abandoned now would be large.

If the policy decision is to maintain the rail line and Port, then export grain traffic through this outlet should be maintained at substantial levels both because of the savings that would result from its use at such levels and because it is the major existing economic contributor to continuing operation of the line and Port. The recommendations presented below were submitted to assist in on-going development and operation of the Hudson Bay route if this policy option is selected:

1. In terms of grain exports the Port will be economically viable only for higher levels of grain throughput, beyond approximately 600,000 tonnes per year. Maintaining the Port and the railway line and not using it at or above such throughput levels is the worst option in terms of the economics of handling and transporting export grain.

2. Some investments would be required in the elevator under these conditions. The major one is the implementation of a dust control system which will permit the elevator to meet regulatory standards and improve the safety and environment of the workers, at a capital cost of about $5 million in 1985 dollars. The cost of this improvement has been included in the economic comparisons.

3. The line related costs of the Churchill line, currently about $4.6 million per year, should be paid for out of general government subsidies, rather than out of subsidies ear-marked for grain transportation and out of grain freight rates, as a large proportion of these costs are paid now. This would be consistent with the underlying policy decision to maintain the line and the Port in continuing operation for the reasons cited above.

4. To maintain grain service on the Churchill route will require action to ensure a supply of cars. In the short term this may be done by an interchange agreement between CP and CN to permit CP

cars to be used for this movement. This may also reduce railway operating costs somewhat. Over the longer term three options are possible: rehabilitation of additional boxcars, construction of new cars specially designed for the line such as the articulated hopper car now under development, or refurbishment of the line so that it can handle conventional hopper cars. An early decision on the best method is required so that design and methods of financing can be developed. The estimated costs of the articulated hopper car option were included in the economic comparisons.

5. Consultation should take place among the Canadian Wheat Board, the Governments of Canada and Manitoba and other interested parties in order to reach a consensus on how to achieve the benefits associated with the use of the Port of Churchill for grain exports.

6. Overseas buyers and shipowners should be made more familiar with operations through the Port of Churchill. It was found that some had an "irrational" fear of taking delivery of grain through the Port, while others, more familiar with northern waters, had no such concerns. The Governments of Canada and Manitoba have already made a start in this by familiarizing the international insurance business with Port operations and improvements made to the operation of the sea routes to and from Churchill.

7. Better communications and information services should also be established to ensure that captains sailing to and from Churchill, particularly early and late in the season, are fully informed about ice conditions and that the Canadian Coast Guard is informed of vessel arrivals and departures so that ice breaking escort services can be provided on a timely basis. This is discussed more fully in the Study A report.

If the decision is taken that the line should be closed over the long term then the study team had the following conclusions and recommendations based on the economic analyses:

1. Today, with existing car supply, the Port should be used for Churchill volumes of over about 800,000 tonnes per year. If this volume can be achieved then the Port and railway line should be kept open until attrition in the boxcar fleet no longer permits this level of throughput.

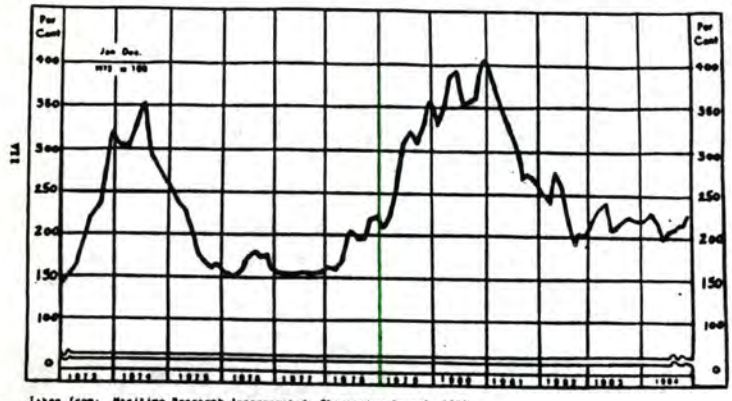
2. The elevator and the line should be maintained in safe operation for this period with a minimum of new capital investment.

The conclusions as to the viability of the port are also based upon the assumption that the Canadian Wheat Board can sell grain at Churchill for a price which reflects the actual marine transportation cost differential for onward delivery of the grain. While CWB commercial secrecy precludes verifying this assumption there is reason to believe that it is largely true in years of normal and strong grain markets and that discounts in years of weak grain sales would likely be less than the entire marine freight rate differential.

In the meantime, it is hoped that the economic comparisons presented in the report will assist the Government of Canada, the Government of Manitoba and other interested parties in reaching the most appropriate policy decision, in the long term interests of the country and its various regions.

Exhibit 1

WEEKLY GENERAL FREIGHT CHARTER INDEX, 1973-1984



Taken from: Maritime Research Incorporated, Chartering Annual, 1984

Exhibit 2

SUMMARY OF OVERALL SYSTEMS SAVINGS
RELATIVE TO NO GRAIN MOVEMENT THROUGH CHURCHILL
(1985 $000's)

	1986/87		1991/92	
	500,000 tonnes	1,000,000 tonnes	500,000 tonnes	1,000,000 tonnes
Rail System Volume Related Cost Savings	460	920	-1,069	-2,138
Port Cost Savings	-4,035	-4,035	-4,035	-4,035
Marine System Cost Savings	4,639	9,278	4,639	9,278
Total Cost Advantage if Line Related Costs not paid by Grain Shippers	1,064	6,163	-465	3,105
(Savings per tonne)	(+2.13)	(+6.16)	(-0.93)	(+3.11)
Railway Line Related Costs	-4,618	-4,618	-4,618	-4,618
Total Cost Advantage if Line Related Costs Paid by Grain Shippers	-3,554	1,545	-5,083	-1,513
(Savings per tonne)	(-7.11)	(+1.55)	(-10.17)	(-1.51)

PROBLEMS IN THE GRAIN HANDLING SYSTEM

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Abstract

This paper discusses how changes have evolved in the grain handling and transportation system from the 60s to the 80s, and outlines unresolved problems which are limiting the system in becoming more efficient and economical. Certain actions of the federal government which have led to preservation of inefficiencies in the system are also discussed. The role of inland terminals in shipping export standard grain to the ports is outlined.

Introduction

In the 50s, when the cost of operating branch lines started to increase, the railways began pointing out that the Statutory rates set in 1925 were too low. The federal government appointed commission after commission to study the grain handling and transportation problems from both the producer and railway perspectives, but failed to take any initiative to resolve the concerns until the early 80s.

It was hoped that the initiatives taken by the federal government in the early 80s would resolve some of the problems facing the prairie grain handling and transportation system. However, after the passage of the Western Grain Transportation Act (WGTA), several concerns regarding the grain handling system have remained unresolved and no solution appears to be in sight. It is very unlikely that the federal government will attempt to make any substantive changes in the present grain handling system without a resolution of the many conflicts among various interest groups, e.g., method of Crow benefit payment, incentive rail rates and the operation of uneconomical branch lines, etc.

Grain Handling and Transportation System in the 60s

Business recessions in 1954 and 1957 reduced the railways' revenues below expectations. Hence the railways were forced to apply for further increases in the general level of rates; Statutory rates were excluded from all increases. On many levels of traffic, higher rates drove business to competitors. Early in 1959, when the railways again applied to the Board of Transport Commissioners for a

further increase in rates, the government took these steps:

- appointed a Royal Commission
- forbade the Board from authorizing further rate increases
- passed the Freight Rates Reduction Act, giving railways $20 million for the fiscal year ending March 31, 1960

The Royal Commission (MacPherson Commission) submitted its report in 1961; it found four major areas of concern:

- uneconomic passenger services
- unprofitable branch lines
- Statutory rates on grain
- statutory fee transportation.

The commission hoped that its recommendations, if implemented, would make the railways pay their own way without government aid. The main exception was the exportation of grain.

The National Transportation Act, 1967

In February 1967, Parliament passed legislation based on the MacPherson Report of 1961. The main thesis of the report was that every mode of transport should be operated on business principles.

Canada's national transportation policy was set forth under Section 3 of the National Transportation Act:

> "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 these objectives are most likely to be achieved when all modes of transport are able to compete under conditions...".

The Situation Since 1967

Implementation of the National Transportation Act of 1967, did not resolve the issues confronting the railways and the shippers. The railways wanted to abandon hundreds of kilometers of branch lines which were not economical to operate. The federal government issued a prohibition order in 1965 protecting all but 2,960 Km of prairie branch lines from abandonment until January 1, 1975. It was further extended to June 30, 1977.

Since 1977, the railways have been allowed to abandon uneconomical branch lines. In the late 70s and early 80s when payments to railways increased significantly, the federal government undertook extensive consultations at all levels with regard to the Statutory rates issue.

The government pays financial assistance directly or indirectly for feeder services provided by the main line carriers on their branch

lines, because many of these branch lines would have been abandoned if no government assistance was forthcoming. Financial assistance has become a part of the grain handling and transportation system because of the long distances between production areas and export positions.

In February 1982, the federal government appointed a task force to develop, in consultation with the parties affected, a consensus to resolve the issues of Statutory rates. The report submitted by this task force formed the basis for the Western Grain Transportation Act which was passed by the Parliament on November 13, 1983. The Act became effective on January 1, 1984.

Western Grain Transportation Act (WGTA)

The passage of the Western Grain Transportation Act was a major development for Canada's railway system. The major objective of the WGTA was to facilitate transportation, shipping and handling of western grain. Under this Act the federal government has committed to pay the railways' losses incurred on grain dependent lines. Based on complicated costing formulas, the payments for Statutory rates were set at:

- $599.6 million for the 1984-1985 crop year
- $629.1 million for the 1985-1986 crop year
- $658.6 million for the 1986-1987 crop year, and subsequent crop years.

Under the above payment schedule the grain producers' share of railway costs would increase gradually over the years. The federal government contributions of $658.6 million towards Statutory rates could also increase as the Act provides for government contributions for inflation over six per cent.

Under the WGTA, the Crow benefit is paid to the railways, although several studies have recommended payment to the producers. It has become one of the most controversial issues in the grain handling system debate.

Developments After the Implementation of the WGTA

Under the provisions of Section 62 of the Western Grain Transportation Act (WGTA), the federal government, in April 1984, appointed a committee to provide recommendations on the method of Crow benefit payment.

The committee held public hearings and sought input from farm organizations, grain companies, the two national railways and the provincial governments from western Canada.

In addition to the legislative mandate, the Minister of Transport provided supplemental terms of reference to the committee for

further guidance, which were as follows:

1. Criteria
   - resource neutrality
   - equity
   - efficiency
   - administrative feasibility
2. Agricultural impacts
3. Transportation and handling impacts

Recommendations of the Committee of Inquiry on Crow Benefit Payment

The recommendations of the Committee of Inquiry on the Crow Benefit Payment were based on extensive consultations and research conducted by the Canadian Transport Commission for the committee. The committee viewed the Crow benefit as compensation to grain producers who were affected by a major shift in public policy in Canada. Payment of this benefit can usually be seen as a refund for increased grain transportation costs. The Committee made several recommendations concerning the method of Crow benefit. One of the key recommendations was that the Crow benefit of $658.6 million be paid directly to producers in the Canadian Wheat Board (CWB) designated area, in the form of a Grain Transportation Refund (GTR).[1]

Review of the Western Grain Transportation Act (WGTA) and the Method of Crow Benefit Payment

The federal government delayed action on the recommendations of the Committee of Inquiry on Crow Benefit Payment because of opposition from the prairie pools and some farm organizations in eastern Canada. In order to neutralize the situation, the federal government appointed the Grain Transportation Agency (GTA) to review the WGTA and the recommendations of the Committee of Inquiry on Crow Benefit Payment. The GTA was also asked to assess:

- the ability of grain producers to pay assigned transportation costs
- cost sharing levels between producers and the federal government beyond the 1985-1986 crop year
- the advisability of beginning a system of awards and sanctions
- the operation and effect of the safety net provision
- the need for future reviews of the Act.

The GTA report was released by the federal government on June 13, 1986. The report contained 45 recommendations on the changes to the WGTA. The federal Minister of Transport indicated that there were many useful and positive recommendations put forward and he asked the GTA to discuss these proposals with system participants. A few of the key GTA recommendations were:[2]

- that the Hall Commission Grain Transportation Refund not be implemented.

- the Crow benefit to be paid out on an annuity basis with the "details on payout" to be worked out by a "task force" to be appointed by the Minister of Transport.
- that the government provide an interim trucking subsidy on movements to port position to provide competition between truck and rail.
- that a productivity sharing agreement between the railways and shippers be implemented.
- in terms of incentive rates, the GTA suggested the removal of restrictions upon implementation and appeal procedures, thus providing easier accessibility.

Almost a year has gone by since the GTA review was published. The federal government has once again delayed any action on the GTA's recommendations apparently for reasons other than economic ones.

The Federal Government and the Grain Handling System Inefficiencies

Method of Crow Benefit Payment

It could be pointed out that inaction on the part of the federal government regarding changes to the Western Grain Transportation Act (WGTA) has led to preservation of inefficiencies in the prairie grain handling and transportation system. Initiatives undertaken in earnest in the early 80s to resolve the problems, concerns, and inefficiencies in the grain handling and transportation system have been stalled.

- One of the most contentious issues regarding the WGTA is the method of Crow Benefit Payment. Under the Act, this benefit is being paid to the railways. Several farm groups/organizations along with the Alberta government have made submissions to the federal government suggesting that the Crow benefit of $658.6 million be paid to producers. Even the studies commissioned by the federal government have recommended paying the Crow benefit to the producers. So far, the federal government has not shown any indication that it will be making changes to the WGTA in the near future.

- There is general agreement on all sides of the debate that paying the Crow benefit to producers will lower grain prices on the prairies and encourage more domestic use of grain. Increased domestic use of grain will encourage intra- and inter-provincial trucking of grain, thus generating more economic activity in rural communities. The IBI study estimated that an increase in trucking activity for hauling grain could add $22 million to revenues of the commercial trucking industry on the prairies.[3] Alberta's share of this additional revenue could be between $7 and $9 million per year.

- Concern has been raised in eastern Canada that paying the Crow benefit to producers would encourage growth of the livestock industry in western Canada. Most studies have concluded that under the pay-

would be modest, having little effect on livestock production in eastern Canada.

Payment of the Crow Benefit and the Grain Companies

The grain companies fear that if the Crow benefit was paid to producers, they (grain companies) would not be able to direct the marketing of grain. Some of their potentially obsolete facilities might be bypassed by producers who wish to realize better prices and lower elevator costs by delivering grain to high throughput elevators. They might also bypass facilities that are not so obsolete.

A study by Agriculture Canada showed that an elevator with lower capacity (1250 tonnes) and turnover ratio of 3:1 could offer savings of $2.40 per tonne if the turnover ratio were increased to 5:1. An elevator with higher capacity (6250 tonnes) could offer savings of $1.20 per tonne if the turnover ratio were increased from 3:1 to 5:1. If the turnover ratio for the high capacity elevator is increased to 6:1, the savings could increase to $1.60 per tonne.[4]

A survey done for the Alberta government revealed that 67 per cent of grain producers could not estimate what they paid to transport a tonne of grain by rail to Vancouver. Only 15 per cent of the respondents estimated the cost to be in the range of $8.40 to $16.00 a tonne.[5] If the full costs were disclosed to producers they would strive to minimize these costs by evaluating alternatives.

Paying the Crow benefit to producers would provide them with the opportunity to influence the future development of the grain handling and transportation system for which they are being forced to assume an increasing portion of the costs. An alternative they might choose could be increased use of commercial/custom trucks delivering grain to more efficient higher throughput elevators that offer better prices and services.

An "off-line elevator" concept has been suggested by various studies as one of the alternatives to minimize costs. Off-line elevators could be kept in already established communities. In this way the communities would not suffer a tax loss.

In view of the above, there appears to be a unique opportunity to have grain producers involved in developing an efficient grain handling and transportation system by:

- paying the Crow benefit to producers
- exposing full costs of the system to grain producers.

Under the WGTA, producers have not been allowed to choose a least-cost grain transportation mode. Grain transportation costs are hidden and producers have very little or no apparent economic incentive to reduce these costs. If the full costs are made obvious to producers, they will search for the most cost-effective method of marketing

grain. Otherwise they are locked into a system served by railways at Statutory rates regardless of cost variations in the system.

Grain Handling and Transportation System Efficiency Measures

The grain handling and transportation system presently in place does not encourage transportation efficiency and maintains cost-ineffective operations, contrary to the objective of the national transportation policy. Maintaining the status quo will cost grain producers more to use the system. All the parties involved in the system, namely, the federal government, the railways, the grain companies, and producers, should make earnest efforts to introduce measures which will reduce the overall costs of transporting grain to export positions and local markets. The following are some of the suggested measures which can be undertaken with least cost to improve efficiency.

Federal Government Efficiency Measures

The federal government should settle the Crow Benefit Payment in a way which will expose all the transportation system costs to the users. It should allow competition between different modes, as stated in the National Transportation Act. Specifically, the federal government can undertake the following measures to promote efficiency and cost savings:

1. Pay the Crow benefit to the producers' instead of the railways so that full transportation costs are exposed to the producer. Users will then strive to minimize initial hauling costs and deliver grain to the primary elevators that offer the better price and service.

2. Allow railways and grain companies to implement efficiency measures (discussed below) to reduce overall system costs and retain part of the savings.

3. Allow abandonment of uneconomic branch lines and assist provincial and municipal governments by transferring of the savings from branch line operations to maintain and upgrade the road network.

4. Encourage competition between the modes.

5. Implement performance objective regulations as stated in the WGTA.

Railway Efficiency Measures

Railways should be encouraged to introduce efficiency measures and new technology to their operations that will lead to cost savings to shippers. Railway cars should be able to pick up full loads of grain of the same grade for export positions at central locations.

Some of the technological innovations and efficiency measures which can result in considerable cost savings are as follows:

1. Technological innovations: Current third generation locomotives have increased fuel economy seven per cent over previous models. This amounts to roughly 2,100 gallons of fuel per year per locomotive. With further engine refinements, higher traction locomotives, improved operating procedures and better maintenance, increases in fuel economy of two per cent per year are possible:
   - Railways should attempt to use six-axle cars to increase the payload. Tare weight reductions of four or five tonnes and the high utilization of cars can increase tonne/kilometer productivity by some 10 per cent in the near future.
   - Traffic control systems are the key to further improvements. These systems have the ability to increase system capacity without resorting to major capital investments.
   - Marshalling yards should continue to be increasingly automated through computer applications which reduce freight terminal time, increase yard capacity and reduce labour intensive activities.
   - In the area of trackage innovations, continuous welded rail and concrete ties are claimed to last 50 years compared to 30 years for wooden ones. As well, the concrete tie reduces maintenance costs by 30 per cent.

Large track machines capable of lifting old rail ties, performing all maintenance functions and relaying new rail and concrete ties in one operation are proving effective. Estimates of rail replacement savings run as high as $3 million per year.

2. Long term outlook: The external factors which influence technological development in the rail industry include energy, capital, labour, demand, government policy regulation and safety. Energy is the most significant factor. It will most likely determine the policy on electrification, the future of alternate fuel development, and encourage research in fuel-efficient technologies. Capital is the second most important factor. In the capital intensive rail industry, new technologies have been proven effective but will not be implemented if the capital is not available.

3. Co-operation with grain companies: Many rail efficiency measures require associated changes by grain companies. For example, to decrease grain car turnaround time, high throughput elevators and consistent flow of grain are required. One of the most beneficial changes to rail operations would be the implementation of unit trains. Adopting a unit train policy would require changes in both grain collection methods and elevator facilities.

4. Cabooseless trains: "End of Train Units" ETU's - eliminate one man, and possibly two, of a typical four man crew (leaving the engineer and conductor) which would result in a decrease in labour costs.

5. Increasing car payload: Higher car loading may still be possible because of improved cars (lower tare weights) and the increased capacity of rail. Higher tonnage trains may be possible as a result of railway grade reductions, high technology traction devices and mid-train remote locomotives.

6. Train speed: Branch line rehabilitation is continuing and will allow speeds up to 50 km/h on branch lines that previously limited speeds to 15 km/h. This will result in decreased turnaround time.

7. Elimination of waiting time: Double tracking projects are underway which will eliminate waiting time, especially through mountain passes. This will also result in decreased turnaround time.

8. Compatible working hours: Making working hours of the railways and grain companies compatible will improve the grain handling and transportation system.

Grain Handling Efficiency Measures

If grain companies can introduce some efficiency measures in handling grain, considerable savings can be realized in costs. Some of the grain handling efficiency measures are:

1. High throughput elevators: A typical primary elevator in Alberta has a capacity of about 3,000 tonnes and usually operates at 2.5 to 3.5 turnovers per year, giving it an annual throughput of 7,500 to 10,500 tonnes. The concept of high throughput elevators was developed as a potential solution of some of the inefficiencies inherent in the present elevator system such as high fixed costs, slow grain car turnaround, long storage time, slow loading and unloading, etc.

Other changes which may also be necessary to convert an existing facility into a high throughput elevator are:

- extend the length of sidings to carry longer strings of rail cars for loading
- heavier tract and/or upgrading roadbed for sidings; at many of the present facilities, cars cannot be loaded to 100 per cent capacity; 70 per cent loading of cars is quite common
- improvements to unloading facilities to allow handling any size of truck; upgrading terminal access roads to ensure adequate flow and capacity for the increase in truck volume
- provisions for on-site grain cleaning can offer further savings to producers
- installation of modern computer management systems may be considered in order to achieve maximum cost efficiency.

Although some of the above changes may be required and/or desirable in the development of a particular high throughput elevator, in most cases the capital investment required would be relatively small. These changes should allow loading 10 to 12 grain cars per day from one high throughput elevator compared to the 2 to 3 cars per day seen in a typical primary elevator operation.

2. Projected development: Many factors will affect the rate of consolidation of primary elevators and the subsequent development of high throughput elevators, thus it is difficult to make definite growth estimates. However, if the present market and political and economic factors remain constant, some guesses can be made:

   - development will continue to be slow over the short term, (the next five years) within the order of 3 to 4 high throughput elevators developed per year per prairie province
   - developments will likely speed up in the 1990s and there may be 80 to 100 high throughput points across the prairies by the year 2000

3. Off-track: This is a true off-track system in that the initial destination of the grain is a facility which is not associated with a rail branch lines. Grain is unloaded from small trucks into the elevator, which may or may not have cleaning facilities. From the elevator, grain is loaded into large trucks in A, B, or C trailer configurations and hauled to a central terminal where grain is loaded into hopper cars for export destinations.

Producer Efficiency Measures

The grain handling and transportation system in place does not provide any incentive to producers to strive for efficiencies and cost-effectiveness. One of the obvious factors could be a lack of information on full transportation and handling costs.

Although producers have very few options in minimizing basic transportation and handling costs, these should still be considered and evaluated. Some of the options that producers may consider are:

1. Hauling grain a few extra kilometers to a primary elevator offering better price and service. A high throughput primary elevator may offer a reduction of $1.50 to $2.00 per tonne in elevation and other related charges. In some instances producers have hauled grain in tandems over 100 kilometers to high throughput elevators to obtain a better price for their products.

2. Producers with smaller trucks should evaluate the possibility of using the service of commercial and/or custom carriers. Studies have shown that over longer hauls, commercial trucks are about 25 per cent less expensive than average sized farm trucks. Custom

truck operators, although not authorized to haul for other producers, can offer even higher savings.

3. Two or more producers should consider joint ownership of a truck trailer. This type of ownership would require working out details in regard to the operation and maintenance of the unit.

4. Single-axle truck owners should consider buying tandems if requirements warrant.

Producers can realize savings of about $3.50 to $8 per tonne by delivering grain to high throughput grain handling facilities from where export standard grain can be shipped by unit trains.[6]

Inland Terminals and the Grain Handling System

The three inland terminals in Alberta (Edmonton, Calgary, and Lethbridge) were purchased by the provincial government from the federal government in the fall of 1979. Effective August 1, 1984, the three terminals have been licensed as primary elevators by the Canadian Grain Commission. In 1986, Alberta Terminals Ltd. (ATL) was also given agent status by the Canadian Wheat Board.

During the last seven years most of the grain deliveries to the ATL facilities have been by commercial and farm trucks, and very little by rail. Rail has been used to ship grain from ATL facilities to various destinations. Deliveries of grain by truck have not resulted in the optimum utilization of ATL facilities as expected. Railways have been seldom used to haul grain to these facilities because of additional transhipments costs, i.e., stop-off charges or rail car diversion charges.

During the 1973-1974 crop year, the trucking program moved over 280,500 tonnes of wheat and barley for the Board to the Edmonton and Lethbridge terminals. The trucking program led to better utilization of available railway equipment as grains were shipped by unit trains to the ports. One estimate showed that during the test haul period rail cars took 7 days from Lethbridge to Vancouver and back. The same cars used to take about 12 to 15 days for a return trip.[7] Average rail car cycle to various ports is about 19 to 21 days.

ATL and the Strike at Thunder Bay

It was not until September 1986, that a strike at Thunder Bay led to diverting grain by rail from primary elevators in Alberta to the three ATL facilities for cleaning and grading to export standards. Grains are usually shipped directly from primary elevators to the port terminals on the east and west coasts. Grains are cleaned cleaned at these terminals to export standards and shipped to customers around the world.

During the strike at Thunder Bay port terminal facilities were shut down for about five weeks. To meet export commitments via the

east coast, the only choice left was to ship grain from primary elevators to inland terminal facilities for cleaning and grading. This option was exercised at Alberta Terminals Ltd. in Edmonton, Calgary, and Lethbridge. In order to keep grain moving, the railways waived all additional charges which would have been applied in a normal situation.

Wheat and barley were shipped to the three facilities from all over the province by rail, as shown in Figures 1, 2, and 3. After cleaning and establishing export standards grades, trainloads of grain were sent to the port of Montreal for ocean shipping. Table 1 shows the volume and number of grain cars shipped to and from ATL from September 22 to October 20, 1986.

TABLE 1

GRAIN SHIPMENTS VIA ATL TO THE PORT OF MONTREAL

	Calgary (Barley)	Edmonton (Barley)	Lethbridge (Wheat)
1. No. Of Cars Unloaded	141	171	248
2. Scale Weight (t)	11,181.045	12,434,760	22,173.200
3. Dockage Weight (t)	123.435	244.309	202.416
4. Average Weight Per Car			
- Scale Weight (t)	79.298	72.718	89.408
- Dockage Weight (t)	.875	1.429	.816
- Dockage Percentage	1.11	1.96	.913
5. No. Of Cars Shipped	134	159	238
6. Net Weight Shipped (t)	11,018.998	12,125.270	21,565.669
7. Average Weight Per Car (t)	82.231	76.260	90.612
8. Savings In Cars Shipped	7	12	6
9. Weight Difference Per Car, Dirty vs. Clean (7-4)	2.993	3.542	1.204
10. Cars To Be Shipped	-	-	4

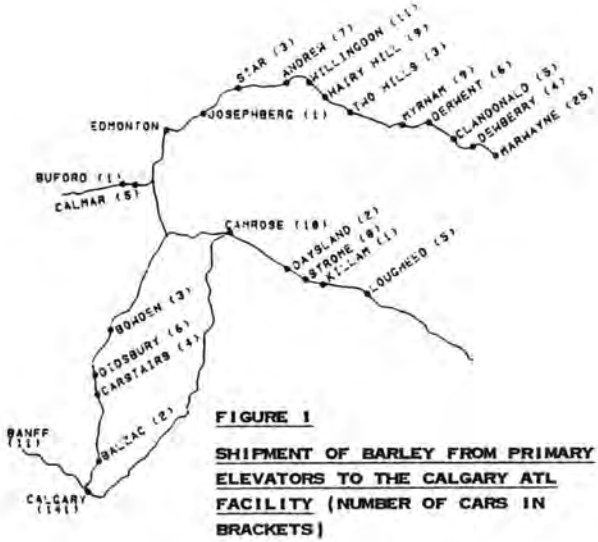


FIGURE 1

SHIPMENT OF BARLEY FROM PRIMARY ELEVATORS TO THE CALGARY ATL FACILITY (NUMBER OF CARS IN BRACKETS)



FIGURE 2

SHIPMENT OF BARLEY FROM PRIMARY ELEVATORS TO THE EDMONTON ATL FACILITY

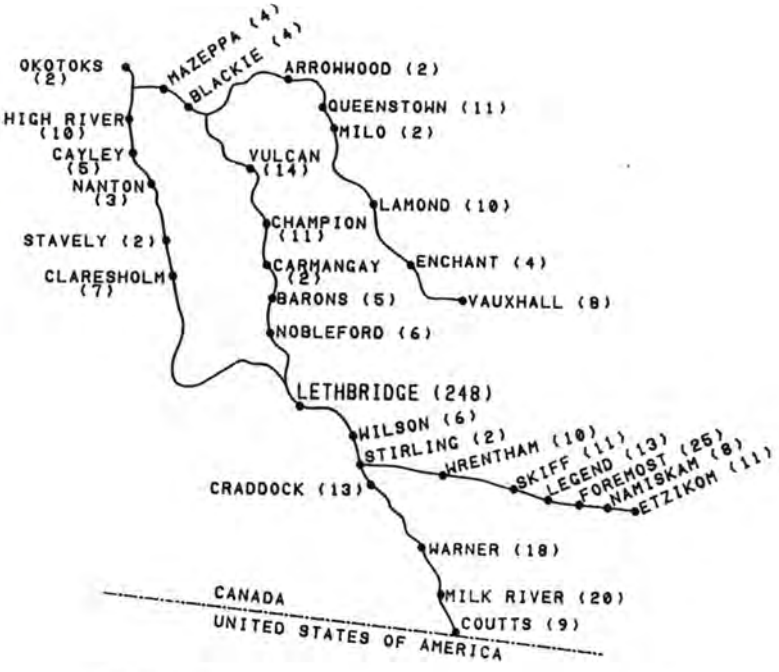


FIGURE 3

SHIPMENTS OF WHEAT FROM PRIMARY ELEVATORS TO THE LETHBRIDGE ATL FACILITY (NUMBER OF CARS IN BRACKETS)

The difference between scale weight received at the ATL facilities and net weight shipped from these ATL facilities was due to dockage, and shrinkage of .25 per cent. Because of the space and certain data limitations, (value of screenings inland vs. ports and rail cars cycles), costs and benefits of this exercise are not included in this paper.

Table 2 shows the number of rail cars shipped from the three ATL facilities to the port of Montreal. A total of 560 grain cars were unloaded at the three terminals. After cleaning and top-loading

TABLE 2

NUMBER OF CARS SHIPPED DURING THE EMERGENCY GRAIN EXERCISE

Date	From Calgary	Date	From Edmonton	Date	From Lethbridge
Oct. 10/86	100	Oct. 8/86	100	Oct. 1/86	93
Oct. 16/86	34	Oct. 10/86	59	Oct. 10/86	42
				Oct. 14/86	88
				Oct. 20/86	15
TOTAL	134		159		238

of the rail cars, 531 were shipped out, resulting in a savings of 25 cars.

During the emergency grain shipping exercise the railways did not levy a stop-off charge of $6.90 per tonne, which would have been applied if grain cars were switched to ATL in a normal situation. The inland terminals have no allocation of rail cars other than the ones allocated to grain companies/purchasers or users of grain.

The present tariff structure, i.e., rates charged by ATL for elevating and dockage, puts the inland terminals at a disadvantage when compared with the tariffs charged at port terminals. Table 3 provides estimates for the costs of moving export standard wheat with and without the use of ATL facilities. When all charges are considered, e.g., primary elevation, railway stop-off charge, and the difference between inland and port terminal charges, shipping from inland terminals would cost about $10-11 per tonne more than the conventional shipping method. However, there could be some savings ($1.50 to $3.50 per tonne depending on the throughput) in the form of fewer number of cars shipped, in freight costs on the retained screenings and for top-loading. The trucking option appears to be the lowest cost alternative for shipping grain using the inland terminals. It offers savings of about $3 per tonne over the conventional grain shipping method. However, questions could be raised as to what the additional trucking costs would be. How efficient would a trucking operation be as a replacement? Would trucking add flexibility to the system? Would farmers accept the opportunity to do custom or commercial trucking, etc.? Because of resource and data limitations no attempt has been made to answer these questions in this paper.

TABLE 3

ESTIMATES OF COST OF MOVING WHEAT TO EXPORT POSITIONS WITH AND WITHOUT THE EDMONTON ATL FACILITY[1]

	WITH ATL FACILITIES	WITHOUT ATL FACILITIES	TRUCKING
Costs			
1. PRIMARY ELEVATOR			
- Elevation	6.25[2]	6.25[2]	
- Removal of Dockage at Terminal		1.67[2]	
- Shrinkage			
2. ALBERTA TERMINALS LTD.			
- Elevation	5.00	-	5.00
- Removal of Dockage	2.00	-	2.00
- Shrinkage			
- Weighing & Inspection			
3. RAILWAY CHARGES			
- Stop-Off	6.90	n/a	n/a
4. RAILWAY FREIGHT COSTS			
- Edmonton to Thunder Bay	37.96	37.96	37.96
- Edmonton to Vancouver	27.88	27.88	27.88
5. TERMINAL POSITION[3]			
- Fobbing Charges:			
at Thunder Bay	4.31[4]	4.31[4]	2.40[4]
at West Coast	4.31	4.31	2.40
6. TOTAL COSTS (1+2+3+5)[5]	24.46	12.23	9.40
7. TOTAL COSTS IF SHIPPED TO A TRANSFER POSITION (1+2+3+2.40)[5]	22.55	12.23	9.40
8. TOTAL COSTS INCLUDING RAIL RATE:			
- Edmonton to Thunder Bay	62.42	50.19	47.36
- Edmonton to Vancouver	52.34	40.11	37.28

1. No calculations done for shrinkage at inland vs. port terminals, and for savings on cars not shipped because of retained screenings and top-loading.
2. Alberta Wheat Pool Charges.
3. Includes elevation, outward weighing and inspection, terminal elevator receipt cancellation and Lake Shippers' charges.
4. If export standards grain is shipped to a transfer position, the rate will drop to about $2.40 per tonne.
5. Does not include - rail rate, Canadian Grain Commission inspection and weighing charges, or any other charges at port terminals.

If variable rates are allowed to be implemented, centralized grain handling facilities could offer savings of $2.00 to $6.00 per tonne, depending on the number of cars shipped. High throughput inland terminals/primary elevators can offer further savings of about $2.00 to $3.00 per tonne depending on turnover ratio. Savings realized through the above efficiencies can be passed on to grain producers for additional trucking or switching of rail cars.

As the box and hopper car fleet is depleted, and the federal government has indicated that no more funds will be allocated for buying new cars, the available stock will require more optimal use and faster turnaround time to haul grain. This can only be accomplished by using more centralized grain handling facilities across the prairies and trucks can play an important role in bringing grain to these facilities.

Terminal facilities can be used to develop unit train operations as was done during the 1973-1974 crop year. The unit train concept allows railways to reduce costs by alleviating extra car handling and by encouraging long-haul traffic. Unit trains offer cost reductions through reduced switching expenses, faster turnaround time and lower administrative expenses. Moreover, railroad efficiency is increased on long haul and nonstop traffic. Also, unit trains or multiple car shipments allow for better planning and increased car use.

Commercial/custom trucks can serve as feeders to railways. Grain companies using unit trains can afford to offer higher prices to farmers, which would force surrounding or nearby companies to become more efficient to remain price competitive.

Large volume shipments would prevent temporary blockage of elevator facilities so that farmers would not need to hold their grain or take it to less favourable markets which would reduce their returns. Moreover, railways will be able to predict more accurately the traffic volume, more efficiently allocate equipment and improve train turnaround time.

A more in-depth study would be required to develop the unit train concept and how it could be coordinated with the hauling of grain by truck. At the present there is more truck hauling capacity available than demand, and it will be around for many more years. The Canadian Wheat Board model and several exercises undertaken in the United States could serve as benchmarks for evaluating, refining and implementing unit train operations.

Summary

The prairie grain handling and transportation system has undergone several changes during the last two decades. It was hoped that the implementation of the Western Grain Transportation Act (WGTA) in the early 80s would resolve some of the contentious issues and make the system more efficient and economical. However, inaction on the part of the federal government has led to the preservation of inefficiencies in the system. The most outstanding issue remaining to be resolved is the method of Crow Benefit Payment. Studies commissioned by the federal government after the implementation of the WGTA have recommended that the Crow benefit be paid to producers rather than the railways.

The grain handling system in place does not encourage intermodal competition or transportation efficiency and maintains cost-ineffective operations, contrary to the objective of the national transportation policy. The system participants (federal government, railways, grain companies and producers) should implement certain least-cost efficiency measures, as outlined in the paper, to make the system more efficient and effective.

With the consolidation of the primary elevator network and rationalization of the branch lines, greater emphasis is being placed on more centralized grain handling facilities. The inland terminals on the prairies have been used occasionally to ship export standard grains by unit trains to the east and west coasts for ocean/shipping. Recently, the facilities owned by Alberta Terminals Ltd. were used to ship train-loads of barley and wheat during the strike at Thunder Bay. This exercise, and unit train operations in the early 70s, could serve as benchmarks to evaluate the role of inland terminals to expedite export grain shipments. In view of the reduction in the number of rail cars, decrease in the rail network, and excess trucking capacity in western Canada, inland terminals could play an important role.

FOOTNOTES

1. "Report of the Committee of Inquiry on Crow Benefit Payment", Winnipeg, Manitoba, March, 1985.

2. Grain Transportation Agency, "Review of the Western Grain Transportation Act", Winnipeg, Manitoba, April, 1986.

3. "The Role of Trucking in the Grain Industry", A Report Prepared for Transport Canada by IBI Group, Toronto, Ontario, February, 1985.

4. Waithe, D. "Evolution of the Primary Elevator System in Western Canada", Agriculture Canada, Marketing and Economics Branch, Ottawa, 1984.

5. "Alberta Producer's Grain Transportation Survey", Angus Reid Associates, Inc, 1985.

6. A Research Paper "The Impact of Unit-Trains on Price Relationships at Country Elevators", Published in 'Illinois Agricultural Economics', Vol. 16, No. 2, July, 1976.
   - U.S. multiple car rates.

7. Chaudhary, G. Nabi, "Motor Truck Transportation of Grain to Inland Terminals in Western Canada", Alberta Agriculture, Agdex 843, Edmonton, Alberta, 1975.

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1. Chaudhary, G. Nabi, "Trucking in the Changing Grain Industry", (Phase I), Alberta Agriculture, Production and Resource Economics Branch, Agdex No. 843-3, Edmonton, Alberta, 1985.

2. Chaudhary, G. Nabi, "Impact of Reforms to the Statutory Rates on Trucking", Alberta Agriculture, Production and Resource Economics Branch, Agdex No. 843-5, Edmonton, Alberta, 1986.

3. "Report of the Committee of Inquiry on Crow Benefit Payment" Winnipeg, Manitoba, March, 1985.

4. Grain Transportation Agency, "Review of the Western Grain Transportation Act", Winnipeg, Manitoba, April, 1986.

INSTITUTIONAL CONSTRAINTS ON THE MOVEMENT OF CANADIAN GRAIN TO EXPORT BY ALTERNATIVE ROUTES

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Numerous routes exist for the movement of Canadian grain from the prairies to export destination. Currently all this grain moves by domestic routes to seaboard. These routes include movement by rail to Vancouver/Prince Rupert for transfer to ocean vessel, movement to Thunder Bay by rail for transfer to laker and ultimate transfer to ocean vessel at ports on the lower St. Lawrence, direct rail movement to eastern ports for transfer to ocean vessel, limited ocean vessel pickup at Thunder Bay and movement by rail to Churchill for transfer to ocean vessel. Transfer between modes is accomplished through use of terminal and transfer elevators.

Research by Fruin at the University of Minnesota and by Miller at the University of Manitoba showing the economic potential for use of routes through the United States has stimulated interest in using such routes. This interest has been sharpened by the desire to circumvent the effects of interruptions on current routes such as those arising from strikes and lockouts of elevator employees or longshoremen in port areas, accidents on the St. Lawrence Seaway, and strikes or lockouts of sailors staffing lake vessels on the Seaway. Potential routes for the movement of prairie grain through the United States include: direct rail movement from the prairies to Duluth or ports on the eastern seaboard; direct rail movement to ports on the Gulf of Mexico and to ports in the Pacific Northwest; and a combination of rail and barge movement to ports on the Gulf.

Before routes through the United States can be utilized, several institutional constraints need to be overcome. These constraints take several forms and reflect the regulation put in place with producer support to overcome some perceived problem in the marketing of grain. As a result of this regulation movement through the United States is made more complex than would otherwise be the case.

The constraints affecting movement by U.S. routes include certain aspects of the grading system, the location of cleaning, segregation of grain enroute,

inspection of grain at export position, and issuance of the Certificate Final. Other potential constraints include restriction on the use of Canadian government hopper cars, use of the U.S. handling and transportation system in periods of heavy domestic use and the need for the movement of Canadian grain in bond through the United States. In addition, the current definition of "export" under the Western Grain Transportation Act precludes eligibility for subsidy on movements to the United States. Opposition from Canadian owners of handling and transportation facilities to any diversion of grain can be expected, particularly when these facilities remain underutilized.

History of Grain Movements Through the United States

Movement of Canadian grain through the United States would not be a new development. Canadian grain has moved through that country in significant volumes in the past. In each instance this movement occurred more in response to a limitation of the Canadian system than from the competitiveness of the U.S. system.

Substantial volumes of Canadian grain moved through U.S. ports in the early years of this century. This movement peaked in the early 1920's when up to 50% of Canadian grain moved through Portland, Maine and Buffalo, New York, Table I. U.S. facilities were used since they provided an economic outlet for large volumes of grain. Some grain moved to the U.S. for consumption in that country during the war years. During the period 1946/47 to 1952/53 significant volumes of wheat moved through U.S. ports, Duluth in particular, Table II. Canadian terminal elevators at Thunder Bay had insufficient available storage capacity to expedite shipment. This situation was exacerbated in 1951/52 by a low grade wheat crop, 40 per cent of which was harvested tough or damp. During this period Canadian wheat moved in rail cars in bond to Duluth where it was cleaned and stored in sealed bins, storage facilities being leased so the grain could be stored in these bins. Canadian Grain Commission inspectors were stationed at Duluth, the grain being transshipped by lakers to ports on the lower St. Lawrence. The following year a significant volume, 3.7 million bushels, was re-exported through U.S. Atlantic ports. The competitiveness of this U.S. route remained such that the Federal Government deemed necessary the establishment of the At and East (of Buffalo) rates, rail rates from Georgian Bay ports and those on Lake Erie and Lake Ontario to ports on the St. Lawrence and also to Halifax and St. John, which were competitive with U.S. rail rates at and east of Buffalo.

TABLE I
Comparative Exports of Canadian Grain Via Domestic and United States Ports by Crop Year 1918 to 1927

Crop Year	Volume of Exports Domestic Ports	Volume of Exports U.S. Ports	Proportion of Exports Domestic Ports	Proportion of Exports U.S. Ports
	thousand tonnes		per cent	
1918/19	960.5	519.9	64.9	35.1
1919/20	1315.7	354.4	78.8	21.2
1920/21	891.8	1474.9	37.7	62.3
1921/22	1158.6	2721.8	29.9	70.1
1922/23	2364.3	3534.5	40.1	59.9
1923/24	3450.6	3839.5	47.3	52.7
1924/25	1870.1	2043.1	47.8	52.2
1925/26	3345.3	3869.3	46.4	53.6
1926/27	2922.9	3707.9	44.1	55.9
1927/28	3924.6	3699.4	51.5	48.5
1928/29	5179.9	4192.1	55.3	44.7
1929/30	2147.4	1893.0	53.1	46.9
1930/31	3557.7	2441.9	59.3	40.7
1931/32	3528.2	1325.2	72.7	27.3
1932/33	5035.7	1491.4	77.1	22.9
1933/34	3411.0	1216.0	73.7	26.3
1934/35	2465.2	1053.7	70.1	29.9
1935/36	3524.3	1998.8	63.8	36.2
1936/37	3287.1	1067.0	75.5	24.5
1937/38	1713.5	325.2	84.0	16.0

SOURCE: Processed from Grain Trade of Canada, Crop Years 1918/19 to 1937/38 inclusive.

U.S. grain continues to flow through Canadian facilities on the Lower St. Lawrence. U.S. grain is allowed to occupy 40 per cent of the space in the transfer elevators at these ports, this grain moving to these elevators by vessel from ports on the Great Lakes. In order to ensure the American grain is up to standard upon export an office of the U.S. Federal Grain Inspection Service is maintained in Montreal. The Inspection Service posts inspectors in these Canadian transfer elevators for the purpose of overseeing weighing, grading and the issuance of a certificate final upon export.

Use of the handling facilities of each country has been supplementary to the movement of the host country's grain. In general, such movements have been jointly advantageous. The experience gained from these precedents could well be beneficial to any future large volume movement of Canadian grain through U.S. ports.

TABLE II
Overseas Clearance of Canadian Grains Via United States Ports by Crop Year, 1946 to 1956

Crop Year	Volume of Exports Wheat	Oats	Barley	Rye	Proportion of Exports Wheat	Oats	Barley	Rye
	thousand tonnes				per cent			
1946/47	325.1	19.6	61.9	18.4	7.3	5.8	41.2	13.8
1947/48	428.0	0.4	4.1	33.4	11.8	0.5	7.0	12.8
1948/49	266.5	-	20.0	-	5.3	-	4.2	-
1949/50	3.9	-	-	-	0.1	-	-	-
1950/51	43.1	-	-	77.3	0.8	-	-	32.5
1951/52	108.5	22.1	15.6	21.7	1.3	2.1	1.0	12.5
1952/53	102.0	-	-	2.4	1.1	-	-	1.1
1953/54	3.5	-	-	-	0.1	-	-	-
1954/55	1.0	-	-	29.5	1/	-	-	12.5
1955/56	6.4	-	-	-	0.1	-	-	-
1956/57	13.4	-	-	-	0.2	-	-	-

1/ less than 0.05

SOURCE: Processed from Canadian Grain Exports, Crop Years 1946/47 to 1955/56 inclusive.

Institutional Restraints and the Movement of Canadian Grain

Before proceeding to an assessment of the potential for the various institutional constraints deterring the movement of Canadian grain by U.S. routes, reference to the means used to guarantee uniformity of this grain should be made. This will enable some of the constraints to be placed in perspective. A rigorous grading system has evolved for Canadian grain. Rigid grade specifications are in place for each class or type of grain. Varietal standards exist for most of the classes. Any new variety to be accepted must meet as a minimum the characteristics of the standard variety. The requirement for cleanliness in the grain usually far exceeds that of the grain as received from producers necessitating that the grain be cleaned, this usually being accomplished in the terminal elevators. The grain from many areas is melded when it flows into the terminal elevators. There it is officially graded and weighed by inspectors of the Canadian Grain Commission. Upon export a Certificate Final identifying the weight and grade of the grain is issued by the Commission. The melding and cleaning of the grain results in a high degree of uniformity within grades, this being a characteristic sought after by buyers and one on which Canada capitalizes when merchandising. The Canadian Wheat Board is responsible for the marketing of wheat, oats and barley for export

and for domestic human consumption. Other grains are marketed by private traders. The movement of grain from the Canadian prairies to Thunder Bay and Vancouver/Prince Rupert for "export" falls under the Western Grain Transportation Act. The Federal Government is committed under the Act to pay a significant share of the cost of the movement to the railways with the shipper paying the remainder. The Grain Transportation Agency, established by the Act, performs a general administrative role while exercising a degree of control over the allocation of railway rolling stock to the movement.

Each of the constraints identified is discussed below:

1. Grain Cleaning

Cleaning is one of the constraints affecting movement of Canadian grain through the United States. Cleaning, to be economic, must be done in volume, both from a physical standpoint and also to enable development of a market for the screenings. The majority of the cleaning capacity has therefore been installed at terminal elevators, the screenings having a ready demand in both the domestic and export markets. Cleaning becomes a major profit centre for the terminals, a cleaning charge being imposed at the primary elevator level and the screenings becoming the property of the grain company upon payment of the shippers freight rate to the terminal. Grain diverted to U.S. routes will not pass through these terminals but take a more direct route to seaboard. Terminal elevators in the United States, in general, have only limited and rudimentary cleaning capability. This reflects the approach of that country to dockage in grain. The cleaning requirement for Canadian grain moving through the U.S. must therefore be met within the local areas of production. On the prairies relatively few elevators, including the "interior terminals", have the ability to clean grain to the standard required upon export. Consequently before grain could move in volume within prairie cleaning facilities would have to be expanded and upgraded.

2. Segregation of Grain Enroute Through the United States

In order for Canadian grain to be segregated from U.S. grain enroute, shipments must be made in volume. This is particularly so in the case of combination rail/barge movement when one barge has the capacity of several railway cars. Essentially, the grain should move in trainload lots. Relatively few

delivery points on the prairies can support unit train movements of grain. This follows from the current organization of the primary elevator collection system which reflects transportation costs related to distance rather than cost on other than a collective basis.

Currently, Canadian National has applied, along with several grain companies, for rates $1.50 per tonne lower than those applicable on a system basis for shipments of a minimum of 18 cars from a single origin to a single destination. The impact of this, even though approved by the Canadian Transport Commission, is by no means certain. The tendency will no doubt be, however, towards further consolidation of the railway/elevators network thereby rendering more feasible volume shipments. This consolidation would result in the cleaning of grain on the prairies becoming more economic.

3. Movement in Bond

Canadian grain moving for export through the U.S. must travel in bond through that country. Such segregation is feasible in the case of sealed railway cars which travel directly to seaboard. A different situation exists where trans shipment occurs as would be the case for barge movements. Transfer facilities from rail to barge would also have to be segregated-- sealed bins for the Canadian grain being one alternative. In all cases, the grain would have to be segregated at the seaboard terminal to maintain its identity and ensure that no diversion occurs within the United States.

4. Inspection of Grain at Export Position

In order to ensure the grain exported conforms to the grade indicated, the grain would have to be inspected. In the past, Canadian Grain Commission inspectors have been located at U.S. elevators for grading purposes. This procedure can be expensive in relation to the volume of grain shipped. A feasible alternative would be for the Canadian Grain Commission to reach a reciprocal agreement with the Federal Grain Inspection Service whereby Commission inspectors would grade U.S. grain according to that country's specifications when that grain moved through Canada while the Inspection Service inspectors would grade Canadian grain by Canadian standards as that grain passed through the United States. This would enable each country's grain to be exported under its own Certificate Final.

5. Use of Canadian Government Hopper Cars

Prairie grain moves to Thunder Bay and Vancouver/ Prince Rupert largely in government-owned hopper cars. The degree of use of these cars is reflected in the rate charged shippers for the movement of grain. These cars have been dedicated to shipment to these ports. While this restriction has recently been relaxed to allow their use in the movement of prairie grain beyond Thunder Bay, close control is maintained over these cars. Further relaxation of the restriction would be required for movements through the United States. While such cars would be ideal for unit train movement, extreme care would have to be exercised to ensure these cars were returned promptly and not diverted into the U.S. system. The additional hauling distance to the Gulf could result in a longer average turnaround time with an attendant increase in the number of hopper cars required, these having to be supplied by the railways and thus impacting further on rail rates.

6. Definition of Export

"Export" as defined under the Western Grain Transportation Act in respect to grain "means shipment by vessel within the meaning of the Canadian Shipping Act to any destination outside Canada and shipment by any other mode of transport to the United States for use of the grain in that country and not for shipment out of that country."

This definition essentially removes any possibilities for grain moving for export through the U. S. from qualifying for the rates under the Act. Attempts to have this restriction removed have not as yet met with success. For the rail link between Canada and the United States, the grain, therefore, would move at commercial rates. Discussions with the major railway companies who would be involved in the movement indicate their willingness to quote through unit train rates for the entire journey, any increase in the rates from those under the Act adversely affecting movement through the United States.

7. Access to the United States System

In previous periods the comparatively limited flow of Canadian grain through the U.S. system posed few problems. The latter system was not operating at maximum capacity. The same situation applies today since U.S. export shipments of grain have fallen from a peak of 5042.4 million bushels in 1981 to 3017.7 million bushels in 1986. Decline in exports by route

in millions of bushels are as follows: Great Lakes 1978 to 1986, 555.0 to 193.8; Atlantic 1982 to 1986, 606.4 to 168.0; Gulf 1982 to 1986, 3119.3 to 2057.8; Pacific 1984 to 1986, 925.1 to 545.8, Table III. It is apparent that a substantial volume of capacity remains unused at the present time in all transportation modes. Canadian grain moving to export is welcome in the United States at this time, some terminal elevators being used for storage rather than throughput. Large numbers of barges on the Mississippi remain idle and the potential revenue from Canadian grain would be of assistance to the river traffic. There is no guarantee, however, that this situation will persist indefinitely. With parts of the U.S. system (the river development projects in particular) constructed at public expense for strategic purposes, domestic users can be expected to have priority in periods when the capacity of the system is under pressure. Any diversion of Canadian grain through the U.S. system, therefore, involves a degree of risk. While U.S. grain is guaranteed access to Canadian transfer elevators, no reciprocal arrangements are in place since movement of Canadian grain through the U.S. has not occurred in recent years. A regular movement would require access to the U.S. system to be guaranteed, either by ownership of facilities or by other arrangements which may be easy to obtain if the present bilateral free trade negotiations are successful.

TABLE III
United States Grain Exports by Port Area

Year	Great Lakes	Atlantic	Gulf	Pacific	Total[1]
		million bushels			
1978	555.0	507.8	2617.3	517.1	4197.2
1979	510.5	585.8	2779.7	689.1	4565.1
1980	476.9	528.8	2909.6	917.9	4951.7
1981	491.7	516.6	3034.4	898.2	5042.4[2]
1982	391.2	606.4	3119.3	628.3	4757.9[2]
1983	296.9	367.4	2928.6	760.3	4454.9[2]
1984	336.4	342.3	2887.8	925.1	4576.8[2]
1985	218.9	349.2	2249.6	658.4	3551.8[2]
1986	193.8	168.0	2057.8	545.8	3017.7[2]

1 Includes interior exports
2 Includes sunflower seeds

SOURCE: Processed from Grain Transportation Situation, March 9, 1987.

8. Pricing of Grain for Export

At the present time Canadian grain is exported under Canadian standards, identity of the grain being maintained to port of import. The grain is priced basis port of export from Canada. Exports through the United States would require grain to be priced at point of export from that country. For Canadian Wheat Board grain this would essentially require the grain to be forwarded as agency stocks when in the United States. Since the Canadian Wheat Board has the right to price grain on a C.I.F. (cost, insurance and freight) basis at the import destination, it would seem reasonable to expect that the Board would price grain at U.S. ports. This price would incorporate the cost of movement from the prairies. This would represent an extension of present procedures though in a different country. Certain complexities would be introduced in that the cost of movement through the U.S. system varies over time and according to the volume shipped.

9. Underutilization of the Canadian Transportation System for Export Grain

The Canadian grain handling and movement system for export grain has benefitted from significant infusions of government funds accomplished by a variety of means, whether for the construction of elevators, increasing the lake fleet or the development of the St. Lawrence Seaway. The system, therefore, represents a complex combination of government and private funding and initiative. The whole is bound together by various labour and other agreements. Any diversion of Canadian grain through the U.S. system will reduce volume through a presently underutilized system further raising unit costs. The political fall out from such a diversion could be such as to give rise to Canadian restrictions on movement through the United States.

Action on the Constraints

Each of the constraints identified can be overcome. For some constraints this can be achieved collectively while others must be handled on an individual basis. Problems arising from the grain cleaning and segregation constraints can be jointly dealt with. The volumes required for grain cleaning and for proper segregation can be accumulated by further centralization of the handling and transportation system, a process which is on-going. Fewer delivery points result in a greater volume for each point rendering in-house cleaning more economic and enabling shipments to be made in volume.

Relatively few delivery points at present are capable of sustaining large volume movements but the number can be expected to increase progressively in accordance with the economics of the handling and transportation system, such being made apparent by release of data on the cost of maintaining certain branch lines and the savings attainable by volume movements. In addition, increased sophistication of equipment renders cleaning to export standard at other than terminal elevators feasible. Volume movement assists in the segregation of grain. Unit trains segregate grain from origin to destination, which could be from the point of shipment to point of export from the United States. For movements involving transfers from train to barge, large volumes would also assist in segregation since a unit train of grain will fill about six barges.

Administration of grain movements in bond is made easier where many cars are moved at one time notwithstanding that each car will be sealed. Barges can also be sealed upon transfer, car seals being relinquished for the barge seals. Irspection of grain to ensure grade is up to standard at point of export by Canadian Grain Commission inspectors becomes economically feasible with large volume movements. A reciprocal arrangement between Commission inspectors and those of the Federal Grain Inspection Service (F.G.I.S.) appears nonetheless to hold many potential advantages.

While use of Canadian Government hopper cars should result in lower rail rates on movement through the U.S. this is not a necessary condition for the movement. Substantial numbers of presently underutilized railway hopper cars are available, the supply far exceeding prospective demand. Backhauls would be available for a number of these cars on their return journey, for example, clay, salt and phosphate from New Orleans. This would also avoid the Government cars being diverted into U.S. traffic.

Guaranteed access to U.S. handling and transportation capacity could perhaps be accomplished by reciprocal arrangements covering U.S. movements using Canadian facilities. There would also be merit in the lease of U.S. elevator space so that access would be guaranteed, such space being available at the present time. No problem is foreseen in pricing Canadian grain at U.S. ports. For C.W.B. grains, it would merely involve incorporating the handling and transportation costs beyond the prairie interior elevator while making an adjustment for the transportation cost to the appropriate export position in Canada. The diversion of grain through the U.S. system can be expected to result in opposition from principals in the Canadian movement

system, primarily concerning underutilization and, therefore, reduced earnings. This opposition, on the other hand, should be offset, at least in part, by any additional producer net returns arising from use of the U.S. system. Furthermore, in many cases a different arm of the same firm may be involved in the movement as in the case of the railways. Indeed, if ore and grain traffic again expands to test the capacity of the St. Lawrence Seaway, any diversion of grain will delay or negate any need for extensive investment of additional capital in the Seaway plant.

Each of the constraints identified on movement of Canadian grain through the U.S. can be overcome. This will only be accomplished, however, if there is the will and initiative to seek out and use the alternatives available and to introduce new procedures by which the marketing of Canadian grain can be expedited. The economics of movement are rendering changes essential to the welfare of grain producers. The marketing system has shown the ability to adapt in the past. Consequently the constraints identified can be expected to be overcome as movement through the U.S. is demonstrated to be a viable economic alternative.

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PROMOTING MOTOR CARRIER SAFETY AND FITNESS IN SASKATCHEWAN

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Introduction

The purpose of motor carrier legislation in Saskatchewan is to promote market conditions that are necessary for efficient, adequate, equitable and safe trucking services. It is the belief of provincial transport officials that this goals cannot be achieved without a high level of motor carrier compliance with transport laws.

In the past, Saskatchewan has relied primarily on warnings, convictions, and fines administered through the court system to encourage legal operating practices. However, these deterrents have not proven sufficient to achieve an acceptable level of compliance. Enforcement officials complain that the penalties imposed by an otherwise burdened court system are usually inadequate to discourage illegal operations. Furthermore, the following table (1) shows that few motor carrier trips are even subject to inspection at weight scales or by highway patrol.

SASKATCHEWAN MOTOR CARRIER TRIP INSPECTIONS AND VIOLATION RATES, 1986/87

	WEIGH SCALES		HIGHWAY PATROL	
Inspection Type	Trips Inspected (%)	Violations (%)	Trips Inspected (%)	Violations (%)
Economic Regulation	1.3	10.7	N/A	14.3
Weight & Dimension	5.1	11.2	N/A	22.7
Safety	0.5	19.4	N/A	24.7

Table 1 N/A - not available
Source: Saskatchewan Transport Compliance

The small probability of a trip being inspected is a contributing reason for violation rates of 10 - 25%. These violation rates include infractions of transport law or regulation regardless of their severity, but do not include charges by police forces other than the Saskatchewan Highway Transport Patrol. Nevertheless, it is obvious that inspection rates are not sufficiently high to be an effective deterrent. A 1984 study by Saskatchewan Highways and Transportation, The Effect of Levels of Enforcement on Compliance With Truck Weight Regulations, reported that the percentage of trucks exceeding allowable gross vehicle weights fell rapidly as inspections (apprehension possibility) increased from zero to five percent. Violation rates dropped from 18.6% to 2.8% when trip enforcement went from zero inspections to continuous inspection.

Aggressive carriers in this highly competitive market, often resentful of any restrictions on their operations, are encouraged by the current enforcement coverage to bend the rules if not to break them. There is an attitude that most motor carrier offenses are not serious. Court judgements often support this point of view, as fines regularly only constitute a fraction of the revenue gained by an offending carrier. The economics in such instances are not only rewarding to the carrier, but also suggest social acceptance of the illegal activity.

As an alternative means of promoting a high level of motor carrier compliance, the Highway Traffic Board introduced its Compliance Review Program on May 24, 1984. Under this program, points are assigned to convictions and warnings, and when a predetermined number of points is accumulated by a carrier, a compliance review of the carriers file is triggered. The points system is not used for automatic sanction action. Sanctioning only occurs after a tribunal has reviewed the specifics of a carrier's file.

Carriers earn one point for each conviction and one-half point for each warning. The number of points required to trigger a review varies with the size of the carrier, the number of vehicles registered, and the time period in which the points were earned. If, upon review, the conviction rate of a carrier is found to deviate significantly from the industry norm, progressive discipline is administered through follow-up letters, warning letters, or a meeting with staff of the Compliance Review Committee. The process culminates in a show cause hearing before a tribunal, the Highway Traffic Board.

Compliance Review Program (CRP) carriers fall into five levels according to the progressive severity of their noncompliance. The levels are referred to as preliminary, 1, 2, 3, or 4. Almost 73% of CRP carriers are at the preliminary level which simply means the carrier has accumulated three convictions in the past eight months. These carriers receive an information letter outlining the Compliance Review Program and are requested to provide information on vehicle fleet size, annual kilometres, annual trips, and annual revenue. The nearly 25% of CRP carriers who are at levels 1 and 2 are sent warning letters cautioning them to improve their compliance rating. The remaining 3% at level 3 are required to meet a staff Compliance Review Committee to discuss their compliance performance and to establish a plan to satisfy mutually agreeable compliance targets. No carrier has yet reached the level 4 review by the Board, the show cause hearing. All CRP carriers represent slightly more than 17% of operating authority carriers, but only 4.8% for those at levels 1, 2, 3 or 4. However, if only the estimated active carriers are included then all CRP carriers would make up 23.7% of total operating authority carriers.

A recent examination of conviction rates for carriers in the program demonstrates a remarkable improvement in compliance with transport laws and regulations. Comparing the first seven months of 1985 and 1986, convictions fell by an average of 24%. Carriers with the worst compliance rates, level 3 carriers, had a 54% improvement.

Even though the Compliance Review Program had proven successful in reducing conviction rates, the Board identified a need for more precise and equitable program standards and carrier review criteria. The remainder of this paper details the development of these standards and criteria, the most of important of which was to determine the industry norm conviction rate. The industry norm is required as a standard against which to measure a carrier and for establishing the conviction levels that would trigger a compliance review.

Study Methodology

Survey questionnaires were sent to all carriers in the Compliance Review Program requesting information on 1985 operating characteristics - total company revenue, Saskatchewan revenue, total highway kilometres, Saskatchewan highway kilometres, Saskatchewan trips, and number of vehicles operating within, into, or out of Saskatchewan. The same questionnaire was sent to every fifth carrier with an operating authority, but not currently in the Compliance Review Program. In total, 509 questionnaires were distributed (see table 2), 260 to the carriers in the Compliance Review program and 249 to the sample of carriers not in the program.

Survey Questionnaire Distribution

	Population	Distributed	Distributed To Active Carriers	Returned
CRP Carriers	260	260	260	105
Other Carriers	1245	249	167	71
Total	1505	509	427	176

Table 2

All 260 CRP carriers are active in the market place, as substantiated by their compliance records. However, not all of the other carriers with an operating authority exercise their opportunity to participate in the market. A review of Saskatchewan vehicle registrations, CAVR registrations, and permit records revealed that 82 of the 249 receiving the sample survey questionnaires were inactive. Therefore the return rate for carriers not in the Compliance Review program was 42.5%, or 71 out of a possible 167. This means that the estimated active carriers with operating authorities total 1095; including 260 CRP carriers and 835 (167 X 5) other carriers.

The "CRP carrier" results were proportionally amalgamated with the sample results from the "other carrier" group to produce an estimation of compliance rates and market activity for all operating authority carriers. The 71 survey returns from the "other carrier" sample represents 8.5% of the estimated active population of 835 "other carriers". The 8.5% was then applied to the "Compliance Review Program carrier" data and added to the "other carrier" survey results to produce the "all carrier" estimations, hereupon referred to as the industry norm.

There was a weakness with the methodology. The returns from the "other carrier" sample were not truly random as the choice to respond was voluntary. For this reason it is possible that the results could be biased, though there is no confirmation or proof that this is the case. If the results do contain inaccuracies they are not obvious when the data collected for this study are compared with other sources of statistical data such as Statistics Canada. Furthermore, there is no reason to believe that some carriers would be more inclined than other carriers to respond to the questionnaire. Carriers were simply told that the questionnaire was being used to verify the accuracy of Board records of their operations. The industry was not made aware that the compliance Review Program was being evaluated. In any case, the Board has allowed for a broad leeway in defining an acceptable standard of compliance, and therefore, a high level of accuracy is not vital to the conclusions of this examination.

Survey Summary

Table 3, which describes the general population of carriers with operating authorities, shows that carriers with fleets in excess of 50 vehicles account for 63% of convictions even though their market activity share (in terms of vehicles, kilometres, revenue and trips) ranges from 40% to 51%.

Estimated 1985 Operating Statistics for All Carriers*

Fleet Size	Firms (%)	Vehicles (%)	Kilometres (%)	Revenue (%)	Trips (%)	Convictions (%)
1-10	76	22	15	20	17	17
11-50	21	36	42	40	32	20
51-600	3	42	43	40	51	63

Table 3

*Note: Estimate based almost exclusively on for-hire data.

The medium size carriers, 11 to 50 vehicles, account for 32% to 42% of market activity, but only 20% of convictions. Small carriers, 1 to 10 vehicles, obtain about 17% of convictions with a market share of 15% to 22%.

The conviction to market activity ratio for large firms appears to support the hypothesis that for aggressive operators the benefits often exceed the costs of operating out of compliance. Enforcement officials in this Province have often complained the penalties imposed by the court system and the apprehension possibility are insufficient to offset the potential revenue of not conforming to transport laws.

Table 4 examines the conviction rates and market activity measures for carriers in the Compliance Review program. For this group of carriers the conviction rate for large carriers is lower than their share of market activity. This may be in part because larger, more sophisticated carriers realize there are decreasing returns when conviction rates become excessively high in terms of increased fines and attracting the attention of enforcement agencies. A more plausable reason is that the Compliance Review Program is not currently triggering a review of small carriers early enough. The preliminary review takes place when a carrier receives 3 convictions within 8 months. Therefore small carriers often miss detection and scrutiny at the preliminary stage and are not picked up until their conviction record is proportionally worse than larger carriers.

Estimated 1985 Operating Statistics
For Compliance Review Carriers

Fleet Size	Firms (%)	Vehicles (%)	Kilometres (%)	Revenue (%)	Trips (%)	Convictions (%)
1-10	49	7	5	16	6	15
11-50	38	30	12	11	11	17
51-600	13	63	83	72	83	68

Table 4

Industry convictions have been broken down by each operating characteristic for the "all carrier" category and are presented in Table 5. A comparable breakdown (Table 6) for Compliance Review Program carriers reveals a compliance record 5.5 to 8.5 times worse than the estimates for the industry norm (all carrier category).

Estimated 1985 Convictions for All Carriers*
Broken Down by Operating Characteristic

Convictions Per Vehicle	Convictions Per Million Km	Convictions Per 100 trips	Convictions Per Million $ Revenue
.08 (1:12.5 vehicles)	1.48 (1:675,000 km)	.07 (1:270 trips)	1.41 (1:$710,000)

Table 5

*Note: Estimate based almost exclusively on for-hire carrier data.

1985 Convictions for Compliance Review Program
Carriers Broken Down by Operating Category

Convictions Per Vehicle	Convictions Per Million Km	Convictions Per 100 Trips	Convictions Per Million $ Revenue
.58 (1:1.7 vehicles)	10.50 (1:95,000 km)	.39 (1:33 trips)	12.05 (1:$83,000)

Table 6

It should be noted that an analysis of all carrier convictions recorded in the February, 1984 Motor Carrier Offense List revealed that 76% of the 2,756 carriers with convictions had only 1, and 95% had 2 or less. There are currently about 3,500 carriers on the Motor Carrier Offense List. The Central Permit Office estimates that annually nearly 6,500 carriers are issued 60,000 trip permits. It is also known that commercial vehicle registrations in Saskatchewan for vehicles with gross vehicle weights over 10,000 kg exceed 12,800. There are in addition another 33,742 CAVR registrations that are base plated in another province. Farm truck registrations over 10,000 kg gross vehicle weight account for more than 49,000 vehicles. The point of listing this hodgepodge of statistics is to emphasize that a huge, but unknown number of carriers are operating conviction free. Whether these are frequent or infrequent users of the Saskatchewan highway system is not known. However, it can be induced that the conviction rates for the "all carrier" category (the industry norm) would improve dramatically if data were available to describe this missing market activity and to factor it into this study. This would mean that the convictions per operating characteristic (trips, revenue, etc.) for Compliance Review Program carriers verses the industry norm would be much worse than the 5.5:1 to 8.5:1 ratios documented in tables 5 and 6.

Also, this evaluation has not attempted to include private carrier operations in estimating the industry norm. The Motor Carrier Offense List suggests private carriers have superior compliance records than their for-hire counterparts. Only one private carrier currently in the Compliance Review Program is above the preliminary level even though Statistics Canada estimates they account for more than 50% of the trucking activity in Saskatchewan. Not enough is known about this segment of the trucking industry, therefore it is not possible to calculate their positive impact on industry compliance rates.

The Highway Traffic Board felt the conviction record of the "all carrier" category (our for-hire industry norm) is too rigid a compliance standard in a highly competitive industry such as the trucking industry. This is particularly so under current circumstances where all infractions are given equal weight in determining conviction rates. The industry norm also does not provide any leeway for special operating conditions faced by some types of carriers. (However, Table 7 reveals only small differences in total convictions by type of carrier.) In addition, the industry standard would likely lead to disciplinary action against an unmanageable large number of 1 to 2 vehicle operators over a five year period.

Mean Convictions for Compliance Program Carriers by Carrier Type

Carrier Type	Convictions Per Firm 1985	1984
All Carriers	5.8	6.0
Household Goods	4.0	3.8
Heavy Haulers	4.3	4.5
Livestock	4.9	5.6
G.M. Peddle & Bulk	5.0	6.3
G.M. Long Haul	7.7	7.6

Table 7

Administratively, the Board has a difficulty verifying operating statistics other than vehicle registrations. This means that convictions per trips, per revenue and per kilometre are not suitable as triggers for initiating a review or generating warning letters. These higher level operating statistics should be reserved for level 3 or 4 action where the carrier is interviewed and full discussion of operating practices can take place.

Given the preceding, it was recommended to the Board that the number of annual convictions required to trigger a carrier review should be set at twice the conviction rate of the "all carrier" category, .16 convictions per vehicle. Each carrier, it was suggested, should also be allowed an additional 1.5 leeway convictions for carriers with 10 vehicles or less, and an additional 3.0 leeway convictions for carriers with more than 10 vehicles. The leeway convictions are required to compensate for the fact that all convictions are treated equally, and to ensure the number of carriers in the Compliance Review Program is manageable and confined to those with the poorest compliance records.

Furthermore, it was suggested to the Board that the standards developed and presented in Table 8 be employed at levels 3 and 4 of the Compliance Review Program. These conviction rates are also half as stringent as the estimates for the "all carrier" category (industry norm), and provide the focal point for indepth discussions with carriers.

Recommended Maximum Conviction Rates For Level 3 & 4 Carriers

Convictions Per Million Km	Convictions Per 100 Trips	Convictions Per Million $ Revenue
3	.14	2.80

Table 8

Conclusion

It is obvious to those involved in promoting public safety in the motor carrier industry that the measurement of convictions and the development of related standards is only a part of any definition of carrier fitness. Carrier fitness should be defined by knowledge of and compliance with a wide variety of requirements, including financial responsibility, vehicle inspections, accident records, driver abstracts, conditions of carriage, dangerous goods, vehicle registration, and so on. It is imperative that a broad and nationally uniform definition of carrier fitness be concluded shortly in light of the federal regulatory reform time table. It is hoped that the Saskatchewan Motor Carrier Compliance Review Program will stimulate discussion as one model or approach for consideration.

HOURS OF SERVICE REGULATIONS FOR THE TRUCKING INDUSTRY A REVIEW OF THE ISSUES

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I. ABSTRACT

In an effort to enhance highway safety and to ensure that economic reform of trucking regulation will not lead to a deterioration of truck safety, the National Safety Code will include a regulation establishing the maximum driving and on-duty hours that a truck driver may work.

From Ontario's perspective there are a broad range of issues that must be addressed and considered in developing hours of service regulations for the trucking industry.

The Ministry of Transportation and Communications has increased its involvement with issues relating to hours of service regulation as a result of the Ontario Commission on Truck Safety, the Public Commercial Vehicles Act Review Committee, regulatory reform of trucking, and our primary commitment to highway safety. We have been faced with various issues such as; lack of uniformity between jurisdictions which currently results in severely complicated procedures, and lack of control; need for equity in the complex highway carrier industry; and the need for legislation to be readily enforceable.

MTC officials have felt, that although evidence is inconclusive, it is reasonable to assume that extended periods of driving are not conducive to truck safety. Based upon our practical experience and knowledge of the issues and problems regarding hours of service for truck drivers, this paper offers Ontario's perspective of the issues, and highlights our objectives with respect to a national hours of service regulation.

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Note

At time of writing, a CCMTA task force is still working on developing the hours of service regulation to be included in the National Safety Code.

II. INTRODUCTION

Ontario is committed, as part of a national effort, to develop an hours of service regulation for the trucking industry. It is part of the larger commitment to truck safety, particularly as we progress towards a new regulatory system.

The initiative to limit the number of hours a driver can operate has widespread support. The trucking industry, unions, motorist groups etc. all share a concern for safety, and each agree that some control of driver hours should be established and enforced. Such control is not new. The United States has had federal hours of service regulations in place since 1937, and a number of individual states also limit the hours worked. Canadian operators running in the U.S. must abide by the federal regulations. Other countries, including members of the European Economic Community and Australia also control hours of service.

Similar regulations are in place in Canada at both the federal and provincial levels. But they are a patchwork of confusion. For the most part, regulations are aimed at achieving fair and equitable labour standards, with little or no concern about highway safety. The lack of a safety emphasis must be addressed.

Many claims and statistics abound regarding the extent of the "fatigue problem" in the trucking industry. One recent study by the AAA Foundation for Traffic Safety claimed that fatigue was a factor in 60% of heavy vehicle truck accidents, based upon an analysis of 221 truck crashes. At the low end, an analysis of MTC accident data in 1983 revealed that in less than 0.5% of crashes was fatigue listed as a factor. Scrutiny of the AAA data suggests that a 60% figure is too high, while our own figure is likely too low.

There is a concern about the number of truck accidents which occur for which there is no probable or obvious cause. (e.g. weather conditions are good, road surface is dry, no mechanical defects are found, and the driver is not impaired by alcohol or drugs). Almost 500 truck crashes occurred in Ontario between 1977-1985 which fit the above criteria. Such accidents are cause for concern, and it has been felt that fatigue may play a contributing factor in a significant number of them. One study conducted by the U.S. Bureau of Motor Carrier Safety found fatigue to be a factor in 30% of single vehicle truck accidents.

In Ontario it was also found that for night-time accidents, fatigue was deemed a factor in almost 3 times as many truck accidents than those involving cars. A U.S. analysis of accidents found that of 66 night accidents involving truck drivers, that 2 drivers were asleep, 25 had dozed, 9 were in excess of hours, and 14 exhibited signs of fatigue.

Regulators have accepted that commercial driver fatigue is a highway safety problem, over which there is no adequate control. A national commitment to develop an hours of service standard is evidence of that concern.

Studies and Research

There have been many studies undertaken to examine the effects of fatigue on drivers and its impact on driving ability. (see Appendix I.) Most researchers agree that fatigue has been identified as causing marked deterioration in a number of physiological and psychological driver attributes which could lead to an accident. Decrease in attention, accuracy of response, slowed or impaired perception, boredom and drowsiness are only a few of the characteristics associated with fatigue. There is little doubt that fatigue adversely affects the efficiency of performance, albeit to varying degrees depending on the individual and any number of influencing factors.

It is not clear from studies that a positive and consistent relationship can be established that a certain number of hours leads to fatigue, which in turn results in accidents. But there are a number of interesting findings which have emerged.

- physiological effects of fatigue are evident after 6-9 hours of driving (eg. decreased heart rate)
- major factors which contribute to fatigue include night driving, associated heavy work, irregular scheduling, and activities undertaken in off duty periods
- cumulative fatigue is a problem
- regular rest periods minimize fatigue

In short, it has not been established that the number of driving hours alone are related to the frequency or severity of truck accidents. In fact a study by the U.S. Bureau of Motor Carrier Safety of 25,666 truck accidents, and 485 involving buses, found that the vast majority of drivers were in compliance with regulations governing the hours of service and rest.

MTC Hours of Service Survey

In 1986, MTC conducted a small hours of service survey of truck drivers. The purposes were;

- to determine the extent of hours of service abuse
- to compare the driver record of those who took little or no rest with those who obtained adequate rest
- to identify any characteristics or factors associated with drivers who abuse hours of service regulations.

Trucks were stopped at the northbound King City scales on Highway 400. The time was recorded. Other information taken included the name of the carrier, vehicle registration, destination, and the driver licence number. Lapsed time was then recorded at the Nipigon scales, a distance of almost 1300 kms to the north.

The standard used to determine the extent of excessive driving hours was the federal regulation, the Canada Labour Code, and the assumption made that the average driving speed was 80 km/h. The availability of permits available under the Code were not considered. The 12 hour driving maximum was used. If a driver was to generally abide by the Canada Labour Code, the amount of time it would take, travelling at an average of 80 km/h would be approximately 24 hours if proper breaks and off-duty time were observed.

Of 57 single driver operations, 29 (Group A) completed the trip in an average of 18 hours, while 18 (Group B) averaged 27 hours. There were 13 two-driver operations, 12 of which averaged 17 hours while 1 team took 26 hours. It is a reasonable assumption that 12 of the two-driver operations ran straight through. About 50% of the single driver operations did as well.

Licence abstracts were obtained of all drivers holding an Ontario driver's licence, and of any accident record, in an effort to determine if there were any significant differences between those drivers who likely had adequate rest and those who didn't.

The records of the drivers engaged in double operations have not been considered here.

The sample was limited. Only 12 abstracts were obtainable for each group of drivers. Group A drivers had a total of 23 convictions for moving violations under the HTA, while Group B had 9. It may be that those who drive excessive hours also tend to break traffic laws more often. A weakness in this data however is that convictions were not necessarily related to the operation of a commercial vehicle.

TABLE I
COLLISION REPORTS INVOLVING TRUCKS (1979-1986)

	# of Collisions	Driver Condition	
		Driving Properly	Normal
Group A	6	2	5
Group B	6	2	5

Fatigue was listed as a driver condition in one collision involving a Group A driver. Driver condition was unknown in one collision involving a Group B driver.

It should be noted that in all of the collisions, there were no fatalities or serious personal injuries, nor was property damage significant.

One interesting finding that emerged, was that the average age of Group A drivers was 34 while in Group B it was 41. The finding tends to support other studies which have found that younger drivers are more inclined to put in longer hours on the road.

Neither the small survey conducted, nor our broader experience in dealing with the industry at large leads us to believe there are differences between regulated and private carriers or owner operators and the incidence of driving long hours. An article in "The Logistics and Transportation Review" entitled "Are Truckers Forced to Speed?" supports our findings. That study examined scheduling and the incidence of speeding and hours of service violations and found that "the frequency of violation inducing schedules appears to be unrelated to carrier type or ownership of an ICC authority ... Near identical percentages of each group have violation-inducing schedules."

Ontario Commission on Truck Safety

The Ontario Commission on Truck Safety (1981) chaired by Dr. Robert Uffen had a mandate to inquire into all matters relating to the safety of trucking and to make recommendations it considered appropriate.

In examining matters pertaining to the truck driver, the Commission found that "fatigue has bee identified as a major contributing factor in road accidents", citing the findings of extensive research undertaken in the United States and Europe during the 1970's. Dr. Uffen recognized the problem that there is little evidence establishing a direct relationship between hours of service and accident frequency but attributes this to the probability that few drivers would admit to falling asleep at the wheel for an explanation as to why their vehicle ran off the road. Far better to say that you "swerved" to avoid another car than face a careless driving charge.

The Commission received submissions which dealt with hours of work and fatigue from a range of groups and associates including for-hire and private trucking associations, owner-operators, unions, and auto clubs.

Concerns raised included the following:

- the maximum number of daily working hours (i.e. 15 under the Canada Labour Code) is too high
- overlapping jurisdiction
- enforcement by audit of company records rather than roadside checks
- non-unionized employees less willing to lodge complaints
- owner-operators more likely to exceed maximum hours

The recommendation made by the Commission to address what they viewed as a problem was that tachographs should be mandatory in all heavy vehicles. MTC studied the feasibility of the recommendation. It was not accepted, not because of a lack of concern about the need to minimize the potential for fatigue, but because it was felt to be unworkable and unreasonable, with the major problem being that lack of uniformity would remain.

While it may be reasonable to require heavy trucks registered in Ontario to be equipped with a tachograph, it was not deemed reasonable nor practical to expect that every such vehicle entering Ontario be equipped with such a device.

The position of MTC in not accepting the recommendation was tempered by the objectives of fairness, equity, and enforceability. The objectives could not be met by adopting the tachograph proposal.

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III. ISSUES/CONSIDERATIONS

The Ministry of Transportation and Communications has, in the past five years, become increasingly involved in the many issues related to hours of service regulations. Several events and facts account for such involvement.

Also, it has been our experience that a number of issues surface repeatedly. The following summarizes our experience with the various issues and details analyses undertaken.

1. The Ontario Commission on Truck Safety chaired by Dr. Robert Uffen investigated all facets of truck safety. The Commission examined hours of work for trucking employees and recommended that "MTC should establish the minimum specifications for tachographs which should then be made mandatory in all commercial vehicles exceeding 14,500 kilograms registered gross weight."

2. The Public Commercial Vehicles Act Review Committee, established in 1981 was charged with the task of developing new principles by which to regulate the Ontario trucking industry. A good deal of discussion centred around fairness and equity in the trucking industry - that rules of the game should be the same for all participants. Inconsistencies in the application of hours of service regulations served as a prime example of the need for uniform rules in order that competitors, private or for-hire not have an unfair advantage over others.

3. Highway safety is of major concern to MTC and has become of particular importance with regard to trucking. The public, the trucking industry, unions, shippers, and all levels of government are unanimous that highway safety must not be compromised. Regulatory reform initiatives invariably lead to discussions of safety, and the argument has often been made that economic regulation and safety are inextricably linked. While it is difficult to establish such a link, it is possible that if adequate safety programs are not in place that the level of safety may deteriorate with the increase in competition resulting from economic deregulation. In responding to this concern the Council of Ministers Responsible for Transportation and Highway Safety proposed in October of 1985 that a National Safety Code be developed to improve the level of control in safety regulation.

4. In the past several years, it has become apparent in Ontario that the level of awareness regarding hours of service for truck drivers has increased. The fact that more Ontario truckers are operating into the United States where logbooks are mandatory may partially account for such an increase, but more than likely, it is the increased concern for safety. Many who have contacted MTC have been surprised that we have no direct control over driver hours particularly since the issue is most often viewed as a safety matter rather than a labour standard.

Lack of Uniformity

Without a doubt, the most commonly raised issue is the lack of uniformity between jurisdictions. Those seeking to determine legal requirements invariably pose the questions "what is the maximum number of hours a truck driver may drive, and what legislation are they covered under?"

There is no quick answer, as it depends upon the nature of the operation. Jurisdiction is generally guided by the following:

- a driver for a private carrier which operates intra-provincially or extra-provincially is covered under the Ontario Employment Standards Act, as is a for-hire carrier which performs no extra-provincial service

- drivers employed by a for-hire carrier which performs extra-provincial services are covered under the Canada Labour Code.

- any carrier, private or for-hire operating into the United States must abide by the hours of service provisions contained in the U.S. Federal Motor Carrier Safety Regulations.

Unfortunately, determining jurisdictions or applicability of legislation or regulation is not as simple as the above three scenarios.

Consider the following:

- an owner-operator on contract with an extra-provincial for-hire carrier may or may not be covered under the Canada Labour Code. It depends on whether or not a labour inspector, or a court determines him to be a dependent or independent contractor.

- an owner-operator under contract with a for-hire or private carrier operating solely within Ontario is generally not covered under the Employment Standards Act. But he may be covered if he is a dependent contractor, contracted with an enterprise whose principal business is not trucking, but falls under federal jurisdiction.

- it may not be the case that all employees of a for-hire trucking firm providing an extra-provincial service are covered under the Canada Labour Code. Those drivers engaged in intra-provincial trucking may be covered under provincial legislation, while those performing extra-provincial services are covered under the Canada Labour Code.

- on occasion, we have been informed that private carrier drivers must comply with provincial labour legislation in each province travelled

- while the status of owner-operators is unclear in Canadian jurisdictions, they must comply with the U.S. Federal Motor Carrier Safety Regulations.

Both a lack of uniformity and convoluted legislation has seriously impeded any enforcement effort.

TABLE 2

WHOSE COVERED UNDER WHAT/MAYBE?

Detail	Canada Labour Code	Ontario Employment Standards Act	U.S. Federal Motor Carrier Safety Regulations
Carrier/Driver			
. company driver for intra-provincial private carrier	. no, but maybe if business is federally regulated	. yes	. yes
. owner operator contracted with intra-provincial private carrier	. no, but maybe if dependent contractor (see above)	. no	. yes
. company driver for a for-hire carrier, only licensed for intra-provincial movement	. no	. yes	. no
. owner operator contracted with a for-hire carrier only licensed for intra-provincial movement	. no	. no	. no
. company drivers for a for-hire carrier holding an extra-provincial operating licence	. yes/no/maybe	. no/maybe	. yes
. owner operators contracted with a for-hire carrier holding an extra-provincial operating licence	. yes/no/maybe	. no	. yes

TABLE 3
SUMMARY OF HOURS OF SERVICE REGULATIONS

Detail		Canada Labour Code	Ontario Employment Standards Act	U.S. Federal Motor Carrier Safety Regulations
Maximum Hours per day	Driving	10 Hours	10 Hours	10 Hours
	On Duty (total)	15 Hours	10 Hours	15 Hours
Exceptions to Daily Maximums		12 hours driving, 2 times per week as long as maximum hours weekly not exceeded	Extension to 12 hours per day. By permit only	2 hours for adverse weather conditions
Maximum Hours per week driving		60 Hours/7 consecutive days	60 Hours /7 consecutive days	60 hours/7 consecutive days
Maximum Hours per time frame		70 Hours/8 consecutive days	see above	70 hours/8 consecutive days
Prescribed Rest Periods		10 Min. following 4 consecutive hours, or 30 Min. following 6 consecutive hours	None, but a prescribed eating period, after 5 consecutive hours on duty	None
Prescribed Off Duty periods		24 Hrs. off duty before 7 consecutive days on duty and 8 hours off duty before any shift	None	8 consecutive hours off duty before a shift, and 24 consecutive hours off before 7 consecutive days on duty
Exemptions/ Extensions Exceptions		By special permit and dependent on type of operation	None	Are several minor exemptions

Equity of Ontario Legislation

As previously noted, the PCV Review Committee felt that the entire trucking industry should operate in a fair and equitable environment. Private carriers and their associations on many occasions have raised as a concern, inequitable provisions of the Ontario Employment Standards Act pertaining to overtime pay. A section requires that overtime pay at the rate of one and a half times the regular rate be paid to the driver of a private commercial vehicle after 44 hours in a work week, while licensed for-hire carriers are not obliged to pay such a premium until after 60 hours per week. Unionized employees whether private or for-hire are likely not affected by this disparity as contract provisions usually exceed the minimums contained in the legislation. Among non-unionized firms, private carriers view the inequity as posing a considerable cost burden upon them when in many instances they are performing a service identical to a for-hire carrier.

There is an even more perplexing issue regarding the 60 hour rule. The Act limits as a maximum, 60 hours of work in the course of a week. Therefore, while an employer may dutifully pay his driver overtime premiums for work in excess of 60 hours, it appears that he is in violation of the Act as is the employee who agrees to work more than the legal maximums.

A Task Force appointed by the Minister of Labour is currently examining hours of work and overtime pay provisions, from the labour perspective.

Enforcement

The PCV Review Committee in its Final Report "Responsible Trucking" placed considerable emphasis upon enforcement of the regulatory system.

> "Enforcement is the link that will determine whether the whole framework for regulation will work or not. It is essential that enforcement is used as a system and be coordinated throughout. It must be consistent and directed equally against licensed and unlicensed carriers, and shippers. It should be straightforward, understandable, and capable of being carried out economically".

As with the unanimous commitment to highway safety, there is equivalent support for enforcement of applicable legislation and regulation, particularly regarding truck safety.

There is no on-highway enforcement of driver hours in Ontario, of either the Employment Standards Act or the Canada Labour Code. Occasional random audits are conducted at the carrier's place of business to determine compliance with the federal regulations. Random audits are not undertaken by the Ontario Ministry of Labour. From a highway safety perspective, random audits and on-highway enforcement are essential. With increased highway safety as an objective, Ontario's position is that hours of service regulations cannot be adequately enforced if they are only contained in labour legislation.

It appears that the primary mechanism which spurs enforcement is a complaint by an employee. Rarely in our experience does the nature of the complaint involve the safety of driving long hours. The most common complaint received is that the driver worked "X" number of hours and is questioning why he didn't receive overtime pay. A number of calls are from disgruntled unionized employees who are working on an on-call basis while fellow employees with greater seniority are working well in excess of a 40 hour week and receiving considerable overtime pay. Occasionally, an employee or his spouse complains about what they perceive as excessive hours, and express a genuine concern for safety. In all cases complaints are referred to the Ministry of Labour.

Enforcement of hours of work provisions has at best been sporadic and inconsistent, at worst, non-existent. That provisions do not relate to highway safety accounts for a large part of the problem.

In a submission made to MTC in 1985, the Ontario Trucking Association makes the following point with respect to hours of work provisions.

> ... If as has been the case in Ontario, regulations are not enforced by the various responsible authorities, no change in the present rate of accidents caused by tired inattentive drivers will occur... Any program to reduce fatigue involves two aspects. The first is the process of investigation which includes both on road and in office inspections. The second is the records

required to be kept in order to check hours of service.

The position of MTC is that if hours of service regulations are to be meaningful and effective, that they have to be both enforceable and enforced.

IV. A NATIONAL HOURS OF SERVICE REGULATION FOR THE TRUCKING INDUSTRY

The previous chapter outlined some of the issues and considerations relating to hours of service regulations. They have served to influence the position that Ontario has taken in the development of the regulation under the National Safety Code.

- Of primary importance, Ontario is committed to enhancing and improving upon truck safety by means of new programs and improvement of existing ones. Ontario supports the development of a National Safety Code and the inclusion of an hours of service regulation. While it is not clear from studies that after a certain number of hours fatigue sets in and the likelihood of accidents increase, we consider it a reasonable assumption that maximum driving and on duty rules will minimize the incidence of fatigue, thereby reducing accidents.

While highway safety is the foremost concern, there are other objectives we seek in developing a regulation.

- Firstly the regulation must be uniform across Canada and applicable to all motor carriers and drivers, with rare exception. We should also strive for as much consistency as possible with the U.S. Federal Motor Carrier Safety Regulations. The basic driving and on-duty limits contained in the Canada Labour Code are consistent with the U.S. regulation. International uniformity would be most desirable, particularly in light of growing transborder truck traffic between Canada and the United States.

- Secondly, it should be clear, simple and equitable. We are cautious about incorporating into the regulation spurious exceptions, extensions, and permits to operate excess hours. To allow for such, only serves to dilute the rationale and objectives of the regulation.

- Thirdly, and perhaps most important, it must be both enforceable and enforced. We support a detailed record keeping requirement which will enable enforcement officers to check for compliance either on-road or at the carriers place of business. A daily logbook requirement could serve as the basic record advice. However, appropriate safeguards must be taken. The practice of double-logging, or falsification of logs is commonplace in the United States. Ontario is considering steps to ensure that only one logbook can be maintained by a driver. Failure to prevent such abuse would in our opinion, undermine the enforcement effort as well as enforceability of the legislation. Furthermore it would likely create an inequity. The industry at large is a responsible one and operates within the law, but there are carriers which will flout the law if unfair, inequitable, or illegal practices can offer them a competitive edge. It is a situation we are committed to avoid.

Detail regarding the regulation, and its development rests with the CCMTA task group. As a participant in that exercise, Ontario's position is clear. We support the inclusion of an hours of service regulation in the National Safety Code with the objective of enhancing highway safety. But we recognize the pitfalls of introducing a regulation which is neither uniform, consistent, equitable, nor enforceable. If such elements are not present, the regulation stands a good chance of being rendered meaningless, serving only to impose an onerous paperwork burden on the trucking industry.

***

V. A PROPOSED REGULATION

The following summarizes the key elements of a national hours of service regulation as proposed by Ontario.

General

- applicable to all commercial motor vehicles with a registered gross weight of 4500 kgs or more, and all buses with a seating capacity of 11 or more

- regulation would not apply in severe emergency situations

Hours off Duty

- at least 8 consecutive hours off duty prior to commencing a work shift. Could split 8 hour period into 2 periods for a vehicle equipped with a sleeper berth

Hours on Duty

- 10 hours driving in any work shift
- 15 hours on duty in any work shift
- 60 hours on duty in 7 consecutive days or 70 hours in 8 consecutive days

Extension to Maximums

- 2 additional driving hours for adverse driving or weather conditions, only if under normal circumstances the trip could have been made in 10 hours
- no extended hours permits

Enforcement/Record Keeping

- minimum requirement to be daily log. On board recording devices could exempt operator from log-keeping requirement, but not from keeping auditable records. Exemption would be considered by application.

- on highway enforcement and at company place of business (random and scheduled)

Other

- Ontario considering means to prevent the possibility of "double logging", (e.g. by means of registered logbooks)

- should consider exempting certain operations from log keeping requirement but not from maintaining accurate records at place of business (eg. peddle operators, municipal bus operators)

* * *

APPENDIX 1

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ENFORCEMENT OF VEHICLE MASS AND DIMENSION REGULATIONS

by

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1.0 INTRODUCTION

The legal basis for vehicle mass and dimensions regulations in New Brunswick is in the Motor Vehicle Act. The enforcement of the Act is administered by the Minister of Transportation through the office of the Registrar of Motor Vehicles.

The Motor Vehicle Act specifies interalia, the maximum lengths, widths and heights of trucks permitted on New Brunswick highways as well as maximum allowable gross vehicle masses, permissable axle and axle group loadings. Enforcement of these regulations is accomplished through the use of permanent weigh scales, portable scales and the New Brunswick Highway Patrol who issue tickets for violations of the Act.

This paper presents the findings of an analysis of New Brunswick vehicle mass violations in 1986. The analysis was done in order to evaluate the degree of enforcement of the Motor Vehicle Act and to look at trends in the violations. A 1% random sample of all 1986 violations was extracted from the Department of Transportation's files.

2.0 THE MOTOR VEHICLE ACT (Mass Regulations)

The imposition of load limitations is designed to prevent excessive deterioration and overloading of public highway infrastructure. Fines levied for violations of these limitations should reflect the risk of road deterioration caused by the excessive load and provide a deterence to further violations.

The highway vehicle loading control system used in New Brunswick is designed around the "Ontario Bridge Formula" which is based on the projected impact of loads on highways and bridges (1:2-63). The regulation of gross vehicle mass was developed in 1970 and combines the current 9,000 kgs. maximum single axle loadings with an allowable tire loading of 10.7 kg/mm of tire width on pavement. The vehicle loading control system also considers the spacing of the axle loads and the ability of a structure to support the combined load.

The maximum licensed gross mass of a motor vehicle or combination of vehicles is determined by the number of axles, the configuration of the axle groups and the axle spacing. The maximum allowable gross vehicle mass in New Brunswick is 56,500 kgs. It should be noted that road class and seasonal considerations are also incorporated into the regulations.

2.1 Axle Masses

The following is a summary of the mass regulations found in regulation 83-42 of the Motor Vehicle Act.

As mentioned earlier, the single axle maximum mass is 9,000 kgs. This is also the basis for determining the maximum allowable mass for any combination of axles not constituting a tandem or triple axle group.

Tandem or triple axle mass limitations depend on their spacing and whether the axle group is on truck/truck-trailer or trailer/ semi-trailer. They can vary from 16,000 kgs to 27,000 kgs. Table 1 summarizes the allowable masses according to axle spacing.

Steering axles and front axle loadings depend on the age of the vehicle and the tire width. Vehicles manufactured prior to 1979 are allowed a minimum of 4,500 kgs. or up to the manufacturer's axle rating if this rating is higher than 4,500 kgs. Vehicles manufactured after that date can operate with up to 9,000 kgs. provided the manufacturer's axle rating and/or the allowable tire loads are not exceeded.

Table 1
Maximum Allowable Tandem Mass and Triple Mass According to Axle Spacing

AXLE GROUP	Maximum Allowable Tandem Mass - For a straight truck or truck tractor	Maximum Allowable Tandem or Triple Mass - For a trailer or semi-trailer
minimum 1.20 m	16,000 kg	16,000 kg
minimum 1.35 m	16,500 kg	16,500 kg
minimum 1.50 m	17,000 kg	17,000 kg
minimum 1.80 m	17,000 kg	18,000 kg
minimum 1.20 m, minimum 2.40 m	NOT PERMITTED	20,500 kg
minimum 1.20 m, minimum 3.65 m	NOT PERMITTED	22,500 kg
minimum 1.20 m, minimum 4.25 m	NOT PERMITTED	25,000 kg
minimum 1.80 m, minimum 4.80 m	NOT PERMITTED	27,000 kg

Minimum refers to axle spacing

Source: N.B. Motor Vehicle Act

2.2 Maximum Allowable Gross Mass Determination

The maximum allowable gross vehicle mass for various vehicular configurations can be computed by adding the allowable axle masses. Since each axle has a range of allowable masses it follows that each truck configuration will also have a gross mass range. The range specified in the regulations assumes a normal front axle load of 4,500 kgs. Using a standard 5 axle tractor semi-trailer as an example, the tandem axles on the tractor have a lower limit of 16,000 kgs. similar to the tandem semi-trailer (see Table 1). This explains the lower range value for this configuration of 36,500 kgs. The upper limit for the tandem axles is 17,000 kgs. for the tractor and 18,000 kgs. for the semi-trailer tandem. This determines the upper maximum allowable gross mass for this configuration of 39,500 kgs. If the front axle is loaded above the 4,500 kgs., the maximum allowable gross vehicle mass for the vehicle is increased by the increment, subject to a maximum load on the steering axle of 9,000 kgs.

2.3 Road Class Limits

In 1963, the New Brunswick Department of Transportation adopted a new bridge design standard, allowing for much heavier trucks. Bridges built before that time were not designed for these heavier loadings. Thus the higher gross vehicle mass trucks are restricted from these bridges and associated routes. Regulation 83-42 of the Motor Vehicle Act specifically identifies those routes which permit these heavy trucks.

Figure 1 illustrates the various mass limits permitted on New Brunswick highways. The regulations define three classes of routes: those permitting truck masses of up to 56,500 kgs.; those routes which are restricted to a maximum of 50,000 kgs.; all remaining roads which are restricted to 43,500 kgs. (Note: some bridges on the latter road class are restricted to 38,500 kgs.). Also shown in Figure 1 is the location of the six weigh scales in New Brunswick.

2.4 Spring Mass Restrictions

The structural capacity of a highway is reduced during the spring thaw. The imposition of spring mass restrictions on some routes is the method used to control load limits in this critical period.

During the spring season, the strength of the pavement is monitored weekly on various road sections to determine when and to what degree roads should be restricted. Traditionally, the spring mass restriction period lasts from mid-March to the third week of May. Spring restrictions affect many kilometers of highway in New Brunswick. Figure 2 illustrates the roads affected by the 1986 spring mass restrictions. The diagram shows that most of the arterial highways are unrestricted while other roads are restricted to either 90% or 80% of normal allowable masses. It is noteworthy that no road is restricted below 80% even though road conditions sometimes warrant a lower restriction.

2.5 Tolerances

A common complaint from the trucking industry is the difficulty in meeting maximum allowable axle loadings because of load shifts, moisture buildup and ice buildup in transit, along with other uncontrollable conditions which may cause an increase in mass.

The New Brunswick Department of Transportation has

Figure 1

NEW BRUNSWICK ROUTES CAPABLE OF CARRYING TRUCKS
WITH A GVM IN EXCESS OF 43,500 kg



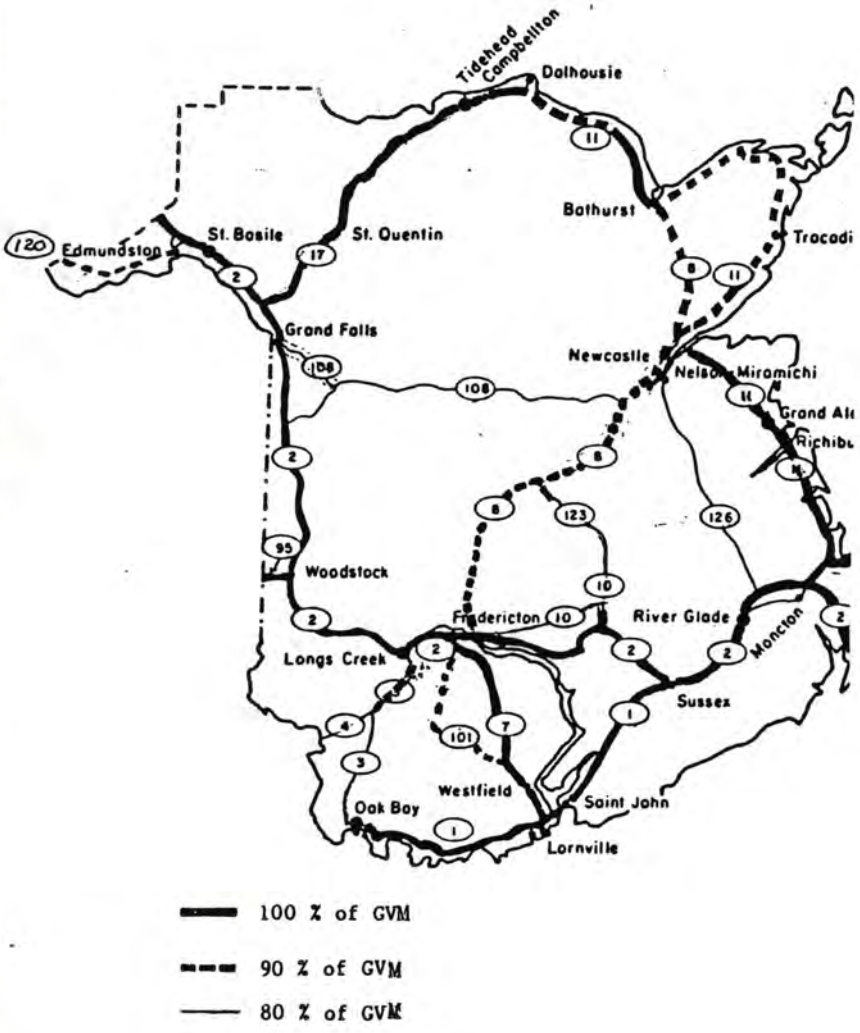
----43,500 to 50 000 kg

▬▬ 43,500 to 56 500 kg

→ ✕ Weigh Scale Locations

Figure 2

1986 SPRING MASS RESTRICTIONS



realized this concern and through the Motor Vehicle Act has authorized axle mass tolerances to reflect these variations. In general, the tolerance for all vehicles and commodities (excluding spring mass restrictions) is 500 kgs. per axle, although the total vehicle mass is not to exceed 56,500 kgs. when the tolerances are added. In effect, this would allow an extra 2,500 kgs of payload on a five-axle tractor semi-trailer combination, which represents an additional 6% allowable mass. The tolerances are even greater for specific commodities and vehicle configurations, such as woodchips, which, in addition to the 500 kgs. per axle, are allowed a 5% tolerance on the drive axle. The transportation of pulp has tolerances of up to 20% on the drive axles and 15% on the allowable gross vehicle mass. It is important to note, however, that these tolerances are not in effect during spring mass restrictions.

2.6 Enforcement Practices

Mass regulation enforcement is accomplished through the use of a series of permanent weigh scales, portable scale spot checks and through the New Brunswick Highway Patrol. The latter two methods are primarily used during the spring restriction period and generate at present a very small portion (approximately 2 - 3%) of all weight restriction violations. The permanent weigh scales account for the major portion of violations. In addition to weighing vehicles, the staff at these stations also check vehicle dimensions, licenses and permits and are responsible for detecting violations of economic regulations.

Vehicles which do not conform to the regulations are issued a ticket stating the particulars of the violation along with other relevant information. One very critical aspect of enforcement is described in the tolerance regulations, i.e. all vehicles charged for overmass will be allowed to proceed to their destination if the excess is less than 1,500 kgs. If the overmass exceeds 1,500 kgs. the scale operator has the discretionary power to permit the vehicle to proceed.

3.0 VEHICLE MASS and DIMENSION VIOLATION ANALYSIS

3.1 Methodology

Approximately 15,000 tickets were issued at the six weigh scales in New Brunswick in 1986. A sample of 177 (1.1% sample) violations was randomly selected from the files of the New Brunswick Department of Transportation.

The information from these violations was stored on a computerized spreadsheet. In the following section, a discussion of the analysis results is presented.

3.2 Types of Violations

The violation types encountered included 13 (7.4 percent) unregistered vehicles, 4 (2.3 percent) vehicles without an inspection certificate and 4 (2.3 percent) vehicle dimension violations. The latter included 2 width and 2 height violations. The remaining 156 were overweight violations. No gross vehicle mass violations were encountered in the sample. This is because all overload charges are made with respect to the overloaded axle and/or axle group. In most axle load violations, the allowable gross vehicle mass has also been exceeded. Table 2 presents a summary of the distribution of the types of violations.

Table 2
TYPES OF VIOLATIONS

Violation Type	Number		% of Type	% of Total
Unregistered Vehicles		13		7.3
No Inspection Certificate		4		2.3
Dimension Violations				
Width	2			
Height	2		1.1	
Subtotal		4		
Spring Restriction Violations	33		21.2	
Overweight Violations				
Single Axle	13		8.3	
Tandem Axle (Drive)	99		63.5	
Tandem Axle (Trailer)	17		10.9	
Triple Axle (Trailer)	20		12.8	
Drive and Trailer Axle	7		4.5	
Subtotal		156		88.1
TOTAL SAMPLE		177	100.0	100.0

It is interesting that 63.5% of the overweight violations were on the tandem drive axle, indicating that either the trailers are being loaded front heavy, the

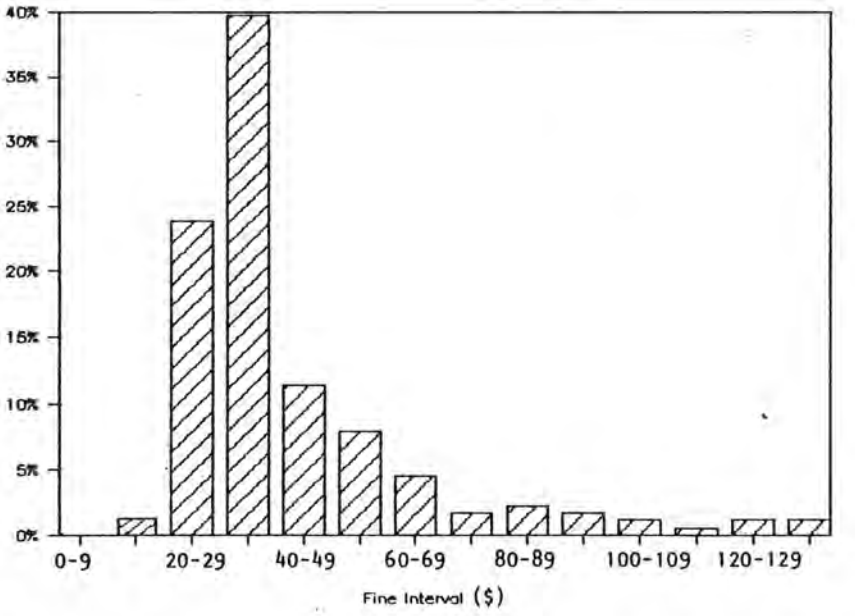
sliding fifth wheel is not properly positioned,the axle spread is insufficient, or some combination of these causes.

Vehicle dimension violations were very few. This begs the question whether there actually are few violators or enforcement is too lax. The fact that dimension regulations can easily be incorporated in the establishment of specifications when equipment is purchased from suppliers, undoubtedly contributes to the low incidence of infractions.

3.3 Extent of Fines and Overmass

The frequency distribution of fines is illustrated in Figure 3. It can be seen that the most frequent fine

Figure 3
Frequency Distribution of Fines



lies within $30 to $39 range. The average fine in the sample was $38.75. This compares favorably with the actual average for all 15,915 violation fines of $38.24. This comparison gives some idea of the reliability of the 1% sample in representing the whole picture. The fines in the sample varied from $10.00 to $366.00. However,

78% of the fines were below $50.00. Amounts over $100.00 were mostly attributable to spring mass violations.

The average overmass for all vehicles in this category was 1,140 kgs. Tandem drive axle violations averaged 1,200 kgs., trailer tandem axles averaged 720 kgs, triple axles 1,370 kgs. and single axle overmasses averaged 900 kgs. The distribution of triple and tandem axle overmasses is shown in figure 4(a) and 4(b).

An interesting observation is the average cost incurred by the carriers due to the fines. This cost can be translated into an average of $0.03 per kilogram of incremental payload attributable to the overload. It is doubtful this is a deterent to overmass loads or representative of the damage cost done to the highway infrastructure.

Figure 4 (a)

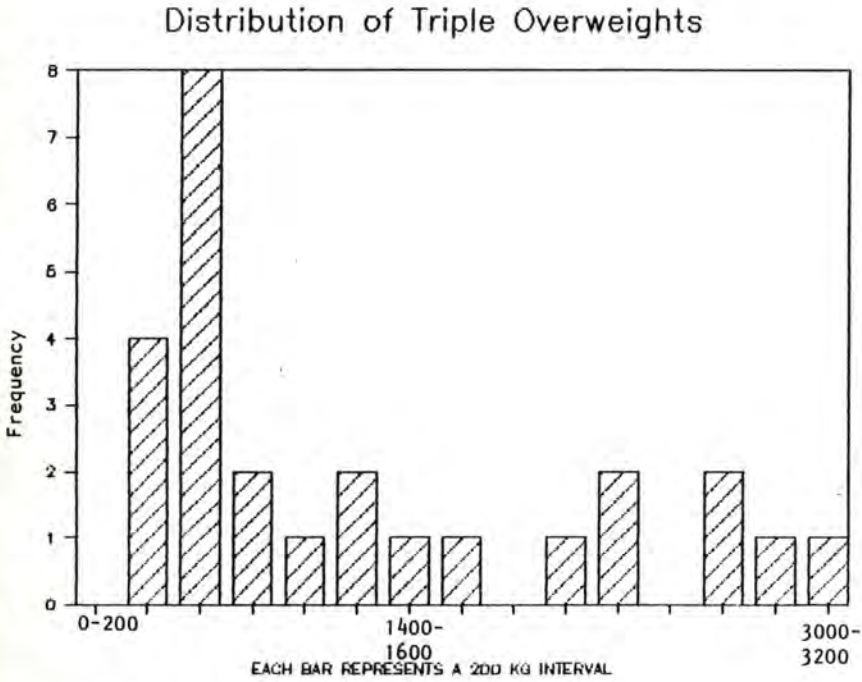
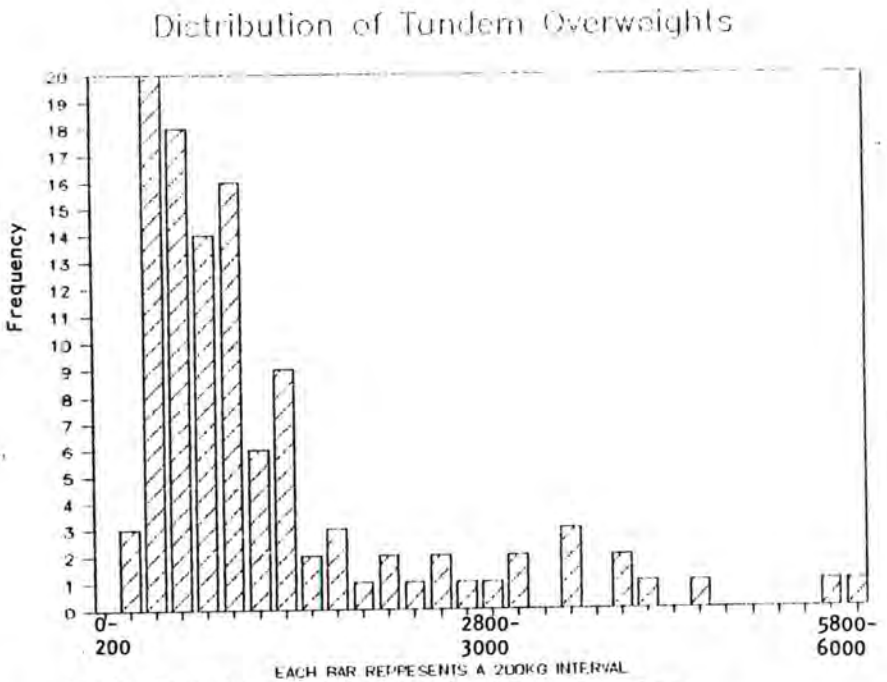


Figure 4 (b)



Reviewing the spring restriction violations separately, the average fine was $62.74 and the average overmass was 2,050 kgs. Again this represents an average cost to the carrier of $0.03 per kilogram. It is surprising to note that very few of the violations involving an overmass greater than 1,500 kgs. were required to remove a portion of their load prior to proceeding to their destination.

A further perspective on enforcement levels can be obtained using probability concepts. In 1986, the total annual truck traffic volume passing by the weigh scales in New Brunswick was approximately 1,600,000 vehicles (Note: estimated from 1984 Altantic Provinces Truck Origin-Destination Survey using 2% annual growth factor). Taking into account the 15,000 tickets issued in 1986, the probability of receiving a ticket was approximately one percent. Given an average fine of $38.24, the expected cost of a violation from the point of view of the operator was therefore $0.38 ($38.24 times 0.01).

The above analysis understates the expected cost to a

certain degree because it does not account for tickets issued by the portable scales and Highway Patrol. Furthermore, records show that the weigh scales were only open 52% of the time in 1986. However, even if one were to assume that the probability of getting a ticket is double the value calculated above, i.e. 2%, the expected cost is still only $0.76.

The concept of expected cost of a violation is more meaningful when consideration is given to the marginal revenue which can be earned from an excess load. For example, assuming a tariff of $5.00 per hundred weight ($0.11/kg) for a certain commodity movement, the incremental revenue from an overload of 1500 kgs. on a 5 axle tractor semi-trailer unit is $275 (Note: the actual overload is 2500 kgs. taking into account tolerances of 500 kgs. per axle assuming that a tandem group is overloaded). Given that an overload of this magnitude does not have to be removed from the truck, the marginal revenue is more than six times the actual fine of $40.00 and far in excess of the expected cost of a violation (less than $1.00). To the extent that this example is representative of normal trucking operations, it should not be surprising that truckers would consider the existing fines as a very low cost of doing business. It is clear therefore that the deterent effect of the existing fine regime is virtually negligible.

3.4 Operational Sensitivity

3.4.1 Commodities

The most common commodities found in the sample are listed in Table 3.

Table 3
Violations by Commodity

No.	Commodity	Number	% of Total
1	Fish	20	11.4
2	Woodchips	17	9.7
3	General Freight	10	5.7
4	Gasoline	7	4.0
5	Lumber	6	3.4
6	Produce	6	3.4
7	Pulp	6	3.4
8	Feed	5	2.8
9	Flakeboard	4	2.3
Total		81	46.1

The interesting aspect of the fish commodity is that 50% of the O-D pairs were between Nova Scotia and Boston, Mass., via the Longs Creek scale. Because of the U.S. regulations this commodity moves primarily on the five axle semi-trailer which contributed 85% of the violations for fish movements. The average overweight amount for fish was a little under the average at 1,060 kgs. Clearly, New Brunswick is not the only jurisdiction which experiences excessive axle loading.

One of the more interesting commodity movements is woodchips. Out of seventeen woodchip violations, fourteen (82.4 percent) were related to spring restrictions, representing 42.4% of spring restriction violations detected at the weigh scales (Note: approximately 500 - 600 were charges made under the Highway Act during the spring restriction period in 1986. These were detected by the portable scales on roads which do not have permanent weigh stations). The average overmass amount was almost double the average at 2,420 kgs. Eighty-five percent of the woodchip vehicles were six axle tractor trailers and the overweight axle group was the tractor tandem drive axle in 88% of the cases. Eighty one percent of the destinations were to Atholville, Bathurst and Dalhousie from various origins in the south-west.

The destinations reflect pulp mill locations. It appears that Route 17, which is the most direct route to the pulp mills in Atholville and Dalhousie, could benefit from increased enforcement if the newly upgraded sections along this route are to be maintained at a reasonable road comfort index. An interesting fact is that the scale most responsible for issuing the violations is located at the northern end of Route 17, whereas most of the trips originate in the south. Therefore, the vehicles had already completed a large portion of the trip before the overload was detected.

3.4.2 Origin-Destination Pairs

Table 4 provides a profile of 1986 violations by traffic lane. It is noteworthy that 74% of the violations in the sample can be accounted for by extra-provincial traffic, particularly since this category accounts for only 22.1% of the annual truck traffic in New Brunswick. Again, taking into account the limitations of the sample size, the data suggests that possibly the extra-provincial truckers do not perceive the fines to be overly burdensome. Furthermore, there is strong evidence that the problem of the lack of deterent impact of fines is not unique to New Brunswick. Indeed,

Table 4
1986 Violations

Traffic Lane Comparison

Category	Percent (%) of Violations
INTER-PROVINCIAL Through Traffic (ie. no O-D in N.B.)	24
Origin New Brunswick	37
Destination New Brunswick	13
TOTAL	74
INTRA-PROVINCIAL	26

the fine regimes of the four Atlantic Provinces are quite similar. Each province has a base fine for each offence ranging from a low of $10.00 in N.B. to a high of $50.00 in P.E.I., plus a charge per increment of 50 kgs. for the amount of excess load. The charge starts at $1.00 per 50 kgs. and increases by $1.00 per 50 kgs. at discrete intervals as the overload increases. In N.B., N.S. and Nfld., the maximum charge is $5.00 per 50 kgs. for ovrloads above 9,000 kgs.

3.4.3 Vehicle Configuration

The most prominent vehicle configuration in the sample was the six axle tractor-trailer, representing 43% of the violations, followed closely by the five axle tractor trailer which represented 36% of the violations. The next most common vehicle configuration was the three axle straight truck accounting for 6% of the violations.

Taking into consideration that tandem semi-trailers are significantly more numerous than triple-axle trailers in New Brunswick, it seems that the triple-axle trailer is receiving more than its expected share of violations. One explanation is that the triple-axles are generally used to transport heavy commodities and are therefore more prone to overloads.

Another explanation is that many of the triple-axle

violations occur during the spring restriction period. It is not uncommon for operations to replace tandem equipment with triple-axles during this period in order to achieve greater payloads. Since the New Brunswick restrictions result in either a 10% or 20% reduction of gross vehicle mass, substitution of a tri-axle for a tandem can offset the payload penalty that would be experienced by the tandem vehicle.

Not withstanding the above observations, it should be noted that in 68% of the cases the overload on the six axle vehicle was on the tandem drive axle, not the tri-axle group. Origin-destination pairs for the six axle tractor trailers indicate that the violations are occuring on the primary arterial highways.

4.0 SUMMARY AND CONCLUSIONS

By far the most common violation of the mass and dimension regulations is axle loadings. They represent 89% of the total sample of infractions in this study. The tandem drive axle on the tractor represented 67% of all overmass violations in 1986, indicating improper load distribution and/or improper fifth wheel placement. Very few dimension violations (2.8%) were detected in the sample. This reinforces the notion that the major enforcement problem appears to be axle loading.

The average fine for violations was $38.75, corresponding to an average overload of 1,140 kgs. The resultant cost to the carrier is a little more than $0.03 per kg. of incremental payload. The fine amount probably does not reflect the damage costs incurred to the road infrastructure, especially during the spring restriction period where the average fine was $64.83, or approximatly $0.03 per kilogram.

The probability of receiving a ticket due to violation of mass and dimension regulations appears to be in the 1 - 2% range. This may not be an unreasonable level of enforcement. However, the evidence presented in this paper suggests that the major enforcement issue is the regime of fines to which violations are subjected. The fines appear to be low in relation to the marginal revenue that a trucker can realize from an excess load. Taking into accunt the probability of getting caught, the expected cost of a ticket is almost negligible in comparison with the marginal revenue. As a consequence, it is doubtful that the current fines act as a deterent.

They are simply one of the many costs of doing business.

The three most susceptible commodities to overload violations were fish, woodchips and general freight. Fish transported from Nova Scotia to Boston, Mass. using tandem axle trailers averaged slightly over 1,000 kgs. overmass. Woodchips movements within New Brunswick appear to be one of the major offences. Violators had an average overload of approximately 2,400 kgs. during the spring restriction period. In fact, 41% of all spring restriction violations in the sample were woodchip movements. Route 17, a recently upgraded primary highway, was the most frequently utilized route by these movements. It is also important to note that most of the damage to this route is done prior to the detection of the overload since the weigh scale is located at the destination end of the trip.

It should be noted that the above observations apply to roads with permanent weigh scales. On other roads where portable scales are used, raw forest products and sand and gravel are the commodities which are most prone to violations. Data indicate that extra-provincial movements experienced a higher rate of violations when compared with overall traffic totals. Again, this may reflect a lack of concern on the part of extra-provincial truckers for the consequences of being caught in contravention of the regulations and the evidence suggests that the enforcement problem is not unique to New Brunswick.

In summary, although the analysis and conclusions presented in this paper are based on a limited sample (1%) of mass and dimension violations which occurred in one province (New Brunswick), in one year (1986), the findings suggest the need for a greater research effort into the enforcement aspect of these regulations.

In the past 2 to 3 years, the various levels of government in Canada, working in conjunction with the trucking industry, have made considerable progress towards a more uniform and effective regime to regulate the interaction between trucks and highway infrastructure. The benefits of this initiative will only be achieved if the regulations which are ultimately implemented are effectively enforced. The findings of this paper point to the need for a comprehensive investigation into both the level and methods of enforcement that might be appropriate in the future.

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TRANSPORTATION RESEARCH REGULATION A KEY FACTOR FOR PRODUCTION INCREASE AND LABOUR SAVING

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Abstract

The idea for this paper has risen from the personal experiences achieved within the transportation Research & Development area and the philosophy/sociology of labour.

In studying trasportation scientific-technological innovation as well as epistemology and sociology, it is fundamental to focus on the basic concept of *system*.

On the basis of this remark, the authors feel suitable to mix and integrate their different education and knowledge to develop the theme of the *Trasportation & Communication system* as a *service system*, revising the classical definitions not only of the tertiary but also of the primary and secondary sectors in the economic structure.

This problem should necessarily be tackled taking into account the idea (marking the current post-industrial social-economic scenarios) of the *qualitative development* instead of the simple *quantitative growth*.

Therefore, since it is a service system, we must design and plan the Transportation & Communication system in such a way as to optimize resources, means, methodologies, procedures and processes involved, in terms of effectiveness, efficiency, reliability and cost/benefit ratio.

In fact, in the present situation of *Technological Unemployement*, these elements and their distinctive features provide the conditions for a positive impact in transportation mass-production activities and trades.

Besides, they constitute the determining factors in creating additional jobs and skilled positions and stimulating the progressive *social quality* standard improvement.

1.0 Introduction

From a historical viewpoint, the concept of *system* has developed through several evolutionary trends and successive improvements. Generally, system means aggregation, composition and integration of parts (*components*) that constitute a unitary structure (*set*). The very basic differences abide in the manner in which this joining composition is made up. In fact, it can be either:

- mechanical, or
- organic.

In the first case, the parts are originally "non-systematic": the subsequent system stage is attained by juxtaposition or assembly[1] of the various parts. In the second one, the original phase is the system itself, where the componing parts are organically connected, necessarily inseparable (even though different in their specific roles) and dynamically interacting and co-operating with one another.

In the strictly logical-epistemological area, the organicistic or antimechanistic idea of system has been prevailing[2]. Particularly, in the sociological reflection context, this organicistic conception ends with being the reception pole of the suggestions arising from the logical-epistemological sphere. The world of man (society) is felt in its complete "systemization" or "complexity", that is, like a set or plexus of parts interacting variously. It follows that the analysis of any single part becomes more complex and difficult, since it inevitably involves the study of the whole.

Nevertheless, it must be noted that the latest system theories (6, 10) tend to be free from the organicistic conception and to exceed the limits. But, this trend does not prevent one of the classical theorist of the system idea, as Ludwig von Bertalanffy (2), from underlining the *organimische Auffassung* (organicistic conception) validity. Any componing part must be considered as part of the whole, even if in itself is, after all, a set or an aggregate of parts. In any case, all of these parts constitute a system, named also "total", or better "integrating" if it does not allow any part to remain "non-integrated".

2.0 The Transportation and Commu ication system as a services system

In viewing the Transportation and Communication (T&C) system, it is fundamental to keep in mind the theoretical and general preliminary considerations aforementioned.

First of all, we must remember that the T&C system is a services system, which, in virtue of this peculiarity, can also be considered a *tertiary system*[3]. On the other hand, being a *complex system* (set of systems), the tertiary system, naturally, does not include just Transportation and Communication.

Everybody knows services variety and diversification: for example, health services, welfare and social security institutions, educational structures, economic-financial services

and so on.

Therefore, the tertiary system can be subdivided and articulated into further smaller systems or *subsystems*. In this way, the T&C system must be seen as one of these subsystems.

Moreover, it is impossible to leave out the existing correlations and interactions (many-directional, synergic, of several kinds marked and characterized by intensities also depending on external inputs) of the tertiary system with the *primary* and *secondary* ones.

In the current configurations and social-economic organizations, we can no more agree with the traditional and general tripartition of the work sphere in the primary, secondary and tertiary sectors without some substantial objections and precise specifications. In fact, this partition is based on the merely economic division between the *productive work* (supplying the concrete and material goods) and the *unproductive work* (providing the services).

Besides, it is necessary to keep in mind the distinction between *extractive activity* and *manufacturing activity*.

The extractive activity, being a direct and immediate producer of goods, can be distinguishable and classifiable in function of the natural places where it is carried out. Owing to this, the work of the farmer, shepherd, fisherman, miner etc., falls within the primary sector.

In its turn, the manufacturing activity (it also being the supplier of goods, although mediately) deals with the elaboration of raw materials through skillful manual labour transformation processes at first, and subsequently through industrial ones.

We must also add that the manufacturing activity sector (distinguished from the extractive activity just as the secondary sector is from the primary one) has progressively attained a preeminent and prioritary significance since the work force previously in charge of the primary sector has been flowing into it[4].

At a certain step, this phenomenon caused an inversion of roles: in the place of the extractive activity sector, the manufacturing activity has turned into primary. Furthermore, owing to the gradual transition from the industrial to the more properly post-industrial era (1, 8, 18) and the macroscopic expansion of this last one marked by effects not as much of de-industrialization type as rather of industrialization requiring less and less conventional work force, it turns out to be the most complex and branched extension of the tertiary sector.

"The main elements [connected with this] evolution are:

- [the strong] qualitative and quantitative change potentials [...] arising, to a large extent, from a trend saturation of needs and demands historically faced by this tertiary;
- [the considerable] resistance [...] to change caused by both the sale requirements and the different services production. [This tendency is] justified and supported by a set of protected markets filtering [...] the urgent

need for transformation [...];
- the large influence that political & agreement evaluations and choices have both on the 'mission' (i.e., transportation) and the basic social structures (i.e., trade, commerce) of the 'traditional' tertiary.

As a whole, the effect of the physiological and structural push for changes/innovations [...] produces a substantial co-presence of activities, typologies and situations, that can also be very different among themselves, with a [consequent...] large dispersion" (4, p.50).

Therefore, the socalled *advanced tertiary* - system including the T&C subsystem - in reality ends up by being the primary.

In fact, by being supplied by the technical-scientific knowledge progresses and related applications at a technological-productive level, this system strongly affects and influences the other working sectors.

So, we are in front of a social-economic macrosystem, within which the various systems and subsystems are in a position of mutual interaction and necessary integration conditions, indipendently from which we cannot exactly and adequately define the boundaries of any problem, not even the specific one of Transportation and Commmunication.

The briefly outlined phenomena mostly have effected, on a worldwide scale, the highly industrial (or rather, post-industrial) countries, with an elevated technological level and characterized by rapid growths and developments. In this view, it is evident that this phenomenon involved and involves also Italy, especially for the continuous technological updating and maintenance connected with the pulling productive sector (the one relative to vehicles and, particularly, autovehicles) and its induced area.

Rather, owing to its peculiar geographical configuration and hierarchical-organizational inner structures, Italy could be a symbolical reference of a situation where we need be aware of the principle of *qualitative growth* in the T&C system as an alternative/complementary item to the one of *quantitative growth*.

In fact, in this specific case, it was and it is quantitative growth in the T&C system that arouses and stimulates the problems connected with the monitoring and control of the agreement rank to the growing standard requirements. Just consider the town & metropolitan areas that have become unlivable because of a lack of quality involving also Transportation and Communication. Neither can we think of only the ecological problems like atmospheric and noise pollution and their consequences on the quality of life and health itself. We must also keep in mind the problems arising during a historical age when the T&C system has to be "redesigned" and "reintegrated" in accordance with the present restructuring processes of metropolitan areas. In fact, these areas cannot be both manufacturing activities and services centres at the same time. Furthermore, they end up by being in more and more anomalous and precarious interrelation conditions with the suburban areas that even when "actively" used still lack the essential

connecting/communicating structures. It is evident that the solution of these problems is basic and of priority for the completeness and unity of the social-economic macrosystem.

Therefore, we must think in terms of advanced and innovative *large network systems*, the only ones able to act as organizing factors "for town and productive installations that grew rapidly and spread widely following the micro scale logics. [...] The goverment/management of urbanized poles, [...] *polyfunctional* [from] the point of view of activities (the more or less traditional industry, the neo-productive sector and the tertiary) and *polycentric* in lay-out, especially is ruled at the moment of transmission and exchange levels of material and immaterial goods [...]. [In our country] the [main] infrastructural programming is at a turning point: while investments are going down (-5% in the public works sector, from 1984 to 1985), projects [are multiplying]. The bridge at the [Messina] Strait, the superhighway network plan, the Spluga railway tunnel, the [new] subways in Rome, Milan, Genoa, Turin [and the extension of the present ones,...the] proposal of ship canals across the Po plain, indicate a state of pre-alarm at the various [corcerned and involved] levels. [...] The road transportation network needed to continuously adjust and adapt to the increasing traffic load rates. A variegated "mobility demand" range flows on the motorways. [The] metropolitan & urban transits, [...] the long routes of commodities and the passengers' traffic converge to road saturation also because no other means of transport offers [efficient and] reliable alternatives. [...] In order to free the overcrowded network lines, [it is necessary] to find new enterprise loops and [related] subjects able to effectively support these design trends" (4, pp. 335-336).

Therefore, despite the induced structural stiffening, the interconnection principle of networks (starting off with the T&C) constitutes the basic implementation to increase the efficiency, yield and "performance" of exchanges, transmissions and trades within the social-economic macrosystem.

3.0 Transportation System optimization in an overview of global social-economic optimization

We must look at the transportation system especially from the point of view of the future, which very meaningfully has been named "future in the present": a future that produces shock, and which is in itself a shock. In fact, this is what A. Toffler has defined it, pointing out, among other things, the need to decentralize, to a large extent, the production activities, with the support of an estremely fast (real time for information) and reliable T&C system (17).

Here we must take into account the indications arising from the setting concept of industry-town, which has unfavourably affected and marked the beginning of the industrial era[5]. The task of post-industrial civilization is to make all spaces (town and extraurban) "within man's reach". To reach these ends, the

realization of a T&C system which, being a specific service system, meets the exact requirements and the merely social constraints, is rather essential. The big risk is that of making the "economic reason" absolute even if it cannot obviously be disregarded.

Let us consider private urban transportation as an example. In regard to this, an Italian scientist says: "Some people are so attached to their adored four-wheeled gadget that would call you a utopian, a visionary [...], if you were to take the liberty of telling them that the private automobile traffic should be forbidden in city areas. It won't even cross their minds the simple fact that city traffic with the present large number of vehicles is impossible. [Nobody can] solve the problem of putting two liters of water into a one liter bottle" (19).

The problem can and must be solved, without necessarily resorting to the neoluddite attitude (for instance, removing private traffic):

- by increasing the passenger/kilometer ratio of public trasportation services;
- by developing alternative propelling systems (hybrid, dual-mode, electric vehicles) and/or unpollutant fuels.

In both of these cases, we provide for a qualitative growth really alternative to the simply quantitative growth.

Naturally, the problem on hand has a high integration rank and involves other problems: Research and Development (R&D), resources, mass-production processes and those related to the existing dichotomy between public and private advantages. In fact, in this precise case, we must judge whether it results more profitable for the vehicle industry to produce public transportation means or private ones. Of course, this induces us to consider how the structural/managerial optimization of transportation, overcoming the strictly technical and economical logics, after all, turns out to be a political matter.

The mutual interferences between the technical and economical aspects are also evident from a different angle. Any R&D activity applying to transportation must develop within the range of the profitable costs/benefits ratio values, at least in the phases characterized by an intrinsec risk rate. It is clear that, in the first place, we refer to the costs/benefits analysis from the point of view of industrial logics. For example, let us take the R&D activity aiming to develop unpollutant fuels, carried out by the OCSE-International Energy Agency, which looks at the real "hydrogen economy" with utmost interest. This type of economy concerns particularly the production of transportation means, which hence needs the relevant *know-how*. However, although it can be easily obtained by electrolysis, the hydrogen industrial mass-production is, presently, economically unprofitable owing to the high cost of the needed electric power. In other words, the hydrogen manufacturing cost is higher than the potential benefits. But this does not mean that the vehicle industry is not interested, at least in expectation. Therefore, by engaging research teams to supply exact know-how, it can, at the same time, help to reduce the so-called *Technological*

Unemployement (see Tables 1, 2, 3).

The Technological Unemployement constitutes the most negative aspect of post-industrial society. In reference to the current Italian situation, it is worth noting that particularly the vehicle industry and relative induced area show large automating/automatizating processes even with the use of *labour-saving* solutions due to which there have been, and still are, transferring phenomena of the work force into the tertiary system. And, the transportation falling within this system, we can reasonably expect that this could even help to cut down unemployement rates. It is appropriate to consider that the goal can be achieved also by giving an impulse to the know-how connected with the design, building up and management of electrolysis facilities and plants, which, in their turn, can extend employement areas while waiting for a "suitable" widespread use of hydrogen traction.

This example demonstrates clearly that trasportation system optimization cannot be pursued as if it were a "closed" system and as if the problem had only technological outlines or just social-economical characteristics.

These implications have expressly been taken into account within the *Project on Transportation Research* (PFT) managed by the *National Research Council of Italy* (CNR).

The main goals of PFT (saving of primary energy; transportation planning and development with reference to the various land scales, to the land/transportation interactions and the "quality of life"; improving service levels; training of operators in the advanced research and related management areas; support of the home sector industry competitiveness) are pursued through the development and setting up of whole systems. This choice arises from outlining that the realization of "finished

TABLE 1

Labour employement in the Italian big industries (basis: 1980 = 100)

1980	100.0
1981	86.8
1982	92.4
1983	87.8
1984	83.0

Source: Censis estimates

TABLE 2

Sectoral distribution variability index (1) of some business trend variables (millions of Italian Lire 1983)

(1) Standard deviation from the average sectoral value

SECTOR	Net Results		Proceeds of sales		Sales per worker		Value Added per worker	
	82	83	82	83	82	83	82	83
Clothing	3	4	126	144	87	319	26	32
Food	8	23	165	771	108	577	31	40
Chemical Industry	67	26	350	303	165	231	25	35
Manufacturing of Transp. Vehicles	20	29	1850	1858	51	81	18	29
Graphics and Publishing	3	6	115	116	60	93	34	39
Electromechanical and Electronic Manufacturing	40	45	384	407	77	98	56	67
Pharmaceuticals	10	12	112	126	105	118	43	47
Rubber	29	6	271	232	76	70	30	28
Construction	17	19	296	290	143	154	54	53
Non Metallic minerals	4	6	104	97	180	116	45	139
Mechanical Industry	93	10	415	120	111	111	30	35
Metallurgical and Steel Industry	48	159	212	536	83	101	37	23
Petroleum & By-Products	213	32	3200	3223	1441	1560	54	73
Natural Textile Fibres	22	23	51	49	59	62	24	24

Source: Censis estimates based on Mediobanca data

TABLE 3

Companies grouped according to sectoral activity and type of variation for 1982 and 1983 of the sales and added value per worker (%)

(a) Negative variation
(b) Variation between 0 (stationary) and the average value
(c) Positive and above average value variation

SECTORS OF ECONOMIC ACTIVITY	Sales per worker				Value added per worker			
	a	*b*	c	average variat. 82-83	*a*	*b*	*c*	average variat. 82-83
Clothing	40.0	45.0	15.0	20.9	45.0	30.0	25.0	6.2
Food	36.7	21.7	41.6	5.0	21.7	33.3	45.0	7.4
Manufacturing of Transp. Vehicles	44.5	19.4	36.1	8.0	27.8	55.5	16.7	20.8
Graphics and Publishing	29.4	47.1	23.5	18.6	5.6	72.2	22.2	29.3
Electromechanical and Electronic Manufacturing	20.7	47.6	31.7	13.5	18.3	58.5	23.2	16.5
Pharmaceuticals	2.9	74.3	22.8	15.1	11.4	51.4	7.2	15.1
Rubber	26.3	15.8	57.9	6.4	42.1	26.3	31.6	3.4
Construction	40.8	22.2	37.0	8.7	48.2	22.2	29.6	7.0
Non Metallic minerals	36.4	11.4	52.3	1.9	34.1	15.9	50.0	2.6
Mechanical Industry	33.3	4.1	32.6	11.4	42.0	5.9	51.3	2.8
Metallurgical and Steel Industry	37.7	26.1	36.2	9.6	-	-	-	-7.7
Petroleum & By-Products	30.4	4.4	65.2	0.1	17.4	43.5	39.1	21.8
Natural Textile Fibres	32.7	32.7	34.6	1.8	-	-	-	-4.3

Source: Censis estimates based on Mediobanca data

products", in addition to maximizing the social-economic impact of the R&D activity and allowing the quantitative evaluation of the ruling investments profitability ranks, assures the large involvement of the technical-scientific competences in the country with widespread fall-out on the general state of the art, in the short-medium term.

4.0 Conclusions

We have shown that an intervention of the R&D and practical/concrete realizations acting on the T&C complex system, so that it develops until it reaches "positive" goals, means to get into a task that is not simply scientific and technical,

particularly since total optimization requires mostly improving the "social quality".

This cannot be attained by doing without the technologically advanced civilization conquests, neither simply without those seemingly specific and typical of the T&C system. In fact, people cannot give up the motorcar or the airplane. This idea needs to resolutely be asserted, considering that, within the theorizing of post-industrial civilization, it has developed an ideology (certainly enchanting but out-of-date) that urges the use of *tools* acquired outside of the above civilization (8). Also with special reference to the T&C system, the post-industrial scenario holds in itself enough energy to generate a new type of "quality of life". It all depends on ensuring that the "facilitation technics" (7), among which are to be counted those that have revolutionized and can still revolutionize the T&C "open" system, remain as technics serving man and not against man. And, at man's service must remain the T&C system which can, among other things, supply an extraordinary contribution also in solving the problem of *Technological Unemployement*, due to its requirements of research/invention capacities and related management skilled experiences. The T&C system optimization (in its genetic meaning and political planning/design as well as in agreement with the other systems optimization) demands the overcoming of the "two cultures" theory (16), the technical-scientific and the traditionally humanistic. We have reached the human dimension horizon of science and technics and in this we must place the T&C system, so that it is scientifically promoted and technologically carried out to improve "social quality".

But, we must not forget that also the T&C system optimization can have positive results only if it is guaranteed and supported by a decisional political power which can no longer be thought of as strictly centralized. The choices and decisions related to a transportation policy have to be, at the same time, unitary and separated and involve science and technics. Thus, we avoid the risk of neglecting research time relinquishing the duties of using a capital from which depends the destiny not only of a simple system or subsystem, but rather that of a *Society in Evolution* (9). To come to the point, in the present social-economic configurations it is impossible to suitably fulfill the human needs without the necessary progressive changes in the Transportation and Communication areas. Nevertheless, it is basic to bear in mind that we deal with a scientific and technical, economic and social problem. So, the positive solution probabilities depend greatly on the presence of a policy-making will sensitive to the fundamental role of *Transportation Research and Innovation*.

Endnotes

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1. The term derives from the classical mechanistic vocabulary.
2. This is also due to the concomitance with the crisis of the "mechanistic idea" of the world (the *Weltbild* of M. Heidegger).
3. More exactly, *traditional tertiary system*.
4. We refer to the work force flow from the primary sector to the secondary one. The intensity of this flow, starting with the factory/plant idea statement, has little by little increased following the giddy growth/development of the industrial era.
5. Think of the *Coketown* of literature.

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BENEFIT COST ANALYSIS OF A TOLL HIGHWAY- BRITISH COLUMBIA'S COQUIHALLA

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ABSTRACT

The Coquihalla is a major new toll highway bisecting existing routes to British Columbia's "Interior". This ex ante benefit cost study estimates the user benefits to traffic diverting to the new highway as well as reduced congestion benefits to those remaining on the old routes. Tolls reduce the number diverting to the new highway, therefore reduce the overall net benefits. The benefit cost analysis is conducted both from a global and provincial perspective. The project shows a modest net benefit or loss depending on the perspective adopted, the discount rate used, and other assumptions. Optimal timing is also considered; the highway would have a slightly higher net benefit if construction had been deferred for a few years.

Introduction

The Coquihalla Highway project involves the construction of 189 kilometres of four-lane divided highway through the Cascade mountains in southeastern British Columbia. The highway connects the town of Hope and the Lower Mainland area of B.C. with interior cities of Kamloops and Merritt. The new highway saves a considerable distance for travellers destined to Kamloops and points north, and those traveling on the Trans Canada highway from or to the Lower Mainland. Exhibit 1 is a map of the surrounding area.

The highway is being constructed in two phases. Phase I, which connects Hope to Merritt, was completed in early 1986. Phase II consists of the remaining link between Merritt and Kamloops; it will open in 1987. (A third phase which would connect eastward toward Kelowna and the Okanagan area is still in the planning stage and is not considered in this paper).

This paper summarizes a social benefit cost analysis of the Coquihalla highway. Unlike some public projects, there are few externalities and social impacts to be included. Most of the benefits accrue directly to users of the project. There are some interesting features concerning the evaluation of this project. The new highway lies between two existing major highways; hence estimating project benefits require that interaction or network effects of the new highway be considered. Another interesting feature is that this is a toll highway. This case provides a useful illustration of the effect of pricing and finance policies on the economic benefits of a project. Although the project will generate a substantial cash flow from toll revenues, the presence of tolls causes the overall economic benefits of the project to be reduced.

Although the highway is partially open, this analysis is an ex ante rather than ex post study. It uses information and forecasts developed before the highway was built as this is more relevant to assessing the original decision to build the

highway. A few issues are addressed which have arisen subsequent to the highway's construction.

The following sections outline the project costs, the benefit categories, the forecasts of traffic levels and diversions among routes, and the estimation of benefits by categories of users. The base case benefits are estimated without tolls. A subsequent section incorporates the impact of tolls on net benefits on the highway. Distinguishing between provincial and non-provincial users provides an alternate calculation of net benefits. From the Province's perspective, toll revenues from non-residents are a benefit, while other benefits which accrue to non-residents are excluded. Nonetheless, the results still show that the imposition of tolls reduces the overall net benefits of the project. The remaining sections of the paper explore the question of optimal timing of the project (was now the right time to build it?) and raise a few benefit and cost considerations which warrant further study.

Project Costs

There are three broad categories of costs: construction costs, ongoing maintenance and snow removal costs, and environmental costs associated with construction and ongoing use of the highway. In addition, the rerouting of traffic will entail diversion of road-related business (e.g. gasoline sales) from one route to another. As is customary, these transfers of economic activity are not included in the analysis (although, not surprisingly, the secondary effects of diverted spending by highway users have generated controversy in the affected regions).

The total undiscounted costs of the project (in 1984 dollars) are $375 million. In lieu of more precise budgeting figures, it was assumed that the construction outlays over the years were proportional to the published estimates of the number of direct jobs associated with the project:

1984: 2750 jobs - $105,225,000
1985: 4700 jobs - $179,850,000
1986: 2350 jobs - $ 89,925,000

The present value of the construction costs (at a 7.5 per cent real discount rate) is $338 million .

For this project there was no shadow pricing of construction costs. That is, it is assumed that the amounts paid to contractors reflect the actual opportunity costs of the resources employed on the highway project. This may be an overstatement. The B.C. economy was not healthy during this period, so some of the employment and equipment used may not have had comparable opportunities for employment elsewhere. Therefore, a case could be made to "shadow price" at least part of the inputs used in constructing the highway. (There is a counter argument that, during times of unemployment, the alternative to this public project would be some other public project; in order to accurately evaluate the relative merits of the different projects, it would be appropriate to value the resources used at a consistent price such as their usual market price).

The Coquihalla is a new addition to the road system and will incur costs of routine maintenance and snow removal. The latter is potentially important for this route. Examination of snow removal and maintenance costs for several

mountain highway districts revealed annual costs between $2500 and $7500 per kilometre. A conservative figure of about $2600 per kilometre or $500,000 per year was used for this cost category.

Environmental costs are of several types. The construction is through mountainous terrain with many river crossings. The Coquihalla is a valuable river for steelhead, salmon and trout. The impacts of highway construction could have been severe. However, by careful timing of construction activity and special efforts to repair any encroachment on the river (including relocating and reconstructing river habitat for fish), most of the these potential environmental impacts have been prevented. That is, the costs of mitigating environmental impacts have been incorporated into the construction cost estimates. There may be ongoing environmental impacts such as the impact of greater surface water runoff and sedimentation of the river, but these effects are unknown at this time.

The other environmental impact is the inevitable encroachment of civilization on this area which was previously largely a wilderness area. There will be impacts on wildlife through greater hunting and fishing pressure as well as animals killed by cars. However, this is the paradox of all such wilderness access. Clearly, there are costs of harming the wilderness, yet it is also clear that people value the opportunity to penetrate these areas. That is, there are both benefits and costs of access to regions with limited previous access. These environmental benefits and costs have not been included in this study.

Benefit Categories

The primary benefits of the project accrue to the users of the highway in the form of savings in operating costs and time. There are also significant safety benefits associated with the project, and there are benefits to road users who remain on other highways but who experience lower congestion levels once the Coquihalla has opened.

The Coquihalla cuts 72 kilometres off the previous Hope-Kamloops route. At a cost of $0.10 per vehicle kilometre, this is a saving of over $7.00 per trip for automobiles. For large trucks, the saving is even greater, about $33.50 per trip.[1]

The reduction in distance and increased average speed means significant time savings to traffic who divert.[2] The valuation of travel time is often contentious in transportation studies. Usually this is because only small time savings are involved. The time savings per vehicle are substantial in the case of the Coquihalla. The value of time for leisure travelers was set at 25 per cent of the gross wage; multiplied by the typical passengers per car on B.C. Highways results on a value of time of $6.68 per vehicle hour, or a time savings worth about $8.00 per trip on average for cars diverting to the Coquihalla. Higher values of time were used for automobile drivers assumed to be traveling on business ($12 per hour) and truck drivers ($14 per hour) (the former based on the average wage in the service sector as reported by the Statistics Canada, and the latter from Trimac Consulting Ltd., 1982)

Building the Coquihalla will relieve traffic volumes on the existing highways Number 1 and Number 3. The effect will be minor during periods of light to moderate traffic, but there will be significant benefits during congested periods. This is a difficult category of benefits to estimate. It requires knowledge of the

number of hours of various degrees of congestion, and the impact on operating speeds (hence time and cost savings) of reducing the level of congestion. Only rough approximations of this benefit category were possible; they are described later.

The other major benefit category is safety. Use of the Coquihalla saves substantial distance (thus reduces the chance of accidents). In addition, the Coquihalla is a divided four lane highway with adequate shoulders. Such a highway has a significantly better accident record than regular two lane highways. One set of estimates are as follows:

Effect on Accident Rates of Changing to Divided Highway*
(accidents per million vehicle kilometres)

	fatal accident rate	injury accident rate	property damage only	total accident rate
two-lane	.0316	.323	.472	.825
divided expressway	.0236	.273	.472	.769
freeway	.0155	.168	.304	.490

* For rural highways, partial access control; converted to metric.
Source: Pacquette and Wright, (1979) p. 73.

These figures show that fatal accidents can be reduced by 25 to 50 percent by changing from two-lane undivided to multi-lane divided highways. We use an estimate of 33 percent for our calculations. For accidents involving injuries and property damage only accidents, we assume reductions of 33 and 15 percent, respectively.

The safety benefits arise for two reasons: (1) reduced distances travelled; and (2) travel on a safer highway.

In the base year of 1987, approximately 130 million vehicle-kilometres could be saved due to the shorter distances travelled. For a fatality rate of .0316 per million vehicle kilometres, this implies a saving of 4.1 "statistical" lives. (By way of comparison, the B.C. death rate per million vehicle kilometres is .027 from Government of British Columbia, 1984). Similarly, the reduced distances travelled imply a reduction of about 42 accidents involving injuries, and 61 fewer non-injury accidents.

The other safety benefits are due to the use of a safer highway. The base year calculation estimates 313 million kilometres diverted to the new highway. Using the estimated accident reductions noted above, this results in 3.3 additional lives saved, 3.4 fewer accidents involving injuries, and 22 fewer property damage only accidents.

Therefore, total safety benefits for the base year are 7.4 lives saved, 76 fewer accidents involving injuries, and 83 fewer p.d.o. accidents. These benefits can be expected to grow with increases in traffic volumes.

The valuation of safety benefits is a highly controversial subject, but at least some estimate needs to be included for the study. The most contentious figures are those involving loss of life. Arbitrarily using a value of $500,000 per statistical life[3] results in a base year benefit of $3.7 million.

The valuation of non-fatal accidents depends on accident and injury severity. Christofferson (1984), citing several sources including work by Lawson, used $10,780 for the average cost of an accident involving injuries. The more comprehensive study by Miller, Reinhert and Whiting calculated a range from about $2300 to $261,000 depending on accident severity. This study uses a single figure of $11,000 for an accident involving injuries. Property damage only accidents entail lower total costs. Christofferson (1984), citing several Canadian sources, settled on $2000 per such accident. This is the figure used here. The base year accident reduction benefits add about $1.0 million to the benefits of lives saved, for a total annual safety benefit of $4.7 million dollars.

A final category on the benefit side is the residual value of the project. The highway will last much longer than the 20 year life used for the analysis of benefits and costs. In principle, the residual value for such a project would be the capitalized value of benefits accruing after 20 years, less all reconstruction costs which would be necessary to keep the road in operation, all discountered back to the present. A simple procedure often done is to include all or part of the initial construction costs as a terminal value, on the assumption that much of the initial road investment will still be useful at the end of the assumed project life. The latter practice was used here. A residual value of 75 per cent of initial construction cost was included as a terminal value.

Forecasts of Traffic Diversion

There are two forecasting tasks: first is forecasting the overall volume of traffic, and second, their assignment among alternate routes. B.C. Highway Officials had made such forecasts as part of the original environmental impact study of the project. The B.C. Highway's forecast were for a base year (1986) with and without the Coquihalla Highway. These forecasts are illustrated in Exhibit 2. In order to calculate a net present value, it was necessary to extend the forecast 20 or more years into the future. Projection methods were used based on recent traffic growth but with a "EXPO bulge" for traffic in 1986. Sensitivity analysis was used to assess the significance of the results to the forecasts; variations in the forecasted growth rates did not change the results significantly.

It was necessary to construct price-sensitive diversion rates to the Coquihalla because tolls will be charged on the new highway. To do this effectively required that total traffic forecasts be disaggregated into different categories. Separating cars and trucks was done on the bases of existing data on the mix of vehicles travelling on the highways. It was also important to disaggregate traffic into different origin-destination catagories. For example, Highway 1 north of Hope (the Fraser and Thompson River canyons) includes local traffic and traffic going on north at Cache Creek. This traffic is not candidate for diversion to the new road. Of the traffic going on to Kamloops, some traffic

either originates or terminates there. The time saving of the Coquihalla is a more significant portion of total journey time and cost for this "Kamloops-determined" traffic than it is for traffic continuing on the Trans-Canada highway or turning north up to the Yellowhead highway (Jasper Park and Edmonton). Typically, one would expect higher diversion rates for Kamloops-determined traffic than traffic travelling greater distances because the time (and operating costs) savings represent a larger share of total journey costs for the Kamloops-determined traffic.

Similar arguments apply to traffic previously taking the southern route, Highway 3. Traffic destined along this route or continuing to the Southeast are not likely to divert to the Coquihalla, whereas traffic which rejoins the Trans-Canada highway east of Kamloops would be candidates for diversion.

Predicting the precise diversion rates for different toll charges is very difficult. Ideally it would require extensive surveys or other investigative techniques, and even then there would be considerable uncertainty concerning the reliability of forecasts. A simpler approach was adopted.

Aggregate traffic forecasts were disaggregated into various origin-destination groups. These were based on an origin-destination survey by B.C. Highways. The various origin-destination pairs were reviewed to identify those most affected by opening of the new highway. In the absence of tolls, it was assumed that 100 per cent of traffic would divert for those O-D pairs able to use the full distance saving of the Coquihalla. This traffic was then disaggregated by truck, commercial auto travel, and general or leisure auto travel, and grouped into broad origin-destination categories. Two of the categories, traffic travelling on north and traffic destined to the southeast, were assumed not to divert to the new highway at all. Local traffic was also excluded from estimates of diverted traffic. For the remaining traffic, they must be separated into diverted, undiverted and generated traffic. The latter refers to new traffic attracted to the roads because of the improved travel conditions. Because the time and operating costs of travelling is only a part of the total costs of travel, generated traffic is not likely to be important except on the Coquihalla route itself, and this will primarily be for the "Kamloops-determined" traffic (ignoring tolls, the time and operating costs savings via the Coquihalla rather than via Highway 1 represent a 28 percent saving in total trip cost; this is sufficient to stimulate some response in the total amount of travel by this traffic category).

The proportion of traffic diverting to the new highway -- and the potential amount of generated traffic -- will be influenced by the level of tolls. Estimating price and time elasticities of demand is a difficult task. For this study some approximations were used. First of all, for each traffic group affected by the Coquihalla, the potential time and operating cost savings were calculated. It was assumed that if the toll charged was exactly equal to the average time and costs saved, that the traffic group would split 50/50 between the two routes. If there were no tolls, then a much higher percent of traffic divert, 100 percent for traffic which realize significant savings via the Coquihalla. Interpolating between these two diversion rates and toll charges (zero tolls and tolls equal to total time and cost savings) for each group gave predictions of diversion rates for each traffic category for different toll charges.

Our forecasts of traffic volumes on the three highways appear to be very close to B.C. Highways' forecasts. With tolls, our estimates of the traffic allocation

among Highways 1, 3, and the Coquihalla are 34, 35, and 31 percent, respectively. B.C. Highways' figures are 32, 34, and 34 percent, respectively (Kasianchuk and Warburton, 1986). Without tolls, we estimate that about 50 percent of through-traffic would use the Coquihalla.

For generated traffic, the size of time and cost savings were compared to total costs and travel (adding estimates of food and lodging costs) to get an idea of the percentage change in "trip price" which faced travellers. For commercial vehicles, this percentage change in price would be multiplied by a derived elasticity of demand for freight transport, typically a fairly low elasticity (for example, if the elasticity of demand for final products was unity, and the transportation costs represent 10 percent of the delivered price of goods, then the derived elasticity of demand for freight transport would be -.1). The only significant amounts of generated traffic were for Kamloops-determined traffic, and levels of generated traffic were modest in comparison to other traffic volumes already on the road. Therefore, the overall results are not very sensitive to generated traffic estimates.

The remaining traffic estimates of potential importance are the total volumes of traffic on the old highways. During congested periods, the presence of the Coquihalla means that traffic congestion on other highways will be reduced, and all undiverted traffic (including local traffic) realize a benefit. To calculate this benefit to undiverted users requires a comparison of the traffic volumes relative to the rated road capacity, and relating this to speed-flow conditions to estimate any time and operating cost savings to undiverted traffic. Surveys of highway use by time of day had been projected by B.C. Highways. An estimate was made of the total annual time the existing highways would encounter congested conditions ("Level D" and "Level E" service, unstable vehicular flow at 55-70 kph and 55 kph, respectively, Government of B.C., 1978, p. 17) Traffic diverting to the Coquihalla will greatly reduce congestion levels for traffic which remain on the old routes. A 20 minute saving was estimated for through-vehicles on the old routes (traffic figures were based on volumes away from settled areas, this tends to exclude local traffic which realize smaller benefits from reduced congestion). The benefits to undiverted traffic were proportional to the number of cars diverting to the Coquihalla, and the latter is a function of the tolls charged.

Base Case Evaluation

The base case consists of the Coquihalla highway with no tolls. Exhibit 3 summarizes the benefit and cost categories using a 7.5 percent real discount rate and an arbitrary project life of 20 years.[4] A positive terminal value for the project was assumed at the end of the calculation period.

The "bottom line" shows a positive net benefit for the project although not a very large one. The internal rate of return (IRR) of the base case is about 11 percent.

Exhibit 3 also lists the benefits (and costs) with current toll charges of $40.00 maximum for trucks ($35. used as an average) and $8.00 for cars. The project costs are largely unaffected by tolls (there are the annual costs of toll collection), but the project benefits are smaller because fewer travellers divert when tolls are levied. There are also costs and time delays imposed while collecting tolls (this cost is not included). The toll revenue itself represents a transfer of benefits from users to the government or tax payers, therefore toll

revenues are not included in calculations because it would be double counting (but see the discussion from a "Provincial perspective," below).

The overall project benefits with tolls are positive but small at a 7.5 percent discount rate. Exhibit 4 plots the IRR's for the project with and without toll charges. This exhibit is also useful for illustrating the sensitivity of project benefits to the discount rate.

Traffic diversion rates for other toll levels were interpolated between the base case (zero toll) and the currently-imposed tolls. Therefore, the sensitivity of net benefits to different toll charges are estimated as a straight forward proportion of the difference between the two net benefit calculations and any proportionate change in the overall level of tolls charged. Different categories of users were assumed to have different elasticities of demand, for example, truck and commercial automobile travel are expected to be less sensitive to tolls than are leisure travellers. It would be difficult to discriminate among the two types of auto traffic, but a shift of tolls charged to increase those on commercial automobiles and decrease them on leisure travellers could generate the same toll revenue but with less reduction in project net benefits (up to a point). The same argument could apply to toll charges for commercial trucks relative to leisure cars, but additional information on their respective demand elasticities would be needed to settle this.

Project Finance and Benefits from a Provincial Perspective

The relationship between project benefits and project pricing is an illustration of basic economic principles which date back to Dupuit, 1844. The Coquihalla is a classic example of a public project with largely fixed costs and low variable costs with use. Such a project gives rise to a paradox because financial and economic criteria diverge. The optimal policy from an economic point of view is to keep the price low in order to encourage use of the project because the incremental costs of additional use are very low. But then the project runs a financial deficit. A better method of finance for such a project is to levy a fixed charge such as via general taxation rather than specific tax (toll) which discourages use of the facility.

However, there is still the necessity to finance the project. The usual illustration of the foregoing principle applies to "first best" world where prices equal marginal costs everywhere and there are few or no taxes. If taxation is discussed at all in text-book illustrations of the problem, taxes are limited to a head tax or some other non-distorting tax. But in practice, a variety of taxes are imposed, so the decision to add another public project such as the Coquihalla may not necessarily leave total taxation unaffected. Whatever form of taxation is used to finance the project will have some resource allocation effects. The estimate of the reductions in net benefits due to tolls is an over-estimate of the actual loss because it ignores any economic costs (resource allocation effects) of the ultimate forms of taxation used to finance the project. But the basic principles are still valid: levying a specific tax (toll) on a particular group (users) causes reductions in project benefits not compensated for by reductions in project costs.[5]

The other interesting facet of project benefits, costs and finance is to focus on the project from a purely provincial perspective. The project is financed by

B.C. residents, yet many of the benefits accrue to non-residents. Without a toll, the residents of B.C. would be incurring costs for the benefit of non-residents. The tolls are a way of capturing some of the benefits for B.C. Accordingly, we reestimated the project benefits distinguishing between B.C. and non-B.C. residents. This is shown in Exhibit 5.

Surveys in the 1970's showed that out-of-province license plates constitute over 30 percent of traffic on Highways 1 and 3, especially the former. However, the proportion of out-of-province vehicles is less during winter months than it is during the rest of the year. We used an arbitrary figure of 25 percent of traffic on the Coquihalla as out-of-province vehicles. The provincial benefits are defined as the time savings and operating costs savings to provincial car users, and toll revenues from non provincial vehicles. From the purely provincial perspective, net benefits of the project without tolls are reduced compared to the base case calculations; this is because a provincial perspective does not count benefits to non-B.C. users. Counting the toll revenues from non-B.C. residents as a benefit still results in even lower overall net benefits. That is, the impact of tolls causes a sufficient number of B.C. drivers not to use Coquihalla thereby reducing the benefits to B.C. users, and the reduction in benefits to B.C. users because of tolls is not offset by the toll revenues collected from non-B.C. travellers. The Provincial net benefits without tolls are positive whereas the net benefits with tolls are slightly negative at the 7.5 percent discount rate. Sensitivity analysis showed that assuming a higher proportion of non-B.C. travellers made little change to this basic result.

Another possible approach would be to only levy tolls on non-B.C. users. Setting aside the probable negative reaction by travellers and the possible harm to B.C.'s tourist reputation, such an approach would probably yield a small net benefit, although it would be less than the base case net benefits without tolls (it is less because compared to the base case without tolls, the benefits to non-B.C. users are replaced by toll charges paid by this group and the tolls are less than the savings realized by this group).

Optimal Timing of the Project

Most project evaluations concentrate solely on the question of whether or not to build a project, that is, are the discounted net benefits positive? An often neglected question concerns the optimal timing of a project, viz, is it appropriate to undertake the project immediately or would the net benefits be even larger if the project were deferred for a few years? Setting aside the short term macroeconomic concerns of employment generation during an economic downturn (which were a consideration in the Coquihalla construction), the net benefit calculation can be carried out for different years' construction and all results discounted back to the same base year. The optimal year for construction is the year for which the NPV is largest.

Most transportation projects will realize a larger undiscounted benefit stream by postponing the project. Traffic is usually growing over time, therefore larger user benefits (and reduced congestion effects) will arise if a project is built later. The key point for determining the optimal timing of a project is to compare the change in benefits (discounted to a common year) by postponing a project, with the opportunity cost of capital. The costs of postponing the project are the foregone benefits which are primarily those of the first year; the benefits of postponement are the opportunity costs or use of the capital for the

postponed period, and the present value of the increased benefits that would result from the higher traffic volumes over the life of the project.

Exhibit 7 plots the net benefits of the project for various years' opening. The optimal year appears to be about 1990, i.e., the economic analysis based on existing forecasts suggests that the highway was built a few years early. However, because the NPV curve in Exhibit 7 is fairly flat, this indicates that there is very little loss by premature construction. The question of optimal timing is sensitive to assumed growth rates, which are somewhat uncertain, therefore not too much confidence can be placed on precise dates for the optimal timing of this project. If one then considers the need for employment stimulation and the enthusiasm for facilitating EXPO 86, the earlier construction to open in 1986 may be understandable.

Caveats and Questions for Further Analysis

This paper was prepared during construction of the Coquihalla, but following the opening of Phase I there are a few developments which warrant comment. First, there is a general caveat which must accompany nearly all benefit cost studies. Finding a positive NPV is not a guarantee that there might not be alternate projects with even higher social returns. This study has also been confined to examining the given scale of the project. The Coquihalla is a four lane divided highway for most of its length. This paper has not inquired into whether or not a phased construction might generate higher net benefits. For example, this study did not consider building a two lane highway and later expanding it as traffic grew. The Ministry of Highways reportedly did consider this but found that the cost savings of two construction periods were very small (Kasianchuk and Warburton, 1986).

Since the opening of Phase I, there have been some comments about construction and vehicle operations which warrant mention. A high priority was placed on opening at least part of the highway (Phase I) in time to handle expected traffic for EXPO 86. The accelerated construction required greater use of overtime and weekend construction, which raised costs. Because bids for construction work on the highway were reportedly less than in previous years, the project has remained largely on budget. Nonetheless, the greater amounts of overtime and higher cost working hours suggests that the project could have been built at a lower total cost if construction was spread over a longer period.

A related problem are allegations that some paving was done without adequate time for the road base to stabilize. If so, this may require additional maintenance and/or premature reconstruction at some time in the future. However, it has not been possible to substantiate or estimate these possible costs.

In the use of the Coquihalla, there have been complaints, especially from truckers, concerning the very long grades on the highway (Vancouver Sun, June 14, 1986). The grades are no steeper than on other major mountain highways; however, allegedly the grades are so long that cars and trucks are more prone to overheating and similar mechanical problems. If so, the expected operating cost benefits may not be as high as forecast.

Conclusion

The Coquihalla makes an interesting case study of the economic evaluation of highway projects. It is a large scale project with significant effects on traffic

flows on the highway network. Substantial time and cost savings accrue to users. While there is always some debate over the valuation of these savings, the amounts of time and costs saved by individual vehicles using the Coquihalla are much larger than the magnitude of these benefits on most other road projects. Therefore, there is more confidence in the economic significance of these benefits than comparable figures for many other road projects.

The project has a modest net present value at a 7.5 per cent discount rate without tolls. Tolls reduce the level of benefits (although the net benefits are still positive at a 7.5 per cent discount rate) because tolls reduce the amount of traffic diverting to the highway.

The highway construction was rushed for at least partial completion in time for EXPO 86. The hasty construction suggests that the project costs could have been less if construction had been spread over a longer period. Based purely on the user benefits and construction costs, the highway may have been constructed a few years earlier than warranted by projected traffic growth. However, given the uncertainty of growth forecasts, the need for employment stimulation in the B.C. economy in the mid 1980's, and the concern for facilitating EXPO 86, the actual project timing is not surprising.

Footnotes

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[1] The vehicle operating cost figure was selected following perusal of figures estimated by the Canadian Automobile Association. The figures for truck operating costs were based on Trimac Consulting Ltd. (1982) figures.

[2] The time savings are based on design speeds of the new and old highways, taking into account traffic volumes. If people exceed the speed limit on the new highway, the time savings would be greater than calculated.

[3] This figure is slightly below the figure (in current dollars) cited by the Insurance Corporation of British Columbia as the social costs of a fatal accident (Rockerbie, 1980).

Bailey (1980) surveyed a number of studies estimating the valuation of life for decision making purposes. He found a range of figures, from about $170,000 to $584,000 per life saved (1978$). Studies based on direct interviews often produce higher estimates, e.g. see Jones-Lee, Hammerton and Phillips, 1985.

[4] The standard discount rate recommended by the Treasury Board Guide (Government of Canada, 1976) is 10 per cent. However, it has been argued that the appropriate social discount rate for Canada is closer to 7.5 per cent (e.g. Burgess, 1981; Jenkins, 1981; Sumner, 1980). The latter discount rate is used here; however, the sensitivity of results to the choice of discount rate can be seen in the plots of internal rates of return (Exhibits 4 and 6).

[5] For projects with substantial external benefits such as most urban transit projects, where most of the benefits accrue to non users via reductions in congestion, the folly of trying to pay for projects by increasing user charges (therefore, decreasing use and losing the external benefits) is fairly clear. In the case of the Coquihalla, the vast majority of benefits are those which accrue directly to users via time and operating costs savings. Therefore, the loss of benefits from toll charges is far less of a loss (reduced net benefits relative to total benefits without tolls of only 23 percent) than for many other public projects with greater non-user benefits. Therefore, given the practical necessity to finance large projects by a government facing financial constraints, the toll policy may be an understandable approach.

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Exhibit 1
Map of Coquihalla Highway and Nearby Routes

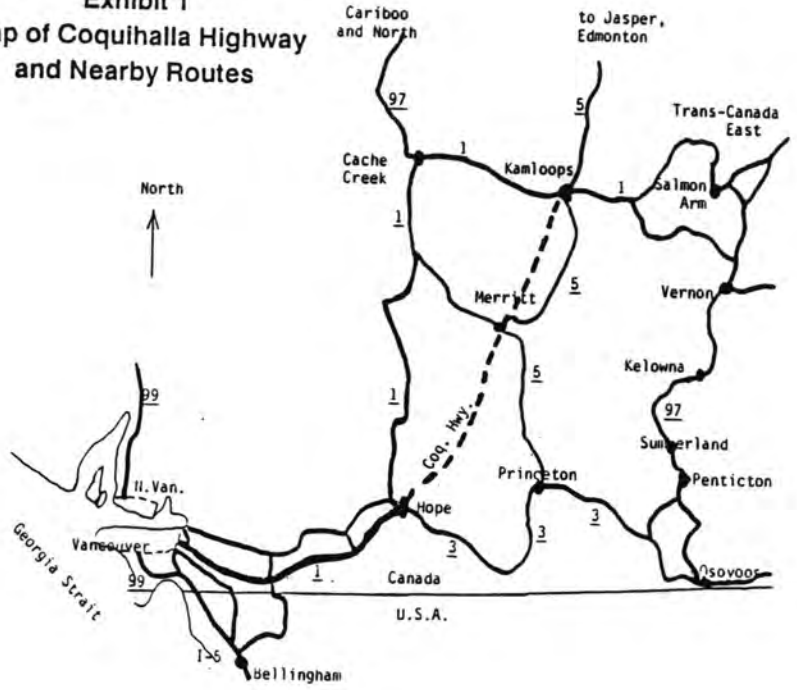
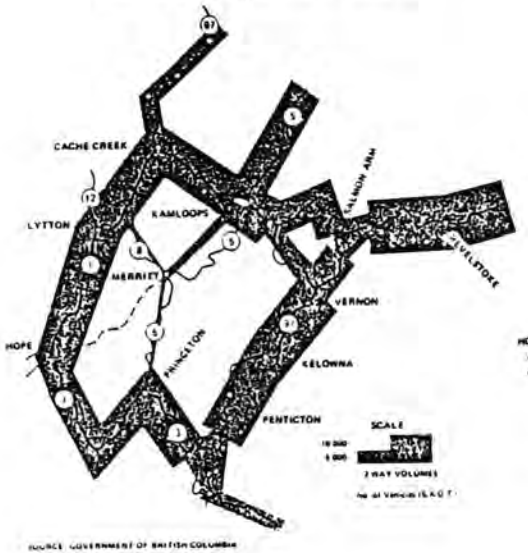


Exhibit 2
Traffic Assignment

1986 S.A.D.T. ASSIGNMENT
WITHOUT COQUIHALLA ROUTE



1986 S.A.D.T. ASSIGNMENT
WITH COQUIHALLA ROUTE

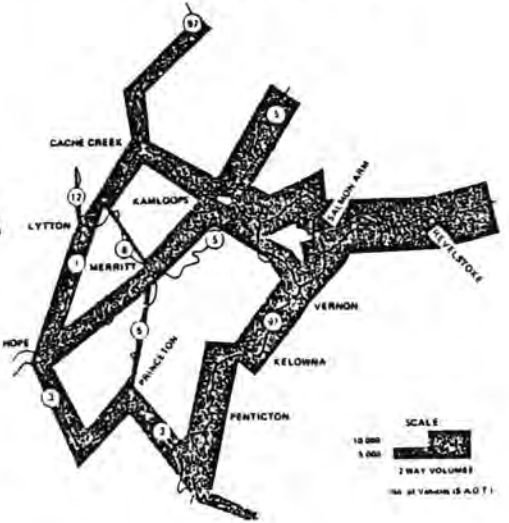


Exhibit 3

Summary of Project Benefits and Costs With and Without Tolls

(7.5% discount rate)
(Million 1984 dollars)

Project Costs:	No Tolls	With Tolls
Construction	338.1	338.1
Maintenance	7.6	7.6
Toll Collection	-	8.4
Toll Booth Const.	-	.3
	345.7	354.4

Project Benefits:	No Tolls	%	With Tolls	%
Coquihalla Traffic	389.8	75.3	290.4	73.6
Residual Value of Coq.	53.3	10.3	53.3	13.5
Safety Benefits	52.1	10.1	36.5	9.3
Traffic decongestion (#1 & #3)	21.9	4.2	14.1	3.6
Generated Traffic	.8	.2	.3	.1
Total Benefits	517.9		394.5	
Net Benefits	172.2		40.1	

Exhibit 4
Net Benefits vs. Discount Rate
(with and without tolls)

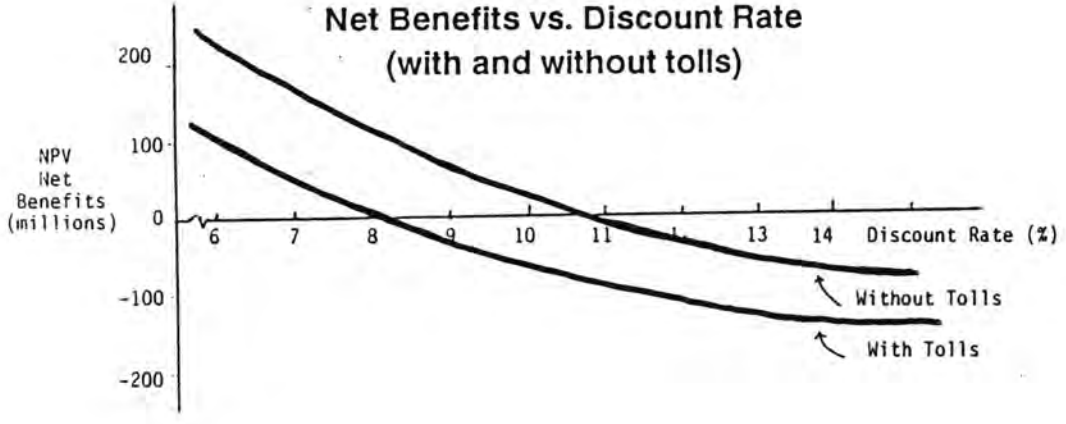


Exhibit 5

Benefits and Costs from a Provincial Perspective
(excludes benefits to non-residents but includes their toll revenues paid)
7.5% discount rate
(Millions 1984 dollars)

Project Costs:	No Tolls		With Tolls	
Constructions	338.1		338.1	
Maintenance	7.6		7.6	
Toll Collection	-		8.4	
Toll booth Const.	-		.3	
	345.7		354.4	
Provincial Benefits:	**No Tolls**	**%**	**With Tolls**	**%**
Toll Revenues	-	-	37.0	10.7
Coquihalla Traffic	292.3	76.1	217.8	62.9
Residual Value	53.3	13.3	53.3	15.4
Safety Benefits	39.1	9.7	27.4	7.9
Benefits to Traffic (#1 & #3)	16.4	4.1	10.6	3.1
Generated Traffic	.6	.1	.2	.1
	401.7		346.3	
Net Provincial Benefits	56.0		(-8.1)	

Exhibit 6
Provincial Benefits vs. Discount Rate
(with and without tolls)

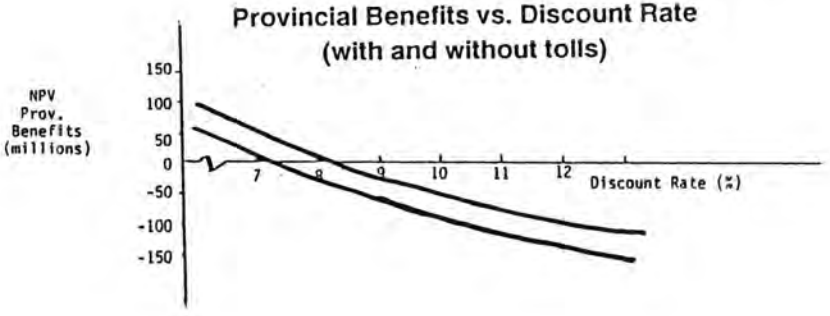
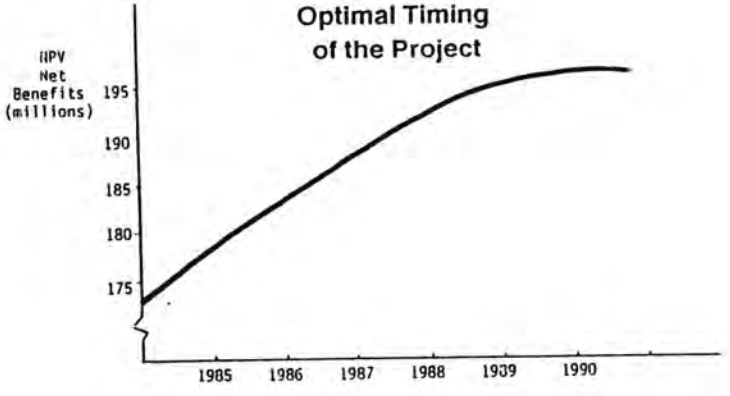


Exhibit 7
Optimal Timing
of the Project



SHOULD ACCESS TO FREEWAYS BE METERED?

by

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ABSTRACT

The pros and cons of metering access to freeways are described and discussed. The basic flow characteristics of freeways are described and used to show the extent to which flows can be improved and delays reduced on the freeway if volumes are limited. The benefits that can be achieved by users of the freeway and surrounding corridor through co-ordinated control policies, and disbenefits of these controls to certain users, and the system in general, are discussed. The Ottawa Queensway corridor is used as a case study example where the decision not to meter ramps in 1972 was based on incomplete information.

BACKGROUND

Urban freeway systems carry large volumes of traffic at high speeds due mainly to their generally high designs and strict access controls. However their popularity attracts high volumes, especially during periods of peak demand such as the morning and afternoon commuter rush hours. When demand exceeds capacity the freeways' design for high speeds is wasted. This happens because the traffic density is too high to allow vehicles to attain the design speeds of freeways. Rather, the travel time of a trip under oversaturated conditions relates most to the rate at which the queues can be served, i.e. the saturation flow or capacity of a highway. Other than the effects of any differential queue service rates, queues of traffic are discharged with similar characteristics on most roads. Furthermore, the opportunities for escaping to adjacent routes are more limited on freeways, as traffic is caught in a closed system, and can exit at relatively few off-ramps. Also, the effects of incidents are generally more severe on freeways, as greater amounts of capacity are lost, and access for incident response systems is generally more difficult. The above factors tend to result in larger queues and greater delays on freeways, due to incidents such as accidents than on surface arterials.

For the above reasons, metering and closure of freeway on-ramps have been implemented throughout the world in the last two decades.

These have met with varying degrees of success and considerable debate. Some applications have been naturals while others had a number of disadvantages, and became quite controversial. Few comprehensive pre-evaluations have been conducted, as all of the relevant factors were not clear and there was not a simple and effective evaluation technique. The availability of an appropriate evaluation technique is reaching a mature stage, and the random effects of increased traffic volumes on freeways are becoming better understood. These, combined with a greater knowledge of the effects of ramp controls on the various user groups, have greatly improved our ability to pre-determine whether, and if so to what extent, freeway ramps should be controlled.

VOLATILITY OF FREEWAY OPERATION AS VOLUME APPROACHES CAPACITY

Because of the multilane design and relative freedom to select one's own speed, the average speeds on a freeway are relatively insensitive to traffic volume until the volume begins to approach a value of the order of 1800 vehicles per hour per lane. Above this volume the high speed can sometimes be maintained, but there is an increasing probability of breakdown to queueing conditions as higher volumes try to squeeze through (1,2). A representative average condition is illustrated in Figure 1.

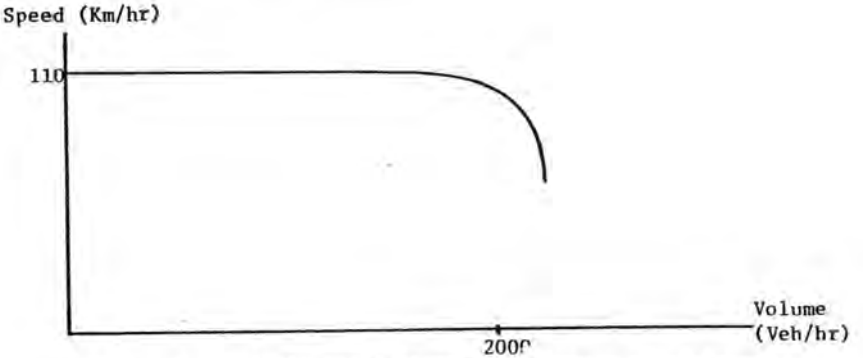


Figure 1 Typical Speed-Volume Relationship on a Freeway

EFFECTS OF LIMITING VOLUMES ON FREEWAY FLOW CHARACTERISTICS

Limiting the volumes on freeways below critical levels reduces freeway congestion in a number of ways. It helps to ease the queues and delays which accompany incidents, by limiting the extent of demand overload that exists before the incident can be cleared, and by making possible easier access for incident response systems. It then increases the rate at which any built-up queue is dissipated. It also reduces the incidence of accidents and of capacity reductions due to

flow breakdown, both of which result in spontaneous degeneration to stop- and -go flow. Accidents and other types of flow breakdown occur with greater frequency when freeway volumes are allowed to grow uncontrolled. The higher the volume, the more precarious the flow, and greater the probability of accidents and/or flow breakdowns.

Since accidents and flow breakdowns occur at random, albeit with greater probability under higher intensities of flow, the question of whether or not to control volumes leads to the complex problem of selecting that rate at which volumes will be metered. This presumes of course that metering is acceptable. That question is the main topic of this paper and is discussed at length later.

Since the flow characteristics on a freeway were seen to be quite robust to volume levels until they reach the breakdown level, it is clearly best to operate at volumes just below this breakdown level. However, the breakdown level varies, depending upon the many complex driver and vehicle interactions that occur at any given time. Therefore, the best that we can do is to estimate the probability of breakdown at each flow and then determine an optimal flow cutoff level. This dilemma re optimal flow level is not the subject of the present paper, and has been discussed by Yagar (1) and Van Aerde and Yagar (2). It is only introduced to illustrate that there is not a simply determined optimal flow level for a freeway, even if we could agree to meter at such an optimal level.

Selected Example For Both Controlled and Uncontrolled Conditions

Figure 2 illustrates the queueing scenarios that might be experienced on a hypothetical 4-lane directional freeway under assumed sets of demand and capacity conditions.

(i) Uncontrolled Case:

Figure 2a assumes that a paved shoulder has been converted to a traffic lane to provide 5 lanes in one direction. The demand is 10,000 veh/hr for 3 hours and then drops to 6,000 veh/hr. An incident occurs after 36 minutes, reducing the capacity to 5,000 veh/hr for 1 hour. After the incident is cleared, the queue can discharge at about 1,800 veh/hr per lane, or 9,000 veh/hr. The queue finally dissipates about 4-1/2 hours after the incident started, and the total time lost in queue is about 25,800 vehicle hours.

(ii) Controlled Case

Access to the freeway is metered to allow only 1800 veh/hr per lane, or 7,200 veh/hr. This example does not consider where the metered 2,800 veh/hr go, or how much of the metered demand would even exist if metering had begun some time ago when the peak freeway demand was still only 7,200 veh/hr. Further, it is assumed that the paved shoulder, which was converted to a lane in the uncontrolled case of Figure 2a remains a shoulder for the controlled case, but is available for use in bypassing an incident. Therefore the queue discharge capacity is the same as for the access-controlled case, i.e. 5,000

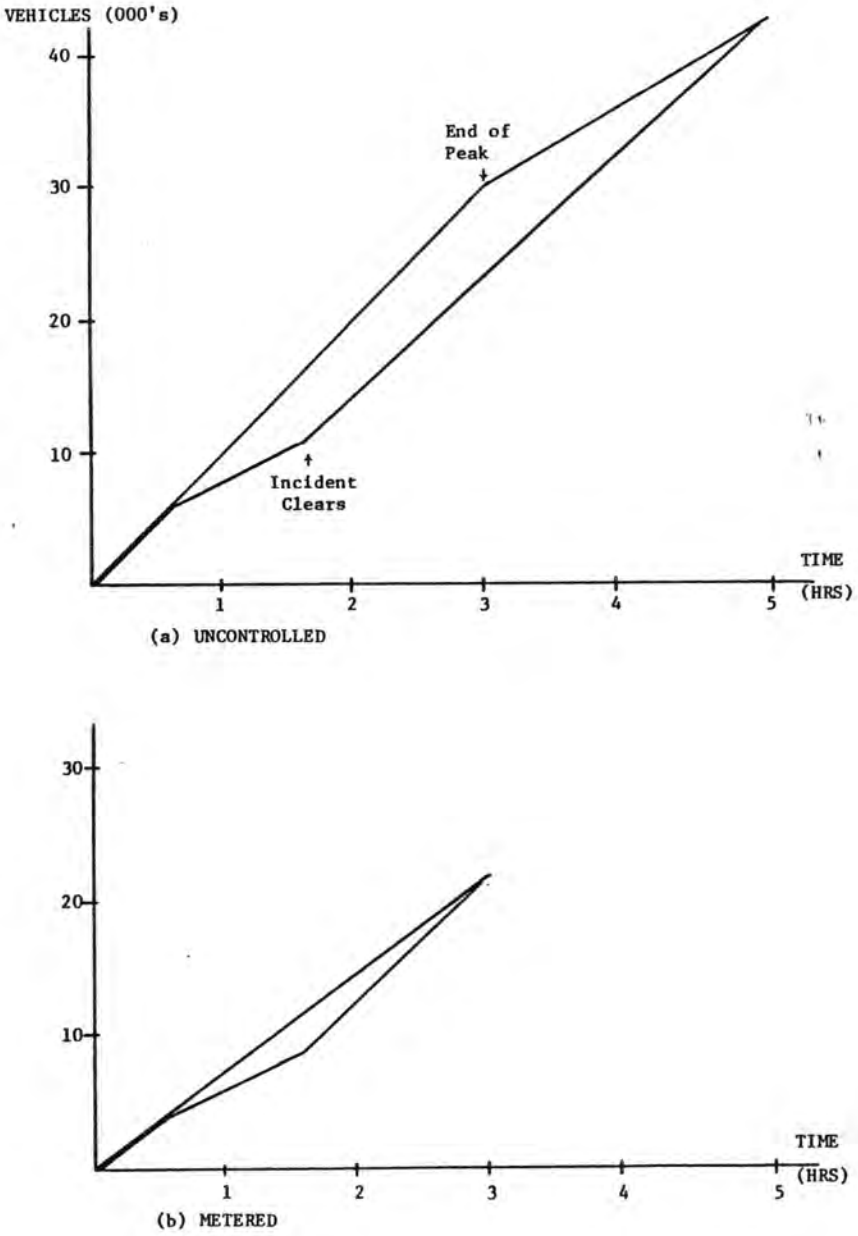


Figure 2 Queueing for Hypothetical Uncontrolled and Metered Scenarios

until the incident clears and then 9,000 until the queue clears. The queueing diagram for the controlled case is shown in Figure 2b. The queue lasts for about 2-1/2 hours in this case and the total time lost in queue is about 2,500 vehicle hours, about one-tenth of the time lost in Figure 2a.

While Figure 2 represents just a simple idealized hypothetical example, it does illustrate the types of time savings that can be achieved on the freeway, but at the expense of queuing on the surface streets and/or reduced travel.

Although it is clearly better to have pre-controlled freeway volumes on days when accidents occur, it is generally felt that the more vehicles that could be pushed through on accident-free days, the better, i.e. if one knew how many vehicles could have squeezed through in a given period prior to breakdown, one would have allowed precisely that number onto the freeway. Not having the benefit of this hindsight, one can only consider the probabilities of breakdown at each volume and work out the optimal solution according to any specified criteria.

However, even if the accident-free days could be predicted in advance, and if controls did not serve to reduce accidents, it is not clear that volumes should not be restricted on these days. There is increasing evidence that by keeping volumes below the critical ranges on all sections of the freeway we can inhibit the spontaneous flow breakdown. This improves the reliability of the freeway, and can reduce the average travel time as well.

SOME USER BENEFITS OF FREEWAY RAMP CONTROLS

The foregoing section has discussed the most visible benefit of ramp metering, the reduction in queueing on the freeway. There are a number of other beneficial effects associated with ramp controls. The following are discussed below:

(i) - Minimizing an aggregate objective function such as total travel time of all users

(ii) - Efficient use of the total capacity in a corridor

(iii) - Discouraging paths with high societal costs

(vi) - Introducing order into the path-selection jockeying of commuters

(v) - Reducing the variance in trip times in a corridor

(vi) - Majority public acceptance

(i) Minimizing Total Travel Time

Before attempting to weigh the other pros and cons of ramp metering, we generally want to know how metering will affect the total travel time in the network. If there is not a large potential gain here, the other factors will not likely justify metering.

(ii) Efficient Use of Capacity

If there is no excess capacity on the surface streets it is not likely that shifting additional queueing to them from the freeways will improve the overall operation. However, if there is excess surface street capacity, total delay in the network can usually be reduced by metering traffic off the freeway.

(iii) Discouraging Paths With High Societal Costs

A driver that has a simple inexpensive alternative to using a congested freeway should be encouraged to do so, as this can reduce the queueing and total cost on the freeway by a large amount. However, if that driver is getting onto the freeway at the front of the queue, he/she has no personal incentive to change. Strategic metering can force this change, reducing the total cost to the freeway users, at little cost to that metered user.

(iv) Reducing Jockeying for Paths

By reducing the choices of those whose paths are not very different in cost, we reduce not only their jockeying but also the second order movement of others whose path costs are varied by this jockeying.

(v) Reduced Variance in Trip Times

Uncontrolled freeways tend to have short trip times when there are no accidents or flow breakdowns, and high to very high trip times when there are breakdowns and accidents, respectively. The metered freeway has much more stable trip times. This variance in trip times can force those with a high cost of being late to either leave early, and generally arrive too soon, or use the less volatile surface street.

(vi) Majority Public Acceptance

The public relations impact of good traffic management can be positive rather than negative, and traffic control is very visible. A later discussion on public involvement will discuss the importance of this factor. A case study from Ottawa, which will be described later in this paper, and in which some driver opinions were volunteered, indicates clearly that drivers will tend to prefer metering, and even suggest controls to improve a congested freeway.

SOME DISBENEFITS OF RAMP CONTROLS

Ramp controls obviously impact negatively on those who are metered off the freeway. While the obvious increased delays to these drivers can be quite simply weighed against the reduced delays on the freeways, there are a number of negative impacts which cannot be accounted for simply in an accounting of respective total queue times on and off the freeway. The following subtle and less-than-obvious, but real, negative impacts are discussed below:

(i) - Encouraging longer trips

(ii) - Transfer of land values

(iii) - Favoring through traffic over the metered local traffic

(iv) - Tampering with an evolved status quo

(v) - Cost of operating the system

(i) Encouraging Longer-Trips

Ramp controls generally result in shorter trips being replaced on the freeway by longer ones, such that the freeway capacity upstream of a critical bottleneck section is more fully utilized (3), i.e., those taking up critical bottleneck capacity also tend to make use of the long uncongested upstream or downstream sections of freeway. Thus, the freeway's capacity tends to be reserved for these longer trips which have the greater need for the freeway. The science of freeway control has been developed to a point where traffic engineers can generally synthesize plans which will reduce total travel time in a network (4,5,6) for the given origin-destination trip demands. The original CORO model for testing the effects of any ramp control plans was applied to the Ottawa Queensway Corridor (3) and the Queen Elizabeth Corridor in Toronto (7), allowing recommendations for appropriate control measures and locations to be made. However, this catering to longer trips can have the long-term feedback effect of encouraging, rather than discouraging commutes from farther out. This tends to lead to longer trips. Thus, any gains in trip time and energy due to the efficient treatment of current demands may be lost many times over if this treatment of traffic causes longer trips.

(ii) Transfer of Land Value

There is reason to question the equitability and fairness of ramp controls. Users who have become accustomed to ready freeway access may be rerouted in favour of new users. This can cause the value of the land with which they are associated to drop through a transfer of land use.

(iii) Favoring Through Traffic

When local users are metered off a freeway to encourage through traffic to pass through the neighborhood, they begin to examine the impacts of the freeway on themselves. It has been built through their neighbourhood but they cannot use it. If the through and local traffic are from different political jurisdictions, their representatives must get involved, and one must question whether the building of a freeway through an "unserved" local area would have been allowed. Does metering, or worse yet ramp closure, not accomplish exactly this?

(iv) Tampering-With-a-Status Quo

If metering were installed before the freeway became congested, so that the local access volumes never had to be reduced, then people would not have to change their evolved trip patterns. Theoretically, one could argue that only new traffic would be metered off. Although this might cause existing users to re-evaluate their trip paths somewhere in the future, this situation would just evolve and not have the sudden impact of metering to reduced access volumes.

However, the existing trip-making patterns have evolved, and drivers have in some sense accepted the status quo, and tend to use it as a benchmark. To transfer values for no net gain invites trouble and questions of the integrity of the system. People are played against one another, and there must be some societal justification for this.

(v) Cost-of Operating the System

The cost of installing and maintaining control hardware must also be considered. While traffic management schemes can have short payback periods, all costs must be included so that the overall correct decision is made re implementation.

PUBLIC INVOLVEMENT

Any plans to implement ramp controls will raise a conflict of opinion between the potential beneficiaries from the controls and those who stand to lose by them. The traffic engineers and politicians become the arbitrators, the former advising the latter, who must make the ultimate decisions. Those who stand to benefit generally remain silent, while the potential losers may be very vocal in their reaction. The latter usually tend to be the minority, although their potential net loss may even be greater than the aggregated potential gain by the beneficiaries, when all costs and benefits are considered.

This paper attempts to adopt a neutral position, neither supporting nor condemning freeway ramp controls. It merely attempts to bring out some of the factors on both sides which are often

neglected in decisions concerning such controls. This is in keeping with the philosophy that the decision-makers should have all of the available information in order to make the best possible decision. Some of the factors for and against freeway controls have been discussed above. Since such decisions are often made on political grounds and/or in response to public pressure, the representative collective thoughts of the affected populace should be known.

The public-opinion related information that is presented should include the feelings of as many people as possible, not only the unsolicited contributions of a small minority.

Problems of Non-Representative Feedback

Those who stand to benefit by the freeway controls will have gradually become accustomed to and accepted the status quo of freeway queueing which may have developed over a period of years. It is partly for this reason that they are not as inclined to vocally complain about their present plight as their potentially metered counterparts are to react to metering.

In order to receive unbiased feedback on any proposal from a sample of the total affected population, it is necessary to choose this sample carefully. A sample which chooses itself will seldom be unbiased, as is the case when unsolicited letters are received. To illustrate the effects of using a more representative sample, a survey performed on the Queensway Corridor in Ottawa was summarized. The results of this survey are described below.

CASE STUDY ON DRIVER OPINION

Comments were solicited from users of the Queensway Corridor where there was congestion and queueing on the freeway. As part of a study (3) of the operation of the corridor, the questionnaire in Figure 3 was prepared to solicit information on trips in the morning peak period. A mail-back postcard questionnaire was handed out to drivers at on-ramps leading onto the Queensway, and at one location on a parallel arterial. It first asked for some very specific information, related to the origin, destination and path of the trip, and then allowed the respondent to fill out a comments section. This comments section was left as an option with the user given no hint or clue as to the type of comment that he/she might volunteer. One was merely given the opportunity to express oneself briefly. An attempt was made to classify the comments only after they had all been read by the analyst. Thus, the comments were treated in an open-ended manner, with no pre-chosen categories that might hint at solicitations or bias.

The purposes of this specific study were purely technical. It did not take a political stance or adversary position. It was naively assumed by the author that traffic controls would be implemented if they were deemed to be beneficial. In this regard, we only wanted to know the origins, destinations, paths and starting times for morning

DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS OF ONTARIO TRAFFIC SURVEY

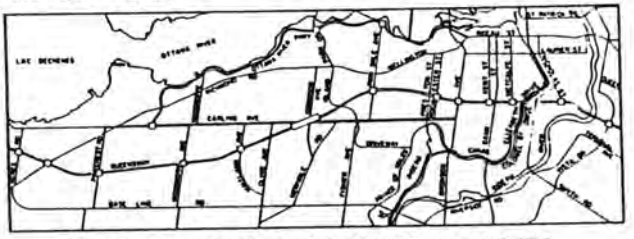
WE WANT TO IMPROVE TRAFFIC CONDITIONS IN THE OTTAWA AREA AND TO DO THIS WE NEED YOUR HELP. PLEASE ANSWER THE FOLLOWING QUESTIONS AND RETURN THIS CARD BY MAIL. NO STAMP NECESSARY.

a) How many mornings per week do you make this trip? (circle one) (1) (2) (3) (4) (5 or more)

b) Where did this trip start? (nearest intersection) .....

c) Where did this trip end? (nearest intersection) .....

d) Please trace as much as you can of your trip on the map below. (Also mark origin, destination and planned stops with an X)



YOUR COMMENTS ARE WELCOME. THANK YOU FOR YOUR HELP.

Comments : .....

.....

Figure 3 The Survey Questionnaire

Table 1 Summary of Questionnaire Response Statistics

Number of drivers passing handout stations	=	12290
Number of returned questionnaires, i.e., 52% of drivers returned questionnaires	=	6187
Number of comments volunteered, i.e., 26% of drivers volunteered comments	=	3199

peak trips in the Queensway Corridor. The comments section was included to satisfy the drivers that the survey was being conducted by people who had their interests at heart, as a way of encouraging them to provide us with the trip information that we wanted. In this regard it met our expectations, as indicated by Table 1. Table 1 indicates that 52 percent of all drivers mailed back their questionnaires, and about half of these volunteered comments. The comments are classified and their respective frequencies tallied in Table 2. In fact, our expectations were more than met, as indicated by the nature of the comments in Table 2. If we had paid attention to this "volunteered" information we would have seen evidence of major local public support for active traffic management, including freeway ramp controls, on the Ottawa Queensway. Furthermore, if this unsolicited information had been made available to the decision-making authorities, the political decision might have favored a proposal for ramp metering on the Queensway, rather than narrowly defeating it.

SUMMARY OF DRIVER COMMENTS

Since about half of all users answered their questionnaires and an additional half of these volunteered comments, it seems that many of the drivers were indeed interested in improving the traffic operation in the Ottawa Queensway Corridor.

Since there was no hint given to the drivers as to the type of subject that they might appropriately address, the comments covered a broad range of subjects. For purposes of statistical summarization, these comments are classified into as few types as could be considered appropriate.

The intent is not to unduly read any meaning into the comments, and therefore the details of Table 2 are not dissected or discussed. The reader is, of course, free to draw his or her own conclusions from these user comments. Clearly, most of the comments seem to indicate a need for some action, as opposed to maintaining the status quo. About half of the respondents did not volunteer comments. We shall not speculate how many of these were satisfied with, or even preferred, the status quo. There were no stated comments in favour of the status quo. However, approximately 635 (20 percent) of the comments indicated a need for more restrictions and/or control on drivers, such as: driver education, enforcement of traffic laws, stricter laws, ramp controls, staggered work hours and car pools. This number of respondents was far greater than the number that often sways decisions in favour of abandoning plans for increased traffic controls. As was stated, a proposed ramp control project for the surveyed portion of the Queensway was turned down by local politicians, without soliciting statistics such as these.

Although only 76 drivers specifically called for ramp controls, it must be noted that the above comments represent users making shorter-than-average freeway trips, as the incoming freeway users from west of Acres Road could not be stopped and handed questionnaires. The unrepresented drivers who make only "through" trips would

Table 2 Types of Comments and Corresponding Frequencies Observed

Type of Comment Sub-type of Comments	Sub-Group Frequency	Group Frequency
Traffic engineering and design		917
Ramp metering and/or closure	76	
Better freeway design	160	
Higher speed limits	81	
Improve traffic signal operation	140	
Synchronize signals	28	
Decrease parking	23	
Improve transit	237	
Stagger work hours	44	
Car pools	28	
Construction		985
Widen freeway	534	
Road repairs	114	
Increase capacity of arterials	337	
Education and control		464
Reduce illegal driving (education, policing)	308	
Control speeds and parking	156	
Observation of symptoms		361
Freeway congested	290	
Ramp problems	31	
Prefer another route	40	
Miscellaneous		272
Weather-related problems	139	
Provide bicycle paths	33	
Irrelevant or not related to study area		190
Totals	3189	3189

likely have favoured ramp controls even more, as they would benefit if the existing freeway congestion could be reduced. Therefore, the above statistics probably underestimate the desire for traffic controls such as ramp metering.

DISCUSSION

This paper does not advocate for or against freeway ramp controls. it merely states that they should be implemented only if they will create a net benefit while satisfying any reasonable constraints. These constraints might require that they do not impose an undue hardship or inequity on any group of users in terms of factors such as travel time or land use. Politicians should avoid arbitrary political decisions. The bureaucrat or analyst can aid his own cause, and that of the politician, by obtaining as much bias-free information as possible, and by anticipating the arguments of the vested interests.

Each freeway ramp control proposal should be judged on its own merits, with all costs and benefits represented as accurately as possible. We have attempted to identify the types of issues that should be considered in weighing ramp control strategies, and to illustrate the types and frequencies of the public opinions obtained in a real survey. The number and type of comments volunteered in our example situation indicate that members of the driving public are aware of and concerned about traffic problems. It also shows that they have opinions about possible solutions, and are willing to contribute these if a medium for this communication is made available. Therefore, we need not merely rely upon intuition or the unsolicited lobbying of vocal minorities with possible vested interests.

CONCLUSIONS

There are no simple guidelines re whether or not to meter the ramps of a given freeway. The decision for any system of freeways and surface streets must involve a comprehensive management plan which considers the effects on all represented user groups. This plan is especially important in cases where the decision reduces to one of how, rather than whether to control.

Drivers favor rational controls which will make a given system operate better. While we should not overstate the case for controls, we must also not underestimate the benefits, including driver acceptance.

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AIRPORT LANDSIDE CAPACITY EVALUATION: AN AIRPORT GRAPHICS DISPLAY SYSTEM FOR TERMINAL FLOW SIMULATION

BY

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and

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ABSTRACT

Capacity limitations of airport terminal buildings are reached when peak conditions are encountered. This leads to congestion, delays and hence a deterioration in the level of service experienced by users. The capability of airport management personnel to respond rapidly and efficiently to situations approaching or exceeding peak conditions is restricted by their ability to test alternative solutions due to the complexity of analyzing the traffic flows in an airport terminal.

Terminal flow simulation models have been developed to aid in both planning of future terminal facilities and in operational decision making. A major inconvenience of such models for use, particularly in an operational setting, is the lack of graphics display to depict, in an animated or static fashion, the traffic flow conditions inside the airport terminal. The purpose of the software system presented in this paper is to depict graphically on the microcomputer screen (and also produce hard-copy graphs of) the results of the terminal pedestrian flow simulations.

The Animated Graphics Display System (AGDS) for airport pedestrian flows is a micro-computer software package which depicts the flow of pedestrians in an air terminal building. The package is developed as a tool to assist airport planners and operations personnel in reviewing and analyzing traffic flows and to provide decision support for developing solutions to congestion in air terminal buildings in a timely and efficient manner.

A modular approach has been taken in developing the system. The system maintains a high degree of flexibility with respect to its input parameters and output presentation. Two input files are required to run a simulation; an airport layout file and a simulation file. The user creates the airport layout file, which contains the terminal building plan and area definitions by using the system's mini-CAD package. The simulation file contains area pedestrian occupancies and other relevant queueing statistics calculated by a traffic flow simulation model.

Two output presentation modes are available to the user. The first is an overview format, or macro-scale simulation, which displays the terminal building in plan view and depicts the level of pedestrian congestion in specified areas by changes in predetermined color codes. The second is a detailed view, or micro-scale simulation, which displays pedestrians in specific air terminal building areas, as well as line graphs providing information relevant to the area's congestion in the hour both preceding and following the current simulation time.

KEYWORDS: Airport Terminal Building, Pedestrian Flow, Airport Planning, Airport Operations, Computer Simulation, Microcomputer Applications, Animated Graphics

TERMINAL FLOW SIMULATION MODELS

Computer simulation of the pedestrian traffic flows through the various processors of an airport terminal building is essential for the proper evaluation of their operational performance and level of service as well as for the sizing of needed additional facilities. The simulation techniques are typically used for large airport terminals with complex traffic flow patterns. These enable the detailed analysis of all traffic movements and processing activities on a terminal specific basis, and provide a capability to test multitudes of planning and operational scenarios.

One such model is Transport Canada's Terminal Flow Simulation Model[1]. The model is an interactive event-oriented computer program that performs a detailed simulation of pedestrian and baggage flows through an airport terminal building (ATB). 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 subsystem processing rates; and the daily flight schedule, the model predicts the number of users within each terminal facility at any time during the day, thus yielding the diurnal profile of demand accumulation (occupancy) for each ATB facility.

The model operates as follows: enplaning passengers as well as well-wishers and greeters arrive at the curb according to lead-time distributions unique to each flight sector (e.g. domestic, transborder (Canada-U.S.A.), other international) 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 may occur at different points along a path, and 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, hold-room, U.S.A. preclearance, etc.) in their respective paths through the terminal. In the deplaning direction, each arriving aircraft is assigned to a baggage claim dispenser(s) that best fits the input assignment criteria. Each deplaning passenger is then processed through the terminal system elements in his/her flow path, (e.g. gate, links, primary and secondary inspections, baggage claim, customs, arrivals concourse, and the curb. The baggage is delivered to the dispensers based on 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.

As an example, Exhibit 1 illustrates schematically the manner in which the enplaning and deplaning flows are simulated by the model for a small airport terminal. The model feeds its output to the Graphics Display system whose description is the main course of this paper. An IBM micrcomputer version of the model is presently under development.

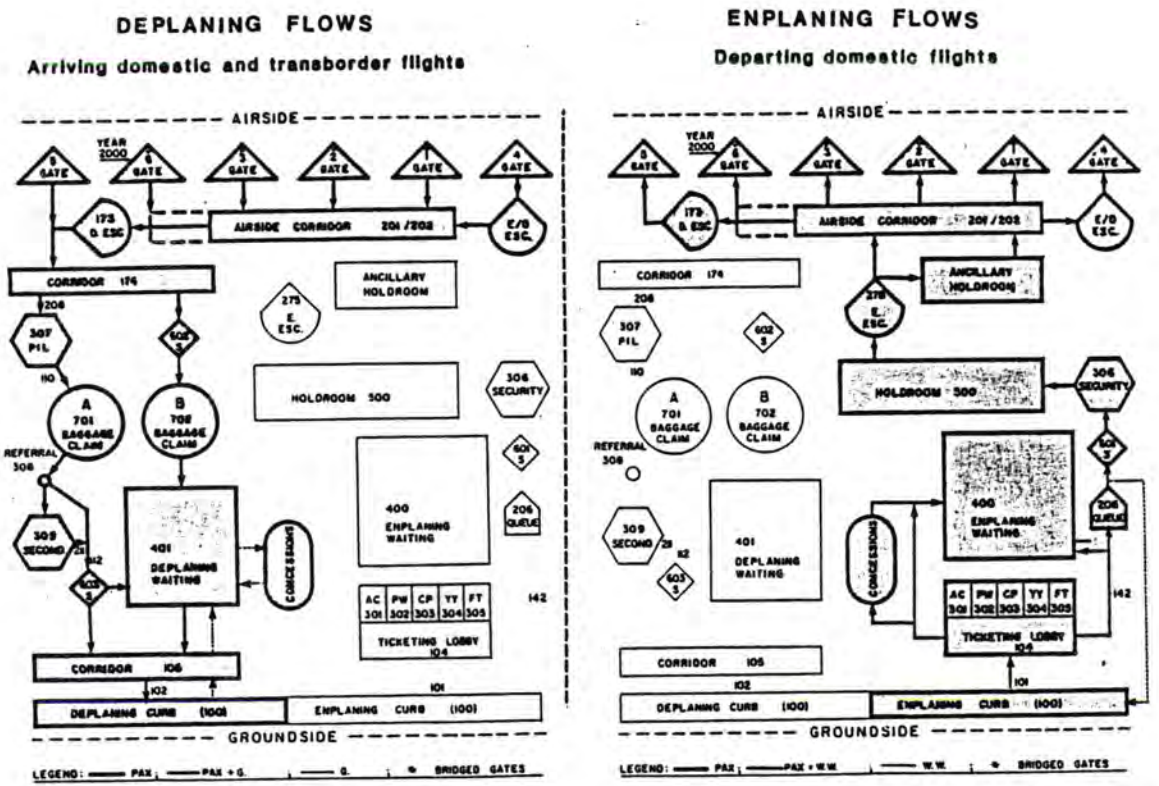


EXHIBIT 1 SIMULATION OF PEDESTRIAN FLOWS THROUGH AN AIRPORT TERMINAL

SYSTEM DEVELOPMENT

The overall approach taken in developing the Animated Graphics Display package was designed to maximize the model's flexibility. This refers to its compatibility with relevant existing and anticipated software, its adaptability to changing needs, and its applicability to a full range of applications.

Compatibility

Because the functionality of the AGDS depends upon the output of the Terminal Flow Simulation models, it is essential that it easily interfaces with these models. This has been achieved via a modular approach to the package's development.

The AGDS has been developed as an inclusive module, which does not actively interact with the simulation models, but rather acquires the source pedestrian occupancy statistics from the latter's output file. This approach has several advantages, including:

- It allows programming revisions to be made to the graphics package or the simulation model without creating errors in the other,
- Eliminates the need for additional programming effort to develop an interactive component,
- Allows flexibility with respect to the programming language used for each model,
- Allows the AGDS to run more quickly, and
- Creates user flexibility by facilitating a simulation "rewind" feature.

Adaptability

The modular approach has been carried further within the AGDS itself. The model comprises three modules, briefly described as follows:

- Airport Definition Module: A mini-CAD package used to define the air terminal building and the specific areas modelled.
- Macro-Scale Simulation Module: Produces a plan-view, color coded simulation of pedestrian traffic flows.
- Micro-Scale simulation Module: Produces a detailed view of a specified terminal building area, as well as line graphs depicting the status of the area.

Each of these modules performs a specific and distinct function. The modular approach facilitates the adaptability of the package to future requirements by allowing individual modules to be enhanced without requiring major adjustments to the entire program.

Functional Flexibility

Central to the impetus for developing the AGDS is to not only enhance the display and interpretation of the Terminal Flow Simulation output, but to also widen the spectrum of users by giving due consideration to the existing and potential usage needs in the process of developing the model's key features. These features are briefly summarized as follows:

- Outputs: The display of outputs provides both an overview and a detailed analysis capabilities.
- Adaptability: The system has been designed with both input and output features which will allow it to be utilized for air terminal buildings of varying size and complexity. In addition, it allows for modification of ATB parameters to test different terminal building configurations.
- Model/User Interface: The system is menu driven, requiring single key inputs from the user. Where appropriate, messages are provided to explain the model's current status.
- Hardware: The computer hardware available to the potential users was considered in the selection of the run-time hardware configuration.

An overview of the AGDS's features is provided in this paper, and detailed information on these can be found elsewhere[2].

Development and Testing

The system was developed and tested using Edmonton International Airport in Canada as the base air terminal building configuration. This airport is of sufficient size and complexity to ensure the system's applicability to larger terminal buildings.

SYSTEM FEATURES

The AGDS presents the user with a number of outputs in two basic formats. This section describes these presentation formats and the specific information provided in each, as well as an overview of the system's operating features used to control the output presentation.

Output Presentation

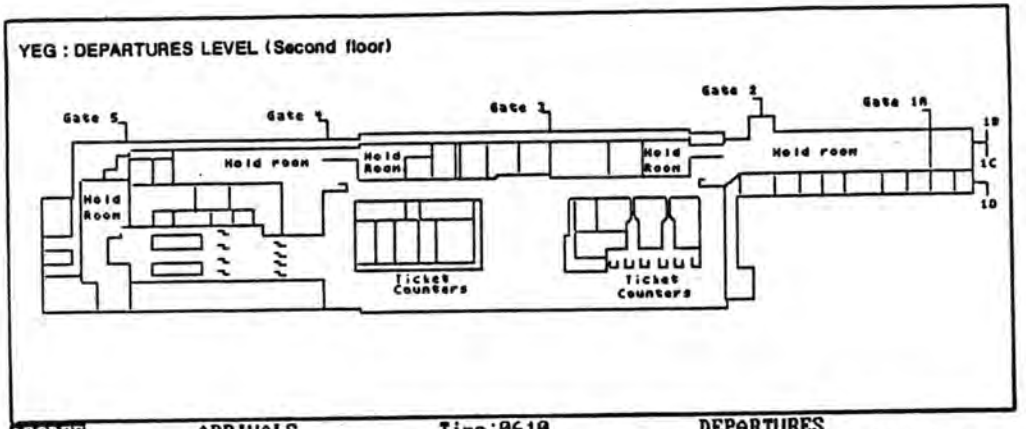
The primary purpose of the AGDS is to present pedestrian traffic flows in a manner which facilitates its timely interpretation and analysis. This is achieved by providing the user the capability of viewing the simulation results in two levels of detail. The first is an overview format, or macro-scale simulation, which depicts the level of congestion in specified areas of the air terminal building by changes in predetermined color codes. The second is a detailed view, or micro-scale simulation, which displays pedestrians in a specified area of the terminal building, as well as line graphs providing information relevant to the area's congestion over a two hour simulation period.

Macro-Scale Simulation Mode

The macro-scale simulation mode provides an overview of the air terminal building traffic flows. Traffic flows are depicted by color changes in predefined terminal building areas. The presentation is in plan view, which for most airports can be displayed on one screen. Where the size of the terminal building prohibits scaling to a single screen, or its shape is not conducive to incorporating the required detail on a single screen, multiple screens, (or pages) can be used. For example, the Edmonton International Airport is displayed on two pages, with the departures level on one page and the arrivals level on another. The Edmonton International Airport departures level is depicted in Exhibit 2.

Color codes have been used to facilitate the monitoring of terminal building congestion levels utilizing Transport Canada's level of service standards as outlined in Exhibit 3. The current degree of congestion and associated color of each area are determined by comparing the areas' current occupancy with a table of service levels. The area is then filled with the color that corresponds to that level of service. This procedure is carried out for each specified terminal building area, for each simulation time interval. As the simulation progresses, the specified terminal building areas will change color according to the prevailing occupancy/level of service during that simulation interval.

The terminal building layout and specified areas are first initialized by the user. These areas can be modified to test the impact of alternate configurations on congestion. As well, the user can change the default parameters for level of service thresholds, the associated color codes, speed of the simulation and other parameters. These features are discussed in more detail later in the paper.



ABCDEF ARRIVALS Time:0610 DEPARTURES

Time	Flight	Gate	From	Aircraft	Class	Time	Flight	Gate	To	Aircraft	Class
0645	AC 790	5	YYZ	D9S	D	0615	CO 448	4	LAX	747	D
0715	CO 643	1B	YUG	72S	I	0630	UA 793	1D	YOW	72S	D
0730	UA 951	1A	YUG	D9S	D	0700	AC 665	1B	YOW	747	D
0800	AC 466	1C	YOW	737	I	0745	WD 417	4	YUG	72S	T
0815	AC 126	3	YYZ	72S	T	0830	CP 621	4	YOW	737	T
0930	CO 101	3	YYZ	747	D	0845	CO 979	4	LAX	72S	T

Press action key to pause simulation F:YEG1 Pg:2/2

EXHIBIT 2 SYSTEM DISPLAY A DEPARTURES LEVEL LAYOUT

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 3 ATB LEVEL OF SERVICE STANDARDS

In addition to the terminal building plan view, which is presented in the top two-thirds of the screen, the macro-scale simulation presents schedule information in the bottom third of the screen. The schedule display includes aircraft arrival and departure times, airline, flight number, gate assigned, flight origin or destination, aircraft type and flight sector. This schedule information is the basis of the simulation results and are helpful in subsequent determination of the causes of pedestrian congestion in the airport terminal.

Micro-scale Simulation Mode

At any point during the simulation, the user can pause the simulation session and "zoom-in" on a specified area for a detailed picture of its status. This micro-scale simulation also presents a split screen. The top two-thirds provide a detailed plan view of the terminal building area selected and appropriately displays pedestrians currently in the area in the form of dots. If the area is a processor, the pedestrians are drawn in queues behind active servers in a random fashion, thus simulating actual queuing. If the area is a hold room, wait area, or baggage claim area, its occupants are distributed randomly within the boundaries specified for the area. An example of this screen is presented in Exhibit 4 for one of Edmonton Airport's hold rooms.

Detailed line graphs depicting information relevant to the area of interest are displayed in the bottom one-third of the screen. For each area type, two line graphs are presented representing the status of the areas over a two hour period, one hour before and another after the current simulation time.

For each selected area, the first graph on the left side of the screen displays the maximum and average pedestrian occupancy in the specified area during each time interval. To assess the degree of congestion, the level of service standards determined for the area can be represented by horizontal lines across the graph. If desired, any or all levels of service can be displayed on this graph.

The information presented in the second graph on the bottom right side of the screen varies with the type of area selected as follows:

- Link or Wait/Hold Area: The number of pedestrians entering and exiting the area during each simulation time period.

- Processor (e.g. ticketing/check-in) or Baggage Claim Area: The maximum and average queue length and waiting time of the occupants of the area.

In this micro-scale simulation, the user has the option of returning to macro-scale simulation or proceeding step-wise, backward or forward, through the micro-scale simulation. In addition, the user may print the entire screen, including the detailed area display and two graphs, or a full-page print of either graph by itself, as shown in Exhibits 5 and 6.

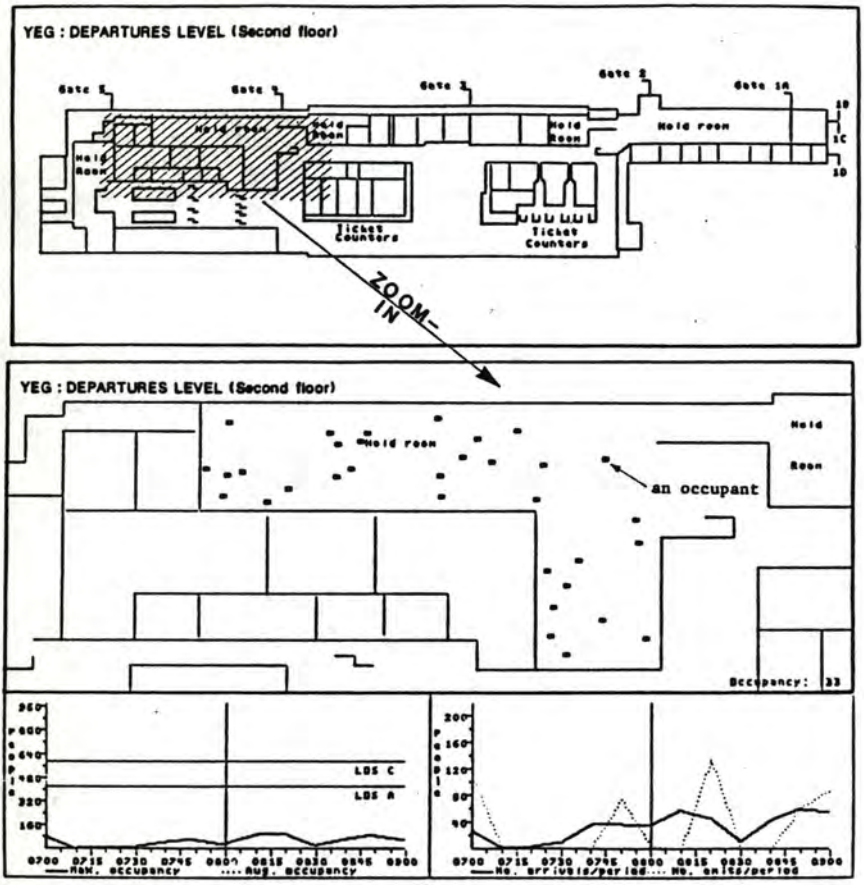


EXHIBIT 4 THE ZOOM-IN/ANIMATE FEATURE

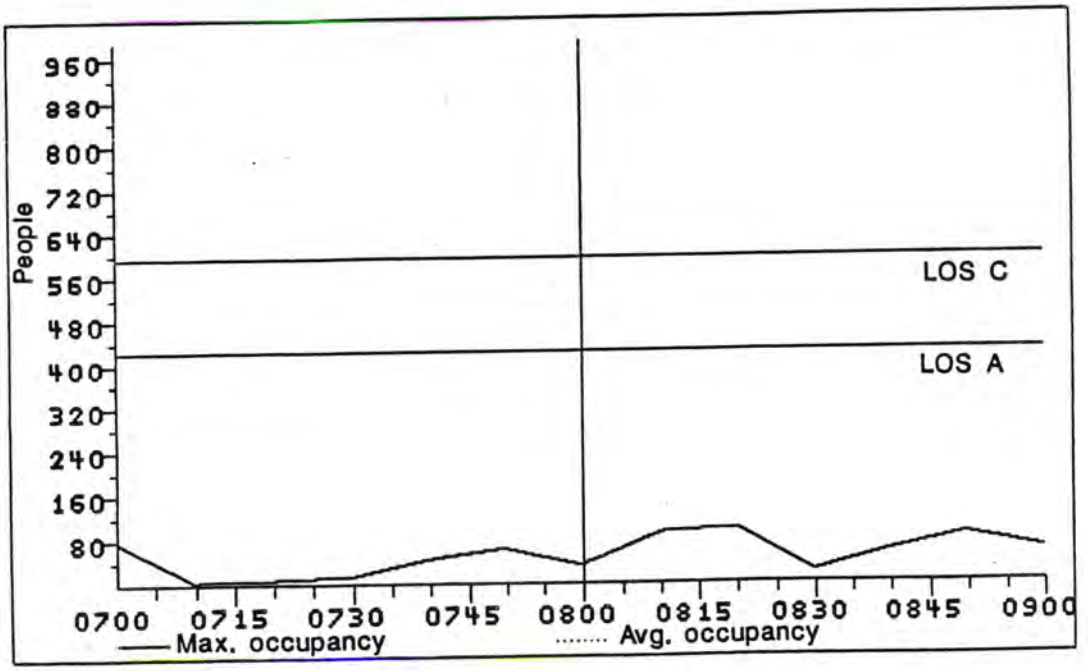


EXHIBIT 5 SYSTEM DISPLAY OF OCCUPANCY/LEVEL OF SERVICE FOR AN ATB AREA

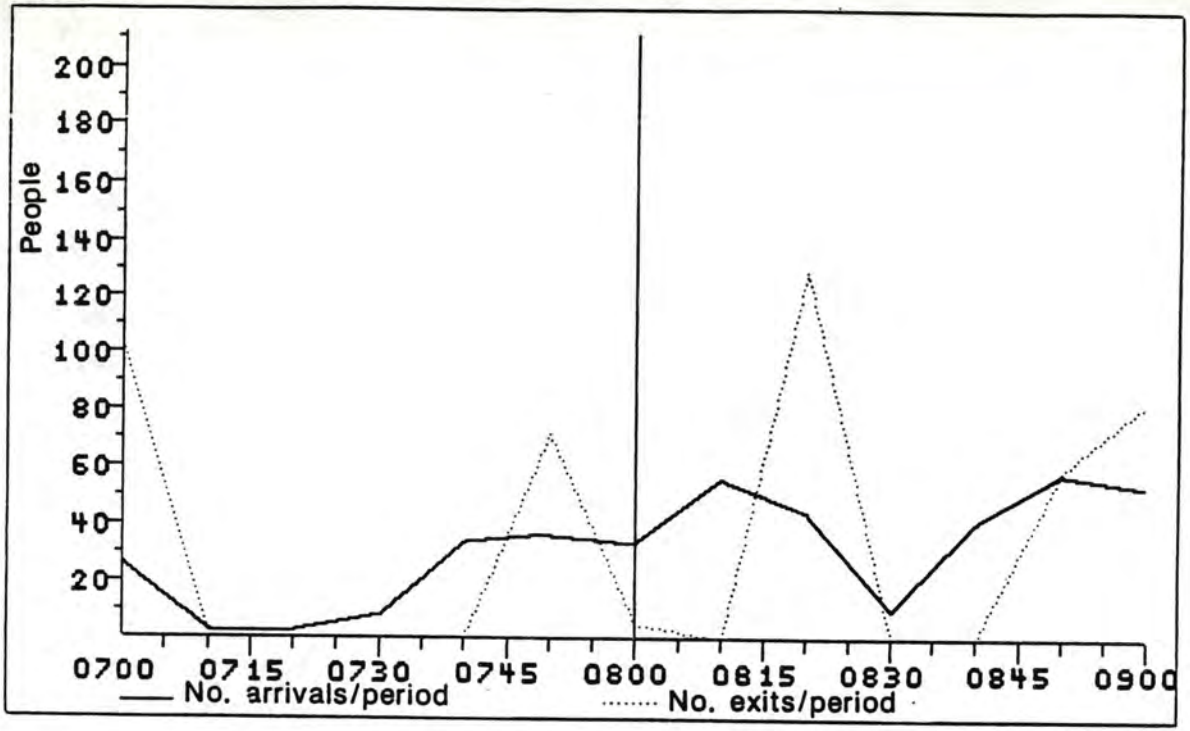


EXHIBIT 6 SYSTEM DISPLAY OF OCCUPANCY ACTIVITY OF AN ATB AREA

Operating Features

The AGDS is menu driven, requiring only single key inputs by the user. The menu is presented in the bottom one-third of the screen. During a simulation session, this area is replaced with information pertinent to the simulation, as described above. A message area is reserved on the bottom line of the screen to display operating and error messages.

Menu options and simulation operating features are selected by depressing the key of the highlighted letter (usually the first letter) of the desired menu option. The operating features of the AGDS are briefly described below.

Beginning a Simulation Display

Before proceeding with a simulation display session, the system is initialized by selecting an airport layout and a simulation file. The airport layout file contains the plan view of the terminal building as well as the defined areas modelled. The user may have several layout files for a single site to test the effectiveness of alternate configurations (or operational changes) in alleviating a traffic flow or congestion problem.

The simulation file contains the output of the terminal flow simulation model required to drive the AGDS package. As with the layout file, the user may have several simulation files with which to test the sensitivity of passenger flows to changes in pedestrian paths (resulting form changes to the terminal building configuration), the number of active servers at processors or the flight schedule itself.

Before beginning the simulation display, the user has the option of changing a number of default parameters which affect the presentation of the simulation outputs. These are briefly outlined below:

- **Simulation Time:** The user can select simulation start and end times to run only a portion of the simulation file. The default start and end times are those of the simulation file.

- **Skip Factor:** The simulation will proceed displaying the results of each simulation time interval sequentially. If this detail is not desired, the skip factor can be set to select every second, third, etc. up to ninth simulation time interval.

- **Delay Factor:** Depending upon the processing capability of the hardware, the simulation may run too quickly for the user. The delay factor can slow the simulation by up to 999 milliseconds (almost one second between intervals).

- **Fast Draw:** To speed up the macro-scale simulation mode, the fast draw feature can be selected. This option does not redraw background detail within areas filled with color.

- **Even Draw:** Again to speed up the macro-scale simulation mode, the user can choose not to refill those areas whose color does not change from period to period.

- **Animate:** To speed up the micro-scale simulation mode, the animation option, which draws occupants in the detailed area, can be de-selected.

- **Max/Ave Occupancy:** Either the maximum or average area occupancy per time period can be selected to determine the level of service and subsequent color coding.

- **LOS Table:** Two Level of Service (LOS) tables are available, the first is a detailed table (19 area types) usually used for engineering design and the second (6 area types) for planning purposes.

Controlling the Simulation

Once the model has been initialized, the presentation parameters have been selected, and the simulation has been initiated, the user has three "action keys" available to control the presentation:

- P(Pause the Simulation): The simulation begins in the macro-scale mode and can be temporarily halted by pressing the P key. The simulation can be resumed by pressing the R key.

- Z(Zoom-in to Micro-scale): At any point during the macro-scale simulation mode, the micro-scale simulation is accessed by pressing the Z key and pointing the cursor to the selected area.

- ESC (Exit the Simulation): Both the macro-scale and micro-scale simulations can be exited by pressing the ESC key.

Within the micro-scale simulation mode, the user can step through the simulation, either backwards or forwards, using the cursor directional keys. The micro-scale simulation mode screen and line graphics can be printed in combination or separately.

MODEL INPUTS AND INITIALIZATION PARAMETERS

As mentioned above, prior to running a simulation display session on the AGDS, input files must be created and the system's operational parameters initialized. The input files consist of the airport layout and simulation files which are specific to an airport site and incorporate data regarding the terminal building configuration and pedestrian flows. The system's operation parameters are the default values imbedded in the system which control color options, graph parameters, flow simulation parameters and level of service thresholds. The initialization parameters are specific to the users tastes and purpose. These files and their composition are briefly described below.

Airport Layout File

The airport layout file is created and edited using the AGDS's airport definition module. This module consists of a mini-CAD (Computer Aided Drafting) package developed to draw the airport in plan view and define the areas to be monitored. Once an airport layout file is created, it is saved for future use. The master file may be altered or edited to reflect either anticipated or desired changes in the terminal building,s configuration. These revised configurations may be saved as separate files, and used to test the effect of anticipated or hypothetical alterations to the terminal building on pedestrian traffic flows or congestion.

Utilizing the system's mini-CAD package, the plan view of the air terminal building can be drawn to the level of detail required. Once this is completed, the specific areas to be monitored are defined and labelled.

Four basic types of areas are modelled to analyze pedestrian traffic flows in an air terminal building. These include:

- Links: Connectors to more specialized airport areas.
- Wait/Hold Areas: Areas where passengers and meeters/greeters wait for flights to arrive or depart.
- Processors: An area where passengers are served by airline and airport personnel.
- Baggage Claim Areas: Areas where arriving passengers claim their baggage.

Each area defined is labelled by both an area number and area type. This facilitates the assignment of the appropriate occupancy values to the subject area. The area type ties the area to a specific vector of level of service thresholds.

The area definition also consists of drawing the subject area's boundaries. It is within these boundaries that the color depicting the area's current level of service is shown. In addition, these boundaries are used to calculate the physical areas (e.g. meter^2) of the area defined. This calculation is used to determine the level of service and congestion status at each simulation time interval.

For wait/hold areas, the determination of the area boundaries is relatively straight-forward as these area types usually have well defined limits. In the case of processors and baggage claim areas, the boundary definition is somewhat more arbitrary, as it is not always clear where these areas end and adjacent areas, which are usually links, begin. It should be noted that this is not a critical problem if judgement is used in the interpretation of simulation presentation. Because in practice, usually no physical boundaries exist between wait/hold areas or baggage claim areas and links, pedestrians will utilize available space and optimize their own inter-personal distance within the space available. Thus, regardless of the specific boundaries defined for an area, if a specified area is shown to be severly congested, with low or moderate congestion in the adjacent areas, it should be recognized that in practice the pedestrians in the congested area will spill over into the adjacent areas. Likewise, if the adjacent areas are also severely congested, the problem is more severe as there is no place for the congestion to be spread over. This discussion highlights the problems associated with analyzing traffic flows in a "piece meal" fashion.

Simulation File

This file consists of specific pedestrian flow information in a specific format. The input data expected by the AGDS (which are outputs of the terminal flow simulation model) are:

Links:	Maximum occupancy (persons)
	Average occupancy (persons)
	Number of arrivals (persons)
	Number of exits (persons)
Processors:	Maximum queue length (persons)
	Average queue length (persons)
	Maximum queue time (minutes)
	Average queue time (minutes)
	Number of servers open

Wait/Hold Areas	Maximum occupancy (persons)
	Average occupancy (persons)
	Number of arrivals (persons)
	Number of exits (persons)
Baggage Claim Areas	Maximum occupancy (persons)
	Average occupancy (persons)
	Maximum wait time (minutes)
	Average wait time (minutes)
	Number of bags on the device

These inputs are identified by area number to be cross-referenced with the areas defined in the airport layout file. In addition, each output is associated with a specific simulation time period to drive the simulation display. The simulation file also includes the flight schedule information used by the simulation model to derive these outputs. The flight schedule is not, however, necessary for the operation of a simulation display session.

Initialization Parameters

Prior to running the AGDS, certain initialization parameters are confirmed. These pertain to the default values used for the colors indicating level of service, detailed graph parameters, flow simulation parameters and the level of service thresholds. As the choice of specific values depends upon each individual user's preferences and functional purpose, these parameters can be adjusted and saved so as to be automatically loaded each time a simulation is run.

- **Color Options:** Sixteen color options are available to the user for text, terminal building plan and area boundaries, graph colors and background color. As well, the default colors associated with each level of service can be specified.

- **Graph Parameters:** The graphs presented in the micro-scale simulation mode can be customized for specific users or functions. Parameters which can be adjusted include: the data series displayed, Y-axis scale, and Y-axis labels.

- **Flow Simulation Parameters:** As these parameters control the simulation presentation, they can be adjusted prior to starting the simulation. However, permanent adjustments can be made to their default values in this file.

- **Level of Service Parameters:** The level of service parameters can be adjusted to meet specific airport site requirements, or accommodate permanent changes in standards.

HARDWARE/SOFTWARE CONFIGURATION

The AGDS has been designed to run on a Personal Computer of the following configuration:

- IMB/PC, IBM/XT, IBM/AT, or other 100% compatible hardware.
- IBM Personal Computer DOS release 2.0 or higher, or MS-DOS release 2.11 or higher.
- 128K installed RAM minimum, 384K RAM desirable.
- 1 floppy disk drive minimum, 1 floppy disk drive and 10 Megabyte hard disk or greater desirable.
- an IMB Enhanced Color Display monitor or compatible with a minimum of 128K graphics memory. A regular Color Graphics Adapter (CGA) or monochrome card is not supported by the system.

The software required to run the AGDS consists of eight files occupying approximately 135,000 bytes on one floppy disk. For optimum use of the AGDS, a hard disk is recommended. The software development environment was "TURBO PASCAL" (a computer programming language), in conjunction with the "TURBO GRAPHIX TOOLBOX", a graphics library well-suited for applications such as the AGDS.

CONCLUSIONS

The AGDS is a tool which is designed to enable airport planners and operations personnel to review and analyze air terminal building traffic flows and congestion in a timely and efficient manner. In addition, it has the potential to significantly enhance the analysis of airport pedestrian traffic flows by making the results of traffic flow simulation models readily accessible to a wider variety of users, on an interactive basis.

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COLLECTIVE RATEMAKING AND PUBLIC POLICY ISSUES IN CANADA'S REGULATORY REFORM DEBATE

by

Grant M. Davis, University of Arkansas
Theodore C. Alex, Wayne State University

1.0 Introduction

Public policy issues associated with the U.S. regulatory reform movement entailed a number of interrelated sub-issues which were not anticipated when the various reform bills were enacted. The primary emphasis for deregulation in the U.S. was a putative belief that prices were too high, carriers were inefficient, and that U.S. productivity was lagging as a result of the inflationary based pricing practices of U.S. carriers. The complexity and interrelationship of these issues obviously involves capacity, rates, industrial relations, the financial environment, as well as a myriad of other issues.

The public policy debate in the U.S. has been raging since 1980,[1] with various results. In the aviation industry for example, economic regulation has been eliminated, but a concatenated form of state federal regulation exists with respect to bus transportation, as well as in the domestic for-hire motor carrier industry. One major issue has not yet been resolved: the collective ratemaking issue prevelent in both the U.S. and Canada which is interrelated with capacity, financial environment, concentration, etc., for the following reasons: price determines revenues; revenues are interrelated with capacity; the replacement of capacity; service levels; ad infinitum.

Why has the public policy debate concerning trucking regulation and deregulation not been specifically resolved to all parties satisfaction in the U.S.? The approach conducted by the U.S. has dealt with specific problems such as rate and entry control, an approach that fails to recognize the interrelationships of a number of sub-issues ranging from collective ratemaking to industrial relationships that are closely associated with "rates and entry." By not fully recognizing the impact of price, Congress subsequently has laid the ground work for a continuing debate regarding these various sub-issues which had they been known in advance could have perhaps been resolved.

Regulatory reform in the trucking industry in Canada involves not only the traditional entry-pricing questions, but a variety of topics such as capacity, investment, the financial environment of the industry, the status of collective ratemaking, and market entry which must be dealt with. The essential ingredients for a prolonged public policy dispute on this issue are present--that is to say, questions regarding administering the Combines Act, the trend of rates to either increase or decrease, monopsony, the potential entry of a plethora of new carriers, and labor unrest are all present in the motor carrier segment of the Canadian trucking industry.[2]

The basic purpose of this terse paper is two-fold. First, to report on the current state of issues such as capacity, price, etc., in the U.S. Secondly, to examine the current status of collective ratemaking in Canada and to provide a data base for future decision-making by public policy makers. In this regard, the results of a questionnaire recently submitted to be completed by shipper respondents in the Ontario and Quebec provinces regarding collective ratemaking. Collective ratemaking plays a quintessential role in any deregulation effort or modernization for the following reasons: price and capacity affect earnings, concentration, labor relations, and other issues. Collective ratemaking, moreover, represents a quintessential price-information system for both carriers and shippers.

2.0 Issues Involved in the U.S. Regulation Debate

By focusing specifically upon entry and rate control, Congress basically attempted to provide flexibility in pricing, and to eliminate what were perceived to be inordinately rigid barriers to enter the for-hire trucking market in the U.S. Unfortunately these areas are interrelated and cannot be treated in isolation. Also, the U.S. Interstate Commerce Commission for all practical purposes administratively chose not to enforce the congressional dictum of the Motor Carrier Regulatory Reform Act of 1980, and hence a virtual regulatory void evolved at the federal or interstate level.

In the area of rates, market strategy employed by carriers has basically entailed reducing prices by publishing discounts to shippers primarily based on the financial magnitude of shipper purchasing power. The quality of transportation price-information in this particular segment of the industry has diminished as a result of the Commission permitting rates and tariffs to be published by named accounts, numbers, and a variety of other practices and purposes (ICC, 1983). Entry and ergo capacity has been augmented by the presence of over 30,000 new carriers, but all of these operate in the highly price

competitive truckload special commodity segment of the industry. In the LTL segment of trucking, only one new carrier entered this market. This carrier has subsequently exited. This rapidly changing intercity freight market highlights the current unresolved issues in the U.S. motor carrier deregulation debate.

3.0 Unresolved Issues in the U.S.Trucking Regulatory Reform Debate

The capacity problem is without doubt the most serious problem facing the U.S. trucking industry under regulatory reform. With 30,00 or more new carriers entering the market, all competing for truckload freight, substantial diversions of traffic have occurred between LTL carriers and truckload carriers. Entry requirements for this segment of the industry are astronomically low when compared to the LTL general freight carriers, and as a result of traffic diversion, a tremendous amount of pricing pressure has been placed upon LTL carriers. As a result of this particular pricing pressure brought about by TL traffic diversions, together with the presence of some monopsony shippers, a number of carriers have been eliminated from the market either by ceasing operations or through bankruptcy proceedings.[3]

The trucking capacity problem will probably continue to intensify because the average productive life of equipment used is being extended. Also, the traditional classification of carriers has been administratively modified to where LTL carriers are in the process of competing with truckload carriers by opening new subsidiary firms which in turn could be a genesis for future labor relations problems.

Regarding financial issues, the LTL general freight industry has continued to encroach upon its capital base by not earning a sufficient return on investment to even replace the existing physical plant. Many parties contend that this action will result in a curtailment of physical supply of trucking which over time will be self-correcting (Silberman, 1985). However, a corollary to the current financial environment involves concentration. Presently four LTL general freight carriers dominate U.S. transportation markets, with putatively ologopolistic pricing practices. The concentration problem ha- ominous public policy implications for capacity and price.[4] Interestingly, the largest carriers in the LTL market do not rely extensively on bureau tariffs.

In the area of collective ratemaking, the LTL general commodity carriers still use collective ratemaking because of areas of mutual concerns ranging from general rate increases and tariff publications to joint rates. Although

controversy continues to surround the collective ratemaking issue in the U.S., for all practical purposes it has been demonstrated extensively that the collective ratemaking immunity merely provides for a forum for carriers to publish rates in areas of mutual concern, i.e., general rate levels, general tariff restructuring, and joint-line prices. Rate bureaus do not set rates, carriers set rates, and the bureaus merely publish these prices, thereby providing carrier list prices (West, 1985).

As a result of the relative demise of the LTL general freight carriers, the various rate bureaus have been under inordinate pressure to reduce staff and services. Pricing is no more simplified today than it was ten years ago, and yet bureau activities are being curtailed dramatically. By eliminating bureau type pricing, a benchmark of pricing or common reference of pricing will be eliminated, and therefore the quality of price information in existence today is somewhat specious and shipper transaction costs are increasing.

The other major issues associated with regulatory reform in the U.S. are federal preemption, industrial relations, and the social role of for-hire transportation. Federal preemption of state regulatory powers is virtually complete with the exception of trucking and state resistence to any preemption efforts are substantial (Davis, 1987). Industrial relations have been affected by regulatory reform because all of the new TL carriers are non-union, and most LTL carriers are "double-breasting" with new subsidy firms that are non-union. also, some carriers have adopted ESOP's which in effect are dual-wage structures, a practice that virtually insures future industrial relations conflicts.[5] Lastly, in the U.S. the concept of common carriage with its attendant duties to serve has been eliminated for all practical purposes. Social cost vary dramatically in the U.S. among various geographical areas and required transportation links are no longer guaranteed for service to small communities, although some studies indicate that small community service has not declined.[6]

Notwithstanding all of the issues associated with the U.S. deregulation efforts, the one intermidable issue is collective ratemaking in trucking; an issue that is closely related to all of the various issues and sub-issues because of price and capacity relationships. Why does the issue remain? First, collective ratemaking is generally misunderstood. Secondly, collective ratemaking debates normally lack any difinitive empirical data upon which to resolve public policy issues.[7] For example, does collective ratemaking result in high rates? Are collective pricing processes used to diminish price competition? Questions of this sort were not resolved by the Motor Carrier Ratemaking

Study Commission in the U.S.[8] In fact, even the MCRSC's report was controversial, and collective ratemaking and its attendant immunity from antitrust remains in the U.S.

Many of the data problems associated with collective ratemaking in the U.S. will also be present in Canada's move to reform or modernize trucking regulation. The sub-issues, moreover, will be present ranging from capacity and investment to the need for quality price-information. The remainder of this paper is devoted to reporting the results of a recent survey of shippers in the Ontario and Quebec provinces regarding their perceptions of collective ratemaking that should at a minimum provide some insight into how well or poorly the collective ratemaking process, at least for trucking, is functioning in these two provinces. This survey should assist public policy makers with some basic knowledge regarding how users of motor carrier services in the provinces of Quebec and Ontario perceive collective ratemaking insofar as trucking is concerned.

4.0 A Recent Survey

To gain the necessary insight regarding Ontario and Quebec's shipper's attitudes and perceptions of motor carrier collective ratemaking, a questionnaire was mailed in 1985 to a sample of traffic executives.

The sample was drawn from traffic executives of shippers who appeared in Traffic Services Corporation's 1986 "Official Directory of Industrial and Commercial Traffic Executives." This directly provides a current listing of the names, titles, and addresses of 29,000 executives who are actively engaged in managing the transportation activities of 17,000 industrial and commercial firms throughout Canada and the United States. The 1986 directly listed 4562 Canadian firms, with 3628 located in Ontario (2372) and Quebec (1256).

A stratified random sample of 750 traffic executives from Ontario and Quebec was drawn from the sample. The sample size was chosen after factors such as data gathering costs and potential response rates (estimated to range from 20% to 35%) were considered. If an individual firm had more than one traffic executive listed, the questionnaire was sent to the person with the highest ranking title. The sample was stratified by province: 490 from Ontario (65.3% of 3628); and 260 from Quebec (34.7% of 3628). A total of 232 were completed and returned in u able fashion, with 163 (70.3%) from Ontario and 69 (29.7%) from Quebec. This represented an overall return rate of 31%.

The respondents were divided into groups based on total annual sales of their firms in an effort to determine whether differences of attitudes and perceptions existed

TABLE 1
CLASSIFICATION OF RESPONDING TRAFFIC EXECUTIVES
BY FIRM'S ANNUAL REVENUES

Category	Number	Percent
Less than $10,000,000	62	26.7
$10,000,000 to $49,999,999	59	25.4
$50,000,000 to $199,999,999	61	26.3
$200,000,000 or more	50	21.6
Total	232	100.0

among the groups (Table 1). The chi-square statistic was used as a measure of association between firm size and responses to questions on the survey. This chi-square statistic was used because the precise form of the population was not known and the variables were nominally scaled. Cells with expected frequencies of less than 5 were combined with adjacent cells.

The respondents were asked about their experience with motor carriers. This question examined the breakdown of modal splits with the expectation that some perspective would be gained on the extent of dependence upon motor carrier freight transportation by the respondent's firms. All of the revenue categories, as displayed in Table 2, reported heavy usage of motor carriers.

TABLE 2
MEAN PERCENTAGE OF FIRM'S FREIGHT TRANSPORTED
BY MODES OF TRANSPORTATION

Response Categories	Less Than $10 Million	$10-49 Million	$50-199 Million	$200 Mil. Or More	Mean%
Rail	11.7%	9.8%	10.9%	10.8%	10.8
Regulated Motor Carriers	63.3	66.1	63.6	60.8	63.6
Water Carriers	2.2	4.5	4.4	7.5	4.5
Firm's Own Transportation System	17.8	15.6	16.1	16.9	16.6
Other	4.0	5.0	4.0	5.0	4.5
Total	100%	100%	100%	100%	100%

The respondents were asked: "Does your firm receive freight tariffs from motor carrier conferences?" The question sought to determine the extent to which freight tariffs (rates) published by motor carrier rates were utilized with the data serving as an indicant of the usefulness of collective ratemaking to shippers.

Firms with annual revenues of less than $10,000,000 tended to use motor carrier rate conferences less often (45.2%) then did firms with more than $200,000,000 in annual revenues (36.0%). The data regarding the other two revenue categories, illustrated in Table 3, reflected an apparent trend toward motor carriers usage increasing with the size of revenues. The calculated chi-square statistic was 21.482 with 3 degrees of freedom. At the 0.05 significance level, the critical value of chi-square is 7.81. Hence, the hypothesis of independence between firm size and motor carrier rate conference freight tariff usage was rejected. The calculated chi-square statistic for the three smallest revenue categories was 0.4165 with two degrees of freedom. At the 0.05 significance level, the critical value of chi-square is 5.99. Thus, for all but the largest revenue category, we fail to reject the null hypothesis that firm size and rate conference tariff usage are statistically independent.

TABLE 3
FIRMS RECEIVING FREIGHT TARIFFS
FROM MOTOR CARRIER RATE CONFERENCES

Response Categories	Less Than $10 Mil.		$10-49 Million		$50-199 Million		$200 Mil. Or More		All Resp.	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	28	45.2	29	49.2	31	50.8	43	86.0	131	56.5
No	34	54.8	30	50.8	30	49.2	7	14.0	101	43.5
Total	62	100%	59	100%	61	100%	50	100%	232	100%

The percentage of firms not utilizing the tariffs indicated that usage of collective ratemaking was not universal. These findings support the proponents of collective ratemaking who contend that the process is a price information system rather than a cartel, and that shippers have other alternatives available to them in regard to freight tariffs.

The results imply that large firm size may have an influence on the degree of usage of motor carrier rate conference freight tariffs. This disparity in tariff usage rates may be the result of differing needs among the various classes of respondents.

Another method for determining shipper's perception of the usefulness of collective ratemaking is to examine the extent to which shippers are bypassing the process. The respondents were asked: "What percentage of motor carrier freight rates used by your firm are negotiated directly with the carriers?"

Compared to the United States, motor carrier rate conference freight tariffs have never been universally used in Canada. The data, presented in Table 4, illustrates this point. For shipments within Canada, firms with annual revenues of more than $200,000,000 negotiated slightly more of their motor carrier rates (54%) than did firms in the other revenue categories (45-50%). This small difference may be due to the more powerful negotiating position some of the larger shippers have with the motor carriers due to their ability to direct large volumes of freight to specific carriers.

TABLE 4
PERCENTAGE OF FIRM'S FREIGHT TRANSPORTATION RATES NEGOTIATED DIRECTLY WITH MOTOR CARRIERS

Response Categories	Less Than $10 Mil.	$10-49 Million	$50-199 Million	$200 Mil. Or More	Mean %
Canada	45.0%	48.0%	50.0%	54.0%	49.0
United States	65.0%	62.0%	64.0%	68.0%	64.6

Respondents in all of the revenue categories reported a high percentage of negotiated rates for freight shipped to and from points in the United States as shown in Table 4 (65-68%). The heavy usage of negotiated rates may be due to the recent changes in the relevant regulatory and legal environment.

One of the condition precedents for exemption from antitrust or anti-combines statutes is the right to independent action. This right gives motor carriers and shippers the ability to set rates at different levels than a rate conference might, thus providing evidence that rate conferences are not cartels. For independent action to be effective, shippers must be able to obtain information regarding independently announced motor carrier freight rates. The respondents were asked about the incidence of difficulty they had experienced in obtaining such information.

The data, shown in Tables 5 and 6, indicated that the system appears to be working well in both Canada and the United States. The incidence of difficulty reported in

TABLE 5
INCIDENCE OF DIFFICULTY EXPERIENCED IN OBTAINING INDEPENDENTLY ANNOUNCED MOTOR CARRIER FREIGHT RATES DURING THE LAST FIVE YEARS (1981-1985) FOR SHIPMENTS WITHIN CANADA

Response Categories	Less Than $10 Mil.		$10-49 Million		$50-199 Million		More Than $200 Mil.		All Resp.	
	No.	%	No.	%	No.	%	No.	%	No.	%
Never	40	64.6	42	71.2	41	67.2	37	74.0	160	69.0
Very Infrequently	9	14.5	10	16.9	9	14.8	8	16.0	36	15.5
Somewhat Infrequently	8	12.9	7	11.9	8	13.1	5	10.0	28	12.1
Somewhat Frequently	5	8.0	0	0.0	3	4.9	0	0.0	8	3.4
Very Frequently	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	62	100%	59	100%	61	100%	50	100%	232	100%

obtaining independently announced motor carrier rates for shipments within Canada (Table 5) was very low. The data regarding shipments to and from points in the United States, presented in Table 6, reflected a similar experience.

The calculated chi-square statistic was 3.504 (Canada) and 2.473 (United States) with six degrees of freedom. At the 0.05 significance level, the critical value of chi-square is 12.59. Therefore, in both instances we fail to reject the null hypothesis that firm size and the ability to obtain independently announced motor carrier freight rates are statistically independent.

The respondents were asked if they believed that motor carrier collective ratemaking was necessary for rate stability. The data regarding shipments within Canada and to and from points in the U.S., displayed in Tables 7 and 8, indicated that more than a majority of the respondents in each of the revenue categories felt that collective ratemaking was necessary for rate stability. The degree of support was strongest among respondents representing the smallest sized firms and weakest among those representing the largest sized firms.

TABLE 6

INCIDENCE OF DIFFICULTY EXPERIENCED IN OBTAINING INDEPENDENTLY ANNOUNCED MOTOR CARRIER FREIGHT RATES DURING THE LAST FIVE YEARS (1981-1985) FOR SHIPMENT TO AND FROM POINTS IN THE UNITED STATES

Categories	Less Than $10 Mil. No.	%	$10-49 Million No.	%	$50-199 Million No.	%	More Than $200 Mil. No.	%	All Resp. No.	%
Never	34	54.8	36	61.0	38	62.3	33	66.0	141	60.8
Very Infrequently	12	19.4	9	15.3	11	18.0	9	18.0	41	17.7
Somewhat Infrequently	9	14.5	10	16.9	12	19.7	8	16.0	39	16.8
Somewhat Frequently	7	11.3	4	6.8	0	0.0	0	0.0	11	4.7
Very Frequently	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Total	62	100%	59	100%	61	100%	50	100%	232	100%

The calculated chi-square statistic for rate stability was 2.963 (Canada and 2.061 (United States) with 3 degrees of freedom. At the 0.05 significance level, the critical value of chi-square is 7.81. Therefore, in both cases the hypothesis that firm size and perceptions of collective ratemaking's necessity for motor carrier freight rate stability are statistically independent were not rejected.

The last question in the survey sought to specifically measure respondent's preferences toward the future of the collective ratemaking process. The respondents were asked: "Do you favor retention of the collective ratemaking process in the motor carrier industry in Canada, and in the United States?"

A majority of respondents in all of the revenue categories favored retaining the collective ratemaking process in Canada, as illustrated in Table 9. Support for retention of the process was highest among those representing the largest sized firms (52.0%), a surprising result given the U.S. experience. Similar results, presented in Table 10, were reported for respondent's attitudes toward the

TABLE 7
RESPONDENT'S PERCEPTIONS OF THE NECESSITY OF COLLECTIVE RATEMAKING IN REGARD TO MOTOR CARRIER FREIGHT RATE STABILITY FOR SHIPMENTS WITHIN CANADA

Response Categories	Less Than $10 Mil.		$10-49 Million		$50-199 Million		$200 Mil. Or More		All Resp.	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	42	68.0	33	55.9	33	54.0	28	56.0	136	58.6
No	20	32.0	26	44.1	28	46.0	22	44.0	96	41.4
Total	62	100%	59	100%	61	100%	50	100%	232	100%

TABLE 8
RESPONDENT'S PERCEPTIONS OF THE NECESSITY OF COLLECTIVE RATEMAKING IN REGARD TO MOTOR CARRIER FREIGHT RATE STABILITY FOR SHIPMENTS TO AND FROM THE UNITED STATES

Response Categories	Less Than $10 Mil.		$10-49 Million		$50-199 Million		More Than $200 Mil.		All Resp.	
	No.	%	No.	%	No.	%	No.	%	No.	%
Yes	40	64.5	32	54.2	31	50.8	25	50.0	128	55.2
No	22	35.5	27	45.8	30	49.2	25	50.0	104	44.8
Total	62	100%	59	100%	61	100%	50	100%	232	100%

TABLE 9
RESPONDENT'S ATTITUDE TOWARD RETENTION OF THE MOTOR CARRIER COLLECTIVE RATEMAKING PROCESS IN CANADA

Response Categories	Less Than $10 Mil.		$10-49 Million		$50-199 Million		More Than $200 Mil.		All Resp.	
	No.	%	No.	%	No.	%	No.	%	No.	%
In Favor of Retention	41	66.1	35	59.3	34	55.7	26	52.0	136	58.6
Not in Favor of Retention	21	33.9	24	40.7	27	44.3	24	48.0	96	41.4
Total	62	100%	59	100%	61	100%	50	100%	232	100%

TABLE 10
RESPONDENT'S ATTITUDE TOWARD RETENTION OF THE MOTOR CARRIER COLLECTIVE RATEMAKING PROCESS IN THE UNITED STATES

Response Categories	Less Than $10 Mil.		$10-49 Million		$50-199 Million		More Than $200 Mil.		All Resp.	
	No.	%	No.	%	No.	%	No.	%	No.	%
In Favor of Retention	40	64.5	35	59.3	34	55.7	26	52.0	135	58.2
Not in Favor of Retention	22	35.5	24	40.7	27	44.3	24	48.0	97	41.8
Total	62	100%	59	100%	61	100%	50	100%	232	100%

retention of the collective ratemaking process in the United States. Affirmative responses ranged from 64.5% (smallest sized firms) to 52.0% (largest sized firms).

The calculated chi-square statistic for retaining collective ratemaking was 2.567 (Canada) and 1.986 (United States), with 3 degrees of freedom. At the 0.05 significance level, the critical value of chi-square is 7.81. Therefore, in both instances we fail to reject the null hypOothesis that firm size and attitude toward retention of collective ratemaking in the motor carrier industry are statistically independent.

Several conclusions are apparent from the data produced by the survey. The respondents indicated that they were experienced with the freight transportation services of motor carriers and thus were qualified to provide the information sought by the survey. Secondly, firms the respondents represented appeared to utilize motor carrier rate conference freight tariffs for a portion of their motor carrier freight shipments. The respondents also noted that they had experienced little or no difficulty in obtaining independently announced motor carrier freight rates.

Thirdly, a majority of respondents believed that collective ratemaking was necessary for rate stability in Canada and the United States. Most importantly, a majority of respondents favored retention of the collective ratemaking process in both countries. While some slight differences of opinion existed among the respondents representing different sized firms, support for the collective ratemaking process was evident in the data.

5.0 Summary and Conclusions

As Canada prepares to implement the "freedom to move" policy in transport regulation matters, several experiences endured in the U.S. should be acknowledged and assimilated. Problem specific approaches to transport deregulation can create a number of important issues associated with industry restructuring. Issues such as investment, industrial relations, monopsony, inter alia are salient issues that evolve when entry and rates are changed dramatically. This terse paper examined these issues in the US. and reported the results of a recent survey of shipper perceptions of collective ratemaking in the provinces of Quebec and Ontario. A shipper perception data base is important because quantitative data associated with collective ratemaking is difficult to obtain or verify. The survey found a substantial body of support for collective ratemaking in Quebec and Ontario; support that conflicts with recent trade press stories regarding the putative evils of collective ratemaking. The survey provides at least a point of reference to the collective ratemaking controversy assessing a large body of users of transportation services.

What can be gained from the U.S. experience in motor carrier deregulation that can assist Canadian public policy makers? First, liberalized market entry without concurrent pricing freedom will insure a prolonged debate regarding the success or failure of the current carrier pricing system. Secondly, a sizeable number of shipper-users will continue to rely upon collective ratemaking for price-service needs. Thirdly, any proposed legislative changes should be evaluated on a broad spectrum of impacts, i.e., rates, investment, capacity, industrial relations, ad infinitum. Fourth, transaction costs can increase dramatically. Fifth, and lastly, there are situations where interlining, joint rates, and rate changes require joint efforts by carriers and shippers.

In the U.S. collective ratemaking remains in use even though for all practical purposes transportation regulation has been eliminated. Why? In the present for-hire segment of trucking, collective ratemaking is merely a price-information system available to both carriers and shippers. However, failure to recognize the interrelationships that exist between collective ratemaking, investment, industrial relations, capacity, and other issues is myopic and will insure continuing debate regarding "freedom to move."

6.0 Footnotes

[1]For a review of the extent of current debate regarding motor carrier deregulation, for example, see U.S. Congress, House of Representatives, Subcommittee on Surface

Transportation of the Committee on Public Works, Motor Carrier Act of 1980 - Oversight Hearings (Washington, DC: U.S. Government Printing Office, November, 1985).

[2]See Adil Cubukgil, Potential Impact of Replacing Reverse-Onus Test With a Fitness Test (prepared for the Canadian Council of Motor Transport Administratives, August, 1986), pp. 107-131, for an evaluation of many of the interrelated issues associated with motor carrier regulatory revisions. Also consult Andrew Tausz, "Shippers in Canada Hail Decontrol Study," The Journal of Commerce (February 6, 1987), p. 18, for reactions from shippers and carriers regarding the potential impact of rate regulation relaxation.

[3]Even carrier bankruptcy has been controversial in the U.S. Consult statement of Norman Weintraub, I.B.T., before the Subcommittee on Surface Transportation of the Committee on Public Works, U.S. House of Representatives, Motor Carrier Act of 1980 - Oversight Hearings (Washington, DC: U.S. Government Printing Office, November 8, 1985), and Marilyn W. Klein, Office of Regulatory Affairs, Five Years AFter the Motor Carrier Act of 1980: Motor Carrier Failures and Successes (Washington, DC: U.S. Department of Transportation, September, 1985), pp. 7-8.

[4]As a consequence of regulatory reform, concentration in the railroad industry is not surprising, but in the LTL general freight segment of trucking, concentration has increased dramatically since 1980. For an analysis of current concentration trends in U.S. trucking, consult Grant M. Davis, "Unresolved Issues in U.S. Trucking Regulatory Modernization Debate," Transportation Practitioners Journal, Vol. 54, No. 2 (Winter, 1987), pp. 170-171.

[5]Problems associated with maintaining dual wage structure are presently being experienced by American Airlines, the first carrier to adopt this practice in response to low-cost carrier competition in the U.S. A similar system is in limited use in trucking.

[6]A review of the "small community service" literature reveals a plethora of studies proving service will or will not be affected by deregulation. In short, not one knows. the U.S. aviation experience suggests that flight frequency will decline.

[7]An entire hearing conducted by the Motor Carrier Ratemaking Study Commission was devoted to examining why such a limited amount of empirical data was associated with collective ratemaking.

[8]Interestingly, Congress has never acted upon any of the recommendations advocated by the Motor Carrier Ratemaking Study Commission.

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TRANSPORTATION AND FREE TRADE - IMPLICATIONS FOR THE ATLANTIC PROVINCES

by

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1.0 INTRODUCTION

A major component of the Gross National Product (GNP) of Canada and the United States is derived from transborder goods and services trading activities. Therefore, the adoption of new transportation regulatory policies and the current free trade initiative suggests significant future implications with respect to the flow of commodities and services across the border. The coincidental policy thrusts of trade liberalization and regulatory reform in transportation tend to blur the lines between these two public policy issues.

The primary focus of this paper is on trade issues as they relate to transportation. This is not a paper on transport regulatory reform. However, since Canadian and American regulatory reform will have a significant impact on transborder transportation systems and trade in transportation services between the two nations, the regulatory issues must be examined in depth, in the context of trade matters.

Transport policy has been radically changed in both countries in recent years. Trade policy could change significantly as a result of the recently initiated negotiations. Technological change and innovative advances in transportation logistics and distribution concepts are other factors which must be taken into account when formulating trade and transportation strategies. The interaction of these factors have the

potential to significantly impact the long term economic performance of the Atlantic Canada (as measured in terms of employment and income levels).

The importance of the Canadian export trade to the United States is illustrated in Table 1. Major shifts could occur either through changes in trade patterns or entry of U.S. carriers into existing markets as a result of regulatory reform. In addition, the road transport's share of total transborder traffic has grown significantly in the past two decades.

Table 1

1984 Exports to U.S.

By Province, By Mode, Million of Dollars ($)

Province	Road	Rail	Water	Air	Other*	Total
Nfld	286.3	23.0	86.4	2.3	0.3	387.3
N.S.	373.6	287.6	330.8	9.4	4.2	1005.6
P.E.I	68.4	0.4	3.6	4.1	0.1	76.6
N.B	475.0	141.1	315.5	4.8	469.8	1406.2
P.Q.	6887.6	4123.0	1031.3	511.1	431.1	12984.1
Ont.	32021.3	12622.7	577.2	2411.9	567.4	48200.6
Man.	984.6	149.5	3.0	40.8	121.0	1299.0
Sask.	949.3	551.4	90.1	10.2	1305.7	2451.7
Alta.	772.9	1229.2	26.7	34.3	7271.1	9334.2
B.C.	1794.8	2093.8	1095.1	47.7	608.8	5645.2
Yukon	2.6	0.9	-	2.3	0.1	5.8
Total	44161.4	21216.6	3559.6	3079.6	10779.6	82796.3

*Other means piplines
Source: Statistics Canada

The importance of Canadian exports to the United States by province is shown in Table 2. The comparison is based on Earned Income statistics. This measure has the tendency to overestimate the importance of exports to the U.S. However, the more appropriate measurement, Gross Provincial Product, was not available through Statistics Canada figures.

In 1984, exports to the U.S. accounted for nearly 27 percent of Canada's earned income. New Brunswick appoached the national figure while the other Altantic Provinces' exports to the United States were less important to their economies. The impacts of freer trade and/or integration of the Canadian and American transport systems could be expected to vary between provinces.

Table 2

EXPORTS OF THE UNITED STATES
AS A PROPORTION OF EARNED INCOME

CANADA AND PROVINCES (1984)

PROVINCE	EXPORTS TO U.S. AS % OF EARNED INCOME
Newfoundland	9.9
Nova Scotia	12.2
Prince Edward Island	8.0
New Brunswick	23.7
Quebec	17.9
Ontario	38.5
Manitoba	10.4
Saskatchewan	22.7
Alberta	30.1
British Columbia	15.7
Canada	26.9

Source: Statistics Canada

2.0 DEREGULATION OF THE TRANSPORTATION SYSTEM

The Airline Deregulation Act of 1978 was the United States' first legistative step towards the deregulation of the transportation industry. American researchers and deregulation proponents have since voiced their disappointment in the reluctance of countries operating in the North Atlantic markets to follow suit. American carriers feel that they are placed at a competitive disadvantage since most, if not all, of the European carriers are heavily subsidized by their national

government. Consequently, there has been an attempt on the part of the United States to apply their laws and regulations extraterritorally. This tendency is, perhaps, clearest with reference to the application of U.S. anti-trust legislation to events and actions which have occurred outside their boundaries.

The American emphasis towards fair competition is likely to spill over into the entire transport system, particularly countries which exhibit geographical or trade links with the United States. This is illustrated by reference to the proposed National Transportation Act which contains regulatory proposals similar in thrust to those stipulated in the Airline Deregulation Act and the Staggers Act of 1980 which were adopted in the United States. Obviously, the American legislation provided considerable impetus to the Canadian deregulation initiative. Similarities do exist, but the resulting transportation policies are not identical.

Deregulation of the U.S. trucking industry has created a new set of complex issues facing the Canadian trucking industry. The decentralization of the Canadian regulatory system highlights the need for a national strategy in order to resolve the issues which are superimposed on the trade negotiations policies.

3.0 TRANSBORDER TRUCKING - BACKGROUND

Transborder trucking operations take various forms. A "single line" operation involves either a Canadian or American carrier transporting freight from origin to destination. An "interline" operation involves switching traffic from a carrier of one country to a carrier domiciled in the other country. Another variation of an interline operation is when the carrier of one country interlines with a subsidiary company which is domiciled in the other country.

Transborder operations represent a significant source of revenue for Canadian carriers. International revenues, as a percentage of total operating revenues, earned by trucking companies domiciled in Canada, reached a high of 12.8% in 1984 (1:10). In Atlantic Canada, international revenue as a percentage of operating revenue in 1984 was approximately 11% for carriers domiciled in Newfoundland and Prince Edward Island and 7% for carriers domiciled in Nova Scotia and New Brunswick (1:11). These statistics tend to justify the extent of debate transpiring between the two countries with respect to problems and issues relating to the future of transborder trucking services. The

remainder of this section will focus on the key issues influencing the truck services trade balance between Canada and the U.S.

3.1 Reciprocity of Trucking Services

Historically, transborder trucking traffic was interlined in order to meet the respective regulatory regimes of the two countries. The U.S. Motor Carrier Act of 1980 substantially deregulated the U.S. motor carrier industry allowing with relative ease Canadian trucking firms to acquire U.S. operating authorities. Consequently, Canadian trucking companies expanded their single line operations into the U.S. Meanwhile, U.S. trucking firms complained that it was very difficult to obtain operating authorities in Canada. Ultimately, the President of the United States legislated a two year moratorium on applications for U.S. operating authorities by Canadian firms effective September, 1982. (2:20) In 1982, a consultative mechanism was outlined in the "Brock - Gotlieb Agreement" allowing for the arbitration of preceived problems associated with the balance of trade in trucking services.

The "Brock-Gotlieb Agreement" may be short lived as an effective instrument in overseeing transborder trucking. The Trucking Deregulation Act of 1985, gives the President power to limit U.S. operations of foreign truckers from Canada or Mexico engaged in practices which have a substantial negative impact on the U.S. trucking industry. (2:20) In Canada, the House of Commons Standing Committee on Transport recommended that the Federal government give consideration to the negotiation of a bilateral trucking agreements with the U.S. (3:22) These measures suggest that each country is concerned with the equity and fairness of transborder activities. Freedom of entry into transborder trucking may be an important bargaining issue on the part of the trade negotiations. Granting of entry freedom may become one of the prices which Canada will have to pay for freer trade, and the impact of such freedom of entry is then a question which must be considered.

The Motor Vehicle Transport Act, 1986 (Bill C-19) is based on the principles agreed upon in a Federal - Provincal Memorandum of Understanding which was developed in February, 1985. The new Act preserves the present decentralized approach to trucking regulation albeit under a more liberal regime. Key features of the Act include: a uniform national fitness test to be used as a licensing standard, effective January 1, 1988; a "reverse onus" public interest test on license applications for a three year period; and elimination of

6conditions of licences such as route restrictions. The license applications by American carriers will continue to be addressed on an individual basis rather than a broader national issue of reciprocity in trade of trucking services. The reciprocity issue may be of sufficient importance to be included within the purview of free trade negotiations. More liberalized reciprocity agreements with the U.S. raises another transborder trucking issue: the perceived competitive advantage of U.S. carriers.

3.2 Competitive Advantage of U.S. Carriers

Canadian truckers claim that they are at a significant disadvantage in competing with large U.S. firms, particularly in the long-haul, less-than-truckload (LTL) segment of the industry.

Successful LTL trucking operations entail extensive terminal networks and support systems. The necessary operational infrastructure reflects the high fixed costs associated with the service. In addition, high density traffic lanes permit direct traffic routing (origin/destination) minimizing the need to perform expensive break-bulk operations at intermediate consolidation terminals. Single carrier service is the optimal alternative door-to-door service from a shipper's perspective.

Given the economies of LTL operations, the U.S. operating environment favours U.S. firms in competing for transborder truck traffic, particularly traffic of a long-haul nature. In Canada, there are three cities with a population over one million compared to forty-two in the U.S. (2:17) Consequently, there is a significantly greater number of high density traffic lanes in the U.S. In 1980, ICC-regulated carriers earned approximately $90 billion in intercity revenues (U.S. dollars) compared to approxiamtely $4.6 billion (Canadian dollars) for Canadian for-hire carriers. The four largest U.S. freight carriers each had approximately $1 billion in revenue in 1980. During the same year, the thirty-two largest Canadian carriers combined earned $1.25 billion. (2:17)

The extensive network developed by the U.S. giants is extremely efficient and cost-effective. The consolidation centres, trailer/driver relay systems and computer tracing techniques incorporated in the hub and spoke operational approach give the Canadian medium size regional LTL operations cause for concern from an "open border" policy. Canadian firms are concerned that the

larger U.S. LTL carriers could control a major share of the transborder traffic by simply adding three or four terminals in Canada to their extensive American network. Using this approach, the Canadian operation would essentially be a marginal cost venture, giving the U.S. firms the marketing ability to offer their customers single service anywhere in North America. The "open border" policy is of particular importance in Ontario where a large percentage of the Canadian transborder LTL operations occur.

Table 3 displays the operating ratios (total operating expenses/total operating revenues) for the three Atlantic Provinces and Canada. The relatively high ratios suggest that some firms may have difficulty withstanding the variety of adverse impacts associated with the free entry of large American carriers into Canadian industry.

Table 3

OPERATING RATIOS MOTOR CARRIERS FREIGHT

CANADA AND SELECTED PROVINCES (1983)

AREA	CLASS I	CLASS II	CLASS III	INDUSTRY
Canada	97	95	90	96
P.E.I.	98*	91	96	90
Nova Scotia	98	94	91	96
New Brunswick	92	97	92	93

* Prince Edward Island and Newfoundland
Source: Statistics Canada

The 1983 financial statistics figures indicate that the performance level of all four jurisdictions is not strong.

Initially, penetration of the U.S. based carriers into the Canadian market would likely occur on the lanes or corridors exhibiting high traffic volumes. These corridors have the highest profit potentials since the average costs are the lowest. The increased competition

on these lanes could cause market fragmentation due to possible route redirection. Consequently, the firms operating on these lanes would experience a decline in revenues which could significantly reduce the available funds for internal cross-subsidization within the firm. Therefore, the small community service could experience increases in freight rates to compensate for the reduction in internal cross-subsidization.

The quality of service to small communities may also be adversely effected by the adoption of an "open border" policy. Increased average terminal costs may rise as traffic volumes fall thus initiating the closure of some operations. In addition, the frequency of service to small communities may be reduced as firms attempt to bring operating costs into line with reduced revenues.

3.3 Impact on Domestic Truck Transportation

Many believe that the major presence of U.S. trucking firms in Canada will go beyond the domain of transborder traffic and have "spill over" effects on the domestic operations. The relative size and mix of operations (LTL and TL) are two fundamental differences between the countries.

In Canada, long haul general freight tends to consist of consolidated LTL shipments of manufactured goods moving in one direction with TL commodity movements in the other. However, LTL and TL operations in the United States tend to be separate. This trend is attributed to the uniform geographical distribution of major centres and the rationalization of operations which has been made possible by the deregulation of the industry.

Typically, the LTL activity in Canada is regional in nature, particularly in Atlantic Canada where all of the firms domiciled in the region tend to concentrate on intra-regional traffic and traffic to central Canada and the Eastern seaboard of the U.S. Therefore, it is unlikely that the LTL and TL traffic components of the Canadian industry will be separated to any significant degree, especially, considering the traffic volume and directionality of the freight.

Canadian carriers, especially regional carriers, are concerned that they could lose a significant amount of interline traffic which is currently obtained from U.S. carriers if the larger U.S. trucking firms enter the Canadian markets. This point of contention was evident

when Consolidated Freightways Corporation of Delware applied for operating authority in the Maritime Provinces. Trucking firms domiciled in New Brunswick and the State of Maine currently serving the region stand to lose a considerable amount of interline traffic upon the establishment of Consolidated Freightways (CF) operations in the Maritime provinces.

Large U.S. firms will probably continue to interline with Canadian regional carriers to distribute traffic beyond their Canadian terminals. Such is the case in Quebec, which has a relatively open door policy towards U.S. trucking firms and continues to exhibit a significnat degree of interline activity between such firms as Yellow Freight, Roadway Express, CF and Quebec carriers. (4:55) This practice is likely to continue so long as the cost of doing so through an interline arrangement is lower than the cost that the carrier would incur if it performed the service. The establishment of terminals within the Canadian border by U.S. firms, as proposed by CF's application, would almost certainly reduce the interline traffic activity.

The close proximity of the major Canadian market centres to the Canada/U.S. border yields yet another competitive advantage to U.S. truckers. The U.S. markets are more dispersed and the interstate regulations restrict Canadian truckers from establishing their own feeder network in the U.S. Many Canadian truckers feel that the greater efficiency of the large U.S. LTL carriers will eventually redirect the domestic traffic over the U.S. gateways. Canadian domestic operations could suffer a significant loss of traffic. For example, the approval of the CF application for operation authority in the Maritimes could conceivably have a Toronto - Saint John freight movement routed through CF's consolidation centers in Buffalo, New York and Chicopee, Massachusetts enroute to the Maritimes. The U.S. giants pose a major threat to domestic traffic presently carried by Canadian operators.

3.4 Owner Operator Component of Industry

Currently, Labour Canada is apparently considering redefining an owner-operator (broker) as an employee of the firm with which he contracts. Consequently, the trucking firms would be obligated to offer the broker a variety of fringe benifits. The implications offer an uneven effect on the firms dependent upon the extent to which the firm uses brokers. Table 4 indicates the payment to brokers as a proportion of total operating expenses of trucking firms by class in Canada.

Table 4

PAYMENTS TO BROKERS AS A PROPORTION OF TOTAL OPERATING EXPENSES (%)

MOTOR CARRIERS FREIGHT
CANADA AND SELECTED PROVINCES (1983)

AREA	CLASS I	CLASS II	CLASS III	INDUSTRY
Canada	17	16	7	17
P.E.I.	47*	6	-	5
Nova Scotia	16	15	6	14
New Brunswick	44	15	7	36

* Prince Edward Island and Newfoundland
Source: Statistics Canada

The table suggests that the broker is most important in the Class I cases of P.E.I./Newfoundland and New Brunswick. The data for the industry in total indicates that the broker is more important in N.B. and of less importance in P.E.I. when compared to the national values. It is difficult to determine the impact of the proposed changes on the various parts of the regional for-hire trucking industry. However, it is possible to estimate the financial implications of these changes by focusing on the 1983 financial statistics for the Atlantic region. A number of assumptions are necessary for this comparative analysis.

Brokers are assumed to pay their share of the applicable benefits from the mileage fees they were receiving at that time. The trucking firms are assumed to incur no additional accounting costs associated with the record keeping of these fringe benefits. Finally, it is assumed that five percent of the total payment to the brokers is an applicable rate of fringe benefit. Table 5 displays the recalculated 1983 operating ratios (Table 3) consistant with the outlined assumptions. A comparison of Tables 3 and 5 reveal that the operating ratios have increased in most instances as a result of making the broker an employee of the firm. In many

Table 5

RECALCULATED OPERATING RATIOS: MOTOR CARRIERS FREIGHT

CANADA AND SELECTED PROVINCES (1983)

AREA	CLASS I	CLASS II	CLASS III	INDUSTRY
Canada	98	96	90	97
P.E.I.	101*	91	96	92
Nova Scotia	98	95	91	97
New Brunswick	94	98	93	95

* Prince Edward Island and Newfoundland
Source: Statistics Canada

cases, the industry is pushed close to a level where the firms are left with insufficient funds available to meet the fixed expenses. It is questionable whether these firms could survive in the long run at current rates. It should be noted that the minimum levels of costs and benefits were assumed in the analysis.

This institutional change on the part of Labour Canada would have an adverse impact on the trucking industry. These changes coupled with the free trade potential could significantly impact the trucking industry.

3.5 Foreign Ownership

Acquisition of a Canadian trucking company is clearly one alternative means of an American firm establishing a presence in the Canadian market. Many believe that Canadian trucking, through a series of mergers and acquisitions, could become a northern appendage to the U.S. system. The present predominant east-west flow of freight could shift to a north-south orientation through the development of new markets and supply parts under a free trade agreement.

The National Transporatation Act (Bill C-18), if proclaimed in its present form, will require that all mergers and acquisitions involving transportation

companies with sales or assets of $20 million or more be subject to review by the Regulatory Agency. Numerous parties have recommended that any foreign acquisition of a Canadian trucking industry should continue to be regulated, irrespective of the value of assets or sales of the Canadian company that would be involved in a proposed merger or acquisition. The key issue is whether the transportation industry warrents its own foreign investment policy, or whether it can live under the same Investment Canada guidelines that apply to other industrial sectors.

3.6 Lack of Data

The regulatory reform and trade liberalization initiatives necessitate the need for more accurate data availability in order to assess the impacts of the policy changes. Ironically, the reform proposals call for a reduction in the data reporting requirements in an attempt to reduce the administrative burden on carriers.

Recently, a for-hire transborder trucking survey was performed by the Motor Carrier Branch of Transport Canada in collaboration with the Transportation Division of Statisitics Canada. Input from the Canadian Trucking Association assisted in the assemblage and documentation of a report (1986) outlining the Canadian component of the transborder activities. However there is no similar information gathered on U.S. carriers which would permit a comprehensive evaluation of market share between U.S. and Canadian based trucking companies. Furthermore, it is unlikely that the Americans would agree to a similar data monitoring procedure since transborder operations represent a small proportion of trucking activity in the U.S. The absence of an appropriate monitoring framework could ultimately lead to the collapse of the establishment of any trade agreement.

It is clear that the restructuring of the regulatory regimes of North America coupled with the thrust towards free trade liberalization pose major questions for the future trucking industry. These questions must be addressed with other issues as regulatory changes lead us towards trade liberalization in transborder trucking services.

4.0 TECHNOLOGICAL CHANGE

Technological advances in transport vehicles as well as terminal and way facilities will have a significant impact on the cost and manner in which goods are transported domestically and internationally. In

addition, computer based technological innovations are extending beyond transportation itself and into the entire administrative, management and distribution processes. It is inevitiable that computers will increasingly be combined with other technology, such as satellite tracking capability, to develop new operating concepts and increase efficiency.

Clearly, technological advances will be one of the major influences in the nature of transportation systems in the future. Perhaps, the best illustration of how technology can radically change transportation logistics and distribution is in the marine transport sector.

Purpose built cellular container vessels have evolved from the revolutionary shift in general cargo trade to unitized container loads in the late 1960s. Fourth generation container ships involved in "around-the-world" service have capacity to carry 4,000 or more twenty-foot equivalent (TEU) container units. The economics of these shipping operations requires rapid port turn-around time and selective port service along major shipping routes. In addition, these ports have developed into "load centres" where container traffic from an increasingly large hinderland is consolidated for distribution. Accordingly, such ports must have access to efficient and cost competive inland transportation systems.

The development of a few load centres on the North Ammerican continent implies that the choice of port for loading or discharging containers will increasingly be made by the carrier rather than the shipper. The interests of the carriers will thus influence the traffic growth at any port.

The continuing growth of containerization among OECD nations has led to increased interest in vertical integration opportunities by the marine carriers. These carriers are seeking to merge with or acquire land transportation systems to complement their ocean service enabling them to provide "door-to-door" service with one "through bill-of-lading". Sea Land, a major U.S. container carrier, has been acquired by CSX a regional rail carrier, while CN Rail was unsuccessful at acquiring shareholdings in CAST (a container and bulk carrier serving Montreal-Antwerp). Government intervention which may prevent Canadian transportation firms from developing vertically integrated systems will result in a competitive disadvantage to their U.S. counterparts.

Long-haul railroad "land bridge" operations

utilizing scheduled double-stacked container trains fosters the emergence of load center ports. Accordingly, the railroads and the ocean carriers will seek to consolidate this type of container traffic through fewer ports.

"Around-the-world" ocean container services and the growth of U.S. double-stacked container railroad landbridges are already affecting the competitiveness of the ports of Halifax and Saint John. Capital-intensive container vessels experience daily operating costs in the order of U.S. $30 000 to $40 000 (excluding fuel). Therefore, only short diversions from the great circle routes across the North Atlantic can be financially tolerated. The Port of Halifax benefits from this operating restraint since it involves a 5 to 6 hour diversion time compared to 18 to 24 hours for the port of Saint John.

A significant loss of Pacific trade has been experienced by the Port of Saint John due to the advent of double-stacked trains landbridging from the U.S. West Coast ports to the American Mid-West and Central Canada. Landbridging/double-stacking allows Far East shippers to save both time and money in getting their goods to the destination by avoiding the circuitous marine route through the Panama Canal to the U.S. East Coast and Saint John.

The ocean container trades continue to evolve consistant with the technological and innovative transport concept advancements. American President Lines have recently ordered the first fifth generation vessels. These vessels are the first to breach the hitherto sacrosanct "Panamax" limits (i.e. larger then the size of the Panama Canal locks) reflecting the development of the landbridging system. Although, landbridging may promise benefits for the future development of Canadian railways, it also implies serious repercussions for Canadian ports. Port alterations would be necessary in order to accommodate the broader beamed container vessels (like APL's recent order), and increased stacking height of containers on deck. Increased container cargo loads means larger land storage areas and the need for greater port handling efficiencies.

The amount of container and schedule liner traffic through Canadian ports may also be effected by the current legislative initiatives proposed by the Canadian government. Mr. G. Hasse, President of ACL Canada Inc., recently argued that certain aspects of the proposed "Shipping Conference Exemption Act" - Bill C122, were

more punative and onerous on both the conference and non-conference carriers than the 1984 U.S. Shipping Act (6). Consequently, the two conferences presently serving East Coast ports may find it advantageous to pick up Canadian cargo diverted to U.S. ports rather than calling on the Canadian ports.

Free trade with the U.S. may both benefit and penalize Maritime ports. Relaxed cabotage restrictions as a result of a free trade agreement, may offer increased opportunities for coastal trade of Canadian goods to various U.S. ports. However, free trade may enable Canadian railways to redirect containers destined to Maritime ports to the closer U.S. ports (particularly if Maritime freight rates subsidies are altered). Container routing to the U.S. could drastically reduce container volume via Halifax and Saint John and reinforce the obvious emergence of New York as the eastern North American load center port. (7)

Significant shifts in marketing port services will be required to maintain and increase trade volumes through the ports of Halifax and Saint John. The future of these ports are tied to many factors in their operating environment which are beyond their control. Technological advancements, freight system characteristics and innovative concepts must be assessed when focusing on the development of transport policies and strategies which will keep Canada competitive in world trade.

The dynamic characteristics of the industry necessitates the need to develop transportation system components which are flexible and time responsive in order to react and adjust to new and different situations. Technological change will clearly be one of the most critical forces guiding the industry. It is essential that the government foster technological innovation in transportation if Canada is to remain a successful trading nation.

5.0 EMERGING TRENDS IN TRANSPORTATION LOGISTICS AND DISTRIBUTION

Companies involved in marketing products in another country are faced with several choices both in terms of marketing and transportation of the finished goods to the other countries. A company may market its product through an agent, distributor or sales subsidiary.

Essentially, the product can be distributed through one of three generic physical distribution systems.

(8:12) Products can be sent to warenouses in the foreign country and stored there until they are ordered by customers. Alternatively, they can be sent directly from the domestic plant to the customer warehouse in the foreign country without the intervention of a subsidiary or distributor. Products might also be shipped to the warehouse of a subsidiary or distrubution after receipt of an order from a customer. The choice of strategy is dependent upon the value of the product and the characteristics of the market place.

The rate of change in the industry has increased because of the deregulation movement. Transport and trade policies can significantly alter the physical distribution strategy of producers. Carriers are more than ever having to develop innovative service/price options in order to fulfill the needs and desires of the shipper and remain competitive in the dynamic environment.

Service/price competition tends to direct the firms toward the formation of transportation conglomerates which can offer multi-modal services within the same company. (9:172) These so-called transportation "supermarkets" will be able to offer shippers "one-stop shopping" for all their transportation needs. Obviously, a truly integrated intermodal transportation system would provide the company with a competitive advantage over other firms adhering to traditional system structures. It also means that shippers could become less influential in terms of how goods actually move from origin to destination.

A new trade policy could also induce changes in manufacturing policies and strategies of companies involved in international business. The Autopact Agreement is an example of the impact of a change associated with trade policy formulation on a manufacturing strategy. The establishment of similar agreements will influence not only the kinds of goods that flow across the Canada/U.S. border but also the volume and routing of those flows. Accordingly, many new transportation markets which heretofore have been non-existent could emerge simply as a result of a change in trade policy.

One emerging approach to manufacturing activity is the concept of "just-in-time" inventory. Under this approach, manufacturing firms hold the minimum amount of inventory possible, thereby reducing their costs. At the same time this approach increases their dependence on the transportation system. The concept of the reliability of a transportation service is usually

defined as the dispersion (measured in terms of time) around the average delivery time. A firm practicing the just-in-time inventory approach seeks to maximize reliability or, in other words, to minimize the dispersion. This is most easily done in regions where there is considerable quality-of-service competiton among competing carriers and where distances are relatively short. An increase in the use of this inventory method will increase the difficulty of attracting manufacturing firms to the peripheral areas of the country, including the Atlantic Provinces.

6.0 TRANSPORTATION AND REGIONAL DEVELOPMENT

The linkage between transportation and regional economic development has been a carefully guarded tenet of transport policy in Atlantic Canada. The region has a fragile economy which is extremely sensitive to government policy initiatives. This concern was raised during the "Freedom to Move" debate and is destined for consideration during the Free Trade negotiations.

Regional development policies inevitably involve government subsidies which can be regarded as unfair competition in the eyes of the Americans. Retalitory measures by the United States could be implemented in the form of countervailing duties. The simultaneous existence of regional development and trade agreement policies necessitates the need for open policy discussion during the course of Canada/U.S. trade negotiations.

Transportation has traditionally been a major component in most initiatives taken towards regional development in the Atlantic Provinces. The American government has been successful at fostering regional development by providing developmental assistance for new products through, such mechanisms as defense contracting. This mechanism has a direct flow through the U.S. transportation system. These actions are (presumably) regarded as being fair because they are covert rather than overt, and ostensibly operated through the market mechanisms. The tasks of resolving the various issues is complicated since the mechanism employed in providing the assistance is more important than is the fact that assistance is provided.

The role of transportation in regional development could well be viewed as a subsidy issue placing real pressures on such support areas as the Maritime Freight Rates Assistance program. Direct subsidies (MFRA and ARFAA), monetary payments from government to a shipper or carrier, could be considered as irritants in the

trade negotiations by the Americans.

Indirect subsidies are derived from the alleged failure on the part of the federal and provincal governments to recover the full costs of those transportation facilities which they have provided. The main beneficiary of this suboptimal pricing is the trucking industry and, of course, shippers using this mode of transport. Other beneficiaries include the airlines, shipping lines and bus lines because of the failure to recover the full costs of their respective infrastructures. The implication is that the user fees charged all these users should be increased to the point where full costs are recoverd. Indeed, the new proposed legislation will move the industry towards a more equitable operating environment.

A recent American document, Highway Cost Allocation Study, found that truckers were not paying their fair share of the highway system costs. The feeling in the U.S. is that the trucking industry should bear a larger fraction of the costs involved, the justification being that the trucks cause a large proportion of the damage to the highway system. This position follows from research which demonstrates that the relationship between damage to the highway and gross vehicle weight is nonlinear. However, as the trucking industry has pointed out, there are technical flaws in the methodology employed in making the cost estimates. More important, however, is the fact that, despite the depth of the study, only about half of the total highway costs could be assigned to the highway users, leaving half as an unexplained residual to be allocated to various classes of user through some arbitrary allocation formula.

The technical problems with the study aside, it does appear as though there will be increased user fees in the United States, and that these will bear heavily upon the trucking industry. If free trade in transborder trucking is one of the components of the Canada-United States agreements, there are implications for the structure of user fees in Canada, particularly those user fees which are not variable with distance. Motor carrier license and motor vehicle registration fees would be two examples. In essence, Canada could be forced to adopt the U.S. approach to motor carrier taxation as a consequence of the new trade arrangements. At the minimum, it appears that we would have to demonstrate that our cost-recovery percentages were not significantly at odds with those south of the border.

The issue, once again, is the question of whether

Canada can have a regional development policy which is independent of that of the United States, a policy which is designed to meet the peculiar needs of the Canadian economy. With respect to publicly provided infrastructure, there are three levels of taxing jurisdiction, each having various responsibilities for investment and operations. Each will, presumably, establish the fraction of total economic cost recovery at a level which is appropriate for its own situation. Where this is less than total cost recovery, an indirect subsidy results. The extent to which such a hidden subsidy alters the ability of competing production points to enter any given market needs to be explored.

7.0 SUMMARY

This paper has raised issues which are emerging from the interaction of changes in transport regulatory policy, Canada/U.S. trade policy, technological advances and emerging trends in transportation logistics and distribution concepts. The issues discussed provide ample evidence of the need for further study in several areas that appropriate strategies can be developed as the trade discussions evolve. Suggested key research topics include:

1. American negotiation concerns with respect to Canada's approach to deregulation as well as financing of the transportation system;

2. Resolution of the reciporacity issues associated with transborder trucking services;

3. The potential impacts of an "open border" policy on the operational, service and traffic flow aspects of the trucking industry;

4. Establishment of an appropriate foreign investment policy for the transport sector;

5. Implications of technological change on the transportation modes and facilities;

6. The effects of trade diversion on marine shipping activities;

7. Development of an appropriate data collection framework; and

The research areas listed above are not mutually exclusive and are by no means exhaustive. They are intended to serve as a general guideline for possible

areas of future study. Many of the topics are national in scope. However, many of them are also conducive to examination from a Atlantic Provinces perspective.

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Transborder Trucking Between Ontario and the U.S.: An Assessment of Recent Trends

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1. Introduction

Transborder trucking markets between Ontario and the U.S. have undergone significant changes in the last few years. The volume of traffic increased considerably as a result of not only increasing trade between the two countries, but also increasing share of the truck mode at the expense of rail. In the early 1980's, transborder truck traffic grew despite the severe economic recession. At the same time, competition in transborder markets intensified significantly with the entry of new carriers. By virtually deregulating entry, the 1980 Motor Carrier Act allowed Ontario based carriers to expand their operations into the U.S. Although U.S. carriers still faced regulatory barriers, a number of large ones gained access into Ontario.

The purpose of this paper is to examine the balance between American and Canadian carriers in transborder trucking markets between Ontario and the U.S. The analysis draws on available statistical sources as well as other market information to decipher market trends between 1979 and 1984. Although statistical information is limited, there appears sufficient evidence to suggest that Canadian carriers have been increasing their market share. This can largely be attributed to the fact that they have enjoyed free access into the U.S. while the entry of their American counterparts into Ontario has been inhibited by continued entry regulation. This situation will naturally change as Ontario further liberalizes entry standards and eventually adopts a "fit, willing and able" test. This paper attempts to assess prospects for Canadian carriers under an "open border" policy which will come about when entry barriers are removed in Ontario.

2. Volume of Transborder Trade

Between 1979 and 1984, volume of merchandise trade between Canada and the U.S. increased from $90 billion to $154 billion, while Ontario's share of this total increased from 57% to 64% (1). In constant dollars, Ontario exports increased by 50% and imports by 7%, yielding a 24% increase in the value of merchandise trade. Based on Statistics Canada data it is estimated that in 1984 66% of Ontario's exports and 75% of its imports moved by road representing $69 billion of merchandise transported by truck.

Although it is evident from trade statistics that a substantial volume of merchandise is moved by road, it is difficult to translate these volumes measured in value to actual trucking activity across the border. A recent study (2) attempted to convert Statistics Canada data on value to volume in tonnage, based on weight to value ratios derived from the U.S. census data (Commodity Transportation Survey of the Census of Transportation). Preliminary results indicate that in 1984, 20 million tonnes of merchandise were transported by truck across the U.S.–Ontario border. This estimate excludes unprocessed agricultural, seafood and mine products since there were no data on these commodities from the U.S. census which surveys only manufacturing establishments.

In 1977, Ontario Ministry of Transportation and Communications (MTC) surveyed international truck traffic based on a sample of customs documents, which also constitute the source for international trade statistics published by Statistics Canada. The survey results suggest that 14.5 million tons of merchandise was transported by truck that year between Ontario and the U.S. Imports represented 7.6 million tonnes, exports 5.7 million tonnes and transit movements the remaining 1.2 million tonnes (3).

In 1983, MTC conducted a roadside survey which covered international border crossings yielding results comparable to the 1977 study (4). Expanding on the 24-hour period covered by the survey, annual truck traffic across the international border is estimated at 36.6 million tonnes. This would represent a 2.5 fold increase from 1977, which appears unreasonable. The increase in the number of truck movements is about 19%, which can be confirmed from an independent source (5). The bulk of the increase in estimated tonnage appears to be due to a dramatic increase in average payload from 6 tons to more than 12 tons per truck. Average pay load probably did increase over this period, but not more than what would support an annual volume of about 20–25 million tonnes in 1983. The median of this range (i.e. 22.5 million tons) would represent a 50% growth rate from 1977, which could be explained as the combined effect of a 20% increase in truck movements and a 25% increase in average payload.

The period of particular concern in this paper is between 1979 and 1984, corresponding to the year prior to the Motor Carrier Act in the U.S. and the last year for which Canadian statistics are available. Based on the 1977 MTC study (15 million tonnes) and the adjusted 1983 survey results (22.5 million tonnes), the 1979 traffic volume can be estimated by intrapolation at 18 million tonnes, and the 1984 volume by extrapolation at 24 million tonnes. This one-third increase also corresponds to the estimated growth rate in the truck share of transborder merchandise trade, in constant dollars from $34 billion in 1979 to $45 billion in 1984 (as previously noted $69 billion in current dollars).

3. Canadian Carrier Revenues

In 1984, Statistics Canada reported $865 million of revenue earned from transborder operations (i.e. international revenue) by carriers domiciled in Canada (6). Of this total, $514 million was reported in Ontario, representing about one-fifth of total trucking operating revenues reported in the province and more than one-third of the revenues reported by those carriers engaged in transborder activities. Clearly, Ontario accounts for a large share of total transborder activity across the country, and transborder traffic constitutes a significant source of revenue for the Province's trucking industry. In the last few years, Canadian domiciled carriers' international revenues have been increasing rapidly (see Exhibit I). For the country as a whole, international revenues increased from $473 million in

Exhibit I

Carrier Revenue - Trade Volume Comparisons

	1979	1984	1984/1979
Canada			
Domestic Revenue (million $)			
(1) current dollars	4193	5874	1.40
(2) constant dollars	4193	3864	0.92
International Revenue (million $)			
(1)	473	865	1.83
(2)	473	569	1.20
Trade by Truck (billion $)			
(1)	45	85	1.88
(2)	45	55	1.22
International Revenue/Trade	1.05	1.02	0.97
Ontario			
Domestic Revenue (million $)			
(1)	1416	2255	1.59
(2)	1416	1483	1.05
International Revenue (million $)			
(1)	295	514	1.74
(2)	295	338	1.15
Trade by Truck (billion $)			
(1)	34	69	2.03
(2)	34	45	1.33
International Revenue/Trade	0.87	0.74	0.85

1979 to $865 million in 1984, an increase of 83%. In Ontario, international revenues increased by 74%, from $294 million in 1979 to $524 million in 1984.

Part of this increase was naturally due to inflation; growth rates in constant dollars are about 20% for Canada as a whole and 15% for Ontario. It is evident, nevertheless, that international revenues have been growing much more rapidly than domestic revenues, which in constant dollars increased by only 5% in Ontario and actually declined by 8% at the national level. These differentials are not surprising given that international trade between U.S. and Canada has been expanding much more rapidly than domestic economic activity. Moreover, the share of international freight transported by road has also been increasing from an estimated 50% to 55% of the national total and from 65% to 70% of the provincial total. Based on these trends, it can be estimated that the value of international trade by truck increased by about 22% at the national level, and as noted earlier in this paper, by about 33% at the provincial level.

Thus, the volume of merchandise trade has been expanding more rapidly than the revenues earned by Canadian carriers from transporting that merchandise. This is particularly evident in Ontario where the increase in international revenue is only 15% compared to the 33% increase in the volume of trade by truck. This can be explained one of two ways; either Canadian carriers have been handling a declining share of the transborder trade, (i.e. losing market share to American carriers), or rates have been declining. In other words, if truck transportation costs per tonne remained constant, the revenue trend could only be explained by a lower share of transborder trucking for Canadian carriers than before. In order for the Canadian carriers' share to have remained constant or actually increased, transportation costs had to decrease. For example, for the Canadian share to remain at 50%, carrier revenue per tonne had to decrease by 12% in constant dollars. A greater decline in average revenue would obviously indicate an actual shift in favor of Canadian carriers; a 20% decline would be consistent with a 5% shift (from 50–55%), 30% decline with a 10% shift (from 45–55%).

Although it is difficult to monitor rate levels over time, market trends show that rates have generally been declining in real terms (i.e. in constant dollars). It is evident that, as a result of eased entry in Ontario and deregulation in the U.S., transborder markets have become more competitive with the entry of new carriers. Between 1980 and 1983, for example, average truckload revenues (per CWT) through the Niagara Frontier Tariff Bureau (NFTB), increased by 3% in U.S. dollars. Extrapolating over 5 years and taking into account the effect of the declining exchange rate, this trend would suggest a 20% increase in transborder rates from 1979 to 1984. In constant dollars, this actually represents a decline of about 20% which, in turn, would be consistent with a 5% shift in market share in favor of Canadian carriers. The overall decline in average revenue (thus the shift in favor of Canadian carriers) was probably even greater than what the NFTB data suggest, since, as discussed later, much of the growth in transborder traffic has occurred outside the NFTB frame where rates tend to be lower.

4. Balance Between Canadian and U.S. Carriers

In order to assess the balance of transborder traffic handled by the two countries' carriers, international revenues earned by U.S. domiciled carriers must be estimated in a manner consistent with international revenue reported in Canada. Although general statistical sources in the U.S. provide more detailed (carrier specific) revenue and other operating data on the trucking industry, it is not possible to isolate carriers' transborder activity from the information they report on all their operations; thus, there is no comparable source to Statistics Canada on "international revenue". It is, nevertheless, possible to generate estimates of American carrier activity across the U.S.-Ontario border by drawing on data reported by the Niagara Frontier Tariff Bureau (NFTB). The main problem with this source is that not all carriers operate through the tariff bureau and, for this reason, it is difficult to account for the transborder activities of other carriers.

The NFTB conducts the Continuing Traffic Study (CTS) based on waybill samples from all the reporting carriers. This study captures total through revenue derived from international traffic from point of shipment to final destination. It includes the revenues of both American and Canadian carriers from traffic handled both on a singleline and interline basis. The sampling procedure allows revenues to be classified by type of traffic (e.g. LTL and TL) and origin-destination (e.g. southbound and northbound) separately for any group of carriers (e.g. Canadian and U.S.). Thus, the data permit fairly detailed analysis of traffic flows and revenue patterns, but only for those carriers reporting to the NFTB (7).

In 1979, the CTS accounted for a total of $550 million (U.S. $462 million) in international revenue. Canadian carriers represented approximately 45% of this total or $250 million, compared with $295 million reported to Statistics Canada. Before these two figures can be compared, however, the latter must be adjusted to include carriers domiciled outside Ontario (in Quebec or the U.S.) but engaged in Ontario-U.S. transborder activity. In 1979, it is estimated that the international operations of these carriers represented $75-$100 million that would not have been included in revenue reported to Statistics Canada in Ontario (8). Thus, total international revenue earned by Canadian carriers that year was probably in the range of $375-$400 million, $250 million of which was earned by NFTB carriers, leaving an estimated $125-$150 million outside the CTS domain.

American carriers represented 55% of total international through revenue captured by the CTS in 1979. In the absence of a data source comparable to Statistics Canada, however, it is more difficult to determine the additional revenues earned by non-NFTB carriers in the U.S. The only way to estimate the share of these carriers is to subtract the revenue for all Canadian carriers and those U.S. carriers reporting to NFTB from the total transborder revenue.

As estimated earlier in this report, the total volume of transborder truck traffic in 1979 was about 18 million tonnes; it is estimated that 50% of this total was handled by for-hire carriers. The CTS accounted for 4.5 million tonnes, leaving 4.5 tonnes that must have been handled by carriers outside the NFTB frame. The average NFTB revenue during that period was about

$120 per tonne, $330 per tonne of LTL and $85 per tonne of TL. Traffic handled by non-NFTB carriers tends to move at lower rates in mostly truckloads. Compared to the NFTB average, a reasonable estimate for these carriers would be about $65 per tonne, yielding approximately $300 million in revenue from the estimated traffic base of 4.5 million tonnes. Since the Canadian share of this total is estimated at $125-$150 million, the share of non-NFTB carriers based in the U.S. would have been in the range of $150-$175 million.

In 1984, the CTS accounted for less traffic (about 3.5 million tonnes) but $600 million of through revenue (9). The Canadian carriers' revenue remained the same at about $250 million, but their share decreased from 45% to 40% of the total. As noted earlier, total international revenue reported to Statistics Canada that year was $514 million, which again, must be adjusted to include carriers reporting Ontario-U.S. transborder revenue outside Ontario. Moreover, some allowance also must be made for small carriers, since Statistics Canada data tend to underestimate the revenues of these carriers which, in 1984, had begun to play a more notable role in transborder trucking activity. Taking both these factors into account, total international revenue earned by Canadian carriers in 1984 was probably in the $600-$625 million range (10). This leaves $350-$375 million of transborder revenue to Canadian carriers outside the NFTB frame, clearly a very large increase from 1979.

The U.S. carriers' share of NFTB through revenue in 1984 was $350 million. The share of non-NFTB carriers can again only be estimated based on the residual from total transborder revenue. Assuming that average revenue per tonne for these carriers increased to $70, the 8.5 million tonnes of traffic (i.e. the estimated for-hire total of $12 million less 3.5 million tonnes handled by NFTB) would represent approximately $600 million in revenue. Subtracting the Canadian share of this total, it appears that revenue earned by non-NFTB carriers in the U.S. increased to the $225-$250 million range which, of course, is more modest than the growth experienced by non-NFTB carriers in Canada.

Based on these rough estimates, it appears that Canadian carriers' share of transborder revenue did indeed increase from about 44%-47% to 50%-52% (see Exhibit 2). This is consistent with the 5%-10% shift estimated earlier based on carrier revenue to trade volume comparisons, with truck rates in constant dollars declining by about 20%-30%. This shift appears mainly due to the increased transborder activities of carriers that remain outside the NFTB frame. The U.S. carriers operating outside the NFTB seem to have experienced more modest growth than their Canadian counterparts.

These observations, are of course, consistent with the fact that since 1980 Canadian carriers have been permitted to penetrate the U.S. American carriers, on the other hand, continued to face regulatory barriers in Canada with the result that only a few have been able to enter transborder markets to take advantage of increased trade between the two countries. As the NFTB data show, those already in the market have been able to increase their revenue. Increasing Canadian participation in transborder operations is also consistent with the fact that there has been faster

Exhibit 2

Balance Between Canadian and U.S. Carriers

	1979	1984
Canadian Carrier Revenue (million $)		
NFTB	250	250
Other	125-150	350-375
Total	375-400	600-625
U.S. Carrier Revenue (million $)		
NFTB	300	350
Other	150-175	225-250
Total	450-475	575-600
Total International Revenue (million $)	850	1200
% NFTB	65	50
% Other	35	50
% Canadian	44-47	50-52
% U.S.	53-56	47-50

growth in exports from Ontario, which Ontario based carriers can capture more easily.

It should be noted that the estimates derived above are based on through revenues which represent total revenue associated with transborder shipments from point of shipment to final destination . Given that shipping distances are longer on the U.S. side of the border, a larger share of transborder revenue is likely to be earned in the U.S. than in Canada. Thus, a balance between the revenues of U.S. and Canadian carriers would in fact imply that the latter earn more revenue travelling the the U.S. than the former do in Canada. In other words, Canadian carriers, in all likelihood, travel more and pay more fuel taxes in the U.S. than their share of total transborder through revenue would suggest.

Moreover, a balance in through revenue between Canadian and U.S. carriers does not imply a corresponding balance between U.S. and Canadian registered vehicles crossing the international boundary. In fact, vehicle counts across the border show that Canadian registered vehicles outnumber American registered vehicles. This is consistent with the fact that most interlining activity between Canadian and U.S. carriers takes place in the U.S. border cities of Detroit and Buffalo; thus more Canadian vehicles cross the border, but only to pick up or deliver shipments at a nearby terminal.

5. Assessment of Market Trends

It is clear from the evidence presented above that transborder traffic increased significantly between 1979 and 1984. Although, at the same time, rates have declined in constant dollars, total carrier revenues still increased considerably over this period. It also appears that Canadian carriers have increased their market share. In order to understand the future implications of this trend, carrier revenues must be examined in more detail to identify those market segments where Canadian carriers appear to have made the most significant gains. Again, the NFTB is the most useful source for examining revenue patterns in more detail. Although the NFTB's share of total transborder traffic has been declining (from an estimated 65% to 50%), trends within the NFTB framework are still helpful for understanding overall market shifts.

As shown in Exhibit 3, in 1979 NFTB carriers derived almost 60% of their revenue from truckload traffic, but by 1984, truckload revenue had declined by $80 million to about 40% of the total. This represented a significant loss of traffic, estimated by the Bureau at around 1.1 million tonnes. Truckload markets came under intense competition over this period; rate increases were curbed but average revenue per tonne still appears to have increased from $84 tonne to $89 per tonne.

The loss of truckload traffic by general freight carriers in the U.S. was not unique to transborder markets. Soon after the 1980 Motor Carrier Act, these carriers lost about one-half of their truckload traffic base to small entrants who flooded the industry once entry was deregulated. Burdened with terminal costs and high wage rates, general freight carriers were at a considerable cost disadvantage compared with independent operators; they simply could not handle truckload traffic at competitive rates within their high network cost structure.

In Canada, the process of change has been much more gradual with entry barriers for small entrants being relaxed over the last decade or more. Moreover, the lack of rate regulation has encouraged more competition than in the U.S. prior to deregulation. This gradual process has helped Canadian carriers confront the competitive challenge in truckload markets. All large general freight carriers have established separate truckload divisions using owner-operators, and have channelled their truckload traffic to these lower cost operations with only minor losses to smaller independent carriers. At the same time, large independent carriers emerged handling large volumes of truckload traffic without being burdened with terminal network costs.

Exhibit 3

Distribution of NFTB Revenue, 1979-1984

	1979	1984	1984/1979
LTL			
Canadian	105	135	1.29
U.S.	125	225	1.80
Total	230	360	1.57
TL			
Canadian	145	115	0.79
U.S.	175	125	0.71
Total	320	240	0.75
All Traffic			
Canadian	250	250	1.00
U.S.	300	350	1.17
Total	550	600	1.09

Conditions in the U.S., on the other hand, inhibited the establishment of truckload divisions owned by general freight carriers; large carriers still face a great deal of union resistance to the use of owner-operators and establishment of "double-breasted" operations. Some independent truckload carriers (e.g. J.B. Hunt, Builders) have been expanding their operations gaining some of the traffic captured by small operators, but this is only a newly emerging trend.

The shifts in transborder markets are more akin to the Canadian trend than the post-deregulation experience in the U.S. Large general freight carriers within the NFTB frame have lost substantial truckload traffic, but a large share of this has been captured by the truckload divisions of the same carriers (Servall of Kingsway, Trojan of TNT, TransCanada of Intercity, Algocen of Thibodeau-Finch and Highland of CP), as well as other large truckload carriers (e.g. Frederick and Laidlaw). Continuing entry regulation in Canada might have inhibited an influx of small American carriers into transborder markets, but in any event, such carriers would not have posed a serious competitive threat to the already established, large truckload operations.

In contrast to their performance in truckload markets, the NFTB carriers enjoyed considerable growth in their LTL revenue, from $230 million in 1979 to $360 million in 1984. There was some increase in traffic volume (from about 0.7 million tons to 0.8 million tons), while at the same time, average revenue increased by about one-third (from about $330 per tonne to $440 per tonne). This rate of increase was considerably below the U.S. national average over this period of more than 50% in U.S. dollars which, due to the declining exchange rate translates to a 75% increase in Canadian dollars. In general, average transborder revenues has been higher than the national average, but under increased competition in transborder markets, revenue differentials appear to have narrowed (11).

There is considerable evidence that between 1979 and 1984 LTL traffic has also grown outside the NFTB frame. Small carriers have taken advantage of freight forwarding activity, as well as of new interlining opportunities with U.S. carriers who could not gain direct access to southern Ontario markets because of regulatory barriers. Some of the larger carriers operating outside the NFTB have also experienced significant growth in transborder general freight traffic (e.g. Central-McKinley, Glengarry, Stockwell), as well as in automotive parts (e.g. Canada Transport, Thompson, Central-McKinley). In addition, there have been a number of new entrants (e.g. Challenger, Concord, Dawson), handling a mix of truckload and LTL traffic in transborder markets.

There are also some American carriers outside the NFTB frame that have enjoyed significant growth in their transborder operations. St. Johnsbury, a large regional carrier, gained direct access into the Toronto area, while others enjoyed growth in transborder volumes to Buffalo or Detroit where they interline with authorized Canadian carriers. As in truckload markets, Canadian carriers appear to have captured a larger share of the non-NFTB traffic than their American counterparts. In contrast to truckload, however, the Canadian carriers lost market share within the NFTB frame, from 46% in 1979 to 37% in 1984. Since NFTB still represents a substantial share of LTL revenue (non NFTB carriers generate at the most $100 million in LTL revenue), despite the relative shift in favor of Canadian carriers outside the NFTB frame, American carriers appear to have increased their share of total through revenue from transborder LTL traffic.

6. Future Prospects

It is evident that Canadian carriers have been very successful in transborder markets gaining market share at the expense of their American counterparts. New Canadian carriers have been able to establish themselves in transborder markets, while others with existing transborder authorities have achieved significant gains in truckload markets. Most of these carriers are no doubt among the most efficient in the province and have been very effective in their aggressive marketing strategies, but their success cannot be totally divorced from the regulatory differences that gave them free access to the U.S. while restricting entry of their U.S. competitors to the Ontario markets. The key question is, therefore, whether Canadian carriers will be able to sustain their success once regulatory entry barriers are removed in Ontario. In order to address this

question, it is essential to understand the "geography" of transborder markets.

Although information on the spatial distribution of transborder commodity flows is still scarce, general patterns can nevertheless be deciphered from a number of different sources (see Exhibit 4). Using Trade Statistics on value of goods, a recent study grouped U.S. census regions (which constitute the basic geographical unit in the compilation of both export and import flows) into short haul, medium haul and long haul markets (12).

Exhibits 4

Distribution of Traffic by Distance

	Import	Export	Total
Value of Goods [1]			
Short haul	73.8	81.9	78.0
Medium haul	14.4	10.7	12.5
Long haul	11.8	7.4	9.5
Total	100.0	100.0	100.0
Tonnage [2]			
Short haul	77.2	84.1	80.2
Medium haul	18.7	14.4	16.8
Long haul	4.1	1.5	3.0
Total	100.0	100.0	100.0
Mileage [3]			
Short haul	49.1	61.7	54.7
Medium haul	25.1	21.8	23.7
Long haul	25.8	16.5	21.6
Total	100.0	100.0	100.0

1. Source: G. Chow, op. cit.
2. Source: 1977 MTC Survey
3. Based on the average of the above distributions, and average shipping distances of 300 miles for shorthaul, 700 miles for medium haul and 1500 miles for longhaul

The short haul category including all the major Northeastern markets within 500–600 mile radius of Toronto, accounted for 78% of total transborder trade by road. The medium haul markets, including states within roughly 600–1000 miles of Toronto (such as Virginia, North Carolina, Tennessee, Missouri and Minnesota), accounted for 12.5% of the total, and the remaining states classified as long haul another 9.5%. This pattern is also confirmed by the tonnage flows estimated in the 1977 Ontario survey. Those states falling into the same short haul definition accounted for 80% of the total tonnage. The medium haul share is larger than that based on value of goods, mainly because it also includes Southern Atlantic states of Florida, Georgia and South Carolina, which are classified as long haul in the distribution of value.

These distributions, however, understate the significance of medium and long haul shipments from a transportation standpoint; if the distance effect is taken into account, these markets would clearly represent a larger share of the total. Assuming an average distance of 300 miles for short haul, 700 miles for medium haul, and 1500 miles for long haul, short haul market share would be about 50% for imports and about 60% for exports. This distribution yields an average shipping distance (per ton) of about 500 miles.

Based on the 1977 MTC survey results, the distribution of international traffic within Ontario can be examined in more detail (see Exhibit 5). Southwest Ontario clearly accounts for a large share of international trade, 84% of exports and 73% of imports. Within this region, Toronto accounts for almost 40% of imports and 20% of exports. It is evident from this distribution that settlement patterns in Ontario are such that a large share of international traffic is generated from, or destined to, major centres within a short distance of the border. Traffic patterns in the U.S. revealed by the previous exhibit, on the other hand, are much more dispersed, involving significantly longer shipping distances from the border. The average shipping distance on the Canadian side of the border appears to be about 100 miles; based on the average of 500 miles, the U.S. portion appears to be four times greater.

These differences in origin–destination patterns have a direct bearing on carriers' ability to handle transborder traffic from either side of the border. Due to more concentrated traffic patterns within a short distance of the border, Ontario markets are much more accessible to U.S.–based carriers than the U.S. markets are to Canadian–based carriers. From terminal operations at border points, and with a few key facilities in major centres, U.S.–based carriers can handle a substantial share of international traffic destined to or originating from Ontario. With a similar effort, Canadian–based carriers command a much smaller share of the U.S. markets, simply because there is less transborder traffic within the distance range that the Canadian–based carriers can reach.

In LTL operations, carriers must provide terminal facilities in areas which they serve directly (i.e., with singleline service), and naturally, terminal operations are only viable where traffic volumes warrant. Canadian carriers command sufficient traffic (both international and domestic) in southern Ontario to retain terminal operations throughout the region. They can

Exhibit 5

Distribution of Traffic in Ontario

	Import	Export	Total
Toronto	19.5	38.8	30.7
Hamilton	12.9	9.5	10.9
Niagara	13.0	5.0	8.4
Windsor	9.6	14.3	12.3
Other	18.3	16.3	17.1
Southwest	73.3	83.9	79.4
East	9.6	7.5	8.4
Central	7.0	6.0	6.5
North	10.1	2.6	5.7
Total	100.0	100.0	100.0

Source: Ontario Ministry of Transportation and Communications, Survey of International Goods Movements by Truck - 1977, Modal Studies Section, Economic Policy Office (Dec., 1979).

extend their networks into the U.S. where traffic densities permit (e.g. New York, Philadelphia, Chicago), but these opportunities are indeed limited. The U.S.-based carriers, on the other hand, can mix international and domestic traffic in their terminals and naturally can provide wider geographical coverage, thus giving them an advantage in reaching distant U.S. destinations. However, Canadian carriers do not have a similar advantage in Ontario since U.S.-based carriers can effectively access most of this market without an extensive network of terminals throughout the province.

In serving LTL markets, therefore, U.S. carriers with wider geographical coverage enjoy a comparative advantage due their ability to provide more extensive singleline service. This is evident from the market trends examined earlier for the period 1979-1984; American carriers increased their share of NFTB revenue from LTL traffic from 54% to 63%. Since 1984, all three large American LTL carriers have expanded their authority into southern Ontario markets; Roadway received approval for the transfer of Harkema authorities, Yellow purchased ICL, and Consolidated Freightways bought the Maislin authorities. The market impacts of these recent developments will soon be felt. As entry barriers are removed, other carriers may also extend their singleline service to major southern Ontario centres (e.g. Carolina, ABF, Overnite).

Since truckload shipments do not generally require terminals, carriers are not constrained as much by their networks or the traffic density they can generate in serving a particular area. On any particular traffic lane, efficiency is largely dictated by their ability to minimize empty backhauls by balancing loads in both directions. This, however, poses a different disadvantage to Canadian-based carriers. Due to customs and immigration restrictions, a vehicle registered in one country and driven by a resident of that country, can carry international traffic to or from any point, but cannot handle domestic traffic on the other side of the border. U.S.-based carriers serving southern Ontario travel much shorter distances from the border to their destination. If they cannot find return international traffic, they can return to the border empty and draw on domestic traffic for the remainder of their trip. Canadian-based carriers, on the other hand, must travel much longer distances into the U.S., and cannot draw on domestic traffic on this longer portion of the trip.

Canadian truckload carriers have been successful in increasing their transborder traffic by employing more U.S.-based drivers and vehicles in order to overcome their balancing problems. In order to sustain their success, however, these carriers do not have to abandon their Canadian-base altogether. They can still employ Canadian operators on traffic lanes where they can generate sufficient backhaul with transborder shipments. In order to penetrate further into the U.S., where backhaul opportunities are limited and cannot be relied upon on a regular basis, they will have to employ more U.S. operators. These operators may come directly into Canadian terminals or interline with Canadian equipment at the border.

As long as Canadian truckload carriers remain efficient and preserve the necessary balance between the equipment on either side of the border, they will continue to be successful in transborder operations. Once entry is deregulated, they may naturally face a competitive challenge from efficient truckload carriers in the U.S. and may, as a result, lose some market share. In contrast to the LTL business, however, carriers in strictly truckload operations are not necessarily disadvantaged by "geography", as long as they retain the flexibility to employ a sufficient number of U.S.-based operators for balancing purposes.

ENDNOTES:

1. Statistics Canada, Merchandise Trade, Catalogue Nos. 65-201 and 65-202.

2. See Garland Chow, Statistical Profile of the Ontario-U.S. Transborder Trade and the Role of Trucking, Draft Report submitted to Consumer and Corpoate Affairs Canada.

3. Ontario Ministry of Transportation and Communication, Survey of International Goods Movement by Truck-1987 Modal Studies Section, Economic Policy Office (December 1979).

4. Ontario Ministry of Transportation and Communications, Ontario Commercial Vehicle Survey, 1983. Policy Planning Branch (June 1984).

5. Statistics Canada, Travel Between Canada and Other Countries, Cat. No. 66-001.

6. Statistics Canada, Motor Carriers-Freight and Household Goods Movers.

7. In 1984, there were 49 American and 7 Canadian carriers participating in the Continuing Traffic Study.

8. Maislin, from its Quebec base and through its U.S. subsidiaries accounted for a significant share of this total.

9. Actual revenue in U.S. dollars declined marginally, but due to changes in the exchange rate, Canadian dollar equivalent increased by about $50 million.

10. By 1984, Maislin had already gone out of business, accounting for as much as $90-100 million of transborder revenue prior to bankruptcy. However, other carriers increased their share and revenue earned and reported in the U.S. by Canadian-based carriers increased.

11. In 1979, average NFT revenue was double the national average, but by 1984 it was 1.5 times the national average.

12. Garland Chow, op. cit.

AND YET ANOTHER MIDDLEMAN . . .

THE OUTLOOK FOR FREIGHT BROKERS AND FULL SERVICE DISTRIBUTION FIRMS IN A RE-REGULATED ENVIRONMENT

During the past five years, CTRF members have witnessed many debates about the merits and the flaws of deregulation. These debates have usually identified winners and losers in a deregulated future. This paper is about two potential winners under re-regulation: an emerging business service -- the full-service distribution firm, and a re-emerging service -- the freight broker.

We came across this emerging trend as a result of several recent consulting assignments for major international manufacturers. This report today is based on these experiences and our observations on the progress of Canadian re-regulation.

A. BACKGROUND

The explosive growth of U.S. freight brokers and arrangers is one of the more significant trends resulting from U.S. re-regulation. Once the scourge of the transport industry, brokers in the U.S. have become a successful and integral part of the industry. Known by several names -- brokers, forwarders, arrangers, NVOCC's -- these companies provide a valuable service to shippers.

Brokers' service offerings have also become much broader. Not only do they offer a full range of transportation services, but they also offer:

Warehousing
Inventory management
Packaging

Order processing
Light manufacturing services.

The transportation services offered today are also broader and are no longer limited to point-to-point shipping. These transportation services include:

- Consolidating small shipments.
- Negotiating confidential contracts.
- Arranging complex movements.
- Providing contract carriage services.

Brokers are now positioning themselves to become full-service distribution firms -- a service firm of the future. Other companies in the public warehousing and international freight forwarding industries are also beginning to position themselves.

In light of these developments, we will examine the development of the U.S. freight brokerage and full-service distribution industries and the opportunities for similar developments in Canada. We will examine such questions as:

- Why use a full-service firm?
- Why have U.S. firms grown so fast and so much?
- What is the outlook for Canadian full-service distribution firms?

B. WHY USE A FULL-SERVICE DISTRIBUTION FIRM?

With the increased attention to global trade, North American free trade and transportation re-regulation, the logistics functions are becoming much more complex. We are already seeing increased specialization in distribution activities as computers and quantitative inventory replenishment models become standard operating practices.

In the future, transportation and inventory management options will become even more involved and complex. To manage these more complex functions, companies are hiring more highly-qualified logistics managers. But we are also seeing the emergence of the full-service distribution firm. These firms can provide a broad range of distribution functions on a contract basis.

You may be asking yourself, why would a company turn over the logistics function to an outside contractor? Are we really at a stage where logistics has become too involved or too complex to be performed effectively in-house? For some companies operating within global markets, contracted logistics is in fact the answer. Domestically, many are doing this today.

Public warehouses are used by many companies to store and ship their goods. Some public warehouses are also providing inventory management and order processing services. Other companies engage freight forwarders to consolidate and transport their goods. In one form or another, contract distribution services are clearly in demand. As the need for integrated services develops, the market for full-service firms will develop.

Here are two examples of the need for full-service firms:

- As manufacturers expand their markets throughout the world, specialized distribution support services are being engaged to assist entry into new markets. Companies offering a full range of distribution services can make market entry much easier.

- In a re-regulated environment, transportation service and pricing options are extensive and often very complex. To take full advantage of these options, shippers need volume for leverage and creativity to innovate. Freight brokers are providing this today.

To date, most contracted services are in two to three specialized areas (e.g. freight brokering, warehousing and forwarding). Increasingly, shippers are beginning to realize the advantage of being able to purchase these services from a single source. Control improves, service level is increased and costs are lower.

Multi-modal mega-carriers in the U.S. and general trading companies in the Far East have grown quickly through this approach to logistics. Mega-carriers offer these services and the trading companies make use of them.

These full-service firms offer a broad range of services. Further, they are capable of customizing service packages to meet specific needs of customers. The range of services are limited only by imagination.

C. WHO ARE THE FREIGHT BROKERS AND HOW HAVE THEY GROWN?

There are over 5,000 freight brokers across North American today. Most of these are in the United States. Freight brokers act as the middleman between the shipper and the carrier. Unlike a freight forwarder, the freight broker does not take ownership of the cargo. Their missions are paid either by the shipper or the carrier. Further, in the U.S., the broker is not held liable for the goods. The broker only arranges for the movement of the goods.

1. U.S. freight brokers

In the United States, the freight broker must be licensed by the Interstate Commerce Commission (ICC). For the most part, the license process is perfunctory. The cost is only $158. For this, a 30-day temporary

authority is immediately granted. If during the first 30 days of operation, the broker demonstrates that he can operate without customer complaints and that a $10,000 surety bond is posted, then a permanent license is granted. With the eventual sunset of the ICC, entry into the industry should be even easier.

U.S. brokers, however, are concerned about the elimination of the ICC. Currently, the ICC protects the broker from liability. With the elimination of the ICC, the broker will have primary responsibility for the cargo and its liability.

In the past five years, the U.S. freight brokerage industry has grown like wildfire. Much of this growth is due to the more open transportation service offerings in the United States. In 1981, brokered freight amounted to about 6% of U.S. domestic service traffic. In 1986, it was estimated that the freight brokered traffic had grown to 20% of U.S. traffic.

Another indicator of U.S. broker industry growth has the exponential growth of the brokers' trade association, the Transportation Brokers Conference of America. Founded in 1978 with fewer than 100 members, the Association now has a membership exceeding 1,300. Continued growth is anticipated. This growth would not have occured at such a rate without transportation deregulation in the early 1980's.

Brokers have succeeded in attracting this new traffic by offering a wide variety of services and offering volume rates to customers. Not only are small shippers using brokers, but many Fortune 500 companies have developed relationships with brokers for all or part of their business. Many of the brokers are experimenting with the full-service distribution concept as a means to attract traffic.

2. Canadian freight brokers

The Canadian freight brokerage business is still in its infancy. Today, it is less than 10 years old. Prior to the mid-70's, only freight forwarding or consolidation services were available.

There are about 40 Canadian freight brokers who specialize in trans-border traffic. Many of these are licensed by the ICC. Some offer domestic Canadian services as well. Overall, the U.S. freight brokerage industry is much more developed than the Canadian industry.

In addition to Canadian brokers offering trans-border services, there are up to 100 brokers offering domestic services only. Many of these brokers are very small companies, typically one or two-man shops, some of which operate as owner/operators as well.

Currently, Canadian law does not recognize the freight broker. They are neither licensed as legal freight carriers nor restricted from acting as brokers. The only stipulation is that they broker freight to licensed common carriers. Since Canadian route authorities are still restricted, the opportunity for broad competition, as in the United States, is limited.

Further, the Canadian trade association, the Transportation Brokers Conference of Canada, is facing growing pains. As a result, effective lobbying for recognition as an industry has been limited. Like all newly-formed entities, it is only a matter of time before a co-ordinated effort is in place to promote freight brokering.

As proposed, the new Ontario trucking legislation will recognize freight brokers by shifting the regulatory focus from control of trucks to control of freight. Although recognition will now be granted to freight brokers, serious concerns about liability are raised. Does this mean the broker, a middleman, must carry full liability coverage for the cargo? Can this liability be passed on to the carrier? And what impact will this increased risk have on the brokerage industry and its potential for growth? In the United States the ICC regulations protect the broker by providing for third-party contingency. This acknowledges the passage of liability from the broker to the carrier.

In Canada, some of the larger brokers are beginning to develop broader service packages. They are developing the concept of a full-service distribution firm. Services such as warehousing, terminal operations, customs brokerage and shipment consolidation are under development. Unfortunately, this far-sightedness and entrepreneurship is only shared by a small handful of brokers. These innovative companies are positioning themselves for the next five to ten years. As U.S. de-regulation experience has taught us, it is the innovators who will profit from de-regulation.

D. WHAT IS THE OUTLOOK FOR CANADIAN FULL-SERVICE DISTRIBUTION FIRMS?

It may take us a little longer to become as significant a player in the marketplace as the U.S. brokers, but the potential is certainly there. A foundation for a strong brokerage industry in Canada is in place. Further, as Canadian de-regulation becomes more realistic, the need for transportation brokers will become accute. Innovative brokers with foresight will begin to see the advantages of expanding services to the full range of distribution requirements.

In fact, the Canadian economic may be more suited than the U.S. economy for full-service distribution firms. These firms can meet the needs of small to medium-sized manufacturers entering the Canadian market.

Both American and overseas manufacturers without a beachhead in Canada, can contract a full-service distribution firm rather than establishing their own operations in Canada. Internationally, firms such as Schenker, Kuehne & Nagel, MSAS and TNT have been actively promoting this concept in markets outside Canada.

Whether it is a foreign branch plant or a homegrown operation that develops a full-service distribution capability in Canada, the market is there. Keep your eyes on this market during the next five to ten years.

ABSTRACT

MANAGING THE CANADA-UNITED STATES TRANSPORTATION RELATIONSHIP

BY

TERRENCE J. CORMIER

The author is an officer of the Canadian Department of External Affairs. The views expressed are solely those of the author.

The Canada-U.S. transportation relationship is the most extensive and dense of any such relationship between two sovereign countries. In addition to providing the means whereby 60 million people cross the border each year, the transportation relationship facilitates the largest bilateral trading relationship in the world. In such a substantial and varied relationship there are a multiplicity of problems which can crop up, either intentionally or inadvertently, to interfere with the smooth operation of the work of truckers, airlines, shipping companies and others engaged in the provision of transportation services between the two countries.

The number of actors who have a stake in the outcomes is tremendous. In addition to agencies of federal, state and provincial governments, there are industry groups such as the Canadian Conference of Motor Transport Administrators and associations such as the American Trucking Assocation. Hundreds of thousands of Canadians earn their livelihood either directly or indirectly through the provision of trans-border transportation services. Somehow the various interests all have to come together if both countries are to ensure that the transportation relationship continues to facilitate commerce and travel.

The importance of efficient and competitive transportation services to the success of Canada's international trade is obvious. The environment in which these services are provided is changing. They are subject not only to changing technology and changing economic forces, but of equal importance, they are

being buffeted by changing political pressures, both domestically and internationally. Growing international economic integration is not simply a concept of theorists in international political economy; it is a reality which the Canadian trucker operating into the United States must face daily. Hopefully, the work of officials will ensure that he is able to profit from the opportunities provided by increasing changes.

This paper examines how the Canada-U.S. transportation relationship is managed in practice. By studying a recent example in the trucking field, the heavy vehicle use tax (HVUT) issue, we identify many of the mechanisms at the disposal of governments in their facilitation of transportation services.

The HVUT is a special U.S. levy assessed against large U.S. rigs because of the alleged extra wear which they cause highways. Up until 1985, only those Canadian carriers deemed to be registered in the U.S. by virtue of their participation in U.S.-based registration plans, i.e. Alberta and British Columbia, had been assessed the tax. In May 1985, the U.S. Internal Revenue Service suspended payment of the tax by Canadian carriers. At the same time, the U.S. Congress mandated a study by the Federal Highway Administration (FHWA) on the implications of the tax for transborder trucking. The Canadian position has been that full liability for the tax to Canadian carriers would be unfair as Canadian carriers use U.S. roads for only a part of their total mileage. The full tax would result in fleet inflexibility and would be a barrier to trade. The FHWA study was to be completed by October 1987.

On January 21, 1987, the Canadian Embassy in Washington learned that there was a move afoot in the U.S. Senate to attach an amendment to the U.S. Highway Funding Bill which would make Canadian carriers liable for 100 percent of the HVUT. Our study traces the official correspondence, diplomatic notes, meetings, including a special meeting of the Canada-U.S. Trucking Consultative Mechanism, contacts with industry groups and lobbying efforts undertaken in an attempt to modify the outcome of this issue. On March 17, 1987, the U.S. Congress decided to impose the HVUT on Canadian operators at the 75 percent level for the indefinite future. This outcome, while not an ideal one for Canada, was clearly significantly better than the 100 percent liability and has the merit of recognizing the special situation of transborder trucking operators.

Our paper attempts to give transportation economists and others concerned with Canada-U.S. transportation issues a first-hand feel for how this relationship is managed. Having explored the history of the HVUT issue we then seek to draw some threads for the future directions of the transportation dimension of Canada's most important foreign relationship. The paper concludes with some suggestions as to the implications this might entail for Canadian providers of transportation services.

STRATEGIC CONSIDERATIONS FOR TRANSPORTATION PLANNING IN A DEREGULATED AND FREE TRADE ENVIRONMENT

BY
Eugene M. Ludwick

Introduction

Hot winds of change are blowing across the transportation landscape; the recently proposed amendments to the National Transportation Act and the Motor Vehicle Transport Act (Bills C-18 and C-19 respectively) and the likelihood that a Canada/U.S. free trade agreement will contain provisions that will vitally affect trade in transportation services are key. Many transportation firms' business planners may feel subject to "information overload" due to speculation about the scope and direction of domestic change and its relationship to the trade dimension.

This paper's intention is to clarify the relationship and in doing so seeks to provide business planners/marketing managers with some strategic considerations that will limit and shape their competitive responses. Speculation on the precise features of a trade in services agreement with the U.S. is not intended other than to show that even in the absence of an agreement, there are strong forces leading to harmonization of the Canadian and American trade and transportation systems. In fact, it is suggested that the act of negotiation can limit the harmonization process. What is intended, however, is to show that the kinds of responses which emerged from the first blush of U.S. deregulation need not be present to the same extent in Canada.

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1. E.M. Ludwick, M.A., M.C.I.T. is President of E.M. LUDWICK & ASSOCIATES INC. a Winnipeg-based transportation management consulting firm. Special thanks to Mr. Andrew B. Klymchuk for his assistance and advice in the preparation of this paper.

Regulatory Reform in the United States

The transportation environment in the United States has undergone major change since the introduction of policies and laws which have largely replaced legal and economic regulation with a reliance upon market forces. Rail transportation was the first of the modes in which it was recognized that the existing regulatory structure appeared inappropriate and partial reform measures began as early as 1974 (3R Act).

As distinct from the financial difficulties of American railroads which necessitated regulatory reform in that industry, the impetus for trucking reform arose from the deregulatory momentum and from the perceived gross inefficiencies and high rates created by restrictions in motor carriers' operating certificates and tariff bureaux (which allowed collective rate making without fear of prosecution under antitrust laws). Analysts and legislators were led to conclude that trucking regulation resulted in substantial waste. After a failed attempt to deregulate trucking in the mid 1970's, the upsurge in oil prices in 1979, with its direct impact on truckers' costs and the ever-increasing recourse to ICC-rubber-stamped rate increases, the passage of the Motor Carrier Act of 1980 was almost inevitable. Its stated aim was to reduce unnecessary regulation by the federal government and its measures intend to eliminate regulatory inefficiences while minimizing disruption to the transportation system. In this regard, specific features include almost complete entry and exit freedom and the prohibition of collective rate making.

In the U.S. airline industry, pre-dereg competition revolved around service, typically the offering of additional capacity. Once again, the rise in energy prices of 1973 had a dramatic effect. With the wage bill being roughly equal to the energy bill in terms of operating costs, deregulation was seen as a means by which labour (and capital to some extent) could absorb the increasing costs. Eliminating the prohibition of discount or promotional (passenger) fares in 1976 and relief from some restrictions on market entry in 1977 led to the Airline Deregulation Act of 1978 which officially permitted comparative pricing freedom, ease of entry and a general reliance on market conditions including the sunsetting of the Civil Aeronautics Board itself.

Regulatory Reform in Canada

In the early 1980's Canadian reaction to changes in the U.S. transportation environment initially followed two streams of thought. Many users of transportation services, especially those involved in transborder trade, who were able to benefit from reduced transportation costs and improved access to competitive

options, were quick to press for similar reforms in Canada. In contrast, carriers (truckers in particular), regulators and some shippers anxious to maintain the status quo were equally quick to point out Canada's uniqueness, the ostensible irrelevance of U.S. legislation to the Canadian scene, and the potential for causing great harm, if not to objectors themselves, to small shippers.

What is the connection between trade in transportation services and regulatory reform? In simplistic terms, significant differences in regulation and prices between two countries can induce trade in transportation services. With U.S. deregulation, occurring at a time of significant excess capacity in the system, prices (in the general sense of the term) fell dramatically in the U.S. Given the fact that over 75% of all Canadian trade is with the U.S. and the fact that some 80% of Canadians live within 100 miles of the border, it became possible to think of tradeable services; that is, the demand for a train journey, or truck journey, could be supplied either by a Canadian or an American carrier. Over time, three sequential effects can be discerned.

First is the "demonstration effect" whereby falling prices in the U.S. raised the expectation that similar savings could become available in Canada. The realization arose that competing American firms in many industries were now enjoying a cost advantage relative to their Canadian counterparts which, depending on the particular commodity, could be significant in determining market share.

The second affect arising from U.S. deregulation was the "diversion effect". (In technical terms, rapid deregulation in the U.S. showed that our regulatory shadow prices were incorrect and because of the economic magnet of the U.S., significant differences in prices on both sides of the border could not be maintained in the absense of subsidies.) The diversion effect took many forms, perhaps the most popular example of which was Canadian air travellers accessing the U.S. air transport system through Burlington, Vermont and Buffalo, New York. More often than not, Canadian carriers were forced to offer services and prices comparable to those available to Americans and in the absence of significant change to the Canadian regulatory system, this meant that both American and Canadian carriers were contravening Canadian law. An example of this was a Canadian Transport Commission investigation on the effects of the Staggers (rail) Act which found that no Canadians were receiving rebates and discounts. In view of the legal implications, the CTC's conclusions though greatly at odds with reality were hardly surprising.

Persistent differences in prices and services gave rise to the "regulatory harmonization effect" which was encouraged by several forces. First, the realization that the U.S. price effects were not to be short-term, coupled with a fundamental shift in the structure of the U.S. transportation industry, meant that Canadian authorities were faced with a policy conudrum -- the currently

illegal behaviour in some sectors brought on by the need to compete had to be legitimized while preserving the identity of Canadian interests. Given the U.S. government's trade stance on "agressive reciprocity" (i.e., opening up the Canadian system to further American entry as part of a general trade thrust) meant that U.S. deregulation carried with it a trade dimension not heretofore considered.

The first mode to undergo regulatory reform in Canada as a matter of policy rather than law (that is, changes in regulations as opposed to legislation) was air transport. For many years crown-owned Air Canada (Trans-Canada Airlines) as a chosen instrument of national policy enjoyed special treatment such as prohibition of competition, first right of refusal on international routes, and automatic approval of license applications. Still a far cry from deregulation, Canadian Pacific Airlines was permitted (in 1959) to compete with Air Canada on a limited basis with the ultimate aim of allowing CP to gradually increase its market share to 25% by 1970. Significant changes to Canadian air transport regulation began with the loosening in 1977, and removal in 1979 of market share restrictions on CP. The year 1977 also saw the removal of the automatic granting of Air Canada's route applications, and the specifically permitted increased use of and removal of regulatory restrictions on the levels of discount fares on domestic routes. Similar measures with regards to discounting on international routes followed in 1979. That year also saw permission granted to charter carriers to apply for any route, with such applications being judged on the basis of competitive considerations rather that service stability considerations. In addition, restrictions such as aircraft size, frequency and number of stops were lifted and carriers were allowed substantial freedom to introduce promotional fares with a minimum of filing notice.

Both intra- and extra-provincial trucking in Canada fell within the jurisdication of the individual provinces and terrritories. Partly in reaction to motor carrier deregulation in the United States, and partly consistent with the vogue of questioning the role and usefulness of government regulation, increased pressure arose for the need to improve the Canadian goods-producing sector's competitiveness as might be achieved by reforming transportation regulation. Despite widely differing approaches to regulatory reform in intraprovincial trucking, in 1985 the territorial, provincial and federal governments signed a Memorandum of Understanding seeking a common approach to regulatory reform in extraprovicial trucking. Specifically agreed measures included: shifting the burden of proof (of public convenience and necessity) from the applicant seeking authority to the respondent seeking to deny authority ("reverse onus"); elimination of legislated but unenforced rate approval requirements; the development of "exempt commodities" common to all jurisdictions for which no public convenience and necessity test would apply; and, several other measures aimed at eventually simplifying entry and fostering competition.

Beyond governing themselves accordingly in a highly competitive environment, Canadian railways continue to operate under the regulatory regime brought into force by the National Trnasportation Act of 1967.

In 1985 the Minister of Transport introduced for discussion a document entitled "Freedom to Move" embodying proposals for a new transportation framework based on the principles of greater reliance on competition and market forces, a reduction of government interference and regulation, and the creation of a regulatory process that is open and accessible. A bill entitled the National Transportation Act, 1986 was introduced in the House of commons for first reading in November 1986, which incorporates the "Freedom to Move" principles and which will, when (if) passed, constitute the next step in airline deregulation, confirm the agreed process for trucking deregulation and inititate regulatory reform in railway transport.

In air transport, entry to any class of domestic commercial air service in Canada will be open to carriers meeting a "fit, willing and able" requirement. It will no longer be necessary for the carrier to establish that its service is required by "public convenience and necessity". Any operator submitting evidence of adequate liability insurance, and in possession of a Department of Transport operating certificate attesting to the adequacy of its equipment and its ability to conduct a safe operation, shall be granted a license. Exit will also be facilitated. Determination of routes and schedules of domestic air carriers will be exempted from regulation, permitting airlines to offer routes and schedules to meet perceived public demand. There will be no ongoing regulation of domestic tariffs, except a review procedure on fare increases, with the power to overturn or reduce excessive increases. Services which are deemed necessary in the public interest, but not provided for under normal market conditions, will be considered eligible for direct public support. Consistent with Canada's obligations under bilateral air agreements, there will be continued regulatory control of market entry to international scheduled services and of international tariffs. However, the Government will pursue reduction of regulations on international routes through bilateral negotiations, such as those ongoing with the United States.

Key features of the Act's rail related articles provide for various ammendments to the Railway Act permitting shippers and carriers to enter into confidential contracts covering domestic and transborder traffic and abolishing collective railway ratemaking. A series of measures are proposed to promote the availability of competitive options for captive shippers including competitive line rates which will give shippers captive to a single railway access to a competing railway through a mandated joint line rate, increased limits for interswitching and, joint terminal running rights. Finally, new procedures are proposed to settle rate

disputes between railways and shippers in a manner which is more expeditions and economical than the currently available measures.

The legislative companion to the new National Transportation Act, the Motor Vehicle Transport Act, 1986 (also introduced in November 1986), confirms the regulatory reform thrusts embodied in the previously mentioned "Memorandum of Understanding".

Marine transport is not subject to economic regulation in Canada. The NTA, 1986 however makes certain provsisions regarding northern marine supply services and other domestic marine matters. Overseas marine transport is subject to the Shipping Conference Exemption Act which allows ocean-going carriers to act collectively to set rates and limit capacity. A new SCEA (introduced in October 1986), while recognizing it is not feasible to eliminate the conference system, seeks to regulate conference operations to produce the greatest benefit to shippers. The new SCEA permits negotiated confidential service contracts and seeks to prohibit predatory conduct by shipping conferences.

Levelling the Transport Playing Field

Because Canada and the United States are each other's and the world's largest trading partners it is logical and reasonable to seek to harmonize the two countries' approaches to an important trade conveyance and facilitation service like transportation. This worthwhile aim takes on even greater significance in circumstances where transportation services are viewed as an item trade unto themselves.

Regulatory reform in Canada is expected to produce benefits to travelling and freight shipping/receiving Canadians along the lines witnessed in the United States. Furthermore the compatibility of the American and Canadian transportation environment expected to evolve with the passage of previously discussed Canadian legislation, is expected will enhance trade by bringing about a more competitive overall North American transportation system and all its attendant benefits like increased choice of service options and lower rates and fares.

As major elements of U.S. regulatory reform legislation were initiated on the eve of a major economic downturn, some observers have attempted to relate the effect on prices and service on the downturn rather than reform. While the effects were clearly complementary, this line of argument is also largely immaterial because the combined effect was to produce irrevocable change. Moreover, the North American economy has turned around (at least on paper) and a restructured American transport industry continues to operate with recession level or, alternatively, competitive prices. In the absence of regulatory reform during the same period, the recession has had similar effects on prices for

transport services in Canada; that is, even without regulatory reform, in 1987, truckers are hauling at 1978 level rates, airlines are "giving away" seats, and many carriers in all modes are losing money. Although many Canadian users of transportation services are anxious for the regulatory reform legislation to pass, they seem to ignore warnings from carriers in all modes that rates/fares have been and are as low as they can go. In other words, Canada has accomplished largely what the United States has accomplished -- a lean competitive transport sector -- even without regulatory reform. Therefore, the major reason (apart from the need to reduce Canadian government expenditures) why regulatory reform legislation is required in Canada is to create an environment where Canadians and Americans view their respective transportation systems as working in harmony and to facilitate the flow of goods and services.

Despite many differences in Canadian and American legislative detail, Canada's national transportation policy statement coincides well with U.S. policy. From the point of view of trade in goods and services, the stated compatibility of policy will give the appearance of equalizing opportunities for each country to carry each others passengers and goods. However, the limited extent of changes embodied in the legislative detail and their potentially distant (i.e., longer term) realization may mean to at least some that the harmonization of the Canadian and American transport systems ends with the laudable but nothing more that lofty opening policy statement.

A key concern to U.S. carriers hoping for easier access to the Canadian market is their ability to enter through acquisition. If an acquisition or merger involves a Canadian company with assets or sales of over $20 million, it will be subject both to examination and the requirements of the Investment Canada Act and the NTA (not to mention the possibility of CCA and provincial review). While the new rules may remove some bureaucratic burden from any acquiring firm (Canadian or American) seeking targets worth less than $20 million, this limit won't buy anything major. Also, if the criteria is sales, then a lot less than $20 million in assets is required to generate those sales.

In response to Canadians' concerns that the new regulatory regime should apply to federal government operations (services and carriers) in transportation, the NTA seeks to streamline the services provided by Transport Canada (air traffic control, coast guard, safety etc...) and to stress that Crown corporations should govern themselves as commercial enterprises to the degree possible. To a certain extent however, at least in the early stages, streamlining government services means increasing user fees. Crown corporations pose a particularly difficult problem. Even if their public interest mandate has disappeared, the fact remains that they are viewed as being attached to the federal purse. Experience has shown that even where there is almost an arm's length arrangement, financial markets do recognize the

implicit links to the government.

The legislative provisions changing the airmode are aimed at facilitating entry and enhancing competition in domestic (southern) markets. Potentially, a more competitive air transport environment will lead to market expansion (and therefore increased choice for Canadians) by those American and other foreign carriers already licensed to operate in Canada. Because such licensing now does and will continue to depend on the terms of the air bilateral treaties negotiated between two countries, new entry into the transborder and international market will not arise from regulatory reform but from renegotiated air bilaterals. Moreover, since such treaties are designed to benefit both participants mutually, putative equality between air transport trading partners already exists.

Rules on mergers and acquisitions notwithstanding, access to the Canadian motor transport market will not be facilitated until at least 1991 (and based on recent discussions, this may be extended to 1993). Even though the interim reverse onus test will be applied uniformly throughout Canada in accordance with the Memorandum of Understanding and the Motor Vehicle Transport Act, 1986, any U.S. carrier seeking access to the Canadian market will still be required to undertake the necessary filing (or in the interim, application) with the motor transport board in each province the carrier wishes to enter as opposed to the single source of authority available to Canadians wishing to enter the American market. Thus while at least in the next four years Canadians anticipate more competitive Canadian motor carriers, this competitiveness will only have significance on movements to border interline points until Canadian carriers are allowed more economical access to U.S. traffic and when U.S. carriers can enter Canada more freely. Again, the Canadian regulatory reform legislation will have little effect on transborder flows until other impediments which can be negotiated away are removed.

Transborder marine movements are rather limited. Therefore any changes to the Canadian regulatory regime affecting marine transport are designed to benefit the domestic component of the Candian industry's operations. The U.S. and Canadian marine sectors will continue to be subject to protectionism.

Where the new NTA makes real moves toward the harmonization of the American and Canadian systems is in rail transport. For example, as in the U.S., confidential rate and service contracts between shippers and railways will be permitted and collective rate-making will be prohibited. Provisions unique to the new Canadian legislation will provide Canadian shippers captive to a single railway, access to a competing railway through competitive joint line rates, increased interswitching limits and joint terminal running rights. All of these measures are aimed at providing competitive options to Canadian shippers; in addition, the competitive joint line rate measures will facilitate greatly American rail carriers' ability to capture Canadian transborder

traffic previously unavailable to them. In these cirucmstances, Canadian shippers will be able to enter into confidential contracts not only with Canadian rail carriers for domestic movements, but domestic portions of transborder movements and with U.S. rail carriers for the U.S. portion of transborder movements. Furthermore, U.S. rail carriers will see the Canadian market as less burdensome to exploit because of the removal of tariff publishing requirements in Canada. In one sense, Canadian railways will benefit through their ability to capture some traffic previously lost to U.S. carriers through arrangements of previously questionable legality. Moreover, the new rules of the Canadian rail trnasport game will optically and actually place Canadian and American railways -- infrastructural limitations notwithstanding -- on an equal footing for transborder movements.

Canada's new NTA and regulatory regime embodies a desire to harmonize the Canadian and American systems and to yield an enhanced environment for freer trade in transportation services. Substantial changes have been made in the rail mode. The delayed implementation of trucking industry regulatory reform reflects the concerns of truckers numbering in the hundreds and the different approaches and circumstance of 13 governmental jurisdictions. Limited changes to the marine mode reflect limited need to make any changes in view of the American protectionist attitude toward their own marine sector. Nominal changes in the air mode reflect limitations imposed by the existing system of bilateral air treaties. If nothing else, it can be argued that Canada will have in place (with the passage of the various new acts) a system which eventually reflects that of the U.S. Quite apart from the positive trade implications and anticipated benefits to shippers, based on the experience in the United States and comments from affected parties, several cautionary notes concerning regulatory reform are raised.

Regulatory Reform in Canada: Building on the U.S. Experience

As expressly feared by U.S. opponents to trucking regulatory reform, the motor carrier industry did suffer destabilization, to a degree, following passage of the Motor Carrier Act (1980). However, following two years of sharp declines in tonnage, revenues and profits, the improvement in carrier returns and recouping of traffic by 1984 are strong evidence that the instability was more a function of the recession than regulatory reform. Moreover, a number of effects produced by U.S. trucking deregulation may be instructive to the Canadian trucking environment notwithstanding the gradual phasing in of many of the reforms here.]2[

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2. Summarized from Western Transportation Advisory Council, "Under Debate": The Framework for Canadian Trucking, vol. 12, No. 1 January 1986.

In terms of rate and service effects, the U.S. trucking environment is clearly more competitive than it had been, featuring more rate and service options for shippers. Small shipment rate levels have risen. Shippers offering large volumes of TL and LTL freight have been able to negotiate discounts and special services. Most small communities have not been negatively affected, but, as should occur in a market-driven environment, they have not benefitted as greatly as have the large communities.

In terms of the indust y's structure, the number of firms with ICC operating authority had almost doubled to 31,000 by 1984 (all but one of which new entrants were truck-load carriers); this caused dramatic reductions in TL rates. Probably as an indeterminate function of both deregulation and the recession, by 1982, approximately 350 firms with revenues of $3.2 billion and 67,000 employees went out of business, filed for bankruptcy or severely curtailed their operations. In 1983 and 1984 five carriers in particular representing $712 million in revenues and 13,000 employees declared bankruptcy. In recognition that previously expensive to obtain operating authorities had dwindled in value to nothing, the federal government allowed firms to write off their value as an extraordinary loss; no such measure is anticipated in Canada at this time.

There have been no major new entrants into the LTL business. In fact concentration in the LTL market has increased with the top 10 carriers increasing their share of the market from 38% in 1976 to 48.5% in 1982, but this trend appears to have abated. Lack of new entrants and higher rates in the LTL market has given rise to rapidly growing involvement by intermediaires (freight forwarders, consolidators, shippers' agents, brokers, etc...) who buy truckload space at wholesale prices from carriers and sell it back to small shippers or large shippers with "smalls" at retail rates.

In the sphere of labour and employment, unionized labour has experienced pressure for lower wage settlements, relaxation of work rules and a lower pay scale for new as compared to established employees. The trend towrads a decline in the incidence of unionization was accelerated; between 1980 and 1984, 30% of Teamsters Union members involved in trucking were on layoff.

The important outstanding issue remaining in the U.S. trucking environment which the new Canadian legislation seeks to redress is the matter of safety; the aging fleet, deferred maintenance and the use of less experienced (lower paid) drivers have all contributed to an increase in the accident rate in the U.S. To the extent that the new Canadian legislation (Bill C-19, MVTA, 1986) seeks the provision of strict comprehensive inspection procedures adminstered by the provincial and territorial jurisdictions, it should be possible to avoid here the safety problems expected to continue in the U.S. Thus because Canadian legislation has had the benefit of learning from and correcting for some of the problems experienced in the United States, it is expected that Canada will be able to

replicate the benefits but not the problems associated with the gradual creation of the new Canadian trucking regulatory regime.

The nature of railroading and the types of problems experienced by U.S. railways which led to regulatory reform mean that the effects of deregulation in the U.S. rail industry are quite different than those experienced by the trucking industry. For example, new entry or new capacity is not something to cause concern in American or Canadian railroading. The main impacts of U.S. rail reform have been beneficial. For example, the new found ability to price flexibly has allowed U.S. roads to regain traffic previously lost to trucking while at the same time improving their margins on captive traffic.

U.S. railways' revenues per tonne mile have decreased (largely a reflection of a greater emphasis on bulk goods transport) but costs per tonne-mile have decreased even more dramatically (a reflection of productivity gains). In particular, greater use of unit trains and relaxed work rules have helped. Overall, rail revenues have increased (more traffic despite lower rates) and costs have declined.

Thus deregulation of U.S. railways has brought about a healthier rail industry while offering shippers attractive rates. The key problem that lingers in the United States is the lack of recourse or options for captive shippers. Canadian legislation combines some of the best of the U.S. measures with specific provisions to redress the captive shipper problem although, the impact of Canada's resolution of this matter on Canada's railways remains to be seen.

As mentioned earlier, policy or regulation changes in Canadian air transport closely paralled legislation in the United States over its evolutionary period. That is, even though past changes and a few new ones are embodied in the NTA 1986, reflection on the impact of a more competitive Canadian air transport environment based on a review of U.S. experience, must take into account that a lot of the impacts have already occurred and that the Canadian market has limited scope for adjustment.

In both countries (i.e., after deregulation in the U.S. and before deregulatory legislation in Canada), the past few years have witnessed substantial rationalization. In the U.S., failures of major airlines such as Braniff in 1982, Continental in 1983, Frontier and the major post-dereg entrant, People's Express in 1986 and 24 other bankruptcies have altered the structure of the American air transport industry markedly. Whether in an attempt to gain market security from the acquisitor's viewpoint or to avoid failure from the seller's viewpoint, Canada's air sector has gone from two large national carriers, five regional carriers and an incipient or aspiring national carriers to a large (Air Canada), a medium (Canadian Airlines International) and a small (Wardair) national carriers.

While the U.S. saw the certification of many new carriers (primarily commuters) mainly using used aircraft, entry into the smaller Canadian market has been and is expected to remain nominal, with the possible exception of a few small local or feeder airlines. Elimination of route restrictions has led to the creation of hub and spoke operations throughout the U.S. leading to greater service/routing alternatives but at the same time a lower availability of nonstop flights. An examination of Canadian airline schedules indicates that to a large degree this sytem has existed for years and is becoming even more prevalent in Canada with Toronto as the main hub and other major centers serving such roles in a very minor way. Major U.S. airlines' market share reduced from 91% to 80% (revenue passenger miles) to the benefit of commuter and regional carriers. That phenomenon and its counterpart in Canada may have reduced large carriers' RPM's but owing to the use of local carriers to feed major centers, the large carriers are free to abandon small points and non-lucrative segments and to concentrate on high density and high yield legs. This has often meant replacement of jet service with propeller (and in some cases no) aircraft both in the U.S. and Canada.

Between 1979 and 1983, airlines in the U.S. recorded deficits amounting to $6.6 billion. Since 1984 the industry's financial health has improved, but many firms still face difficulties. For example, only four firms together chalked up 60% of industry profits in 1984. Canada's air transport industry has not made a collective profit since 1984.

On the consumer side, a wide range of variously priced products have been advantageous if not confusing. Both in Canada and the U.S., a myriad of discount schemes, seat sales, promotions, frequent flyer incentives and other devices have been introduced to attract brand loyalty. An interesting difference between the two countries is that while American pricing schemes have ranged from cheap "no frills" fares to luxury services at premium prices, Canadian carriers have lowered fares without reducing inflight service quality while tying to add luxuries at premium prices to attract higher yield captive (to travelling not to carrier selection) traffic at the top end of the fare spectrum.

Although American air industry employment has increased overall because of a recovering (from the recession) then growing travel market, deregulation has been turbulent for labour. For example,]3[between 1978 and 1982, 40,000 full-time employees lost their jobs. Employment amongst the major carriers fell by 11% while growing by 31% in the small airlines. Average wages and

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3. Summarized from: Western Transportation Advisory Council, "A New Threshold for Canadian Air Transportation," vol. 12, No. 4, October 1986.

benefits for full time employees decreased by 6% overall but there are marked differences between the average wages and salaries of the established versus new carriers -- $41,800 versus $22,000 per year respectively. Measures used to reduce labout costs by established airlines included the incorporation of non-union subsidiaries, termination of labour contracts under Chapter 11 of the Federal Bankruptcy Act and concessions in exchange for stock options. Similar measures are being attempted in Canada but, with the exception of an unreported amount of job rationalization associated with mergers, have yet to meet with great success.

The effects of air deregulation in the United States are still being evaluated. It is thought however that carrier debt burdens are undesirably high in view of the associated risk levels and the excess capacity problem will only be alleviated through continued rationalization. Canadians expecting further fare decreases following passage of the new National Transportation Act are likely to be disappointed. Given an already non-lucrative air industry in Canada, major developments will involve route, service and equipment rationalization yielding cost reductions, not to permit reductions in fares, but in order to recoup or prevent further losses.

Conclusion

Having discussed the basic relationship between regulatory reform and trade in transportation services, two important questions need to be addressed. First, does regulatory harmonization ensure freer trade-in services; or, in the context of a bilateral agreement, does harmonized regulatory reform mean there is anything left to negotiate? Is there something about the trade negotiations (in services) process per se that will limit or shape harmonization?

First of all, the underlying economic forces for integration and harmonization are quite clear and lead to the conclusion that Canada could or should lose chunks of its transborder (and possibly domestic) trade to American carriers. However, this does not imply that there is nothing to negotiate because there are other barriers to trade in services not directly related to the transportation itself (e.g., the effects of U.S. immigration laws on Canadian carriers' ability to back-haul); the negotiation process must of itself limit the possibilities for full harmonization and this is not necessarily a bad thing.

Starting from the example of the air bilaterals, which is the only solid working example of a services bilateral agreement, negotiation begins with the premise that there is a Canadian industry and an American industry, each with their own strategic interests, which leads to the negotiation of quantifiable measurable items (landing rights, access to markets, etc...) to mutual advantage. Air bilaterals even cover such

non-airline-related regulation issues such as customs pre-clearance and immigration. In this sense it is clear that regulatory harmonization in a trade context demands thinking in terms of "our" industry versus "theirs". In other words, while deregulation in Canada will appear to make the border less relevant, the trade negotiation process begins with recognition of the border's existence, and the fact that there is a Canadian industry on one side and an American industry on the other.

Finally, there is the more difficult issue of whether Canada and its carriers require a policy to help them adjust to the effects of regulatory reform and transportation system harmonization. While this depends a great deal on how one defines "adjustment", assistance in the form of financial re-structuring aid (capital subsidies) need not be considered both as a matter of principal and because of a possible U.S. countervail reaction. Adjustment assistance in the form of transitional (i.e., half-way) measures or delaying implementation dates, while practically acceptable, should be kept to a minimum. As indicated above, even during the regulated period, competitive adjustments took place and carriers responded with evident adjustments in pricing, productivity and in the transportation industry's structure. In short, private sector adjustment has been an on-going affair. Adjustment by transportation users of all kinds and labour is what remains to be seen.

Implementation of the new legislation and conclusion of the free trade negotiations in the next several months will allow for discussion of these adjustments at the next annual meeting of the Canadian Transportation Research Forum at Minaki, Ontario May 24 to 27, 1988.

THE GREAT LAKES/SEAWAY SYSTEM: AN EXAMINATION OF THE ORGANIZATION OF THE "SYSTEM"

The Great Lakes/Seaway System is often thought of as a co-ordinated system, as a route or as an integrated whole. Physically this may be true as ships can sail from tidewater to the head of the lakes but organizationally there is no integrated framework - there are various agencies, both Canadian and U.S. with specific mandates but no umbrella organization that draws the components together as a "system". This paper examines the concept of the "Great Lakes/Seaway System", the extent to which behaviour of the various interests is autonomous or interdependent and the mechanisms which have arisen through official negotiation or on an ad hoc basis to co-ordinate the various interests. The analysis is undertaken from the perspective of recent policy level discussions between Transport Canada and the U.S. Department of Transportation and from the perspective of recent sharp decreases in traffic utilizing the system. Conclusions are drawn about the advantages and disadvantages of increased co-ordination of certain aspects of the system.

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