Research in Changing Environments

Canadian Transportation Research Forum
23rd Annual Meeting

Proceedings

MINAKI LODGE ONTARIO MAY 1988

PROCEEDINGS

of the 23rd Annual Meeting of

THE CANADIAN TRANSPORTATION RESEARCH FORUM

Theme:

RESEARCH IN CHANGING ENVIRONMENTS

Minaki Lodge, Ontario

May 24-27, 1988

Proceedings Printed by

University of Saskatchewan
Printing Services

Welcome to CTRF's twenty-third Annual Conference being held in 1988 in a resort setting in Northwestern Ontario.

During the past twelve months, Canada entered a new era in the economic regulation of transportation. Federal and provincial governments have renewed their commitment to a high level of safety in the transport industry as part of the regulatory reform process. Trade patterns are expected to change as a result of a free trade agreement between Canada and the United States signed by the Canadian Prime Minister and the United States President. These are but three indicators of the changing environments which face the transportation industry and its customers.

Canada has become a great nation through its ability to bridge vast distances to serve scattered and remote populations and to meet harsh climatic conditions. The changing transportation environments of today pose no less a challenge to both carriers and transport users. Transportation research is a necessary tool to meet that challenge.

For its part, CTRF has initiated a new venture to encourage transportation research. For the academic year 1988-89, four modest fellowships are being offered by CTRF to Canadian students in transportation.

Through the papers prepared for this Conference, it is CTRF's objective to stimulate discussion, debate and thoughtful consideration leading to innovative action.

On behalf of the CTRF membership, I extend thanks to CTRF Vice Presidents, Richard Wansbutter and Eugene Ludwick, who have voluntarily given a tremendous amount of their time and abilities to organize this Conference.

May you enjoy the Conference and continue your participation in CTRF activities in the months and years ahead.

Craig S. Dickson,
President.

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SHORT LINE RAIL LABOR COSTS

by

Denver D. Tolliver and Frank J. Dooley*

INTRODUCTION

Since passage of the Stagger's Rail Act of 1980, Class I carriers have been rationalizing their rail networks via rail line abandonments and short line sales. Since 1980, 179 new short lines operating 17,533 miles of track have been created (Levine and Rockey). Creation of the new short line railroads is changing the industrial structure of the American rail industry. The future rail industry might be characterized as a "short line/trunk line" system. Under such a pattern, independent short line operators will provide local service over light-density portions of the network, while trunk line carriers will focus on providing through freight service over high-density main lines and principal feeder lines.

High rail labor costs are a major reason underlying the recent growth of short line railroads in the United States. Labor costs are especially critical for light-density branch lines. In 1982, Class I rail labor costs for train crews, locomotive, freight cars, and maintenance of way were estimated to equal 49.2 percent of total operating costs on light-density lines.[1] Short line rail labor costs may be appreciably lower than Class I rail labor costs as a result of lower wage rates, smaller sized train crews, and less restrictive work rules.

Recently, short line sales have become the focus of litigation between rail labor unions and the railroads. Rail labor maintains that sales of rail lines to short lines without labor protection are in violation of the Railway Labor Act. Railroads argue that the Interstate Commerce Commission has the jurisdiction to determine whether a short line sale receives labor protection. The issue is presently before the 3rd U.S. Circuit Court of Appeals which is determining whether short line sales require that the railroad negotiate the effects of a planned sale with labor unions (Keeney).

Class I railroads contend that the formation of short lines will be severely restricted if labor protection provisions prevail. As a result, the alternative to the development of new short lines may be an increase in the number of rail line abandonments.

The overall objective of this paper is to provide information highlighting the differences between Class I

and short line rail labor. Specifically, the organization of the paper: first, reviews the data sources; second, overviews Class I labor cost trends; third, investigates rail labor costs, comparing the nature of labor and operating costs on short line railroads and the Burlington Northern; and fifth, concludes with findings and implications.

DATA

Information required to evaluate changes in rail labor was obtained from secondary sources and a mail survey of short line railroads. A literature review of short line labor was also conducted.

Before proceeding, two aspects of the study should be noted. First, there are several definitions of short line railroads. In this study, a short line railroad is defined to be one operating less that 250 miles of track. Second, the labor characteristics of short lines are compared to those of the Burlington Northern (BN). BN data is used because the BN system is heavily comprised of light-density branch lines, the types of rail lines generally involved in short line sales.

Information about BN labor levels and costs were obtained from a series of annual reports for the years 1978 to 1986. This data was used to develop time series data about Class I job classifications, salary levels, fringe benefits, etc. The data for salaries, wages, and fringe benefits were developed from BN's Wage Forms A and B and Schedule 410 of the R-1 Annual Reports to the Interstate Commerce Commission (ICC). All size and operating statistics were developed from Schedules 700 and 755 in BN's R-1 Annual Reports.

A mail survey of 99 short line railroads across the United States was the principal source of information about short line operations. The survey included series of questions designed to gather information about the short line's general characteristics, job classifications, wage rates, benefits, crew sizes, unionization, and types of work contracted to other firms.

The sample frame was developed from Due's list of recently organized short lines. Responses were obtained from 55 short line railroads. Two surveys were eliminated due to incompleteness and five surveys were eliminated because the railroad operated more than 250 miles of track. The final response rate to the survey was 52.2 percent.

TRENDS IN CLASS I CARRIER LABOR COSTS

One of the major differences between Class I and short line operating costs is the size of train and engine crews and the cost per crew member. In this section of the paper, a time-series analysis is presented for one of America's principal grain and natural resources carriers,

the Burlington Northern (BN). The BN constitutes a good "reference carrier" for short line comparison because the BN still operates a considerable amount of branch line trackage and is one of the carriers aggressively attempting to sell its light-density lines. In particular, the analysis focuses on train and engine crew costs, the principal labor cost component for light-density branch lines (Figure 1).

Like most American railroads, BN began a long-range process of system rationalization in the mid-1970s. Figure 2 graphically depicts this process. Between 1978 and 1986, Burlington Northern increased the density of track on its system from 11 million to 15 million gross ton miles per mile (GTM/M). While the density of traffic has increased, the miles of branch line have decreased steadily from 11,270 in 1980 to 9,049 miles in 1986.[2]

Over the same time-period, the number of train and engine crew members employed by the Burlington Northern declined from a high of 14,526 in 1981 to 11,687 in 1986 (Figure 3). This trend is consistent with the process of rail rationalization, wherein Class I carriers are seeking to cut high cost train operations on light-density branch lines.

At the same time that BN was reducing its miles of branch line track and the number of train and engine crews, the average annual salary of the remaining employees was increasing due to collective bargaining. The average annual salary of BN crew members increased from 23,000 dollars in 1978 to 39,000 dollars in 1986 (Figure 4). Furthermore, associated fringe benefit packages increased along with salaries and wages. Fringe benefits, expressed as a percentage of salaries and wages, grew from 24.0 percent in 1978 to 35.6 percent in 1986 (Figure 5).

In summary, the process of Class I rail rationalization has pared down the amount of branch line track and reduced the size of the train and engine crew force. On the other hand, collective bargaining has significantly increased train crew salaries and associated fringe benefits, resulting in a movement to sell-off light-density lines to short line operators. The next section investigates some of the fundamental differences between Class I and short line labor.

DIFFERENCES BETWEEN SHORT LINE AND BN LABOR

Most proponents of short line railroads argue that the recent growth in short lines is largely attributable to labor cost savings. There is a two-fold source of labor cost savings. First, short line labor wage rates are much less than those for comparable Class I rail employees. Second, labor is more productive on short lines than Class I railroads as a result of more flexible work rules. General information and comparisons for short line and Burlington Northern job classifications and work

rules, and wage rates and benefits are presented in this section.

JOB CLASSIFICATIONS AND WORK RULES

There are four major differences between short lines and Class I carriers in the areas of rail labor work rules and job classifications. These are: (1) the scale of the work force; (2) the number of job classifications; (3) the distribution of employees among the classifications; and (4) the utilization of job classifications, particularly regarding train and engine crews.

First, the size of the labor force differs substantially between the Burlington Northern and the typical short line. At the close of 1986, BN had 34,402 employees, or 1.33 employees per mile of track.[3] In comparison, the typical short line had 13 full time workers, or 0.33 employees per mile of track. Thus, when controlling for size, the typical short line railroad's work force is substantially lower than that of the Burlington Northern.[4]

The second major difference between short line and Class I railroads is the number of job classifications. Class I railroads may have up to 25 different job classifications. Work rules generally segregate work duties, preventing employees within one job classification from performing duties from other classifications.

The number of job classifications for short lines is difficult to determine because most short lines do not distinguish between job classifications. As a result, a direct comparison between job classifications for short line railroads and the BN cannot be made. Nevertheless, 40 of the short line operators grouped their employees among 8 general job classifications (Table 1).

TABLE 1. Short Line Job Classifications and Employment Levels, 1987

Employee Classification	Percent of short lines reporting	Mean Number of Employees on a Short Line
Train Crew	95.0	4.4
Administration	82.5	2.2
Maintenance of Way	57.5	6.6
Mechanical	40.0	3.4
Clerks & Freight Handlers	35.0	2.6
Communications & Signals	27.5	1.2
Yard Crew	15.0	4.0
Shop Crafts	10.0	2.0

The BN obviously has employees from all 25 Class I job classifications. None of the short lines, however, had employees within all of the job classifications. The

three most common job classifications reported by short line railroads were train crews (95.0 percent), administration (82.5 percent), and maintenance of way (57.5 percent) (Table 1). No other job classification was reported by more than 40 percent of the respondents.

The third major difference between short line and Class I rail labor is the distribution of employees among job classifications. While short line and BN job classifications are not directly comparable, several broad categories do match-up. Table 2 shows the percentage of workers in each major classification for the Burlington Northern and a typical short line.

TABLE 2. Percentage of Employees in Major Rail Job Classifications

Job Classification	Percentage of Employees	
	Burlington Northern	Typical Short Line
Executive, Professional & Administrative	20.3	15.8
Maintenance of Way	22.5	20.9
Maintenance of Equipment	17.8	5.4
Train and Engine Crews[1]	34.0	52.6
All Other	5.4	5.3
TOTAL	100.0	100.0

[1]Includes both road train and yard crews.

SOURCE: Burlington Northern. Annual Report to the Interstate Commerce Commission, (R-1). Fort Worth, TX, 1986.

The major difference in the distribution of employees concerns the category of train and engine crews. At the close of 1986, Burlington Northern's train and engine crew work force comprised 34.0 percent of all BN workers (Table 2). In comparison, the typical short line surveyed classified almost 53 percent of its workers as train and engine crew employees.

This is quite significant from a policy perspective. As Table 4 shows, BN train and engine crew wages are 247 percent of short line wages. If short lines were required to pay train and engine crews at the prevailing union wage rate, their total labor cost would increase by 130 percent. A labor cost increase of this magnitude may stymie further short line sales.

Utilization of job classifications is the final difference between short line and Class I railroads. There are three reasons why short lines can succeed with fewer job classifications. First, employees perform more than

one type of duty. Second, short lines contract out some of the less routine work. Finally, strict Class I work rules are relaxed on short lines.

First, the short line job classifications are somewhat misleading because employees typically do several types of work. For example, it is not unusual for a short line employee to operate a train one day, repair track a second day, and make sales calls a third day. Owners and employees may both benefit from the less structured system of job classifications. Many owners responded to an open-ended question that the lack of strict job classifications led to greater operational flexibility and large cost savings to the firm.

According to the owners, the employees also benefited by being encouraged to perform a variety of tasks. The owners felt that by making jobs less tedious and more interesting, employees were more satisfied with their work. This observation has not been corroborated by short line employees.

Second, short lines are able to decrease the number of job classifications by contracting some types of work out to other firms. The types of work most frequently contracted are track maintenance (60.4 percent), car and engine repairs (52.4 percent), and equipment repairs (35.4 percent) (Table 3). This is consistent with the low percentage of short lines reporting employees for these types of job classifications. Contracting may also allow the short line to avoid the associated fixed costs for items such as track maintenance and repair equipment, or car and locomotive shops.

TABLE 3. Types of Work Contracted Out by Short Lines

Type of Work	Percent of Short Lines Contracting
Track Maintenance	60.4
Car & Engine Repairs	52.1
Equipment Repairs	35.4
Other[1]	14.6
Administrative/Clerical	8.3
Communications	6.3

[1]Other includes miscellaneous repairs, dirt moving, radio and signal maintenance, bridge work, and actual operations.

Finally, Class I railroads feel that their operations are restricted by repressive and antiquated rail labor work rules (Gohmann). For example, many trains continue to operate with 4 or 5 man crews. Train crews continue to include firemen and brakemen despite the fact that trains are diesel powered and often do not pull cabooses. In

sharp contrast, the average crew size on a short line is only 2.13 workers.

WAGES AND BENEFITS

Three major differences exist between the wages and benefits for short line and BN employees. First, the absolute wage scale is much lower for short line employees than BN employees. Second, the method of payment for the two types of employees differs. Finally, benefit packages are less attractive for short line employees.

First, short line hourly wage scales are significantly lower than comparable BN wage scales (Table 4). The typical BN employee receives between 152 and 247 percent as much as the typical short line employee. Hourly wage rates for short line labor range between 8.85 to 13.01 dollars per hour, while BN labor receives between 17.00 to 25.00 dollars per hour (Table 4).

TABLE 4. Short Line and BN Hourly Wage Rates by Job Classifications, 1987

Employee Classification	Average Hourly Wage Rates	
	Short Line	Burlington Northern[1]
Train Crew	$10.10	$25.00
Administration	13.01	19.77
Maintenance of Way	8.85	18.00
Mechanical	10.49	17.00
Yard Crew	12.06	25.00

[1]Calculated from ICC Wage Forms A and B. Wage includes: straight time actually worked, overtime, time paid but not worked, constructive allowances, vacations, and holidays. The service hours consist of the actual hours worked at straight pay and overtime rates.

Second, perhaps a more important distinction between the two types of rail labor is the difference in the method of payment. Short line employees are paid on a hourly basis. Overtime is paid on the basis used in most industries, time-and-a-half. The typical work day for a short line employee is 8.26 hours.

Class I rail labor's total salaries are extremely complex to determine. Class I train and engine crews are paid on a dual basis of distance traveled and length of time on duty. Their standard work day is eight hours or a run of 108 miles. This sets a minimum flat payment for all runs, even those that require less than eight hours or 108 miles.

The calculation of overtime is complicated because it also is a function of mileage and time. As a result, overtime payments for Class I train and engine crews may

vary according to factors which affect train speed such as track condition, traffic, or geography of the area. In general, overmiles (miles run in excess of 108 miles per day) are paid on a flat rate per mile. Overtime is paid on an hourly basis at time-and-a-half.

The calculation of Class I train and engine crews salaries is also complicated by work rules resulting in additional compensation for a number of factors not related to work. This includes payment for items such as deadheading, terminal delays, and held-away-from-home terminal. The total salary cost for items other than straight pay and overtime is estimated to equal 23 percent (Figure 6).

The final major difference between short line and Class I employees is fringe benefits. As a percentage of annual salary, the average fringe benefit package of BN employees was over twice that of short line employees. In 1986, BN's employees fringe benefits were estimated to be 35.56 percent of their total salary, while a comparable figure for short lines in 1987 was 16.96 percent.

Class I employees have attractive comprehensive benefit plans. The fringe benefits offered to short line employees are much more limited. According to survey results, benefits vary somewhat from short line to short line with larger firms offering more benefits. The most commonly offered benefits were health insurance, railroad retirement, and dental insurance which were offered by 76.2, 57.1, and 35.7 percent of all short lines, respectively. Other fringe benefits offered by fewer short lines (between 10 and 25 percent) included life insurance, paid vacation, profit sharing, pension plans, bonuses, paid holidays, and unemployment insurance.

DIFFERENCES BETWEEN SHORT LINE AND BN OPERATING COSTS

Differences in rail labor work rules and wage rates offer short line railroads significant labor cost savings relative to Class I carriers. Short line labor cost savings result in lower overall operating costs. This may be especially important on light-density branch lines which are marginally profitable under Class I ownership.

Light-density branch line costing methodologies were developed and translated into computer models for both Class I and short line railroads.[5] The costing models were applied to a designated set of light-density line segments recently sold by the Burlington Northern to a short line operator in southeastern North Dakota (see Tolliver, Dooley, and Zink). System costs and revenues were estimated under BN and short line ownership scenarios. The results were compared to determine the economics of short line operation of light-density branch lines.

Total on-branch system costs for the short line operator were 2.5 million dollars less than the Burlington Northern's, a reduction of 24.7 percent (Table 5). Total

off-branch costs and revenues were identical under both types of ownership.

> "The largest decrease in costs came from train crew savings of the short line railroad. Cost reductions of $1.68 million, or 75.5%, were realized from crew size reductions and a lower rail labor wage rate. Maintenance of way costs were reduced by $0.35 million (15%), while transportation costs (other than crew costs) dropped by $0.25 million (42%). Administrative costs, however, increased sharply by over 300 percent. This higher overhead expense proportion makes intuitive sense given the higher fixed cost nature of short line operations. The larger traffic base characteristic of the Class I carrier is simply not present on the short line network. (Tolliver, Dooley, and Zink, p. 281).

SUMMARY AND CONCLUSIONS

Since the mid-1970s, Class I railroads in the United States have been attempting to rationalize their rail networks by ridding themselves of light-density branch line trackage. A major reason underlying this strategy is the high labor cost of train and engine crews. The average salary of a Burlington Northern crew member has increased from 23,000 dollars in 1978 to over 39,000 dollars in 1986. When forced to operate with 4 or 5 man crews, The Burlington Northern's crew cost per train hour totals 152 dollars. This is 500 percent of the mean hourly train crew cost for a typical short line.

Greater work rule flexibility, fewer job classifications, and lower wage rates may allow short line operators to significantly lower operating costs on light-density branch lines. For example, branch line operating costs were almost 25 percent lower for the short line in the North Dakota case study. As a result, short line carriers may provide a mechanism for the profitable rail operation of light-density branch lines. In addition, short line carriers may be an alternative to the continued abandonment of rail lines by Class I carriers.

A United States appellate court is currently considering a case which may result in the attachment of labor protection provisions to short line sales. If labor protection provisions require that short lines operate with union train crews at prevailing Class I salaries, short line labor costs will increase by 263 percent. The attachment of a labor protection policy may spell doom for further development of American short lines. As a result, Class I railroads may revert to abandonment as the only means to rationalize their rail networks.

TABLE 5. Cost Comparison of Burlington Northern Railroad and Short Line Railroad by Component Cost of Operation.[1]

Cost Component	BN Railroad	Short Line Railroad	Percent Difference
Train Crew[2]	2,221,350	543,716	-75.5
Locomotive[3]	1,187,996	1,369,562	-15.3
Car[4]	1,087,633	993,906	-8.6
Transportation[5]	582,635	336,289	-42.3
Maintenance of Way	2,338,000	1,990,640	-14.9
Administrative	104,203	434,000	+316.5
Property Taxes	303,270	303,270	-
Opportunity Cost on NLV	2,337,905	1,479,687	-36.7
Other	61,799	250,000[a]	-
Total On-branch	10,224,792	7,701,072	-24.7
Total Off-branch	12,305,560	12,305,560	-
Total Revenue	22,741,824	22,741,824	-

[1]Costs were estimated assuming a 15.8% cost of capital for freight cars, for locomotives, and fixed roadway expenses for the BN and a 10.0% cost of capital for the short line.
[2]Includes wages, fringe benefits, alimony and crew over night costs.
[3]Includes locomotive repairs, depreciation/rentals/leases, return on investment, servicing, fuel, overhead and machinery.
[4]Includes car-day and car-mile costs.
[5]Includes train inspection/lubrication, dispatching, crossing protection and signal/interlockers costs.
[a]Includes opportunity cost on working capital and insurance costs.

SOURCE: Tolliver, D.D., F.J. Dooley, and D.L. Zink. "Short Line Operation of Light Density Rail Networks: Economics and Public Policy." J. of the Transp. Research Forum. 28(1): 277-282, 1987.

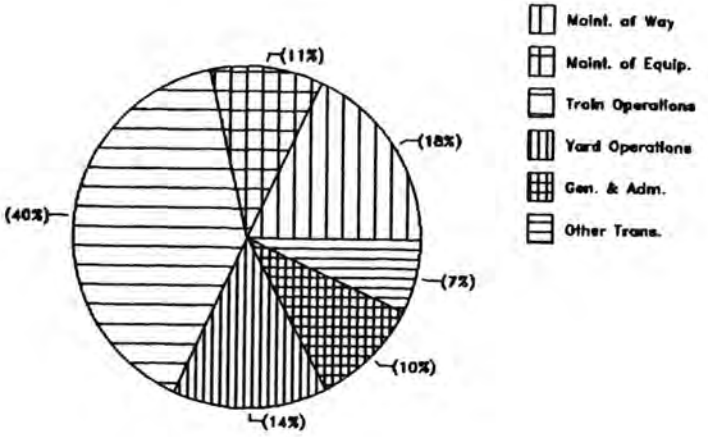


FIGURE 1. Distribution of BN Salaries and Wages.

SOURCE: Interstate Commerce Commission Wage Form A & B. Fort Worth, TX, 1978-1986.

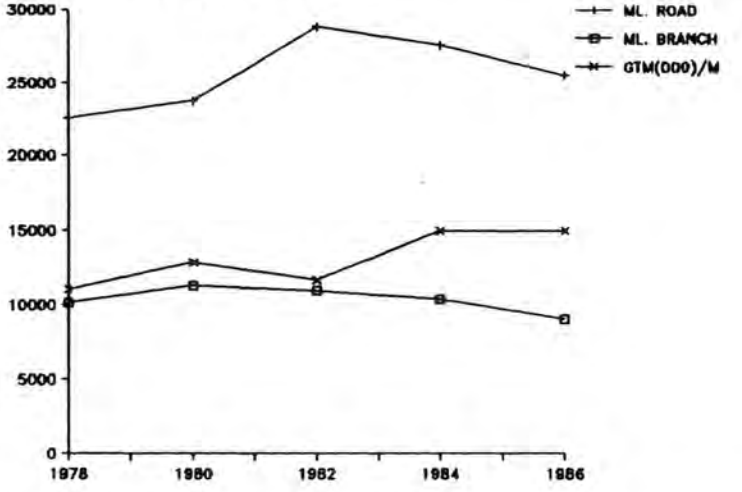


FIGURE 2. BN Miles of Road, Branch Line Track, and System Density.

SOURCE: Interstate Commerce Commission Wage Form A & B. Fort Worth, TX, 1978-1986. Annual Report to the Interstate Commerce Commission, (R-1). Fort Worth, TX, 1978-1986.

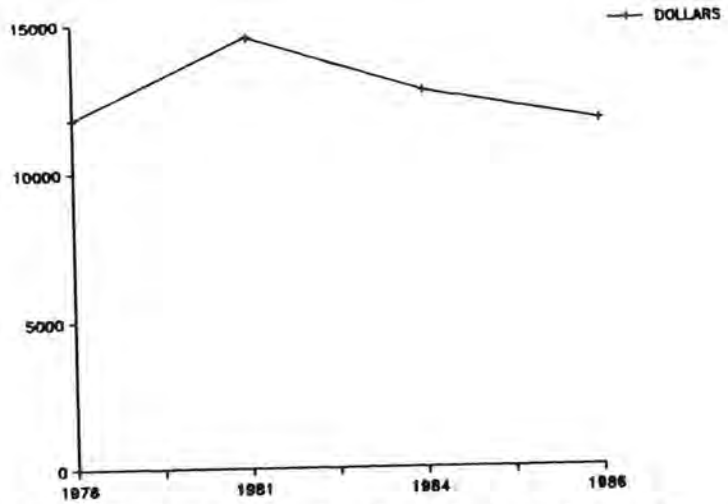


FIGURE 3. BN Average Number of Train and Engine Crew Employees.

SOURCE: Interstate Commerce Commission Form A and B. Fort Worth, TX, 1978-1986.

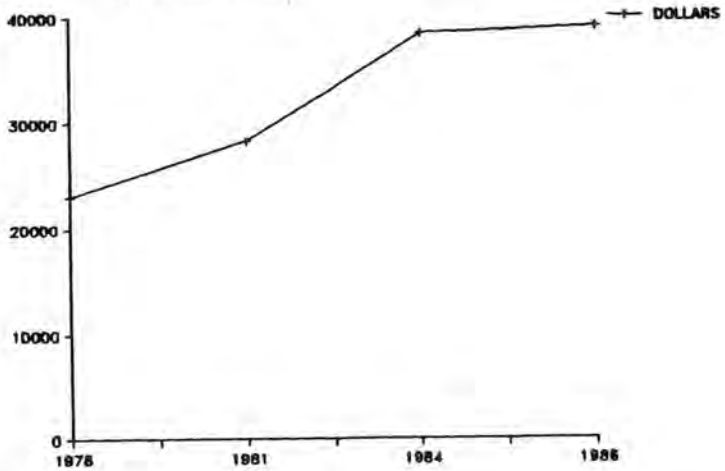


FIGURE 4. BN Train and Engine Crew's Average Annual Salary.

SOURCE: Interstate Commerce Commission Form A and B. Fort Worth, TX, 1978-1986.

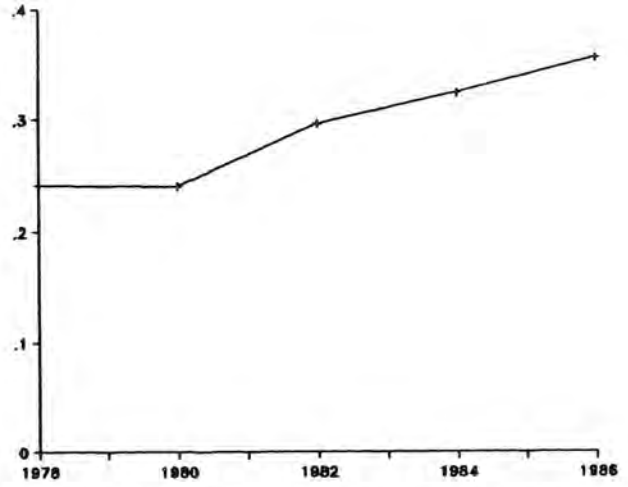


FIGURE 5. BN Fringe Benefits as a Percent of Salaries and Wages.

SOURCE: Interstate Commerce Commission Form A and B. Fort Worth, TX, 1978-1986.

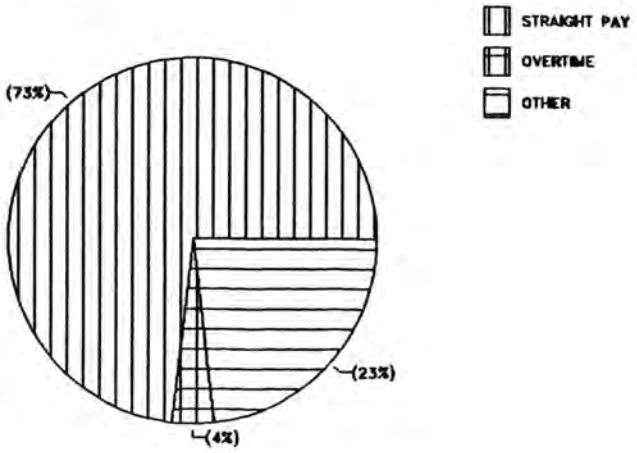


FIGURE 6. Distribution of Compensation for BN Train and Engine Crews.

SOURCE: Interstate Commerce Commission Form A and B. Fort Worth, TX, 1978-1986.

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ENDNOTES

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1. This information was developed from the Burlington Northern's Application to Abandon the Edgeley to Streeter Line. Conventional wisdom has always posited that the preponderance of light-density branch line costs consist of fixed maintenance of way and fixed opportunity cost on roadway investment. However, this application suggests that labor comprises nearly fifty percent of the costs on light-density branchlines.

2. It should be noted that the abandonment process was streamlined with the passage of the Stagger's Rail Act in 1980. Since then, the miles of branch line track have steadily declined.

3. Burlington Northern. Interstate Commerce Commission Wage Form A, 1986.

4. In addition to size, the scale of the work force is related to the density of traffic, the presence of powerful labor organizations, and other variables.

5. For a complete discussion of the model see Tolliver.

CONTEMPORARY COSTING AND SERVICE ON A SHORT LINE RAILROAD

By Charles J. Lapp *

I. INTRODUCTION

Our continental railroad system began in the early 1800's when large numbers of short, local railroads were constructed by area interests in order to offer the benefit of a revolutionary new transportation medium to communities and regions. (1) Very shortly, visionary people could see that if these lines could be connected as a single corporate unit, undreamed of improvements in travel (and profits) would obtain.

New management forms were invented to attempt to operate these unwieldy growing giants under some semblance of coordination and unified control. Military management techniques which had evolved over centuries in an attempt to control large scale geographically diverse organizations, were adopted with "divisions" and "departments," and with "masters" running the several local departments.

New technology was invented and adapted for these huge, new organizations. They were the "cutting edge" of progress and innovation, and were widely recognized as such. The telegraph, telephone, automatic block signal, automatic coupler, air brakes and metalurgical advances along with structural and organizational improvements combined to create the safest form of transportation ever known to mankind.

II. RAILROADS AND CHANGE

But as THE most important structural connection for the local, area, regional, national and continental economy, the railroads were judged to be too important to be left alone to their own devices, custom and the inexorable laws of economics. Over decades rules, contracts and laws began to bind and cast both the technology and operational structure into a monolithic mass. "Rate of Return" laws and regulations erased the large profits which had attracted entrepreneurs.

People of a creative bent often found the mass impenetrable and unchangeable, as often happens in large bureaucratic organizations over some span of time (in

some organizations, it should be noted, in a very short period of time). Entrepreneurs found that large returns were not available from the application of their creative and talented bents in the rail industry, and so went elsewhere. Thus railroads were in large part left to the clerks, technicians and engineers. This aspect of resistance to the changes required for survival that resulted from governmental controls, regulations, laws and even ownership was an unanticipated consequence of governmental actions taken over decades in specific situations in order to "solve" what at the time were deemed to be crises, to improve safety or to defuse labor unrest.

As other forms of efficient competitive transportation emerged which required significant structural changes in the railroads, they began to change and react, but not at a sufficiently significant rate of change when compared with the need. As is the case with the evolution of many other industries and organizations, new small "short line" railroad companies began to replace the least efficient parts of the major railroads. The new short lines were invented as a way to create organizational change in the railroad industry when major railroads were unable to make the required changes. The new short lines allowed the railroads to keep markets located on light density lines.

An appropriate question at this point is whether the large railroads can change fast enough in the future or whether they will die. The author has been involved in research on organizational innovation in the past and believes that the large railroads can change sufficiently fast, but that is the subject of other papers, not this one. (2)

III. A CHANGED ENVIRONMENT

We have discussed the genesis of the present railroad situation. Now we will examine some changes which have occured in the transportation environment (the market place) and railroad reactions to these changes. Were the railroad responses appropriate to the stimuli or were they merely the least difficult responses out of a family of possible changes that could be effected? Why have "short lines" become a popular alternative to major railroad operation of "inefficient" rail lines? What are some of the advantages and disadvantages of short lines? This paper will conclude with examples of rate making on the Hillsdale County Railway Company in conjunction with its major railroad connection and other major railroads.

People in developed countries throughout the world have fallen in love with the automobile. It literally has

allowed them to change the way they live their lives. They have willingly paid taxes in order to construct roads on which they can travel. In the last sixty years we have seen the greatest amount of road construction in the history of our planet. This infrastructure was created by very high levels of investment, mostly generated through user fees paid by automobile drivers as a part of the cost of purchasing fuel for their cars. Truckers have, of course, benefited from this large scale public infrastructural investment.

An unanticipated consequence of the public construction of thousands of miles of new intercity highways on this continent is the relative decrease in the ability of railroads, operating on and maintaining their own rights of way, to compete with the public sector. The relative disadvantage of rail to truck in cost for maintaining their rights of way is in the area of four to one. That is, while railroads pay 25 to 30% of each revenue dollar to maintain their tracks, trucks pay a range of 6 to 8% for user charges to operate on public roadways.

IV. RAIL AND TRUCK ECONOMICS

Trucks have had another percieved advantage over railroads. A standard axiom of transportation economists has been that rail hauls must be in the order of several hundreds of miles to be economically feasible because of high costs of train crew, terminal and switching. The long haul is necessary to cover crew, terminal and other variable costs, and to make a contribution towards fixed costs. Trucking, in comparison, has much lower terminal costs and can move freight when a single trailer is loaded, rather than waiting for a train of cars to be loaded and assembled. Also, since a driver is needed for each load, nothing is to be gained by delaying the movement of the load. Figure 1 is an example of how major railroad and trucking costs compare with respect to mileage.

Further, the trucker can load a trailer daily or even several times a day for short hauls, while a freight car often moves in 15 to 30 day cycles between loads, thereby requiring a capital cost for equipment of several times the truck cost per load hauled. If a $40,000 truck trailer is loaded for a long haul load each four days compared with a $40,000 freight car's load each 20 days, the equipment cost per load is five times as high for the freight car as it is for the truck.

Thus railroads have been percieved as having greater train crew and terminal costs, higher total fixed plant costs and significantly greater equipment costs per load hauled

Figure 1. An Example of the Type of Marginal Costs Incurred by Major Railroads and Truckers

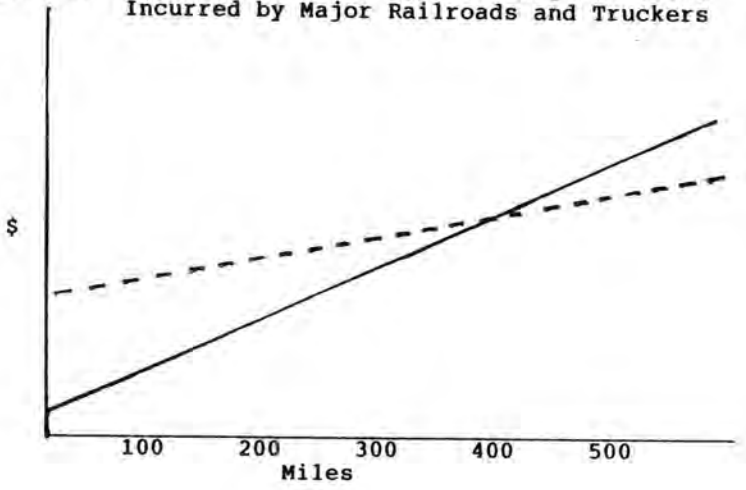
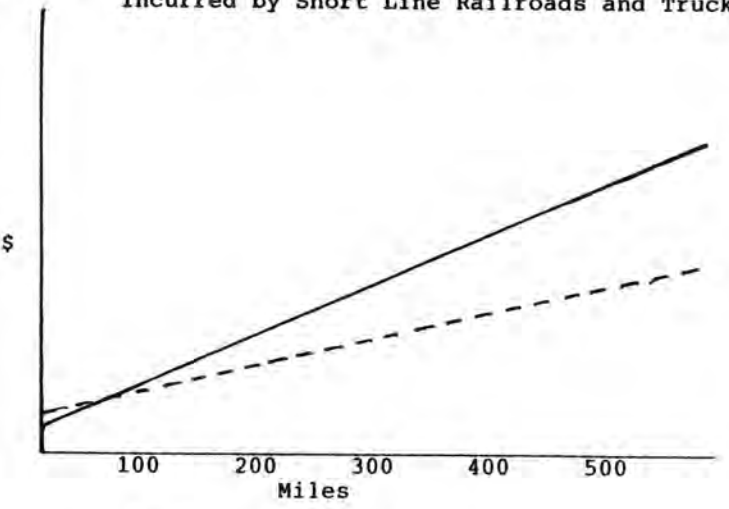


Figure 2. An Example of the Type of Marginal Costs Incurred by Short Line Railroads and Truckers



Rail ---------- Truck _____

than trucks. Please note that the author wrote "percieved" in the above statements. That is because traditional railroad transportation economics has been derived from the traditional way railroads have operated, that of minimizing costs, specifically crew cost, by holding cars at each switching yard until a sufficient number accrued which were heading for the next common switching point to run a train.

As crew costs increased while railroad revenues remained relatively static (a result of competitive pressures from truckers), railroads attempted to increase efficiencies by restructuring to run longer freight trains. New electronic switching yards were constructed with arrival and departure tracks sufficiently long to handle very long freight trains. Tracks were removed from multi-track main lines and computerized centralized traffic control (CTC) installed with long side tracks in order to handle fewer, longer trains efficiently.

The diesel electric locomotive and remote controlled locomotives operating near the ends of freight trains made possible even longer trains without adding additional crew members. Thus, while railroads were losing market share and moving fewer, larger capacity freight cars over their lines, the decreased number of even longer freight trains meant more delay in delivering goods to customers and decreased utilization of rolling equipment.

V. A COMPETITIVE BREAKTHROUGH

During this same period of time truckers were operating over newly constructed highways and offering fast, frequent service, a type of service that major railroads had not restructured themselves to provide. However, a dispassionate analysis of possible contemporary railroad operations indicated that by changing work rules railroads could be more than competitive with truckers for medium and even some short hauls.

While certain existing short lines and industrial rail operations had operated with less than the "standard" main line five person freight train crew working in 100 mile increments to earn one day's pay, the first line-haul rail company to make the change was the Florida East Coast Railroad in the 1960's. The FEC has a 285 mile main line running from Jacksonville down the Atlantic coast to Miami, Florida.

The method by which the change occured is important to understand. It was not a change suggested by the then Florida East Coast Railroad management; rather it resulted from an ownership change in which a single person was

appointed to represent the owners. He determined that the railroad would never be profitable as organized and asked that management refuse a pay hike demanded by one of the rail unions. This led to a strike, during which the representative of the owners required that the railroad continue to operate. As a result of his astute analysis of the problem and solution, the FEC now operates each train between Jacksonville and Miami with a single two person crew rather than three, five person crews (two people compared with fifteen people per train).

VI. ECONOMICS OF CONTEMPORARY RAILROADING

Rather than operating two long freight trains daily the FEC now operates eight to ten, some with very few cars. The economics of the FEC allow it to move piggyback and other freight much cheaper than trucks on a parallel interstate highway, and even at competitive prices with coastal shipping. Because of its low labor cost per train the FEC can operate several times as many trains as before, thus providing fast, consistent service for its customers. (3) It has been able to rebuild its trackage into an outstanding "world class" right-of-way while being one of the consistently safest rail operations over a period of two decades. Figure 2 indicates how costs of a typical railroad short line will compare with truck costs.

This actual main line operation is empirical proof that contemporary "state of the art" railroading can take business off the highways while creating additional jobs in the rail industry. Other major railroads are learning from this, among them the Burlington Northern with its two person piggyback train crews operating across several traditional 100 mile crew districts. While a beginning has been made, the vast majority of the freight operations of large railroads on the North American continent continue to be of the old, labor intensive variety.

The high cost per train of this type of operation creates a senario where light density branch lines cannot be profitable, leading to a spiral of higher costs, lost freight and decreased employment. Managements of large railroads have learned that by selling these light density lines to small new companies, they can keep the business of these "feeder" lines without the high operating costs that previously made these lines untenable. The short lines thus create jobs that otherwise would be lost to the industry.

VII. HCRC RAILWAY COMPANY

The HCRC Railway Company is a short line railroad created in 1976 from fifty-two miles of Penn Central branch line,

with additional track purchased in 1986 from a Norfolk and Western branch line. The HCRC now operates eighty-five miles of main track in southern Michigan, north-eastern Indiana and north-western Ohio. Its main line connection is with the Norfolk and Western Railway (N&W) at Montpelier, Ohio. HCRC is locally owned by shippers and other area interests.

Commodities moved include coal, grain, flour and other milling products and by-products, sugar, plastic resins, fertilizers and miscellaneous goods. Carloads originated, terminated or hauled locally by HCRC in FY 1987-88 will total approximately 3,000.

The main advantages of a short line railway such as HCRC include more flexibility in operating, less cost in running a train or switch engine (this does not necessarily mean lower wages), and the faster decision making, rate making and response time of a small locally owned and controlled company. HCRC has also found that it can obtain decisions and information faster from large railroads on behalf of on-line shippers because as a separate railroad, its officers and staff can directly contact the appropriate levels of a large railroad. It knows "who, where and when" to call.

Tailored personalized service can often be provided for shippers with switching problems or a need for a single "hot" car as a result of HCRC's short response time and small crews. Because of lower train costs, rates can be more truck competitive for short haul local and interline business. For example HCRC has truck competitive "truck wheat" gathering rates to a flour mill in Hillsdale, Michigan, from on-line grain elevators located ten, fourteen, seventeen, thirty, forty-eight and fifty-five miles from Hillsdale.

Often but not always these rates will bring in the wheat. Since railroad grain rates are federally regulated while truck grain rates are exempt, a farmer with a truck can make rates on the spot based on how badly he needs some cash rather than on transportation economics. In addition many elevators own trucks and have drivers on the payroll, and so will make decisions on other than direct transportation costs.

HCRC has instituted rates together with its major railroad connection, the N&W on "truck wheat" moves. Large quantities of wheat are moved to Hillsdale from Latty, Ohio, a truck distance of sixty-two miles. HCRC and N&W rates have resulted in the movement of more than 200 carloads of wheat from Latty this season. Further, HCRC has just instituted a wheat gathering rate from a large

elevator located on the N&W at Montpelier, Ohio this season and believes it will generate a considerable amount of rail business even though it is just 35 truck miles from Hillsdale. On this rate HCRC will pay the N&W a switch charge to switch the cars into and out of the elevator in Montpelier, then interchange them to the HCRC. This rate is possible only because the N&W switch charge is a reasonable one.

HCRC and N&W are regularly moving a significant amount of outbound corn and other grain from elevators located on HCRC to the Lake Erie port at Toledo, Ohio, a distance of approximately seventy truck miles. More than 250 carloads have moved this season. In return the railroads are instituting backhaul fertilizer rates in these cars that will be more than competitive with the $7.00 per ton truck rate for fertilizer from the lake boat "fertilizer pad" in Toledo to HCRC destinations.

N&W, with its cost structure would be unable to be competitive for many of these short, truck-competitive distances alone. But with HCRC providing 50 to 60% of the line haul distance on the moves, plus switching, billing, sales and other paperwork, these short moves have become profitable for the N&W. However N&W is still constrained on its portion of these moves by its high crew and train costs. HCRC has calculated that if it could control the whole move, for example to Latty or Toledo, car utilization could be improved from fourteen days or more per turn to a three to five day turn. This would cut equipment cost by a factor of three to five times, allowing even lower rates.

The above truck competitive short haul rates are proving to cause large shifts in demand from truck to rail. An estimated 1,800 truck loads of grain have been diverted to rail during the past grain season. It should be stressed that these moves are short haul "truck grain" moves. The long haul grain moves such as grain to the eastern seaboard or southeastern U.S. are in addition to this and have not been discussed herein.

VIII. IMPLICATIONS FOR MAJOR RAILROADS

What is it possible to do with a privately owned self guiding "track"? HCRC has a slogan that all employees try to live by. It is "TLAT", Think Like a Trucker.

If a major ralroad were to revise its work rules so it could operate in a "contemporary" manner rather than the present method, many light density lines would become very profitable for it to operate, and business would grow most significantly, in the author's opinion. Service and

equipment utilization would improve compared with the delays and extra crew costs inherent in a multi-railroad operation with interchanges, even when interchanged with efficient short line connections such as the HCRC.

For example, a few grain cars with a locomotive and small crew could shuttle between Toledo, other elevators and shippers on HCRC lines. The delays and multiple crews involved in the existing interchange between HCRC and N&W in Montpelier, Ohio could be eliminated. The reduction in crew and equipment cost coupled with the large incremental increases in medium and short haul traffic would, in the author's opinion, create large profits and a growth industry once again. This would lead to increased rail employment.

What is required of major railroad managements is the true desire to change, and a plan for transitioning from obsolete to state-of-the-art train operations. Until that time, and perhaps afterwords in many cases, the short lines, "thinking like truckers", will provide rail service to the small towns and small customers that are prime truck customers. Short line operators have found that this mode of thinking creates business and profits.

ENDNOTES

* President of the HCRC Railway Company, Inc., Hillsdale, Michigan 49252, USA

1 This is quite similar to the phenomenon in the 1920s and 1930s of visionary communities constructing airports to benefit from another revolutionary form of improved transportation.

2 The author's "Masters in Transportation" program thesis at Northwestern University was a study of innovations and organizational change in eight U.S. railroads. ("An Empirical Study of Some Relationships Between Technological Innovations and Organizational Characteristics in Eight Railroads," Northwestern University, Evanston, IL, U.S.A., 1966).

In 1974 he was invited by an agency of Congress (USRA) to spend 18 months studying eastern U.S. bankrupt railroads in order to help draft a plan for their successful reorganization. The plan led to the creation of Conrail. The author believes that while large railroad organizations are having great difficulty in adopting to a changed environment, they can and will change and adopt rather than fail.

3 While at USRA the author conducted an analysis of how similarly changed work rules on the new to-be-formed Conrail Corporation Railroad would decrease operating costs. The conclusion was that train and engine crew labor costs would be decreased to about 40% of the existing costs, a 60% reduction in crew costs. The author believes that savings in addition to the 60% calculated at USRA would now be available in "state of the art" train operations.

These savings would be available to pay for any combination of: significantly lowering rates, running numbers of additional trains, or operating short trains tailored to shipper needs between shipper sidings or industrial complexes. A study of the elasticity of demand between truck and rail business may well reveal that rail employment will swell as these new operating policies convert freight haulage from highway to rail mode.

Rationale for Regional Railroads in the Northern United States

by

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RATIONALE FOR REGIONAL RAILROADS IN THE NORTHERN UNITED STATES

INTRODUCTION

The development and productivity of the general economy in the northern United States is highly interrelated with the transportation network in that region. The access to resources for growth, country expansion and consolidation depended heavily on transportation linkages. Railroads have been a major factor in the development of this region's dominant industries: agriculture, forest products, and industrial products.

But, the very railroad system that contributed so much to the development of that region is now undergoing continued and substantial rationalization. Rationalization is commonly referred to as abandonment by those shippers who are faced with loosing their rail alternative to reaching their markets. This region, and the country, is still dependent on the railroad for the movement of their products as well as providing competition to other transportation modes. Almost 80 percent of the movement out of this region still goes by rail, usage of rail containers continues to increase, and road system continues to deteriorate because of some of these changes. The major contributing factors to this rail rationalization are economic conditions in the agricultural and forest products industries, transportation technological changes, railroad deregulation (Staggers Rail Act of 1980), the Interstate System, and competition from truck-barge service.

A significant alternative to the abandonment of some of these marginal or nonprofitable lines is the purchase of lines by a private individual or firm and subsequent operation as a shortline or regional railroad. Nationwide, 175 shortlines have begun operation since 1980 (with about half being 25 miles or less in length). The quick sale of branchlines became legal in 1980 under the Staggers Act, which substantially lessened regulation of the railroads. Now, railroads are able to sell "marginal" raillines, which otherwise may have been abandoned, to parties not currently in the railroad business. The Act allows almost immediate action; the sale can take place within 7 days of notification. It would be remiss if we did not point out that the sale of branchlines, allowed since 1980, had not occurred in any significant magnitude until about 1986, just two years before this summer's negotiations between railroads and unions on a 3 year labor contract.

The overall purpose of this paper is to evaluate the rationale for shortline railroads, examining the need and performance of this fairly recent technology. Specific objectives of the paper are to: 1) examine a case study of how the need for a shortline has been determined, 2) briefly review some existing shortline railroads operating in the northern United States, and 3) determine potential benefits and costs that may be associated with shortline operation.

A REGIONAL CASE STUDY OF NEED

No where is the abandonment activity more readily apparent than in the Palouse region of southeast Washington. In 1970, this area had 825 miles of railline trackage. Since then, 285 miles or 35 percent have been lost through abandonment. Such abandonments raise concerns about the availability of transport services, the ability to move bulk commodities efficiently in the future, impacts on the roads system, and increased need for funds to maintain such roadways. Because of this need, the economics of the existing railroad system in the Palouse region was evaluated, paying attention to those alternatives having the potential to retain essential rail service prior to piecemeal abandonment. The study included an estimate of the existing carrier's costs and revenues. Additionally, an evaluation of more efficient alternative configurations of the existing system was made to test for financial viability.

Study Area

The Palouse region includes southeastern Washington and northcentral Idaho. While the lines of the Camas Prairie Railroad east of Lewiston are not in the Palouse region, they were included because they provide an alternative connecting outlet for the Palouse lines.

Agriculture is the main economic activity in the Washington portion of the study area. In the Idaho portion, forest products industries are dominant, although agriculture is significant. Both the agricultural and forest product industries have rebounded somewhat from the economic slump of the early 1980s. Grain production and forest product movement has significantly increased, reaching a volume of the early 1975-80s. Significant increases in production in either industry within the study area are not foreseen. Therefore, the commodities available for shipment in the future were estimated to be at or slightly above the current level.

Raillines-Use and Operation

The 540 miles of raillines still in operation include lines operated separately by the Burlington Northern Railroad (BN), the Union Pacific Railroad (UP), and the Camas Prairie Railroad (CSP), a regional shortline jointly owned by BN and UP. Approximately 25 percent of the mileage is operated by BN, 31 percent by the UP, and 44 percent by CSP. Of the eight branchlines evaluated, all were capable of accommodating the weight of fully loaded 100-ton hopper cars, but five branchline operations had speed restrictions, some as low as 10 miles per hour.

The BN lines averaged 3,297 carloads per year during the 1983-1985 period, and the UP lines 3,282 carloads, generating estimated annual revenues of $6.1 million (including the abandoned Moscow to Arrow line in the estimate) and $3.9 million, respectively. The disparity in revenues is primarily attributed to the high value wood product movement and the low value grain product movement. The 1983-1985 average revenue per carload for

the study area traffic was $800 for grain, $3,500 for lumber and other wood products, and $200 for logs, chips, and other primary forest products. Several factors interact to cause the significant rate differences between these two major commodities. Grain traffic rates from the Palouse are kept down due to intermodal competition and a relatively short haul to deep water ports on the lower Columbia River. Nationally, grain is the very bottom commodity group in terms of revenue per ton mile carried. Lumber and wood products, on the other hand, can command higher rates, as a result of less intermodal competition, and typically have longer hauls to market resulting in higher revenues.

Proximity to the Columbia or Snake Rivers is an important determinant as to whether grain is shipped by truck to the river-barge or by rail. The average distance to the river from grain elevators using truck-barge is 40 miles. The development of rail multiple carloading facilities (MCLF) in recent years has enabled the railroads to compete more effectively with water carriers. This new technology allows the rapid loading of 25 or 26 car multiple trains and has lowered rail operating cost, resulting in lowered rates for wheat of over $2.00 per ton between 1981 and the present.

Line Evaluations

The analyses for this study are based on estimates of existing carrier costs and revenues generated from the area's traffic. These costs and revenues for the branchlines under study were developed using standard industry methods. The analyses of these raillines were made with a computer network simulation model. Total revenues for line segments were available for the BN portions, and estimated station totals were calibrated to these totals for BN lines. Estimated Rail Form A system haul variable expenses for each group was deducted from this revenue, leaving a "branch available" revenue totally attributable to each station. This revenue was then compared to the branchline costs. For an in-depth discussion of this methodology please see the Palouse Empire Regional Rail Study, done by the Departments of Transportation in the states of Idaho and Washington, April 1987.

Existing System Situation

The concept of this alternative assumed that the existing system will continue to be operated by the existing major carriers without significant changes in operation. Overall, the BN lines lost an estimated $.9 million on revenue of $5.6 million (minus 15 percent), UP lines lost $1.9 million on revenues of $3.9 million (minus 50 percent), and CSP lines had a surplus of $1.2 million on revenues of $20.5 million (plus 6 percent). On a line-by-line basis, the analysis showed that only two lines had significant operating surpluses. This was because of the high volume forest products movement off of those two line segments.

System Restructuring

Because the base system reflected such a large operating cost, an analysis of various restructuring options of existing lines was undertaken. Again, existing BN and UP estimated costs and revenues were assumed.

The node-by-node (station-by-station) cost and revenue approach revealed a picture of the weak and strong components under existing ownership of the system and permitted the selection of segments which appeared to have the best prospects of viability after restructuring. The process began by selecting and linking the points with the largest traffic generation potential, e.g., lumber mills, MCLFs and other major rail users. The restructured alternatives included both single and multiple railroad combinations. Adjustments were made in the unit cost to reflect changed conditions such as length of runs, required service frequency, etc., necessary for the restructured alternatives.

An examination of the costs and revenues associated with the restructured alternatives failed to identify an economic viable rail system that included a return on net liquidation value under the existing ownership. In certain circumstances, based on assumptions concerning traffic and connections not fully investigated in this study, it appeared two segment combinations may have the potential to operate with a surplus. However, the majority of the lines failed to support the costs associated with their ownership and operation. In essence, the analysis revealed that neither the existing system nor a restructured system based on existing cost conditions could be operated profitably by a major railroad company. Even with restructuring, most of the lines met the qualifications for abandonment under existing statutes on a revenue minus cost basis when operations are provided by the existing major carriers.

Regional Implications

The expansion of this study to project expected operating results under shortline operations was not done. The scope of the investigation was to provide a snapshot in time that would provide interested parties with information to assist future transportation planning, disclose any existing problems or successes, and reflect the probable time constraints for action. The estimated operating surpluses or losses under the current ownership for the raillines studied revealed ratios of expenses to revenues considerably over 100 for the majority of the existing lines and the restructured options, using BN or UP average costs. The implication is that major carrier operation of the existing or restructured system is unprofitable and most lines will, in the long-term, become candidates for abandonment.

In the analysis, the lines performing most favorably were those operating in Idaho and carrying forest and related wood products. This indicates the major problem for the lines in the study area may be the lack of revenues due to the low rated structure forced by competitive pressures. Without doubt, higher rates, and to some extent increased rail traffic, would make an important improvement in the rail service outlook for this area.

In summary, rail service under current ownership in the Palouse region is in jeopardy. A goal of this study was to identify and evaluate alternatives which would retain as much of the essential rail service in the region as possible. No simple solution such as system rationalization or restructuring was found adequate for the problem. The study revealed that the future of the existing rail system appeared dubious, and immediate action and/or community action are required to preserve a minimum core of essential and viable lines in the area.

This study did not evaluate the specific cost savings of shortline operation. However, it did identify that many private and public shortline operations have been in operation. Some of those near the study area are the St. Maries River Railroad (STMA) in Idaho and the Washington Central Railroad Company (WCRC). These two lines have been functioning efficiently and profitably for their respective owners. The study did quickly evaluate the effect of public agency ownerships or participation in private line operation. Identifying some financial reductions available from public or shortline (non-union) ownership brought the deficits in the revenue cost structure down to levels that could be offset by some minor revenue increases such as the development of new shippers, a return to rail use by existing industries now using other modes, rates surcharges, or other operating efficiencies.

Again, the bottom line of this analysis was that rail service under current ownership in the Palouse region was in jeopardy. The study revealed that the future of the existing rail system appeared dubious; the rationale for investigation of shortline operation was apparent.

Shortline Railroads-Northern United States Case Studies

Just as the earlier case study revealed a potential need for a shortline railroad as an alternative to continued piecemeal abandonment, other areas in the northern United States have witnessed the same need. With the advent of the Staggers Rail Act, we have seen expedited sales of marginal lines by the Class I railroads. These shortline railroads are increasingly indicating an ability to sustain themselves in a profitable fashion. In some cases traffic has increased while costs of operation have been decreased. The examples below are a short indication of the pervasiveness and characteristics of these shortline railroads.

Since the summer of 1986, Burlington Northern Railroad has sold or leased nearly 3,000 miles of its 29,000 mile system. Another 1,600 miles of track has been earmarked for sale. Two hundred and sixty four miles of track was sold by the Union Pacific, out of 21,500 miles, to shortline operators in 1987. The UP shortlines are now on hold but discussions are proceeding on 476 miles of track in southwestern Idaho and southeastern Oregon.

- Washington Central Railroad: This railroad is a good example of a non-union, shortline railroad that has evidences of excellent management and productivity. This railroad is owned by Nick Temple, purchased in October of 1986. The Washington Central serves over 200 shippers between the Tri-Cities and CleElum, both in Washington. This railroad is presently negotiating access to the Seattle area in western Washington. Nick Temple has been

quoted as saying that it would not be possible to make a profit with the existing work rules and costs for union employees. He suggests that is why the BN sold the line in the first place. The Washington Central employees between 35 and 40 people, most of whom worked for the Milwaukee Railroad prior to 1980. The Washington Central runs its trains with two and three man crews instead of four or five people. The railroad hauls horticultural fruit and some construction traffic and has been very innovative in competing for truck traffic.

- Pend O'Reille Railroad: This 61 mile line was operated by the Milwaukee Road until October of 1979. The line serves a large cement plant and several forest product related firms. The line was purchased by a local port district, formed for that express purpose, with an Economic Development Administration grant. The grant was matched by the proceeds of bonds issued by the port and purchased by the two major shippers on the line. Port districts in Washington are allowed by law to own and run railroads, delve into economic development activities, and have substantial authority including taxation and bonding. The port is governed by three elected commissioners and has a full-time staff. This railroad received $2.6 million in Federal and Local Rail Service Assistance funding for rehabilitation, matched by additional bond proceeds and cash provided by a private operator who had leased the line from the port. Austensibly, this is a railroad which a port acquired, rehabilitated, and operated through a lease without any contributing funds from the port being invested. After a shaky start-up, due to management and physical terrain problems, this port is now meeting all debt payments and, in fact, has a positive cash flow.

- Montana Rail Link: This shortline operates on 900 miles of Burlington Northern track from Billings, Montana to Sandpoint, Idaho. This is a very controversial shortline, one which has precipitated a wild cat strike against the Burlington Northern by about 900 members of the United Transportation Union. These members charged the transition was a farce because Burlington Northern still owns and controls the equipment and track. Since that controversial time, the carrier has agreed to maintain its union crews, but the union had to agree to wage reductions and the changing of work rules and job classifications. This railroad is also heavily agricultural in orientation and operates many through trains on its tracks.

- The Red River Valley and Western Railroad Company: This is a new railroad in North Dakota operating on 650 miles of track acquired from the Burlington Northern Railroad. Headquarters for the new line is Whapeton, North Dakota where the president and vice-president are located. Both of these officers are former Burlington Northern employees, having a total of 55 years of railroad experience between them. When fully operational, the line will have approximately 45 employees and 667 miles of track including 12 miles of rights over Soo Line tracks. When Burlington Northern sold this trackage it represented 21 percent of their 3,150 miles of track in North Dakota. The railroad is presently in operation and indications are that marketing activities are resulting in stable and increasing volume on the line. In this railroad, rail traffic can connect with either the Burlington Northern or the Soo Line.

This brief description of the railroads, presented above, shows the diversity in characteristics and variance in structure of these railroads. Some are unionized, some are non-unionized. Some are agricultural in orientation moving shortline movements while others are dependent on long haul movement. Some are publicly owned, some are privately owned and some have a combination of both. The common thread throughout is a combination of lack of alternatives, as far as maintaining the line under Class I status, and the availability of potential cost efficiencies when operated as a shortline railroad.

A CONCEPTUAL RATIONALE FOR SHORTLINE FEASIBILITY

There appears to be a strong conceptual basis for the feasibility of shortline and regional railroads. This is not to say that such firms do not fail, they do. However, what such a model suggests is that if the right conditions exist there are some fundamental reasons why shortline railroads can successfully exist as business firms along side Class I carriers or as partners in movements. In this section we will look at a conceptual model, which supports shortline railroad success, composed of six different but related elements, some of which are concrete and can be empirically measured and others which are more subjective. These six elements evolve around: 1) wage scales, 2) work rules, 3) operational flexibility, 4) decentralized decision making, 5) motivation and incentive, and 6) worker morale and satisfaction.

Differences in wage scale between national carriers and smaller regional and shortline roads obviously works in favor of the shortline. Large and even small Class I railroads pay relatively higher wages than shortlines. Class I railroads pay on the basis of a labor union negotiated national scale of wages developed from a position of labor power over the past 70 years. Local railroads usually pay on the basis of local labor rates, often times rural, which are typically lower. As an example, the Red River Valley and Western Railroad, discussed earlier, pays wages comparable to $8.50 per hour as compared to a rate of $20.72 per hour formerly paid by the Burlington Northern on the same system. Such a difference dramatically improves the economic feasibility of any given rail network.

The second item, work rules, magnifies the impact of reduced labor costs. Work rules for Class I carriers in the United States are very restrictive and archaic and can be characterized as mechanisms for feather bedding. Examples of such rules are the requirement for three crafts to change a head light in a locomotive, the 100 mile day and the need for a caboose. Some shortlines are not unionized and thus do not automatically operate with excess labor capacity. Those shortlines that are unionized often operate without work rules or have work rules which are not as restrictive. The elimination of restrictive work rules can reduce labor requirements significantly, while getting the same job done.

A third element which contributes to the success of a shortline/regional railroad is operational flexibility. This is partially a result of elimination of work rules but is also due to the difference in scope and size between Class I carriers and

shortlines. Large firms lack the same opportunities and flexibility in train scheduling that a small firm has. A small firm can fulfill an extemporaneous service requirement of a customer on short notice. With a large firm this is more difficult, simply because of the size and the complexity of coordination that is inherent in a large system. For instance, if a customer notifies a shortline on Saturday that a train is needed on Sunday it is probably within the scheduling possibilities of a shortline to do so. However, it would be unlikely that a large Class I carrier could do so.

Decentralized decision making is also a factor in the feasibility of a shortline when comparing the same system with a larger Class I rail network. Decisions made by large organizations are often centralized at head or regional corporate offices. Such decisions sometimes reflect a lack of understanding of the business needs at the local level and most always reflect system considerations rather than the needs of the smaller components of the system. Decision making at the local level, inherent in regional and shortline railroads, eliminates this problem. In short, local managers are more aware of customer needs and will make management decisions which reflect those needs if given the ability to do so.

A fifth area enhancing the feasibility of a shortline is the difference in motivation and incentive between Class I and the smaller firms. The marginal traffic which can be generated on a Class I line may pale in comparison to the overall gross revenue receipts by so much, that it is difficult to motivate management to aggressively capture such traffic. For example, Burlington Northern Railroad is a $4 billion plus company annually in terms of gross income. Now assume for an instance that there is an additional five cars of traffic that could be generated by some effort on the part of the marketing and sales department. Assume further that each car would generate an additional $3,000 of revenue. Assuming that the marketing and sales even knew of the opportunity, this would only result in a 0.00037 percent increase in revenue. However, a small regional railroad that only generates, for example, $5 million in gross revenue might look at this opportunity in a much different light. For a small operator of this size the additional five cars would result in a 0.3 percent increase in gross revenue. Furthermore, it would probably be much easier to provide pay incentives for the marketing and sales people for developing marginal traffic than it would be for the larger Class I carriers.

Finally, there is the issue of worker morale and satisfaction. It has been noted that people are happier when busy and productive. The productivity of labor and management alike is much higher on a shortline than a larger railroad. This ultimately could lead to a more satisfied work force with higher morale.

This discussion thus far has only noted some positive points for shortlines in comparison with larger Class I carriers. It does not identify negatives such as higher insurance and administrative costs, lack of working capital, low traffic densities, deferred maintenance problems, etc. However, if minimal conditions in these other areas can be met, the other above factors may just make the difference between survival as a short line or regional railroad or failure as part of a rail network of a large Class I carrier.

FUTURE RATIONALE

In our paper today we have tried to show that there is some continuing rationale for the existence of shortline railroads in the northern United States. A case study of the Palouse region in southeastern Washington and northern Idaho indicates the concern of the region about potential loss of the entire rail system. The cost analysis done indicates that the future of the existing system is doubtful while also indicating that a regional or shortline railroad may find this system a profitable possibility. Secondly, our discussion reviewed very briefly some existing shortline railroads in the northern United States. These railroads have been successful, and in most cases were generated by the possibility of railline abandonment. The existence of these roads and the expressed satisfaction of shippers with these lines does indeed suggest some rationale for their continued growth may exist. Finally, our conceptual discussion of the economics of shortline railroad did reveal many benefits associated, at least on a potential level, with shortline operation. These benefits further strengthen the rationale for the existence of shortline railroads.

We would be remiss in this discussion if we did not caution our statements regarding rationale for shortline railroads. Several of these railroads are built on lines that were "marginal" to the Burlington Northern or Union Pacific system. In such a case, the Class I railroad has found it beneficial, including potential negotiating power with the labor unions, to establish a working relationship with a shortline carrier. As the labor issues are negotiated and settled in the coming year, it will be interesting to see whether the incentive for the Burlington Northern to divest themselves of these lines continues to exist. It should be obvious that if a shortline railroad can make a line profitable, because of decreased labor costs and improved work rules, the same profitability may be available to the Class I railroad upon successful labor negotiations. That may determine the rationale in the future for shortline railroad existence.

Short and Long Term Impacts of Regulatory Reform on Air Transportation in Atlantic Canada

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1.0 INTRODUCTION

The research described in this paper involved an investigation of commercial air transportation activity in the Atlantic Provinces of Canada (New Brunswick, Nova Scotia, Prince Edward Island and Newfoundland). The study focused on scheduled passenger service on inter and intra-regional links.

The new National Transportation Act (Bill C-18) which came into effect on January 1, 1988 has substantially removed previous economic regulatory restrictions on the air transportation industry. In anticipation of this reform, the industry has essentially been operating under the new rules since 1984.

1.1 OBJECTIVES

Commercial air transportation in the Atlantic Provinces has already been affected by regulatory reform. The extent of change in terms of level of service is of prime concern since the region features many low density markets.

The primary objectives of this research were:

1. to measure the output and unit costs of the pre-deregulation air transport system in Atlantic Canada;

2. to evaluate short term (1984-1987) changes in air services in the region;

3. to predict possible future changes in the air service network; and

4. to evaluate probable changes in the air service network with respect to output, service levels, unit costs and changes in the aircraft fleet.

2.0 Short term changes of Atlantic Air Service (1984-1987)

The actual 1984 air transportation system was selected to represent the pre-deregulated period for the Atlantic region. Air service was provided by two air carriers, Air Canada, a major trunk carrier, which tended to provide inter-regional air service and Eastern Provincial Airways, a smaller regional carrier, focused primarily on intra-regional markets. Together these carriers served the Atlantic region providing scheduled air service utilizing both jet and turbo-prop aircraft.

An indepth analysis was performed on this pre-deregulated air network. The analysis was focused on the following attributes; number of direct flights, total frequency and "same day " return service. The results of each were then compared to the actual 1987 air service.

2.1 Flight Frequency Analysis (1984-1987)

The ultimate service an airline can offer is one which offers direct service between Origin-Destination pairs at a convenient time. The analysis of direct service was limited to the major cities in Atlantic Canada and four external gateways (Boston, Montreal, Toronto and Ottawa).

It is interesting to note the increase in frequency of direct flights throughout the Atlantic Provinces to Halifax (Figure 1). The frequency of daily direct air service has increased by almost an average of 50 percent. Seat availability (Figure 2) corresponds with the increase in flight frequency, however it is affected by the size of the corresponding aircraft in use. A further examination of direct service within Atlantic Canada to/from Halifax indicated that direct jet service has remained constant or increased slightly, while non-jet service has almost doubled for each O-D pair.

Considering destinations outside Atlantic Canada, the rate of increase in daily direct flights originating in Halifax was found to surpass that of the other cities. The majority of the cities have either remained stable or declined in direct flight

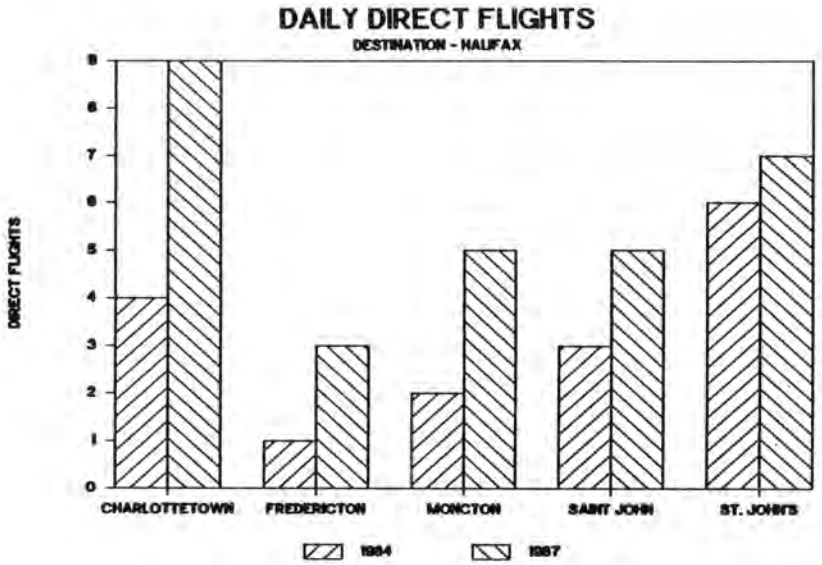


Figure 1

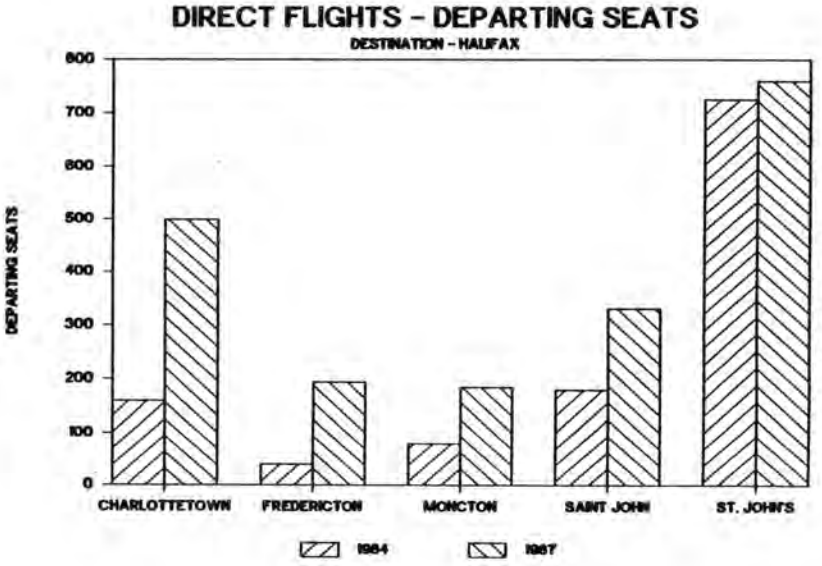


Figure 2

service. Seat availability corresponds very closely to the change in flight frequencies as connections with outside destinations are still receiving jet service only.

It is evident that Halifax is playing an increasingly important role in the new transportation system. In cases where service was offered between two Atlantic Canadian Provinces (ie. Saint John to Charlottetown), direct service has been eliminated. Most intra-regional city pair markets are now served via Halifax. Halifax is served by more direct flights than any other Atlantic city. The increased acitvity at the airport allows for an increase in the number of flights and available seats offered. It would appear that Halifax has assumed the role of a mini-hub for the intra-regional air services and to a lesser extent for inter-regional services.

Figure 3 and 4 illustrate the typical increase of frequency and available seats to Halifax within Atlantic Canada. Analysis of travel to outside destinations shows an increase in flight frequencies and available seats from all origins. It must be remembered that these flights are not only direct, but include the total available flights regardless of the number of scheduled stops that are made. Some O-D pairs have seen a decline in frequency, possibly as a result of being evaluated as overserved in 1984. Examples include-city pairs such as ; Fredericton to Montreal, Halifax to Ottawa and St. John's to Toronto. The decline in the Halifax to Ottawa frequency is suprising, however more flights are being routed through Toronto and Montreal and possibly do not make a convenient connection to the Ottawa destination.

Frequencies into the Atlantic Provinces have generally increased since 1984, but not for all cities. In the case of Charlottetown , frequencies from all external gateways have increased. Fredericton has suffered a decline in total incoming flights from all cities outside Atlantic Canada, and Saint John also shows some decline in arrival frequencies. In some cases, flight frequency has remained stable but seat availability has decreased (eg. Ottawa to St. John's).

2.2 Same Day Return Flights

Same-day return flights are important to business travellers. The opportunity to fly to a city, complete business matters and return home in one day is essential to business passengers in many city pair markets.

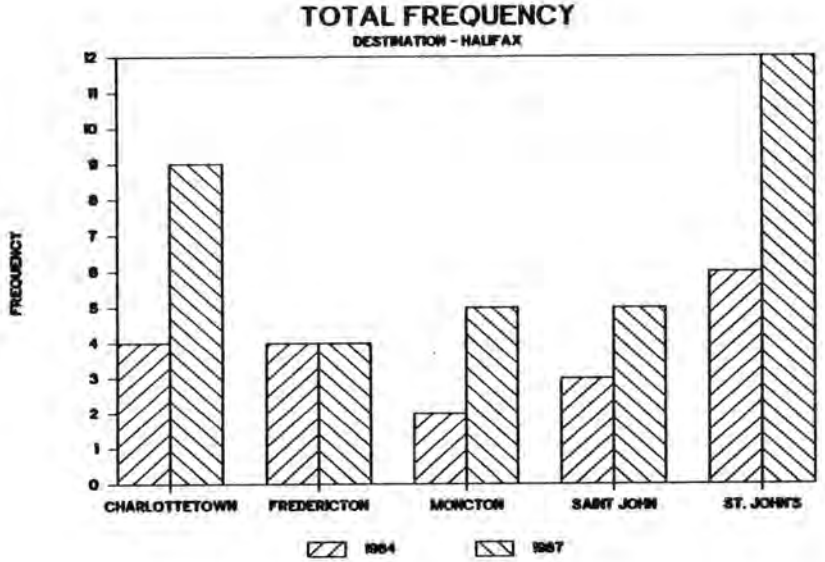


Figure 3

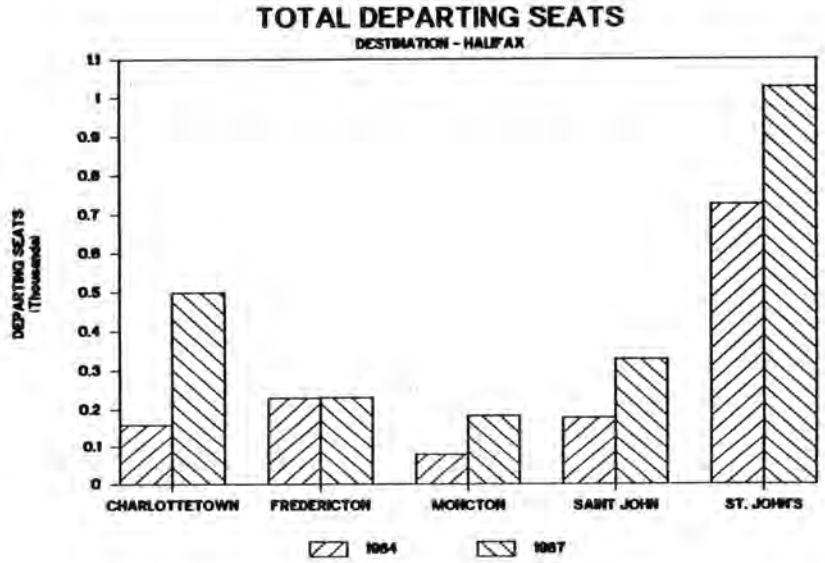


Figure 4

The analysis of same day-return flights in this study was based on the assumption that business travellers require at least five working hours at the destination before returning home. Table 1 outlines the analysis of the same-day return flights between the major cities in Atlantic Canada and the most frequent destinations outside the Atlantic Provinces. Halifax is receiving the best service, with respect to same day return flights. However most cities experienced slightly improved service in 1987. Fredericton exhibited the lowest quality of service with respect to same-day service.

Table 1
Same-Day Return Flights

ORIGIN	DESTINATION	NUMBER OF SAME DAY RETURNFLIGHTS 1984	1987
CHARLOTTETOWN	HALIFAX	1	4
	MONTREAL	1	2
	OTTAWA	0	2
	TORONTO	1	2
FREDERICTON	HALIFAX	1	1
	MONTREAL	1	1
	OTTAWA	1	1
	TORONTO	1	1
HALIFAX	MONTREAL	2	3
	OTTAWA	2	2
	TORONTO	3	5
MONCTON	HALIFAX	1	2
	MONTREAL	2	2
	OTTAWA	1	2
	TORONTO	2	2
SAINT JOHN	HALIFAX	1	1
	MONTREAL	2	2
	OTTAWA	1	1
	TORONTO	2	2
ST. JOHN'S	HALIFAX	3	2
	MONTREAL	2	2
	OTTAWA	1	2
	TORONTO	3	2

2.3 Analysis of Service To/From Small Airports

Table 2 outlines the direct service offered at smaller population centers and the changes that have occured since 1984. Direct flight frequency and available seats to Halifax have increased, including O-D pairs that had no direct service in 1984. Changes in aircraft type have had a major impact on service to/from small airports. Even though frequency has increased considerably, available direct seats have not risen as quickly. For example, in the Halifax-Yarmouth market frequency has increased, yet seat availability has decreased due to the elimination of Air Canada's jet service.

Research findings demonstrate that the number of available seats to/from Halifax have increased at a slower rate than flight frequency. This suggests that the type of aircraft serving Halifax has changed. The increased use of the turbo-prop aircraft has been effective in increasing flight frequency while maintaining reasonable load factors.

Table 2
Direct Service - To/From Halifax

ORIGIN	DESTINATION	DIRECT FLIGHTS 1984	DIRECT FLIGHTS 1987	DIRECT SEATS 1984	DIRECT SEATS 1987
DEER LAKE	HALIFAX	0	3	0	194
STEPHENVILLE		0	1	0	37
SYDNEY		7	10	530	599
YARMOUTH		0	1	0	37
HALIFAX	DEER LAKE	1	3	110	194
	STEPHENVILLE	0	1	0	37
	SYDNEY	6	9	430	479
	YARMOUTH	1	2	100	74

2.4 1984-1987 Short Term Findings

Comparison of 1984 pre-deregulated air service to the present relaxed regulatory environment indicates that many changes have been made on air services in the Atlantic region. The larger airlines have withdrawn from low density, short distance routes and have concentrated on larger, more dense routes that are more suitable to their aircraft types. Air Canada and Canadian Airlines have both established alliances with local/commuter carriers which provide feed traffic from low density routes. Most of Atlantic Canada is now served with smaller turbo-prop aircraft. However many larger cities still have the convenience of direct jet service into and out of the region.

Most airports within the region have experienced a significant increase in frequency of flights to/from key destinations. This has been supplemented in most cases by increases in available seats and flight offerings of "same-day-return" service in key city pair markets. The comparative analysis of service between 1984 and 1987 revealed that less populated centers such as Deer Lake, Nfld., Stephenville, Nfld., Sydney, N.S., and Yarmouth, N.S have received improved service. The big winners in the Atlantic region appear to be Charlottetown, P.E.I. and Halifax, N.S..

Halifax has emerged as somewhat of a "mini" regional hub. Additional frequencies of small turbo-prop aircraft have been initiated by feeder airlines, interlining with alliance carriers in Halifax. This has been reflected by an increase in the level of service between Halifax and the gateway airports in Boston, Montreal, Ottawa and Toronto.

There have been some exceptions to this generally favorable trend, for example, air service to/from Fredericton, N.B. The same level of service is evident in 1987 as was provided during the 1984 base period. While other Atlantic cities benefit from the emergence of Halifax as a regional hub. Fredericton's geographical location in relation to Halifax is such that the use of Halifax as a hub for inter-regional services to/from central Canada is not attractive. Thus Fredericton is excluded from the additional benefits (increased frequency offering) obtained from the hubbing phenomenon at Halifax.

The result of the short-term comparative analysis (1984-1987) of air service suggests that

there has been a significant improvement in intra-regional air service in Atlantic Canada. While communities like Fredericton in the short-run have not received the gains witnessed by other centers, long term improvements should not be ruled out.

3.0 Future Scenarios

Four alternative scenarios were designed to represent potential networks which might approximate an air transportation system shaped by market forces. These scenarios were entitled:

1) Adjusted 1984 Air Service;
2) Halifax Hub;
3) Halifax and St. John's Hub; and
4) Minimum Direct Jet Service Hub.

A description of each alternative scenario is outlined.

3.1 The Adjusted 1984 Air Service Network

The Adjusted 1984 Air Service scenario was designed to illustrate the level of service which might have been provided if the air carriers had had perfect knowledge of passenger demand. The scenario illustrates the extent to which the efficiency of the network could be improved by optimally matching service to demand.

The pre-deregulated air network was adjusted taking into account the actual 1984 STATCAN demand statistics. Air service was adjusted to accomodate this demand by establishing frequencies and aircraft types based on the following criteria:

- maximum practical frequency levels per O-D city pair based on the assumption that on average aircraft fly at 65% load factor;

- air service provided by; 35 seat, 50 seat, 100 seat, 110 seat and 214 seat aircraft;

- same day service for each O-D city pair where demand was sufficient;

- assessments made on a per week basis.

Air service, defined as direct, one-stop and two-stop service was formulated based on the passenger demand between each pair.

3.2 Halifax Hub Scenario

A "hub and spoke" air service concept has been adopted by a number of U.S. airlines since their deregulation. The basic element of this concept is the appropriate selection of a regional airport facility. The designated airport acts as the network's central hub. Other regional airports provide feeder link service to this hub, where passenger demand is accumulated and dispersed to final destinations. The hub concept increases frequency to/from the centroid thus increasing the level of service through additional frequencies.

As the short term analysis illustrated Halifax has emerged as a small Atlantic regional hub since 1984. Some people beleive that in future, all flights in the region will be routed through Halifax. The purpose of this scenario was to evaluate such a concept from a network effeciency and cost point of view. Air service was adjusted to accomodate passenger demand generated to/from the Atlantic region based on the following criteria:

- all movements via a defined hub at Halifax, Nova Scotia;
- serve all O-D city pairs internal to the region exclusively with a 35 seat turbo-prop aircraft;
- assume aircraft operate at a 65% load factor;
- use 1984 STATSCAN O-D passenger data.

3.3 Halifax and St. John's Hub Scenario

A variation of the single hub concept - ie. two regional hubs was also evaluated.

The two hubs which were selected were Halifax, N.S. and St. John's, Nfld.. Air service was adjusted consistent with the O-D demand using criteria similar to the single hub scenario. All movements were directed through the two hubs and aircraft were assumed to operate at a 65 percent load factor.

By nature, a single hub scenario results in increased level of service through additional one-stop frequencies. This of course is at the expense of the number of direct frequencies serving Atlantic provinces O-D city pairs. This may be attractive for intra-regional travel, but passengers wishing inter-regional service may have to backtrack through the central hub. A dual hub scenario addresses this issue by offering an air service network with one hub centered in Newfoundland and the other in Halifax. The Newfoundland hub would serve the inter-regional travel demand with minimal backtracking. The number of frequencies serving intra-regional demand from these hubs would be less than in a single hub network.

3.4 Minimum Direct Air Service Scenario

Although short-term changes in air service indicate a trend towards an increased use of Halifax as a hub the airlines continue to offer direct air service on many O-D pairs.

A minimum direct air service network was designed combining the concept of a network hub with direct air service on selected city pairs. The selected frequency and aircraft fleet was based on the following assumptions:

- maximum practical frequency levels per O-D pair based on the assumption that on average aircraft fly at a 65 percent load factor;

- serve all O-D pairs with ONE direct jet frequency only on routes where demand will support the service;

- all remaining passenger demand to be routed via a defined hub at Halifax, Nova Scotia and;

- serve all "hubbing" air routes with similar aircraft.

In this scenario, passengers receive the benefits of both a single direct jet frequency (where demand is sufficient), and the Halifax hub network attributes. Of the four scenarios evaluated, this one most closely approximates the status quo.

Table 3

SCENARIO COMPARISON

Scenario	TOTAL COSTS (000'S)	TOTAL ASM'S BILLION	TOTAL RPM'S BILLION	TOTAL WEEKLY ASM'S MILLION	AVERAGE COST PER SEAT MILE	APPROX. LOAD FACTORS
Actual	$4,402	2.309	1.511	44.42	$0.100	65%
Adjusted	$3,555	2.284	1.583	43.934	$0.080	69%
Halifax	$5,553	2.614	1.675	58.296	$0.095	64%
Halifax and St. John's	$5,491	2.198	1.666	42.251	$0.082	76%
Minimum Direct	$4,089	2.476	1.63	42.275	$0.095	66%

Table 4

	REQUIRED AIRCRAFT (Based on 8 hr. per day)						Total Aircraft		# of Stops				TOTAL DIRECT O-D CITIES SERVED
	35	40	50	100	110	214	Turbo	Jet	0	1	2	3	
Actual	0	3	0	11	10.7	0.9	3	22.6	97	107	39	0	243
Adjusted	6	0	1.3	2.7	10.1	2.4	7.3	15.2	55	110	59	10	234
Halifax	17.7	0	0	3.4	0	10	17.7	13.4	33	206	0	0	239
Halifax and St. John's	22.1	0	0	4.8	4.2	2.6	22.1	11.6	40	150	53	0	243
Minimum Direct	13.9	0	0	11.7	0	3.4	13.9	15.1	51	194	0	0	245

3.5 Scenario Summary

Each potential scenario was evaluated and the output for each was measured in terms of total available seat-miles and revenue passenger-miles generated and total direct operating costs (excluding

aircraft ownership costs). This output was used to estimate the average cost per seat-mile, average load factor and the total number of aircraft required to serve each scenario. The following tables provides a full summary of this research output.

4.0 The Future of Air Services in Atlantic Canada

The analysis of potential future network scenarios is by no means exhaustive. Many scenarios are possible. However the analysis does lead to several major conclusions regarding future air services.

The cost-effectiveness of air services has already and should continue to improve significantly. All four scenarios feature higher frequency of air service on most city pairs as well as a lower system seat-mile cost.

Halifax has and will continue to emerge as somewhat of a mini-regional hub, particularly for intra-regional air service. However the analysis done in this study clearly shows that the cost and efficiency penalties associated with routing all traffic through Halifax to make connections are substantial.

Competitive factors will also mitigate against the evolution of a pure "Halifax hub". Many centers within the region have sufficient demand to key external points such as Montreal, Ottawa and Toronto to warrant direct service. With freedom of entry into markets, if one airline attempts to route passengers through a hub, another might enter and fly passengers direct from spoke to spoke or spoke to hub as the case may be. The opportunities for such direct services are much greater with smaller turbo-prop aircraft.

The scenario analysis indicates that there is room for significant expansion of the turbo-prop fleet serving the region. The major determinant of the degree of expansion will be the extent to which the commuters are permitted to engage in inter-regional services by the "de facto" regulators of the airline industry - Air Canada and Canadian Airlines International Ltd.. Various factors such as overall market growth and carrier financial performance will have a bearing on the development of such a trend. New Brunswick cities in particular, because of their geographical proximity to central Canada might experience significant substitution of inter-regional

jet services with turbo-prop services. The increases in travel-time (approximately 20-30 min) could be offset by increased frequency and convenience of service.

The outlook for service to small communities is good with one caveat. The potential for improved services to communities such as Charlo, Yarmouth, Deer Lake, Stephenville and Goose Bay has improved because of; 1) the expansion of the turbo-prop fleet serving the region, 2) the resultant pressure on carriers to find opportunities to increase the utilization of these aircraft and 3) the freedom carriers now enjoy in establishing new routes.

5.0 Conclusions

Atlantic Canada has in many respects, led the way in Canada in terms of rationalization of the air transportation system under a market-oriented regulatory policy.

Two regional airlines are now competing in the marketplace as opposed to one in the pre-deregulation era. The alliance partnerships between these two carriers and the two majors have brought a degree of stability to local-commuter services which previously did not exist. In the past decade, several attempts to establish new services ended in failure after a brief period.

The major uncertainty with respect to the future is the extent to which further substitution of jet service by smaller turbo-prop aircraft will materialize. The potential for such substitution is greatest on inter-regional services particularly between New Brunswick and Central Canada.

On balance, both the actual short and projected long term results identified in this study point to a more cost-effective air service network in the region under the new relaxed system of economic regulation.

Acknowledgements:

The authors of this paper whish to acknowledge Transport Canada for funding this research project as well as Prof. A.M. Stevens and Mr. C.H. Glenn for their advice on methodology.

MARKET CONTESTABILITY THEORY AND THE DEREGULATION OF CANADIAN AIR TRANSPORT

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The proposals to deregulate Canadian air transport were first presented as a part of the document "Freedom to Move" (1985) that provided the theoretical framework for the new National Transportation Act(Bill C-18). Under the new legislation, which has become effective as of January 1988, the government retains full regulatory authority over safety, while the economic regulation (entry and pricing) is being substantially relaxed.

On the northern routes[1], entry will be regulated by the "public convenience and necessity" criterion. However, the burden of proof that the criterion is not met by an entrant is to be on the objecting parties. Thus, entry should be much easier on these routes. In the south, where the overwhelming share of traffic is generated, entry will be deregulated for all "fit, willing and able" operators. On most routes, airlines will be free to determine their prices; it is claimed that "freedom of entry and exit... and the attendant increase in competition would eliminate the need for continued tariff regulation" (*Freedom to Move*, 1985, p. 28). The exceptions are northern routes (both price levels and price increased) and monopoly routes in the south(price increases only). Regulatory control, however, is to be exercised only in cases where there is a complaint in writing. The provisions to retain a weak form of price regulation on some routes are made not on the expectation of monopolistic behavior but "in order to *relieve concerns* about unreasonable price increases" (*Freedom to Move*, 1985).

The reliance on potential competition as a principal mechanism of ensuring competitive pricing is consistent with the notion that Canadian airline markets are "contestable". "Freedom to Move", however, does not provide any proof of the empirical validity of this claim. This paper examines the issue of contestability in the Canadian airline industry and its implications for the regulatory reform.

Are Canadian Airline Markets Contestable?

The theory of contestable markets states that markets are contestable when both entry and exit are free, and when there is a possibility of "hit-and-run" entry. Freedom of entry is defined as the lack of any cost disadvantage for potential entrants; "hit-and-run" entry is possible if the entrants can enter and exit markets faster than the existing firms can change their prices, or where there is a ex-ante contracts between entrants and consumers are possible. If the contestability assumptions are satisfied, potential competition may be an effective substitute for actual competition, and inefficiencies traditionally associated with high concentration will not arise (Baumol, Panzer and Willig, 1982).

The authors of the theory have often used the airline industry as an example of contestable markets. (In Canada, Reschenthaler and Stanbury(1981) have made a similar claim.) The arguments to support this claim are as follows. First, " if a route is flown by a single carrier, other carriers who have stations at both end-point cities can readily enter if monopolistic profits become evident" (Baumol et al., 1982, p. XXI). This suggests that entry into a given city-pair market can originate from already

established carriers which are currently serving other markets. Second, entry into a given market can originate from a start-up carrier who, it is claimed, "needs only to fly his airplane into the airport, undercut the incumbent's price and fly his airplane away...even if he only returns his rented aircraft or resells it in the well functioning secondary aircraft market"(Baumol et al., 1982, p. 7). Since the two types of entry are not identical, it is necessary to establish which one is relevant in any particular set of markets.

An example of a country where potential competition in airline city-pair markets may originate from existing carriers is the U. S. Given its huge domestic market, there are many independent carriers operating often overlapping networks in the U.S. For most countries, however, the typical market structure is either monopoly or duopoly.

Canada clearly falls into the second category. According to the *Official Airline Guide* (July, 1986), 82 of the largest 100 city-pair markets (ranked by volume of origin and destination traffic) are served by one or two carriers (Table 1).

TABLE 1
CONCENTRATION IN THE MAJOR CANADIAN CITY-PAIR MARKETS

CITY PAIRS RANKED BY VOLUME OF TRAFFIC	NUMBER OF MARKETS WITH ONE CARRIER	TWO CARRIERS	THREE OR MORE CARRIERS
RANKS:			
1 to 25	3	12	10
26 to 50	5	17	3
51 to 75	7	16	2
75 to 100	6	16	3
Sub-totals	21	61	18

SOURCE: *THE OFFICIAL AIRLINE GUIDE* (JULY 1986)

The two dominant carriers, Air Canada and Canadian Airline International compete with each other on most of their routes. The third carrier, Wardair, provides services on a limited number of routes (primarily high density ones connecting major cities). Given these high levels of concentration, and the fact that Wardair's capacity (at least in the short-run) is limited, potential competition to the two majors has to originate from new start-up operators.

Barriers to entry facing new carriers can potentially originate from the following sources: sunk costs, product differentiation, access to computer reservation systems,

airport access and availability of essential inputs, and (in the case of small and gradual entry) economies of scale.

The most important source of sunk cost is asset specificity. Using Air Canada as a representative carrier, airline assets can be broadly divided into airplanes and flight equipment, and ground property (Table 2). The first category includes airframes, aircraft engines, aircraft propellers and spare parts, and accounts for about 76 percent of the value of airline assets. Given that there is a well developed secondary market for planes and flight equipment, these assets should not result in sunk costs. However, a qualification applies here: selling and buying planes may involve nonnegligible transaction costs, especially when brokers are used. Also, the price of the assets always depends on market conditions - the book value of the assets may not be recovered if there is temporary excess supply.

The second category of assets includes the following: ramp equipment; communications and meteorological equipment; maintenance and engineering equipment; surface and transport vehicles; miscellaneous ground equipment; buildings; furniture, fixture and office equipment. This category accounts for about 24 percent of the total value of the assets. It appears that these assets may be more difficult to resell and therefore at least partly sunk.

In addition to asset specificity, sunk cost may result from expenditures on advertising and labour training which together amount to 2.5-3.0 percent of total operating cost (Statistics Canada, 1981).

Thus, although it is true that the level of sunk costs in the industry is not high, these costs are not entirely absent. Schwartz(1986) has recently demonstrated that even a low level of sunk costs is sufficient to make the industry's performance deviate substantially from the contestability ideal.

The second potential source of entry barriers, product differentiation, involves the characteristics mix of the airline service and consumers' preception of service quality.

The characteristics mix includes flight frequency, type of plane, comfort (i.e. leg space, seat width, amenities, food and drinks, movies, newspapers), baggage handling, number and type of connections, linkages to auto rentals and hotels, frequent flyer programs and safety. Some of these characteristics, such as amenities, comfort features, and types of planes used, can be duplicated and therefore should not result in a competitive disadvantage for new entrants. Others such as frequency and the number of cities served cannot be easily duplicated, especially if entry is small and gradual. The number of cities served is particularly relevant on routes where direct, non-stop service is not available. On such routes, in addition to the cost of the ticket, the consumer costs include time loss between connections, the disutility of switching planes and airlines and the increased probability of losing baggage. Airlines operating in many markets are able to offer on-line indirect service (that is a consumer still has to change planes, but he can stay with the same airline) which can reduce consumer transaction costs.

The product differentiation advantages of established carriers are especially apparent on international routes. In Canada, international routes account for about 47% of the industry's output(Statistics Canada, 1984a).

International traffic is regulated by bilateral agreements between countries. Under a typical agreement, each country has the right to select its designated carriers, and usually only one carrier per country is allowed to serve each route. The designated carriers, having exclusive rights to serve international routes, can experience a competitive advantage over other carriers - new entrants, in particular. The first source of this advantage arises from the consumers' preference for on-line over inter-line service (which is relevant in cases where a trip includes a domestic and an international segment). Another advantage of designated carriers results from their

TABLE 2

STRUCTURE OF AIRLINE ASSETS - AIR CANADA (1981)

ASSETS	$MLN	PERCENT OF THE TOTAL
FLIGHT EQUIPMENT		
1. Airframes	1,723	71
2. Flight equipment	139	5
Sub-total	1,862	76
GROUND PROPERTY AND EQUIPMENT		
3. Ramp equipment	45	1.9
4. Communications and meteorological equipement	2	0.1
5. Maintenance and engneering equipment	27	1.1
6. Surface and transport vehicles and equipment	1.5	0.06
7. Furniture, fixture and office equipement	2	0.1
8. Miscellaneous ground equipment	125	5
9. Buildings and construction work in progress	346	14.2
Sub-total	548.5	24
Total	2,410.5	100

SOURCE: STATISTICS CANADA (1981).

ability to enter agreements with other international airlines. The agreements may include coordinated marketing strategies, flight scheduling, joint fares and participation in each other's frequent flyer programs. (An example of such an arrangement is an agreement between Air Canada and Cathay Pacific (*The Globe and Mail*, July 5, 1986)).

A relatively new tool that enhances the ability of the airlines to differentiate their product are frequent flyer programs. These programs offer premiums to frequent travellers, the typical awards being free flights, upgrades from one class to another, free hotel rooms, free car rentals and cruise trips.

The most popular frequent flyer program in Canada is Air Canada's Aeroplan, membership in which was estimated to be about 225,000 (*The Globe and Mail*, December 8, 1986). Miles can be accumulated by travelling not only with Air Canada, but also with Air Ontario, Air Nova, Northwest Territorial Airways and First Air as well as with specified international airlines. The participating airlines have established a system of clearing the accumulated points and cashed-in awards. In addition to the airlines, program members include car rental companies and hotel chains[3]. Participating car rental agencies and hotels not only offer special discounts to the plan participants, but also allow the fliers to accumulate points if they rent a car or stay in the hotel(even if it means no flying at all). Canadian offers a similar program called Canadian Plus[4].

A frequent flyer program may be considered as a form of "in-kind" discount. Given that microeconomic theory suggests the consumers prefer cash rather then equivalent in cash "in-kind" transfers, the question arises as to why the programs create entry barriers if the new entrants are free to offer equivalent cash discounts? Here are some reasons:

1. In many instances the price of the ticket is paid by the employer of the program member. The award, on the other hand, is received by the traveller himself. Thus, a more expansive ticket offering "in-kind" premium will be preferred to the cheaper one, offered by the new entrant.

2. The big carriers are in a position to negotiate special deals with car rentals, hotels, cruise operators and other program participants. These savings may reflect the bargaining strength of the bigger carriers and also reduced transaction costs for other program participants. Frequent flyer program awards may serve as a mechanism to pass some of these savings to the consumer.

3. Frequent flyer programs typically offer awards which increase progressively with the number of miles flown. If most business travellers are already members of the programs administered by the existing carriers, an entrant may experience a competitive disadvantage. The entrant would have to offer premiums at the high rates currently earned by travellers, thus missing the opportunity of giving proportionally smaller awards at the beginning of the program. This implies higher costs of offering a program as attractive as those offered by the established carriers.

In addition to the characteristics mix, product differentiation is influenced by consumers' perceptions of service quality. Quality, however, can only be assessed by flying with an airline. Given the uncertainty about quality, entrants would have to "bribe" customers to try their service; the cost of the "bribe" is sunk and will result in a barrier to entry.

Information about fares and schedules can be obtained from the Official Airline Guide. However, when fares and schedules change often, using the guide becomes impractical for customers and it is more convenient to rely on computer reservation systems connected to travel agents' terminals. The systems are very expensive and are subject to economies of scale. At present, the dominant system is Air Canada's Reservec which is connected to more then 3000 travel agencies. Although a new entrant may gain access to existing systems by a way of user fees, the owners of the systems may set charges at a monopolistic level. This will impose an extra cost on the entrants and is an extra source of revenues for the system owner.

Perhaps even more important is the so called "display bias" that occurs when the computer program running the system is designed to favor the sponsoring carrier's flights. "Display bias" may have significant implications, because, according to studies conducted in the U. S., nearly *90 percent* of all travel agents' bookings are made from the first screen. Furthermore, as many as *50 percent* of all bookings are made from the first line of the screen (*Air Transport World*, 9, 1983).

The ownership and control of the computer reservation system may give the

host airline additional advantages arising from other uses of the system. Currently, in addition to flight reservations, the systems are known to perform the following functions: hotel reservations, car rentals, baggage trace, scheduling, crew management, inventory management, maintenance scheduling, performance analysis, financial analysis, fuel management, frequent flyer program administration (*Air Transport World*, 9, 1983). Finally, access to information generated while operating the system may allow the host airline to be first in identifying changes in the relevant market conditions.

The feasibility of entry also depends on getting access to airport facilities. Airport facilities (including landing slots) are owned by municipalities and the federal government. The owners typically lease out the facilities to the airlines. At times when there is an excess of airport capacity acquiring access rights may be relatively easy. At present, with the exception of Toronto and Vancouver, this appears to be the case at the major Canadian airports. Excess capacity, however, may not last indefinitely, and the possibility of future shortages of space cannot be excluded. If all airport facilities are leased out to the existing carriers, a new entrant would have to acquire access rights from the very carriers he intends to compete with.

Similarily, as in the case of airport space, the availability of specialized labour, such as pilots and mechanics, varies over time. Although the new entrants (at the time of labour shortages) can attract workers by offering higher wages, this implies higher costs and hence a competitive disadvantage.

The American experience after airline deregulation reveals the typical entry pattern for the class of start-up operators: small scale entry in selected markets, followed by a gradual increase in capacity, and expansion into new city-pair markets (Meyer and Oster, 1984). The small entrants, however, may experience competitive disadvantage versus the established airlines if there are economies of airline size.

The two concept that can be used to describe economies of airline size are economies of scale and economies of traffic density. Economies of scale can be defined as the potential cost reductions due to increase in both the number of destinations served and output. Economies of traffic density in turn can be defined as potential cost savings resulting from an increase in output for a *given* number of points served(Gillen et al., 1985).

While there is a general consensus regarding the presence of economies of traffic density, the issue of economies of scale is subject to ongoing controversy. Most of the empirical studies based on the statistical estimation of airline cost functions suggest the absence of economies of scale (e.g. Caves (1962), Jordan (1970), Douglas and Miller (1974), Gillen et al.(1987)). Because the usual assumptions concerning strict profit maximization and perfect competition in the input markets are rarely met (especially if the industry is regulated and the labour force is unionized), and because of imperfections of accounting data, evaluating economies of scale solely on the basis of cost estimation may lead to biased conclusions. Recognizing the limitations of cost based techniques, Stigler (1958) proposed an alternative method - the "survivor" test. The experience of the American airlines after the Airline Deregulation Act of 1978 may be used to evaluate the presence of economies of scale in the industry. A declining market share of the big trunks operating multipoint integrated network could be interpreted as an indication of the lack of economies of scale; an increase in the market share of the biggest carriers could in turn be considered as an indirect proof of the presence of scale economies.

In the first years of deregulation - between 1978 and 1983, the shares of the first four, first six and first eight carriers dropped from 60.5, 75.1 and 82.2 percent to 45.9, 60.9 and 67.3. This trend, however, was abruptly reversed in the following years. Having adapted to the new environment, the biggest carriers not only regained, but exceeded their pre-deregualation market shares. Thus, in 1986, the shares of the first four, first six and first eight carriers increased to 64.25, 85.35 and 92.03 percent.

The biggest carriers appeared to be winning the "survivor" test.

As already stated, economies of scale and economies of traffic density are usually treated separately. The problem is that they may be interdependent. To see this consider the following example. There are three cities A, B and C located along a straight line. Demand is inelastic and equal to k passengers per day in each city-pair market (AB, BC and AC). Theoretically, the markets can be served by three separate airlines flying k passengers once a day or k/f passengers f times a day. Suppose now that the airlines merge and establish a "hedge-hop" network, that is on a typical flight a plane originating in A picks up 2k passengers going to B and to C, stops in B where it deplanes k (A to B) passengers, while it picks up k (B to C) ones. Thus, the number of passengers on board on each segment doubles compared to the previous arrangement. The airline can use bigger planes that offer lower costs per seat. The idea of combining traffic can be extended beyond a simple linear network, and low density direct flights can be replaced by indirect ones connected into a "hub-and-spoke" network. McShan(1986) has recently found significant effects of "hubbing" on airline costs; carriers operating "hub-and-spoke" networks have had lower costs and higher load factors than their competitors.

In addition to combining their own traffic flows, airlines receive "feed" from commuter carriers. Both in the U.S. and in Canada, the major airlines (using majority or minority ownership and marketing agreements) control most of the commuter carriers. Typically, a commuter and a major airline share the computer reservation code, coordinate flight frequencies and baggage handling. The commuter carriers also participate in the majors' frequent flyer programs. Being denied the "feed" from the commuter carriers, a small scale entrant will not be in a position to capture the available economies of traffic density.

Thus, both economies of scale(network) and the inability to acquire "feed" may result in barriers to entry for a small start-up airline.

In addition to freedom of entry and exit, market contestability requires the feasibility of "hit-and-run" entry. The two arguments used to support the notion of the feasibility of "hit-and-run" entry in airline markets are the following: a) the incumbent airline's price response lag exceeds entry and exit lags of the new entrants; b) there is a possibility of ex-ante contracts between the customers and the new entrants (Baumol et al., p. 7 and 493).

The first argument says that it that it takes more time for the incumbent to adjust prices than it takes for the new entrant to acquire the necessary inputs, secure airport access, inform the customers, fly-in the planes and then withdraw from the market. There seems to be nothing in the economics of the industry to justify this lag structure. Adjusting fares can be done quickly, especially in the case of carriers operating their own computer reservation systems. The experience of the U.S. airlines after deregulation suggests that the established carriers can swiftly react to entry using a variety of competitive tools (Brenner et al., 1985).

The possibility of ex-ante contracts between customers and entrants can constrain the incumbents in the following way: if the incumbents charge excessive prices, the entrants may approach the customers and sign contracts guaranteeing lower process. To prevent this from happening, the incumbents would have to keep prices at a competitive level. The case of ex-ante contracts may be of some relevance in charter markets. However, it clearly does not apply to the regular scheduled service, the very nature of which is its availability *on-demand*. The recent decline in the importance of charter markets and the increasing trend of offering scheduled and charter services jointly (Doganis, 1985), makes this case even less relevant.

In sum, it appears that none of the conditions necessary for contestability is satisfied in the Canadian airline markets. Additional evidence regarding the weakness of potential competition originating from new entrants is provided by the U. S. experience after deregulation. Only two out of fifteen new jet carriers have survived.

Others either went bankrupt or sold out to the majors to prevent bankruptcy (Jankowski, 1987).

Domestic Policies to Enhance Contestability and Their Limitations

The analysis of the previous section suggests that the Canadian airline industry is not contestable. In the past, high concentration, coupled with the presence of entry barriers, provided the rationale for regulation. However, the possibility of increasing contestability should also be explored: if the industry can be made contestable, there would be no need for regulation after all. Furthermore, increased contestability may be beneficial even if incomplete. The two potential benefits are the following: (a) Wardair could disrupt any possible collusion between the two majors if barriers to entry in the markets not currently served by the carrier are reduced; (b) enhanced contestability could reduce the scope for cost inefficiency that often occurs in highly concentrated industries (Leibenstein, 1976)[5]. X-inefficincy is difficult to deal with, and it requires intervention in areas traditionally considered to be management prerogative. Even with intervention there is no guarantee that goverment bureaucrats will promote cost efficiency any better them the firms' management. With lower entry barriers, however, inefficient carriers would become exposed to the threat of entry, even if it is on a small scale. The American experience reveals that while new entry had a small lasting effect on pricing, its impact on the cost efficiency of existing carriers was much greater (Jankowski, 1987).

The first contestability-enhancing policy is industry restructuring. Its objective would be to create a situation where entry can originate from the already existing carriers rather than from start-up operators. This could be achieved by dividing the existing majors, Canadian and Air Canada, into a number of smaller airlines. Actual competition, that is the number of carriers within each city-pair market, would not change (because of economies of traffic density); potential competition, however, would increase since entry into new markets is easier for already-established carriers than for entirely new ones. This policy, however, has important limitations: (a) the airlines would have to forgo the benefits of scale economies, and consequently economies of traffic density (as already indicated these two types of economies are interdependent); (b) consumers' transaction costs would increase when on-line connections are replaced by inter-line ones; (c) on international routes, the competitive position of small Canadian airlines versus large foreign carriers would likely deteriorate.

Industry restructuring could also include disallowing marketing and scheduling agreements between the majors and the commuters. The problem is that, while these agreements result in entry barriers, they improve coordination of schedules, reduce airline marketing costs and lower consumer transaction costs. The public authorities would have to identify and compare the benefits of coordination with the costs of reduced competition. Although theoretically possible, data limitations and estimation problems may make such a comparison difficult at best and impossible at worst.

In sum, it appears that neither dividing the existing majors nor separating them from the commuters is feasible or desirable.

Eliminating the product differentiation advantage of the established carriers is likely to encounter a number of difficulties. First, goodwill generated in the market cannot be legislated away. The new entrant would still have to incur extra promotional costs to induce customers to try its service. Second, if dividing the existing carriers is not feasible, the new entrant will be able to offer only a small number of destinations compared to those offered by the majors. This competitive disadvantage is especially apparent on international routes where bilateral agreements typically do not allow for more than one carrier to serve each route. In order to gain access to these routes the

new entrants would have to replace the incumbents as designated carriers. Although the government can reassign routes (arbitralily or using franchise bidding scheme) such a policy is not costless. First, international routes are part of integrated networks. Uncertainty about route designation would likely hamper integration of these routes with the domestic ones. Thus, economies of scale and density would not be fully exploited. Second, the ability of Canadian carriers to compete with their foreign counterparts might be adversely affected because changes in route designation would not allow Canadian carriers to build goodwill and would force them to incur greater promotional expenditures than their foreign rivals.

Frequent flyer programs are easier to deal with and could be banned as a form of anticompetitive conduct. Even here, however, a qualification applies; banning frequent flyer programs in Canada could hurt Canadian carriers on international routes if the programs are not banned in other countries.

Overall, it is unlikely that the product differentiation advantage of the established carriers can be substantially eliminated.

The problems related to computer reservation system could be addressed using the following policies:

1. Separation of the computer reservation system from the industry. This option could involve two solutions: (a) common ownership of the system by the airlines, with a provision allowing entrants to become equal partners; (b) complete separation of the system by setting up a new independent firm. Since the firm would have a monopoly on reservation services, its charges would have to be regulated.

2. Regulation of the existing systems: current ownership structure would be retained, but user fees, rules regulating flight listing and access to information generated by the system would be established.

Thus, the government is in a position to eliminate some of the problems related to the computer reservation systems.

To ensure the feasibility of "hit-and-run" entry, the incumbents' ability to lower prices when faced by entry would have to be reduced. The question remains, however, as to how long such a constraint should be imposed. Over time costs change, and therefore prices should be allowed to adjust. The government would have to monitor costs and other relevant market conditions to identify which price changes are justifiable and which are not. This in turn amounts to little less than price regulation. Furthermore, regulation would have to be extended to frequency, amenities and the number of discount seats available, all of which may be used to forestall entry. Thus, paradoxically, policies to make "hit-and run" entry feasible degenerate into price and product regulation.

In sum, it appears that the scope for enhancing market contestability is very limited. Some of the important entry barriers are likely to remain, and "hit-and-run" entry is still not feasible.

The New Competition Act and Airline Deregulation

High concentration in itself does not necessarily preclude the industry's performance from being consistent with the standard of workable competition. Such performance (which requires vigorous rivalry between oligopolists), however, is not guaranteed, and the possibility of collusion cannot be excluded. Because of its incorrect theoretical framework, Bill C-18 does not make any provisions to deal with collusion. This, however, might not be a problem if the New Competition Act offered effective protection against such conduct.

The new Competition Act addresses collusion under its conspiracy provision. Compared to the previous legislation, requirements to prove the presence of collusion have been reduced. Nevertheless, it is still necessary to establish that "the parties intended to and did enter into the conspiracy, combination, agreement or

arrangement", and the proof must be "beyond a reasonable doubt" (Section 32). The problem is that the most likely form of conspiracy in oligopoly is "conscious parallelism". The criminal burden of proof (beyond reasonable doubt) and the need to prove intent make the new Competition Law largely ineffective in dealing with this type of collusive behavior.

As was indicated, "hit-and-run" entry is not feasible in the airline industry, therefore predatory conduct remains a possibility. Predatory behavior can be especially harmful when it allows large but inefficient incumbents to deter small but efficient entrants. In such a case, imperfections associated with high concentration may include cost inefficiency, in addition to monopolistic pricing. Reducing the possibility of predation is desirable since it would diminish the scope for X-inefficiency in the industry.

Predatory pricing has often been downplayed in the recent literature (e.g. McGee, 1980), especially in cases where a large firm faces a small scale entrant; the argument being that the incumbent (because of larger output) is likely to incur greater losses than those of the new entrant. This claim, however, does not hold in the airline industry where firms can easily restrict the output that is being sold at reduced prices (capacity-controlled discounts).

The new Competition Act does not change the past provisions dealing with predatory pricing. Predation is defined as "a policy of selling products at prices unreasonably low, having the effect or tendency of substantially lessening or eliminating a competitor, or designed to have such effect" (Section 34.1c). Other forms of anticompetitive conduct, such as increasing the frequency and number of available discount seats, or attempts to erect permanent entry barriers could be addressed under the new Section 51 dealing with the abuse of dominant position.

The major difficulty in dealing with strategic conduct lies in defining what "unreasonably low" prices are and when other practices are predatory. Historically, Canadian courts have not followed any specific rule in defining predatory conduct, and their success in prosecuting predatory pricing has been quite limited (Green, 1985). In the U. S., the Areeda-Turner criterion has attracted most attention and influences many antitrust cases (Hay, 1981). According to this criterion "a price below... average variable cost should be conclusively presumed unlawful...[and] promotional spending should be deemed predatory when timed to coincide with entry or promotion by a rival, and when average variable cost, including the promotional expenditure, exceeds price"(Areeda and Turner, 1975).

The advantage of using the Areeda-Turner criterion is its simplicity and applicability to forms of predatory conduct other than pricing . The limitation of the test is that it may fail to identify predatory conduct if there are economies of scale, and the incumbent firm operates efficiently, or with minimum X-inefficiency. (By setting prices at the level of its average variable costs, or even average total cost, the incumbent may impose losses on the new carrier if entry is below the minimum efficient scale of operation.)

Notwithstanding its limitations, the Areeda-Turner test could be used to strengthen the application of the competition laws in the Canadian airline industry. The following two-stage process could be used. In the first stage, the test would be applied to suspected cases of predatory conduct. If the firm's conduct failed the test, predation would be considered as proven. However, if the test failed to detect predation, the examination would move to a second stage. In this stage a more complete evaluation would follow. It is beyond the scope of this paper to define a complete set of rules to detect predation; however, Bork's formulation of the problem can provide a useful theoretical framework:

Predation may be defined... as a firm's deliberate aggression against one or more rivals through the employment of business practices that would not be considered profit maximizing except for the expectation that rivals will be driven from

the market, having the predator with the market share sufficient to command monopoly profits (Bork, 1965,p.144).

In sum, the new Competition Law may offer some help on dealing with various forms of predatory conduct. However, it is weak and largely ineffective with respect to collusion based on "conscious parallism".

Policy Implications and Conclusion

The analysis of economics and conditions of entry for Canadian airlines reveals that the industry is not and cannot be made contestable. Although in the period of gradual deregulation (1984-1987), the industry's performance was good, and so far there has been no evidence of collusive behavior, collusion remains a potential problem; especially given that it cannot be adequately addressed within the framework of the new National Transportation Act and the existing competition legislation.

The major policy options are enhanced price regulation, "open skies" agreement with the U.S., and liberalization of bilateral agreements with other countries.

Enhanced regulation would allow the regulatory agency to overrule price increases on non-monopoly routes if there is evidence of collusion. Current provisions with respect to monopoly routes (which allow the regulatory agency to overrule price increases only when a formal complaint from the consumers is submitted) should also be amended. This is because consumers do not have enough information to assess which price increases are justified and which are not. Furthermore, airlines may increase the effective cost of travel by reducing the number of cheap seats, rather then by increasing prices. The regulatory agency, which has access to the relevant data and the ability to process them, is best equipped to identify cases of monopolistic pricing. In fact, by appealing *all* price increases, consumers could force the government to review prices on a systematic basis. Such an arrangement, however, is clearly inefficient: it requires that, in addition to the costs incurred by the agency, consumers have to incur costs of making complaints and participating in the review process.

The difficulty lies in designing a regulatory system which, while protecting the public, would not unduly constrain firms' ability to compete and to respond to changes in the market place. The following is a brief outline of such a system: (a) all price decreases would be allowed (with the qualification that suspected cases of predatory pricing be investigated and prosecuted under the competition legislation); (b) airlines would be allowed to increase prices without seeking prior approval from the regulatory agency. All price increases, however, would have to be filed with the agency. The agency in turn would retain the right to overrule (ex-post) those increases that are not justified by higher costs; (c) entry would not be regulated (with the exception of northern routes) and would remain free to all fit and willing operators.

The proposed system is not inconsistent with the general spirit of the new National Transportation Act. In the absence of collusion, the regulatory agency would not have to intervene, and competition between firms (including pricing, frequency and product characteristics) would be the principal mechanism determining the industry's performance. The agency's role would be limited to safety regulation and data collection. Given that after the recent changes in the National Transportation Act the regulatory agency has been downsized, but not abolished, no new institiutions and bureaucracies have to be created to implement the proposed system.

The strength of the market mechanism could be further increased by introducing competition from foreign carriers. The special characteristic of transportation markets is that production and sale cannot be done in different locations. Introducing foreign competition therefore reqires *entry* of foreign carriers into Canadian airline markets.

The geographical proximity of Canada to the U.S. suggests the possibility of an "open skies" agreement between the two countries. The American majors, given their

size and financial resources, should not be afraid of any predatory practices from their Canadian counterparts. Since the American carriers are already well established in Canadian markets (the presence of American carriers in Canada originates from past bilateral agreements regulating transborder traffic - see Appendix), barriers to entry facing them are likely to be small. By operating inefficiently or by setting monopolistic prices, the Canadian carriers would expose themselves to the threat of entry from the American airlines. The threat of entry from the American carriers would clearly be greater than that of the new start-up airlines.

As was indicated, limitations on the number of designated carriers may result in entry barriers. Liberalization of bilateral agreements, which would allow freedom of entry on international routes, would therefore increase potential competition in the domestic markets. Vigorous competition on international routes (which also requires price flexibility) would force airlines to be both cost efficient and innovative. Given that in Canada international traffic amounts to about 50 percent of the industry's output, efficiency of international operations may have a very significant effect on the overall performance of the industry. Although liberalization of international aviation cannot be done unilaterally and is likely to take time, the most recent Canada-U.K. bilateral agreement demonstrates that it is not impossible. Extending the principle of liberalization to all countries, however, may not be always desirable - especially in the case of developing and socialist countries which often use airline service as a source of foreign currency, irrespective of domestic costs. The Canadian government, therefore would have to weigh carefully the interests of consumers, the industry, and the country in general.

From the proposed policies, an enhanced regulatory regime is easiest to implement. It would require only minor changes to the National Transportation Act. Should an "open-skies" agreement with the U.S. be negotiated (perhaps by extending the free-trade agreement to air transportation), and should international aviation be substantially liberalized, the regulatory system would simply become inoperative. It would, however, provide last resort protection against the unlikely scenario that all Canadian, American and other international carriers manage to collude. The proposed policies, therefore can be considered as complementary, rather then exclusive.

Notes

1. The dividing line separating the southern and northern domestic sectors is defined by the 50th parallel from the Atlantic Ocean to the Ontario-Manitoba boundary to the 53rd parallel at the Manitoba-Saskatchewan boundary, the diagonal joining the 53rd parallel at the Manitoba-Saskatchewan boundary to the 55th parallel from the Saskatchewan-Alberta boundary to the Pacific Ocean (Statistics Canada, 1986, p.207).

2. Participating car rentals include Budget, Avis, Hertz and Tilden; participating hotel chains are Westin Hotels, Hilton International, CN Hotels, Courtyard Inns and Ming Court Hotel.

3. Participating airlines are Air Atlantic, Air BC, Nordair Metro, Intercity Airlines, Aloha Airways, Eastern, KLM and British Airways. Car rentals include Thrifty, Budget, Tilden and Park and Fly, Park and Jet, while the participating hotels are VIP, Delta Hotels, Mannot Hotels, Mandarin Oriental, CP Hotels and Pan Pacific Vancouver.

4. X-inefficiency means that firms do not minimize costs. Excessive costs may result from managerial slack and exessive labour costs.

5. Under the terms of the agreeement, each country can designate its airlines to operate from any points in one country to any cities in the other. In addition Canada gains the right for its carriers to carry traffic beyond London to any points in Western Europe, and obtains new rights to points in Algeria or Egypt, and Asia. The agreement also substantially deregulates pricing.

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APPENDIX

AMERICAN CARRIERS AT THE MAJOR CANADIAN AIRPORTS

CITY	PERCENTAGE OF TOTAL OUTBOUND AND INBOUND DOMESTIC TRAVEL	CARRIERS
Toronto	20.20	U.S. Air, Eastern United, American, Northwest
Vancouver	11.58	United, Western, Continental
Montreal	10.03	U.S. Air, American, Northwest, Delta, Eastern
Calagary	8.53	Western, Northwest, United
Winnipeg	6.22	Northwest
Ottawa	7.20	Eastern, Continental

SOURCE: ICAO(1984); STATISTICS CANADA(1985a)

THE CANADA-U.S. AIR TRANSPORT BILATERAL: WILL IT BE FREED?

by

Martin Dresner
Carolyn Hadrovic
Michael W. Tretheway

ABSTRACT

This paper has three purposes. First, it discusses the provisions of the current Canada-U.S. bilateral air transport agreement and outlines the restrictive provisions (as to pricing and route allocation) contained in the agreement. Next, the paper examines movements to liberalize the bilateral agreement. Two limited liberal agreements, signed by the two countries in 1984, are discussed, as well as are proposals presented by both countries for a comprehensive liberal bilateral. Finally, the paper analyzes the future prospects for the signing of a comprehensive liberal bilateral. The conclusions are that the future prospects for a liberal bilateral are slim.

I. INTRODUCTION

On March 18, 1985, Canadian Prime Minster Brian Mulroney and U.S. President Ronald Reagan issued the "Shamrock Summit Declaration" in Quebec City, committing the two countries to negotiate a liberalized trading arrangement. Part of the arrangement was to include a revision of the Canada-U.S. air transport bilateral agreement, aimed at reducing the regulatory impediments arising from the terms of the existing agreement. However, no comprehensive agreement liberalizing the terms of air travel between Canada and the United States has been reached despite ongoing negotiating efforts. As well, transborder air transport was excluded from the "free trade" agreement, signed by the two governments in January, 1988.

The last major review of the Canada-U.S. air transport agreement was conducted by Haanappel (1980). Haanappel provided a detailed descriptive account of the provisions of the agreement as they existed in the late 1970s. This paper will extend Haanappel's work by reviewing events since 1980, by outlining the economic implications arising from restrictions imposed in the current agreement, and by discussing the economic and political implications of proposals by Canada and the United States to liberalize the agreement. More specifically, this paper will address the following issues:

- How does the current agreement impose restrictions on air travel between Canada and the United States?

- What proposals have the two countries presented to liberalize transborder regulations, and what are the implications of these proposals?

- What are the prospects for a comprehensive, liberal, transborder air agreement?

In order to address these issues, this paper has been organized as follows: Section II provides a brief discussion of the nature of air transportation between Canada and the United States. Section III analyzes the major provisions of the current Canada-U.S. air transport agreement. Section IV discusses recent moves towards the liberalization of the agreement. Finally, Section V analyzes the future prospects for a liberal transborder agreement.

II. THE TRANSBORDER AIR MARKET

The transborder scheduled market was served, as of May 1986, by twenty U.S. airlines and by nine Canadian airlines (*Official Airline Guide*, May 1986). Canadian residents composed the majority of passengers on transborder service. As Figure 1 illustrates, between 1977 and 1985, Canadian residents accounted for 60 to 65 percent of transborder passengers.

The majority of *scheduled* passengers, however, were transported by U.S. carriers. Figure 2 illustrates that during the first half of the 1980s, U.S. airlines consistently carried approximately 60 percent of the transborder scheduled passengers. Canadian carriers fared much better in the *non-scheduled* market. Figure 3 shows that during the first half of the 1980s, Canadian carriers dominated this market with between 90 and 95 percent of total passengers.

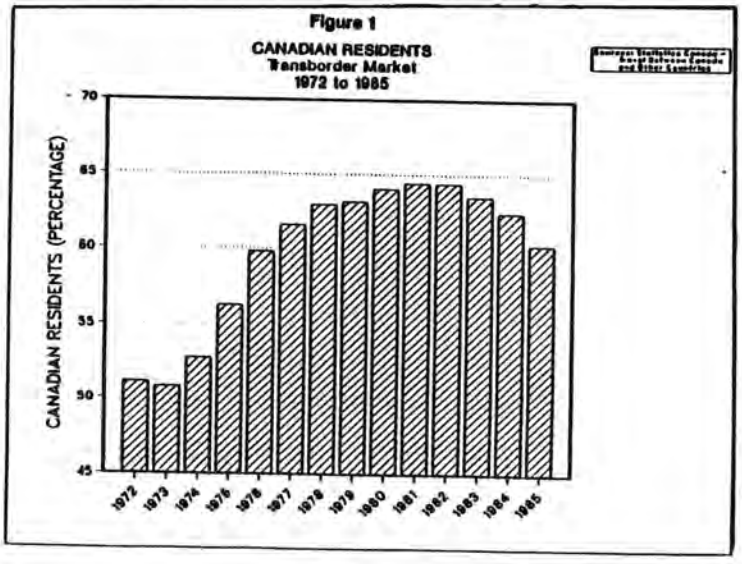


Figure 2

TRANSBORDER PASSENGERS
Scheduled Services
1970, 1975, 1980 to 1985

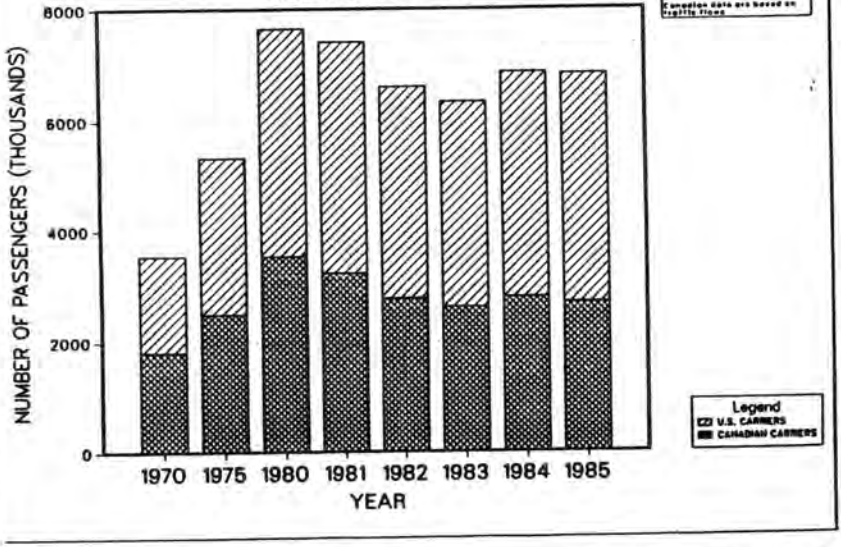
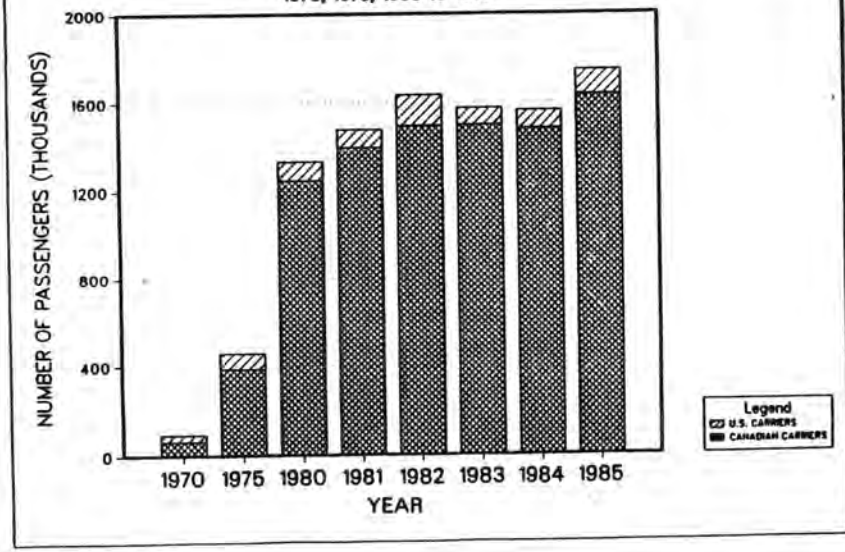


Figure 3

TRANSBORDER PASSENGERS
Non-Scheduled Services
1970, 1975, 1980 to 1985



There are a number of factors which have contributed to the low transborder market share of Canadian scheduled carriers and to the high market share of Canadian non-scheduled carriers. First, the vast majority of non-scheduled passengers are vacationing Canadians, seeking a "holiday in the sun". Canadian based travel operators have been most successful at selling vacation packages to Canadians, and these operators are generally directly or indirectly affiliated with Canadian carriers. Therefore, through these "tie ins", Canadian airlines have been able to corner the transborder charter market.

Second, U.S. customs pre-clearance at Canadian airports has facilitated the carriage of scheduled passengers by U.S. airlines. Passengers travelling on connecting flights through U.S. cities need not worry about claiming baggage at the first U.S. stop and clearing customs. A U.S. carrier can easily transfer passengers (and their baggage) through on-line connections to any of its U.S. destination cities, once customs has been cleared at the Canadian origination point.[1]

Finally, U.S. carriers have been able to use their hub cities to offer on-line scheduled service to a much larger number of U.S. cities, than is economically possible for Canadian carriers. Canadian airlines, not legally allowed to carry passengers from one U.S. point to another, have been precluded from competing with U.S. majors on most of their routes. Canadian airlines have had to be content with carrying passengers on a handful of point-to-point transborder routes. U.S. carriers, on the other hand, can funnel traffic through strategically located hub cities, combining Canadian traffic with U.S. traffic at the hubs, making economically possible on-line service from Canadian points to a wide number of U.S. cities.

In summary, a majority of transborder air travellers are Canadian residents, but customs pre-clearance and U.S. hub and spoke systems provide an advantage to U.S. carriers in the transport of transborder passengers. Canadian carriers, on the other hand, have been able to use connections with tour operators to dominate the charter market, which largely caters to vacationing Canadians.

III. THE CANADA-U.S. AIR TRANSPORT AGREEMENT

Although it has been amended on a number of occasions, the primary agreement regulating transborder scheduled air services remains the air services bilateral signed by Canada and the United States in 1966 (Canada, Department of External Affairs, 1966). This agreement established the primary rules for the regulation of scheduled air routes, capacity levels, and prices; rules which have largely remained in effect to the present. Each of these

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[1] It should be noted that even if Canadian carriers pre-cleared U.S. passengers on flights destined for Canada, the Canadian carriers would not achieve much of an advantage over their U.S. counterparts. This is because most U.S. passengers do not have to make connections in Canada; their first Canadian point of entry also being their final city of destination. In contrast, most Canadian passengers go beyond the initial U.S. gateway.

three areas of regulation are examined, in turn, followed by a review of regulations governing charter air transport:

A. Air Routes

The Canada-U.S. air agreement followed the practice of the precedent-setting bilateral agreement signed by the U.S. and the United Kingdom in 1946 (known as Bermuda I), and established route schedules for Canadian and U.S. carriers. The schedules specified the point-to-point routes that were permitted to the carriers of each country. As is illustrated in Table 1, U.S. carriers were allowed to operate on 16 route groups, while Canadian carriers could be designated to operate on 12 route groups. Each country could designate only one carrier to operate on most routes, unless permission to designate extra carriers was afforded by the other country.

Table 1

Schedule of Routes Permitted to U.S. and Canadian Carriers Under the 1966 Bilateral Agreement

Routes Permitted to U.S. Carriers:

1. Seattle--Vancouver
2. Los Angeles/San Francisco--Vancouver
3. Denver/Great Falls--Calgary
4. Chicago--Toronto
5. Detroit--Toronto
6. Tampa/Miami--Toronto
7. Tampa/Miami--Montreal
8. Los Angeles--Toronto
9. New York--Montreal/Ottawa
10. New York--Toronto
11. Boston--Montreal
12. Washington--Ottawa/Montreal
13. Buffalo--Toronto
14. Minneapolis--Winnipeg
15. United States-Gander--Europe and Beyond
16. a. Spokane--Calgary
    b. Duluth/Superior--Ft. William/Port Arthur
    c. Ketchikan--Prince Rupert
    d. Fairbanks--Whitehorse
    e. Juneau--Whitehorse
    f. Erie--Toronto

Routes Permitted to Canadian Carriers

1. Victoria--Seattle
2. Vancouver--San Francisco
3. Halifax--Boston/New York
4. Montreal/Toronto--Chicago
5. Toronto--Cleveland
6. Toronto--Los Angeles
7. Toronto--Tampa/Miami
8. Montreal--Tampa/Miami
9. Montreal--New York
10. Toronto--New York
11. Canada--Honolulu--Australasia and beyond
12. a. Prince Rupert--Ketchikan
    b. Whitehorse--Fairbanks
    c. Whitehorse--Juneau

Source: Canada (1966).

It should be noted that the route schedules in the 1966 agreement were more restrictive than schedules in many other Canadian bilateral air agreements, in that service was confined to specified route pairs. A more common specification of allowable air routes would have been "points in Canada" to specific U.S. destinations, for services by Canadian carriers, and "points in the U.S." to specific Canadian destinations, for services by U.S. carriers (McGill, 1980, pp. 530-531).

As outlined above, the 1966 agreement has been revised on a number of occasions. These revisions have allowed services to be operated between additional route pairs, but have not opened the border to services that could be operated at the discretion of carriers. Except under specific circumstances (to be discussed in the next section) all transborder routes must still be specifically vetted by both governments.

B. Capacity Levels

The Canada-U.S. air agreement has a liberal capacity clause. Section XII of the agreement stated that neither government could unilaterally impose restrictions on the carriers of the other country with respect to capacities, frequencies, or type of aircraft employed. Airlines, therefore, have the leeway to set capacities and frequency levels, as they see fit, without input from the foreign government.

C. Pricing

Whereas the Canada-U.S. air agreement has liberal capacity provisions, it does not have liberal pricing provisions. All fares must be submitted by airlines operating transborder routes for approval by the governments of both countries. This approval process allows either government to reject a fare submitted by an airline for approval.

D. Charter Air Transport

Charter, or non-scheduled air transport, is regulated under a separate Canada-U.S. bilateral air transport agreement (Canada, 1974). Non-scheduled air transport was defined, for the purpose of the agreement, as "commercial air transportation of traffic on time, mileage or trip basis by a carrier or carriers, where the entire planeload capacity of one or more aircraft has been engaged."

The pricing and capacity clauses contained in the agreement were reasonably liberal. Airlines were permitted to establish "reasonable rates" without prior approval from the foreign government. If the foreign government was dissatisfied with the rates, it could enter negotiations with the other government to find satisfactory solutions. Governments could not impose restrictions on flights, frequencies, capacities, or the type of aircraft used by airlines of the other country, although it was stated that non-scheduled services should not substantially impair the operations of the other country's carriers (scheduled or non-scheduled). A further clause stated that the volume of non-scheduled traffic originating from one of the countries should be reasonably related to the volume of traffic carried by its own non-scheduled carriers. Since the vast majority of non-scheduled traffic was Canadian-originating, this would imply that the vast majority of traffic should be carried

by Canadian non-scheduled airlines. This Canadian advantage was mitigated by a contradictory requirement that U.S. carriers achieve between 25 and 40 percent of the market share of non-scheduled carriers to "Sun" destinations by 1978.[2]

In summary, the agreement covering Canada-U.S. scheduled services specified the routes which may be flown by Canadian and U.S. carriers. It contained a restrictive pricing clause, allowing either government to reject proposed air fares, but a liberal capacity clause, restricting government disapproval authority over capacities. The non-scheduled agreement had both liberal pricing and capacity provisions as well as contradictory clauses which favoured and restricted market opportunities for Canadian non-scheduled carriers.

IV. THE MOVE TOWARDS LIBERALIZATION

In 1978, the United States instituted a new type of bilateral agreement, known as the "liberal bilateral." Features of the liberal bilateral included the following:

- the right of carriers to freely determine capacities without government interference;
- the elimination of the right of foreign governments to reject proposed air fares;
- the multiple designation of carriers on air routes;
- an increase in the number of allowable routes;
- a clauses stating that each designated airline must be allowed a fair and equal opportunity to compete on routes governed by the agreement;
- a separate charter clause permitting non-scheduled services as long as they conformed with the laws of the country in which the flights originated.

Between 1978 and 1982, the United States signed 23 liberal or partly liberal agreements, although Canada was not one of the countries with which the U.S. signed a liberal agreement (Haanappel, 1984, Appendix III).[3] Canada and the United States, however, did sign two limited liberal agreements in 1984

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[2] It can be seen from Figure 3 that despite this requirement, the market share of U.S. non-scheduled air carriers has remained low; less than ten percent.

[3] It should be noted that since 1982, the United States has not made much progress in signing additional liberal bilaterals. This is probably due to a policy shift when the Reagan administration took office.

and have each put forward proposals for comprehensive liberal agreements. The limited agreements and proposals are discussed below.

A. Local Services Agreement

On August 21, 1984, the Canadian and U.S. governments signed an agreement on regional, local and commuter air services (Canada, 1984a). Its objective was "to introduce greater predictability and automaticity in the approval of applications" and "to facilitate and encourage the provision of additional transborder services of a regional, local and commuter nature."[4] Previously, new services had to be approved by the aeronautical authorities of both countries. This agreement, in contrast, implemented an automatic approval system wherein a route application would receive automatic approval if five criteria were satisfied.

First, the aircraft capacity was no more than 60 passengers, and the payload capacity, no more than 18,000 pounds. Second, the city-pair was not named in the 1966 Agreement. Third, at least one city had a metropolitan population of less than 500,000 in Canada or 1,000,000 in the U.S. Fourth, the stage length did not exceed 400 statute miles to and from points in central Canada, and 600 statute miles to and from all other points in Canada. Fifth, the proposed service was not already authorized to an airline of the same country. It should be noted that the aeronautical authorities might approve a route application even if the above criteria were not met.

B. Experimental Transborder Air Transport Program

On August 21, 1984, the Canadian and U.S. governments established an experimental transborder program (Canada, 1984b) in order "to foster new transborder air services" and "to gain experience with innovative pricing and service mechanisms."[5] Under this program, designated carriers were given unrestricted automatic access to Mirabel Airport from any point or points in the U.S. other than seven international gateways.[6] In addition, there were no restrictions on the number of designated carriers which may serve a particular city-pair. However, all flights had to originate or terminate at Mirabel, and points in third countries could not be served on single-plane services.

Unlike the Air Transport Agreement of 1966, this agreement contained liberal pricing provisions. Fares would only be disallowed if they were *rejected* by the aeronautical authorities of both countries. As the reader will recall, in the 1966 Agreement, fares had to be filed for *approval* by both the Canadian and U.S. aeronautical authorities.

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[4] It has been speculated that a secondary reason for the willingness of the Canadian government to enter into this agreement was to increase the market for the then government owned DeHavilland Aircraft Company.

[5] A third reason, not explicitly stated, was to increase the usage of Montreal's Mirabel Airport.

[6] Gateways excluded were Boston (Logan), Chicago (O'Hare), Los Angeles, Miami, New York (JFK), San Francisco and Seattle.

During discussions, it was further agreed that the U.S. government would propose a U.S. airport which would have the same transborder privileges as Mirabel, and the airport at San Jose, California was subsequently chosen.

C. U.S. Concept Paper

On December 18, 1984, Canadian and U.S. aviation officials agreed to exchange concept papers in preparation for future negotiations. Matters to be addressed included the expansion of allowable numbers of routes between the two countries and the amalgamation of the scheduled and non-scheduled air agreements.

Three months later, Canadian Prime Minister Brian Mulroney and U.S. President Ronald Reagan issued the "Shamrock Summit Declaration" in Quebec City which noted their mutual objective of reducing and eliminating trade barriers between the two countries. In particular, the leaders mandated the negotiation of a new air transport agreement which would facilitate "transborder travel and commerce by expanding the number of available services and reducing obstacles to the introduction of innovative and competitive new services." Consequently, the Concept Papers, which were exchanged on June 13, 1985, envisaged the creation of an open transborder system governed by market forces. However, different approaches were proposed.

The U.S. government (United States, 1985) proposed that a free trade market should be established in which carriers would be permitted to operate services between any point in Canada and any point in the U.S. This approach would eliminate such questions as whether all or specific routes should be single-tracked or double-tracked, which cities could serve as intermediate points on routes, and to what extent Canadian airlines should be able to penetrate U.S. markets.[7] In order to offset the structural advantage to its national airlines, the U.S. government would consider certain enhancements for Canadian carriers which could include full stopover rights and change of gauge operations in the United States. Change of gauge rights would allow an airline to use an aircraft on one section of the route which is different in capacity from that used on another section of the route. The aircraft could be leased or operated under a contractual relationship with one or more domestic airlines.

Unlike the Canadian concept paper (to be discussed below), pricing procedures and non-scheduled services were addressed. Under the existing double *approval* pricing regime, scheduled airlines were unable to change fares or respond to competitors' changes freely and quickly. As a result, the U.S. noted that it would be interested in a double *disapproval* pricing regime. In addition, scheduled airlines should be allowed to match charter fares, and vice-versa.

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[7] Single-tracked routes are those routes which can be operated by the airlines of only one country. Double-tracked routes may be operated by both Canadian and U.S. carriers.

With respect to non-scheduled services, the U.S. government stated that the present arrangement should be updated so that it provided a more open operating environment for existing and potential services, including public, affiliated, split cargo, and air freight forward charters. In addition, charter services, which operated in a regular pattern, should be converted to schedule authority.

D. Canadian Concept Paper[8]

The Canadian concept paper (Canada, 1985) differed from the U.S. paper in that it envisaged the creation of a common market, or as referred to in the Concept Paper, a fully integrated North American civil aviation system. This proposal not only allowed carriers to operate services between any point in Canada and any point in the U.S., but also allowed the free movement of factors of production. In other words, Canadian carriers could serve intra-American traffic, and vice-versa (i.e., *cabotage* rights would be permitted).

According to the Canadian government, a common market would minimize or eliminate the structural advantage of U.S. airlines, and thus provide an equal opportunity for airlines of both countries to participate in a pro-competitive environment. As stated in the Concept Paper, the structural advantage of U.S. airlines stemmed from their ability "to accumulate and aggregate traffic originating from or destined to points behind U.S. gateways at airline hubs in the U.S. and then connect these hubs to the principal population centres in Canada." In addition, the pre-clearance program at Canadian airports further enhanced the attractiveness of U.S. airlines in the transborder marketplace, particularly for through-plane services.

The Canadian concept paper stated, as well, that an agreement on routes should be the "centrepiece" of any new Canada-U.S. air agreement. Hence, subsidiary issues like non-scheduled services, pricing and all-cargo services would be influenced by the approach adopted in major route negotiations.

E. Recent Developments

The Canadian and U.S. governments have been unable to reach a compromise on a comprehensive liberal air transport agreement. Transborder air traffic remains regulated by the 1966 bilateral, the separate charter agreement, and the two limited agreements reached in 1984.

Canada was unwilling to accept the U.S. proposal for the free determination of transborder routes, because of the advantages this proposal would afford to U.S. carriers. The U.S. was unwilling to accept the Canadian cabotage proposal, because U.S. carriers were concerned that this would be a precedent-setting move which could result in the U.S. market being opened to cabotage by carriers of other countries, resulting in a loss of business to U.S. carriers. It was likely that this disagreement also contributed to air transport being left out of the Canada-U.S. free trade agreement.

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[8] Canada actually issued two concept papers which had the same major components but differed in the details of implementation.

V. FUTURE PROSPECTS FOR A LIBERAL AGREEMENT

The future prospects for a comprehensive liberal agreement will likely remain slim, as long as airline interests are placed above consumer interests in the negotiating process. It would seem evident that transborder air travellers would benefit from either the Canadian or U.S. proposal, as both proposals would allow more service and competition on transborder routes. Canadian airlines, on the other hand, would likely lose business if either proposal were adopted.[9] In our opinion, the U.S. market has been well developed by the U.S. carriers and their positions would be easily defended against cabotage incursions by foreign airlines, whether Canada or otherwise. We believe the U.S. carriers' fears of cabotage are unfounded. However, to date, authorities on both sides of the border have chosen to "hold out" for an agreement favoured by their carriers, and to, therefore, neglect the interests of the air travellers. Is this likely to change in the future?

The answer seems to be no. Canadian bilateral negotiations have traditionally been "airline-driven". New bilateral agreements are signed when Canadian carriers wish to establish new routes. Consumer interests have traditionally played only a secondary role in Canadian bilateral negotiations.[10]

The United States, as well, at least under the current administration, seems unlikely to sign an agreement that is not supported to its airlines. Given the general protectionist mood that exists in the United States, industry interests are being placed higher than consumer interests. This would imply that even though the U.S. has a record of seriously considering consumer interests in its bilateral negotiations, it would be unlikely that the government would adopt a position contrary to the position adopted by its carriers. Therefore, the conclusion is, that in the foreseeable future, there will be no comprehensive free trade agreement in air transport, signed by the two countries. This seems likely to change only if a) both governments give consumer interests greater weight, or b) the U.S. and Canadian carriers conclude agreements similar to those between the jet carriers (of either country) and their feeder carriers. Such agreements would affiliate a carrier of one country with an airline of the other country to mutually feed service. These agreements would essentially erect a "good neighbor" fence between the airlines party to the agreements, while allowing different groups of affiliated carriers to compete. In this regard, it is interesting to note the agreement

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[9] It has been alleged that Canada put forth the more liberal, cabotage proposal knowing that the U.S. would reject it, thus maintaining status quo.

[10] See Dresner and Tretheway (1987) for a summary of the restrictive pricing and capacity provisions contained in Canadian bilateral agreements signed between 1978 and 1986.

between Canadian Airlines International and American to feed each other traffic in Toronto,[11] and Wardair's decision to participate in Texas Air's computer reservation system, rather than join the Gemini system being jointly established by Canadian and Air Canada.

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[11] Don Carty, former president of CP Air (a predecessor of the recently formed Canadian Airlines International) is a vice president of American Airlines, and was a vice president at American before his tenure at CP Air.

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ALTERNATIVES TO SODIUM CHLORIDE AS A SNOW AND ICE CONTROL AGENT

BY

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ABSTRACT

The pursuit of alternatives to sodium chloride for snow and ice control has grown dramatically in recent years, and several U.S. State governments, provincial governments, the City of Ottawa and private agencies are actively exploring alternatives.

This paper identifies the alternatives being explored for snow and ice control, assesses these alternatives, recommends the most promising chemical alternatives and presents the costs and benefits of using these chemical alternatives relative to road salt. Also included are the preliminary results of field trials performed with the recommended chemical deicers comparing them to road salt.

INTRODUCTION

Ottawa, like most Ontario and Quebec municipalities, has found it necessary to use sodium chloride as part of its program to keep arterial and collector roads free of ice and snow. Unfortunately, the side effects from the use of road salt are severe, including accelerated corrosion to bridge decks, parking structures and automobiles, ground water pollution, and damage to road side vegetation.

The concept of seeking alternatives to sodium chloride is not new: over the past 10 years, debates and studies have progressed. There are a number of factors, however, which make an examination of alternatives in the Ottawa area more promising than in the past:

- public awareness of the impact and high cost resulting from salt use is at an all time high as a result of numerous parking structure problems in Ottawa recently.
- research into several promising alternatives has reduced technical barriers, and produced some alternatives in test/demonstration quantities.
- interest in other jurisdiction and at the provincial level is high, so some cost-sharing may be feasible.
- several States in the U.S. and European cities have taken the step of legislatively phasing out or banning sodium chloride.

In response to this need for an evaluation of alternative to sodium chloride, the City of Ottawa, Department of Physical Environment, contracted SYPHER:MUELLER International Inc.

SODIUM CHLORIDE

The use of salt dates back to the 1940's. Initially its use was for freeze protection of the abrasive, sand. Eventually it was determined that direct application of salt for snow and ice control was extremely effective, both in terms of time and in terms of the snow removal operations budget. Extensive use of salt became widespread in the early 1960's and has grown rapidly. The annual tonnage of salt purchased by the City of Ottawa for the 85/86 winter season is almost 400% the amount used 20 years ago.

A study conducted on the role of salt in snow and ice control polled four hundred and fifty-five Ontario municipalities on their snow clearing techniques. Of the two hundred and one questionnaires that were returned, 94% indicated the use of salt in ice and snow control. The popularity of salt is as a result of its low material cost, availability, ease of application and its effectiveness as a de-icing agent.

A. Benefits of Road Salt

The benefits for the use of road salt as summarized in one report, include reductions to:

- wage loss due to lateness/absenteeism,
- manufacturing loss due to lateness/absenteeism,
- delays in commodity movements, and
- fuel consumption.

Other intangibles such as;

- value of lives saved,
- values of injuries avoided,
- material value of accidents avoided, and
- personal travelling time saved,

should also be included to the total benefit of de-icing.

The relationship between salt and the above factors are complex and have not been clearly quantified.

B. The Impact of Salt

The effects of road salt are often cumulative and therefore require lengthy studies for complete understanding. Present knowledge indicates that the areas of the environment that are effected by road salt runoff and warrant attention are:

- ground water
- surface water
- soil
- vegetation
- animals.

Sodium Chloride solutions are also responsible for increased corrosion rates. Man made materials effected by exposure to the chloride ion include;

- vehicles
- parking structures and bridge decks.

ALTERNATIVE APPROACHES TO SNOW AND ICE CONTROL

A literature search resulted in an extensive list of references on the alternatives to the sodium chloride de-icer. After reviewing recent publications, a number of research and government organizations were identified, contacted and queried on their most recent efforts into alternative de-icers.

The broad options available for snow and ice control are categorized as follows:

- abrasives,
- chemical de-icers,
- asphalt types,
- level of service,
- mechanical removal, and
- corrosion protection.

A. Abrasives

1. Sand

The use of sand in snow and ice control is as a material for providing temporary traction. Sand is used mostly on lighter traffic routes in isolated dangerous spots. For freeze protection sand is mixed with a small percentage of salt. This keeps the abrasive material workable so that it can be easily applied by vehicle spreaders.

2. Clay Granules

The clay in question has been used as a construction material in the making of light concrete. Some West German cities have banned the use of salt and are using this light weight clay granule as a substitute. Granules can vary in size from 2 to 20 mm in diameter. They contain numerous air cells and are extremely light.

B. Chemical De-Icers

1 Calcium Magnesium Acetate (CMA)

In a Bjorksten Research Laboratories study to find an alternative de-icer to salt, CMA was selected as having the most promise. Calcium and magnesium ions form soluble salts. The ice melting ability of this mixture (calcium acetate and magnesium acetate) benefits from the de-icing capabilities of the individual components.

2. Methanol (CH_3OH)

Methanol is essentially a chemical intermediate. Methanol has been used as windshield washer antifreeze and gasoline antifreeze. Liquid methanol causes deicing immediately and at a far lower temperature than NaCl. However, methanol loses its effectiveness beyond approximately an hour or two.

3. Calcium Chloride ($CaCl_2$)

A widely used alternative to salt as a de-icer is calcium chloride. $CaCl_2$ can be produced in a dry pellet form or as liquid. Liquid calcium chloride has been used to wet salt for de-icing with hazardous results. The Soviets have shown interest in calcium chloride granules covered in a phospilate coating. The form in which $CaCl_2$ is currently drawing attention is in a CTS mix (70% sand, 30% salt wetted with a 32 litre/tonne solution of $CaCl_2$).

4. Urea (NH_2CONH_2)

Urea is a nitrogen based fertilizer which has a slower release rate than most nitrogen based fertilizers. To date urea has found most of its use for snow and ice control in airport runway applications.

5. Sodium Formate (Na HCOO)

Sodium formate has recently gained interest as a cheaper alternative to CMA as a de-icing chemical. NaFo is presently produced in million tonne quantities as a by-product for production of products such as pentaerythritol. Pentaerythritol is used in resin manufacturing (e.g. paint resins), the production of synthetic motor oils and other products.

C. Asphalt Type

1. Verglimit

Verglimit is designed to be an ice-resisting pavement consisting of flakes of calcium chloride hydrolized in linseed oil and caustic soda mixed into paving material at 5-6% by weight. Verglimit melts very little snow but prevents the snow and ice from binding to the pavement so traffic can break it up.[3]

2. Plus Ride Asphalt (Rubberized Asphalt)

In the Plus Ride process, some of the mineral aggregate in the asphalt mix is replaced by granulated rubber particles and is used to resurface a roadway. The weight of the traffic breaks up and sheds ice by compressing the protruding rubber aggregate. A spinoff benefit includes the reduction of tire noise and a use for discarded tires.

D. Level of Service

One way of reducing the effect salt on the environment and property is to reduce the amount of salt used and, in turn, the level of service. This means allowing more time to clear the arterial and collectors for which the "bare pavement policy" applies.

E. Mechanical Removal

The most common device is the displacement plow. It is most effective at producing a nearly bare pavement when the ice-pavement bond has partially weakened. Plows alone cannot prevent ice build up from traffic-packed snow, nor can they remove ice bonded to the pavement surface. Bare pavement cannot be sustained with a plowing only policy.

F. Corrosion Protection

1. Chem-Trete

A number of concrete sealers have been evaluated for use as a protective construction measure against the ravages of salt. Chem-Trete is a sealer which has gained the support of the Oklahoma Department of Transportation.

ASSESSMENT OF ALTERNATIVES

Through the course of the literature reviews and the contacts made with researchers presently active in snow and ice control, it seemed logical to organize the summary of all the material under the following major criteria groupings; Effectiveness, Cost/ Availability, Effect on Ecology, Effect on Property and Future Development. In the Rating and Weighting Framework (RWF) approach these major subject areas were weighted according to their relative importance. Effectiveness is assigned an overall weighting of 30 out of 100; Cost/Availability 20 out of 100, Effect on Ecology 15, Effect on Property 25 and Future Development 10.

Under each major subject area, specific criteria are selected and assigned a percentage of the major subjects overall weighting according to their relative importance. Each criteria has been defined such that an alternative de-icer being evaluated against a criteria is scored on a +2 to a -2 basis. A zero rating corresponds to the baseline case, sodium chloride.

The criteria selected to best evaluate the snow and ice control options are:

Effectiveness:	- Function - Effective Temperature Range - Speed of Effect - Endurance of Effect
Cost/Availability:	- Application Costs - Clean-Up Costs - Storage/Mixing Costs - Fleet Conversion Costs
Effect On Ecology:	- Water Contamination - Soil Damage - Vegetation Damage - Animal/Human Health Risk
Effect On Property:	- Automobile Corrosion - Structural Degradation - Underground Utilities
Future Development:	- Research Underway - Field Trials Underway

Each deicer was scored against these criteria using all the available information compiled throughout the course of the project.

Results show that with current knowledge CMA appears to be the best replacement for sodium chloride as a road de-icer. Another chemical de-icer that warrants a further cost-benefit analysis includes sodium formate which ranked second overall. Methanol, CTS and Urea ranked a distant third, fourth and fifth.

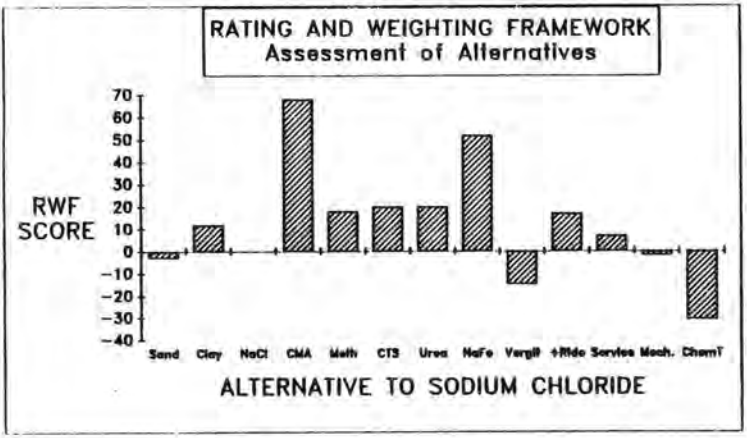


Figure 1. Rating and Weighting Framework
-Assessment of Alternative-

COST BENEFIT ANALYSIS

All indications are that the value to the public of a bare road far exceeds the costs. One study which assessed the value of reduced traffic accidents, lives saved as a result of adequate medical response time, energy savings from reduced gasoline demand, and economic benefits related to reduced lateness and a absenteeism, concluded that bare roads show a benefit cost ratio of 6.3/1 to 18.1/1 depending on assumptions. Indeed fuel savings can be comparable in magnitude to the direct costs of salt use. In addition to the several economic studies which come to the conclusions that bare roads are cost-beneficial, there are the practical realties that almost every community which has attempted to avoid the used of de-icers, and to reduce the level of service provided, has terminated the experiments.

If de-icers are essential to modern life style, then the issue to be addressed is whether the incremental benefits of the most promising alternative de-icers (CMA and Sodium Formate) will more than offset their incremental costs.

The approach taken in this study was not to attempt to develop new benefit-cost data, but rather to draw material from other studies and present it in terms that may cast new light on the key issues. Any increased costs which would result from using a more costly de-icer would be borne by the city budget, while the benefits accrue to a variety of people including the Ottawa tax payer directly. If these benefits are likely to exceed the costs, then the task that the City faces is one of "selling" the concept so that tax increases related to the use of the alternative are acceptable to the voter. For this reason we attempted to reduce quantifiable benefits and costs to a household basis, so that they can be presented on a scale that is comparable to the city tax base. Figure 2 illustrates the major costs and benefits, and their relationship to the household.

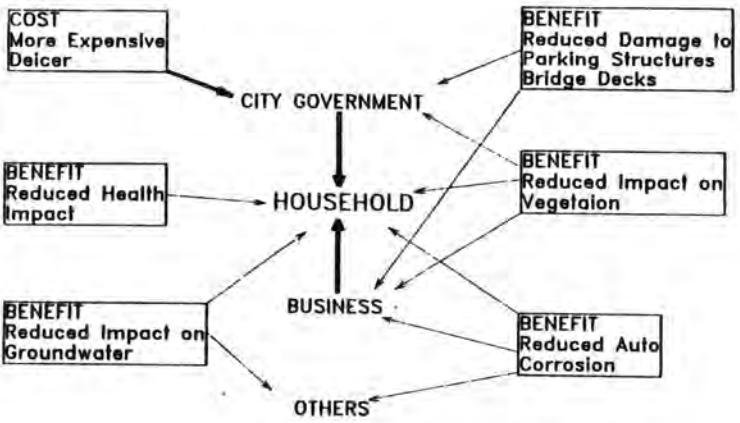


Figure 2. Major Costs and Benefits Associated with the Use of Alternative De-Icers.

In comparing alternative chemical de-icers to sodium chloride, the benefits and costs are best examined from an incremental perspective; that is, what are the extra benefits and what are the extra costs.

Many of the benefits of using alternative de-icers are very difficult to quantify: reduced damage to ground water and vegetation, and reduced impact on human health as a result of lowering drinking water sodium content. It is possible, however to quantify reduced automobile corrosion, and reduced damage to bridges and parking structures. Drawing on data from other studies, it appears that the use of non-corrosive de-icers would reduce automobile depreciation by approximately $192/year/household based on the vehicle/household ratio in Ottawa. The effect of reduced damage to bridges and parking structures is calculated to be approximately $82.00/year/household. This effect is not recognized directly by the taxpayers but flows through to them as a result of reduced provincial taxes, municipal taxes, parking charges, rents and condominium fees.

The costs of using alternative de-icers would be significant. In the city alone the use of CMA would add $19.0 million/year to $30.4 million/year to the City budget, while the use of Sodium Formate would add $7.0 million/year to $14.1 million/year. These costs include de-icer purchased by the city and used on regional roads. On a household basis this would translate to $111/year to $182/year, and $44/year to $95/year respectively.

Unfortunately the benefits would not be realized unless the entire region was salt free, so similar costs would be borne by Gloucester and Nepean by the NCC and by the Province for provincial roads in Ottawa-Carleton. Table 1 summarizes the benefits and costs.

Table 1. Costs and Benefits of Sodium Chloride
(1986 Dollars)

Cost	Total/Year	Per Household/Year
Incremental Cost of CMA	$30.4 million - $19.0 million	$182 - $ 111
Incremental Cost of NaFo	$14.1 million - $ 7.0 million	$ 95 - $ 44
Benefits		
Reduced Auto Depreciation	$23.3 million	$192
Reduced Structural Damage	$10.0 million	$ 82
Total Quantified Benefits[1]	$33.3 million	$274
B/C Ratio - CMA		1.21 - 2.47
- NaFo		2.63 - 6.23
Net present value (20 years @ 10% - CMA	$102 million	$101 - $ 706
Discount Rate) - NaFo	$123 million	$842 - $1276

[1] Benefits related to reduced groundwater damage, vegetation damage, and health impacts have not been quantified.

PRELIMINARY FIELD TRIALS

In February - April 1987, SYPHER:MUELLER carried out limited field trials with both CMA and NaFo for the City of Ottawa. The effectiveness of CMA and NaFo was analyzed using a Tapley meter, synchronized spreading of chemicals and a controlled route of city streets. Five field trials were undertaken as indicated in Table 2.

Table 2. Friction Test Period and Application Rates

Test No.	Date/ Time	Ave Temp. (deg C)	Precipitation	De-Icer Application Rate (kg/2 lane km)	De-Icer Application Factor (Appl Rate/Std Salt Rate*)
1	Mar 1,1987 8:07-8:53 am	- 8	light freezing rain and light to moderate ice pellets	NaCl - 128 CMA - 118 NaFo - n/a	NaCl - 0.91 CMA - 0.84 NaFo - n/a
2	Mar 1,1987 9:40-12:58 am	- 5	light to moderate ice pellets	NaCl - 200 CMA - 104 NaFo - n/a	NaCl - 1.42 CMA - 0.74 NaFo - n/a
3	Mar 1,1987 2:52-5:07 pm	- 3	light ice pellets	NaCl - 204 CMA - 291 NaFo - n/a	NaCl - 1.45 CMA - 2.06 NaFo - n/a
4	Mar 2,1987 12:05-2:30 pm	- 2	light snow	NaCl - 220 CMA - 348 NaFo - 822	NaCl - 1.56 CMA - 2.46 NaFo - 3.70
5	Mar 31,1987 8:40-10:30 pm	- 6	moderate snow turning to freezing rain	NaCl - 148 CMA - 158 NaFo - 133	NaCl - 1.05 CMA - 1.10 NaFo - 0.94

* The City of Ottawa standard salt rate is 141 kg/2 lane km.

Test number 5, which benefited from lessons learned in the earlier tests, provided the application rates closest to those designed for the alternative de-icers. Figure 3 illustrates the braking performance as a function of thime for NaCl, NaFo, CMA and untreated road.

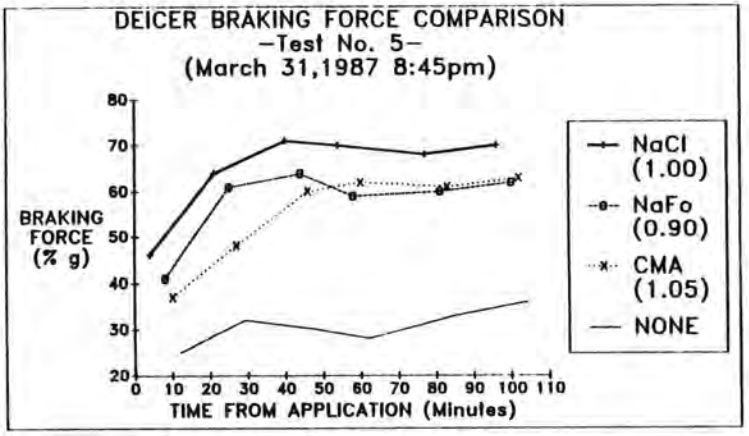


Figure 3. Braking Performance as a Function of Time for Various De-Icers

CONCLUSIONS

An examination of alternatives to sodium chloride for snow and ice control indicates that:

- the use of sodium chloride has a significant cost as a result of health impacts, environmental damage, accelerated automobile corrosion, and damage to parking structures and bridge decks.
- not de-icing is not a viable solution. Theoretical research and trials by cities have shown that the consequences are increased fuel use, increased accidents, and increased tardiness and work absences. These consequences appear to outweigh the direct and indirect costs of using sodium chloride by a factor of 6 - 18.
- attempting to keep roads bare through the use of more frequent plowing is not feasible technically or economically.
- alternatives to salt include abrasives, chemical de-icers and special asphalt surfaces.
- only chemical de-icers can provide the effectiveness of sodium chloride.
- the most promising alternatives to sodium chloride are Calcium Magnesium Acetate (CMA) and Sodium Formate (NaFo)

CMA shows the potential of significantly reduced environmental and health impacts when compared to NaCl.

CMA and NaFo do not contribute to automobile corrosion or structural damage.

CMA is currently 35 times more costly that Sodium Chloride; when usage rates are considered. NaFo is 17 times more costly.

CMA is currently undergoing evaluation in a number of areas, including the Ontario Ministry of Transportation and Communications.

the use of NaFo is a recent concept, and is not as well developed as the use of CMA.

the decision to use a substitute de-icer is primarily an economic issue, rather than a technical issue.

the seasonal increase in chloride levels in the Ottawa River as a result of road salting is an order of magnitude lower than that needed to reach the threshold of taste.

one of the alternative pavement types, Plus Ride, shows the potential to reduce salt requirements.

the benefits of reduced automobile corrosion and reduced structural damage as a result of using non-corrosive de-icers (CMA or NaFo) in the Ottawa area are estimated to be approximately $274/household/year or $33.3 million for the City as a whole.

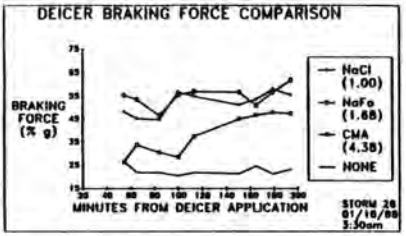
automobile corrosion reduction and structural damage reduction benefits will only be realized if an alternative de-icer was used throughout the Region.

both CMA and NaFo should be evaluated in a controlled field trial before any decisions are made on their widespread use in Ottawa.

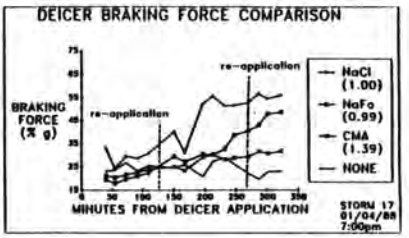
EPILOGUE

The study, "Alternatives to Sodium Chloride as a Snow and Ice Control Agent for Use on City of Ottawa Collector Roads" was the first of a two phase project. The second phase is an extensive controlled set of field trials using the two most promising chemical alternatives; Calcium Magnesium Acetate (CMA) and Sodium Formate (NaFo). From November 1987 to mid-February 1988, the City of Ottawa and SYPHER:MUELLER accumulated over 100 hours of skid friction test data (approximately 2500 test patches) over the period of 40 storms (approximately 80 deicer applications overall). The project team are presently performing tests on low traffic roads and high traffic collector roads. The test team is also experimenting with deicer spread widths, deicer particle size and degradation, deicer mixtures (CMA/salt mix) and skid tests profiling the cross-section of the road. Results of the low traffic tests for typical storms within various temperature ranges are shown in Figure 4. The individual deicer application factors are shown in brackets within the legend of each chart.

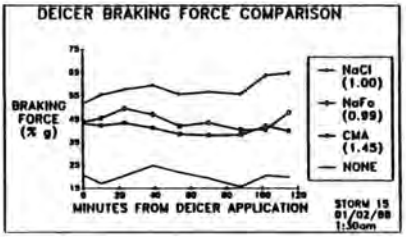
TYPICAL STORM FOR > 0 deg C



TYPICAL STORM FOR 0 deg C to -5 deg C



TYPICAL STORM FOR -5 deg C to -10 deg C



TYPICAL STORM FOR < -10 deg C

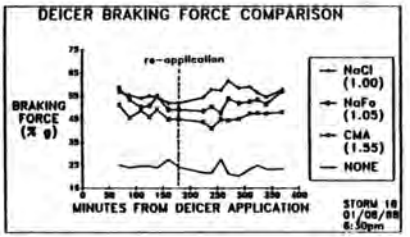


Figure 4. Preliminary Braking Performance Results for Various Temperatures.

These plots show that NaCl remains the quickest acting deicer with NaFo lagging in effectiveness by typically 1/2 hour. CMA acts as more of a debonder than a deicer and typically lags NaCl in effectiveness by 1-2 hours; sometimes longer.

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VEHICLE EMISSIONS INSPECTION AND MAINTENANCE PROGRAMS

1.0 INTRODUCTION

New motor vehicles sold in both Canada and the United States have emission control systems which limit the quantity of carbon monoxide (CO), hydrocarbons (HC), and nitrogen oxides (NOx) emitted to levels required by standards in federal regulations. However, laboratory tests and checks of vehicles operating on the roads and highways have shown that many vehicles are emitting pollutants in excess of the levels specified for new vehicles. In addition, the misfuelling of "unleaded fuel only" vehicles with leaded fuel has resulted in the release of unnecessary quantities of lead into the environment.

The reason for much of this excess emission of pollutants is tampering. Tampering is defined as any non-manufacturer-specified activity involving a motor vehicle and its emission control systems which results in individual vehicle emissions which are greater than either legislated standards or design specifications.

Although it is common to refer to the misfuelling of an "unleaded fuel only" vehicle separately, misfuelling is a form of tampering and one of the most widespread practices. Component deterioration due to insufficient maintenance is also not generally included in vehicle statistics, however, it is also a form of tampering.

1.1 Tampering and Its Effects

The most common forms of tampering which have been detected during in-use vehicle surveys are:

- engine parameter maladjustment;
- emission control system disablement;
- emission control component removal;
- misfuelling; and
- component deterioration due to insufficient maintenance.

The emissions increases which result from tampering can be dramatic. For example, during Environment Canada emissions tests, the removal of the 3-Way catalytic converter from two vehicles resulted in average emissions of HC which were 6.5 times greater than those measured with the catalyst installed. Similarly the emissions of CO were 4.1 times and NOx 3.7 times greater, Table 1.(1)

The emissions increases which result from the removal of a catalytic converter are of the same order as those which result from prolonged misfuelling with leaded fuel. Frequent misfuelling with leaded fuel can destroy a catalytic converter's ability to function and misfuelling may also result in a plugged converter which would render the vehicle inoperative.

Therefore, not only can tampering result in emissions increases, but tampering can also permanently damage expensive emissions control components.

In addition to revealing large emissions increases as a result of tampering, research has shown that the frequency of tampering with vehicle emissions control systems is significant. Annual "Tampering Surveys" conducted in the U.S.A. since 1978 have discovered proven tampering in at least 20% of the vehicles inspected and suspected tampering in another 20 to 30%, Table 2.(2,3) Tampering is most frequent in older model vehicles and appears to increase with vehicle age, Figure 1.(2)

Vehicles have not been surveyed as extensively in Canada, but the limited testing which has occurred (mostly in the form of voluntary inspection clinics) reveals that tampering appears to be equally as prevalent in this country.(3)

Because of the many uncontrolled variables and the complex air chemistry involved, the overall impacts of the excess emissions which result from tampering are difficult to assess. However, the theoretical benefits which can be achieved from an I/M program which eliminates all tampering have been estimated to be: a potential reduction in emissions of hydrocarbons by up to 42%; of carbon monoxide by up to 26%; and nitrogen oxides by up to 24%.(4)

2.0 - WHAT IS A VEHICLE EMISSIONS INSPECTION AND MAINTENANCE (I/M) PROGRAM?

One of the first steps in addressing the tampering problem is to enact anti-tampering/anti-misfuelling legislation. (In the U.S.A. the federal government has enacted anti-tampering legislation; in Canada, such legislation is considered a provincial responsibility.) A vehicle emissions Inspection and Maintenance (I/M) program is a method of enforcing anti-tampering/anti-misfuelling legislation.(5)

A vehicle inspection may consist of one or more of the following:

- a visual check, plus a function test, of a vehicle's emission control systems to ensure that they are as originally installed by the manufacturer;
- a measurement of a vehicle's emissions to determine whether they are within selected limits; and
- an assessment as to whether an "unleaded fuel only" vehicle has been misfuelled.

The owners of vehicles which fail an inspection are required to have corrective repairs (maintenance) performed prior to a retest.

If the program is linked to a government's vehicle registration system then it is common to require an owner to have necessary repairs completed, and/or for the vehicle's emissions to be reduced, before the owner may renew the vehicle's licence.

3.0 PRESENT STATUS OF I/M IN CANADA AND THE U.S.A.

In the U.S.A. studies by the Environmental Protection Agency (EPS) revealed that "excess" emissions from motor vehicles were a major cause of the elevated ambient pollution levels of CO and ozone found in many urban areas in that country.

In the late 1970's, the U.S. EPA judged that compulsory Inspection and Maintenance Programs in large urban areas were a cost-effective method of reducing these excess emissions. Consequently, they ordered several states to implement I/M programs and imposed time limits for those states to be in compliance with the regulated ambient CO and ozone standards.

By the summer of 1987, there were over 60 I/M programs operating in urban areas in more than 30 states. Some programs have been implemented state-wide, but the majority are only in force in selected counties or only encompass major cities and their suburbs.

In Canada, although I/M has been investigated by at least three provinces in connection with ambient ozone problems, there are as yet no regularly scheduled I/M programs in operation in this country.

4.0 TYPES OF I/M PROGRAMS

Although the U.S. EPA required local governments to implement I/M and indicated the emissions reductions they wished to see, they did not specify the details of the programs. Consequently every I/M program in operation in the U.S.A. is different. They vary from

major differences in how programs are administered to minor variations in the exhaust emission test specifications.

Of the options available to those wishing to implement an I/M program, the following present the alternatives for some of the main features:

a) Type of Test Facility
- CENTRALIZED - a few large test centres
- DECENTRALIZED - numerous private garages
- HYBRID - a combination of large test centres in areas of high population density and licensed garages in less populated areas.

b) Facility Operation
- by government employees (centralized system)
- by a single contractor (centralized system)
- by numerous small private operators (decentralized)

c) Frequency of Inspections
- annual
- biennial
- at the time of sale or resale of a vehicle
- only during random police spot checks
- combinations of the above

d) Enforcement
- at registration
- sticker enforcement
- computer matching

e) Quality Control
- government administered and operated
- government administered and contractor operated

Of the I/M programs in operation in the United States, the majority are annual inspections linked to vehicle registration and are conducted at small local garages licensed by the government.

If given a preference, because of the greater ease of quality control, most agencies involved in implementing I/M would choose to build centralized test facilities. However, because decentralized programs allow greater private entrepreneur involvement, they are frequently selected over centralized operations. Although it is more difficult to monitor and maintain program quality with a decentralized program, the large number of local I/M inspection facilities which result from such a program also allow more convenient access to inspections by the public.

Of the above features the most important with respect to program success is quality control. Regardless of the type and design of the I/M program and facilities, a tightly administered quality control-audit function on the part of the control agency is essential for program success. The quality control program should include provision for:

- the training and certification of mechanics;
- the certification and licensing of test centres;
- specifications for analyzers and calibration gas;
- the auditing of the quality of the inspections;
- the establishing of referee facilities to resolve complaints; and
- the accurate control, collection, collation and analysis of inspection data and test records.

The control agency must have (or employ via contractor) a staff of experts with experience in the automotive repair industry. These experts conduct station by station audits on a regular basis; employ a fleet of audit vehicles for covert station checks; and operate a "hot line" to field complaints and questions from the service industry, the I/M operators and the public. The control agency must be aware of the audit requirements and they must budget for their inclusion in the I/M program.

The Colorado decentralized I/M program employs a team of state auditors to check the private garages in their decentralized program. For a fleet of approximately 1.8 million vehicles, the two departments involved employ about 42 people dedicated to I/M of which 24 are field auditors.

5.0 OTHER IMPORTANT FEATURES

5.1 Test Fees and Waivers

In the U.S.A. the test fees vary from "no fee" in five centralized programs to "no set limit" for the decentralized program in California. Average test fees range from $5 to $10.

One of the questions asked most frequently by those considering I/M implementation is "how much does it cost?". They generally refer to the capital and operating costs incurred by an agency in running and administering an I/M program. Because the existing programs are government administered, even when they are contractor run, it is very difficult to separate direct program costs from other government expenses. However, most agencies report that the test fee charged each motorist is sufficient to cover all program costs.

This declaration can be misleading. In Colorado, for example, the maximum test fee is set at $8.50 (and almost all test centres charge the maximum). Of this fee, the state government receives $1.50. However, the I/M program administration also receives $0.50 for every vehicle registered in the program area, plus receives a $25 fee from each test centre for the initial licence and $10 per year thereafter for renewal. (The program is decentralized,with over 1400 licensed garages.) Each licensed mechanic involved in the program also pays $10 for initial registration and $5 per year thereafter to stay in the program. In California, also a decentralized program, the state I/M program administration receives $5 for each inspection certificate issued. They also receive annual fees from stations and mechanics plus fees for government run training programs.

Repair cost waiver fee is another important program feature which requires careful attention. In order to ease the burden on vehicle owners, many of the programs in the U.S.A. have set a maximum fee for I/M repairs. In other words, if to pass a retest a vehicle must be repaired, the owner may apply for a waiver (and receive a conditional pass) if the cost of the emission control system repairs to the vehicle exceed a set limit. The problem with such limits is that if they are set too low then the waiver will quickly be exceeded and the vehicle's emissions may not be reduced, while too high a waiver may encourage mechanics to do unnecessary repairs.

The U.S. EPA has indicated that the failure to set cost waivers sufficiently high is one of the major reasons for many programs failing to achieve their emissions reduction potential. Many of the more successful programs do not have a repair cost waiver and virtually every program requires all deficiencies which are a direct result of tampering to be repaired regardless of cost. For example, in Colorado, the removal of the fuel inlet restrictor is sufficient grounds for the control agency to require the replacement of a vehicle's catalytic converter.

5.2 Exemptions

Since the objective of an I/M program is to inspect the majority of vehicles in the program area, it is important for an agency to limit the number of vehicles which may be licensed without an inspection. For example, at present most programs exempt heavy duty

vehicles (HDVs), i.e. vehicles with a GVWR greater than 8500 lb. This does not necessarily mean that HDVs are devoid of tampering, but rather that most excess emissions result from light duty vehicle tampering. The inclusion of HDVs in a program will require specialized tests, facilities and mechanic training.

Other important exemptions to be considered include vehicles more than 20 years old and vehicles fuelled with other than gasoline and diesel fuel. An analysis of the fleet in a prospective I/M area will establish the consequences of exempting any particular category or type of vehicle from the program.

5.3 Emissions Analysis VS. Visual Inspections

The technique employed to certify whether new vehicles satisfy the requirements of the federal emissions standards, the Federal Test Procedure (FTP), is too time-consuming and equipment intensive to be employed for I/M inspections. The most common method of emissions measurement employed in I/M programs is the idle emissions test which uses a relatively inexpensive analyzer to measure the concentration of CO and/or hydrocarbons in a vehicle's exhaust while the vehicle is idling. (Automobiles normally produce no measurable amount of NOx at idle, therefore NOx emissions measurements are not included in a standard idle test.)

Unfortunately the emissions measured using the idle emissions test do not directly correlate to the standard reference method, the FTP. As a result there has been, and continues to be, controversy regarding the validity of the idle test. Although it is generally recognized that the idle test can detect "gross" emitters, that is vehicles with emissions 2 or 3 times greater than the new vehicle standards, it is the borderline cases which bring this method into question. Several researchers have shown that when employed on a fleet of in-use vehicles the idle test will pass a number of vehicles which would fail an FTP test (errors of omission) and fail a number which would pass (errors of commission).

The idle test failure rate for a fleet of vehicles will depend not only on test procedures, such as a requirement for all vehicles to be sufficiently preconditioned to bring them to operating temperature prior to test plus a requirement to employ both a low and a high idle measurement, but also on the cut-points or emission specifications chosen by the agency. Of the more than 60 I/M programs in the U.S.A., most have different emissions specifications.

Although the U.S. EPA continues to recommend the inclusion of an idle emissions test in a program, they also feel that an anti-tampering program (ATP), a visual inspection of emissions components, is vital for program success. (For best results the ATP should also include the function testing of certain components.)

The idle emissions test may also lead to other problems. In Colorado it was established that a major reason for their first generation program not reaching its emissions reduction targets was because of cheating by inspectors. Many inspectors were entering false idle emissions test results in order to please regular customers. The program requirements were subsequently changed to include computer-controlled analyzers, sophisticated exhaust gas test equipment which was programmed so that inspector/mechanics could not input emissions test results. For similar reasons, in California, computer-controlled analyzers were required for their third generation decentralized program in an attempt to eliminate similar problems.

In order to achieve the greatest potential benefit from an I/M program, particularly for NOx and evaporative hydrocarbon emissions which cannot be measured with a simple idle test, an anti-tampering program which includes the function testing of certain emissions components is now felt to be essential.

6.0 DISCUSSION

6.1 The Success of I/M

For the I/M program in California the following estimates were generated with respect to emissions reductions potential and program performance:(4)

a] - If all tampering with emissions controls and non-tampering defects were eliminated then the maximum theoretical benefits of their I/M program would be:

Reductions of	HC	CO	NOx
in %	42.3	25.7	24.2

b] - The estimated reductions from their second generation licensed garage are:

	12.3	9.8	3.9

c] - The estimated reductions from their first generation licensed garage were:

	2.0	2.0	1.0

What these estimates reveal is that I/M programs have a potential to achieve significant emissions reductions; however, a poorly run program with inadequate quality control, such as the California first generation program, may achieve little.

Although I/M programs have been in place across the U.S.A. for several years, many of the urban areas involved have not reached compliance with respect to either their ambient ozone or CO levels. The U.S. EPA still considers I/M to be a cost-effective method of reducing ozone and CO emissions. They believe that enhancements such as computer-controlled analyzers, visual inspections and the tightening of waiver fees will improve the effectiveness of many programs.

6.2 Impact of New Technology

Each year in Canada a percentage of the new vehicles which enter the fleet are equipped with the latest engine control technology and emissions control equipment. The new technology will have an effect on both vehicle emissions and on inspection and maintenance programs. For example, the increased use of fuel-injection systems with computer controls and feedback systems will reduce the incidence of engine parameter maladjustment by eliminating the adjusting mechanisms which were common on carburetor equipped automobiles. Computer controls will also help to reduce emissions through more precise engine control. However, malfunctions, when they occur, will lead to greater excess emissions than from older technology vehicles.

Maintenance and service of these sophisticated systems has already lead to problems in California where they estimate that less than 30% of the mechanics in their I/M program appear to understand such systems.(4)

6.3 Public Awareness

The most important elements in any program to reduce excess vehicle emissions are an informed public and an informed service industry. Tampering with vehicle emissions control systems frequently results from the mistaken impression that such actions will improve vehicle driveability or reduce operating costs. For today's generation of motor vehicles neither of these assumptions is correct.

The emissions controls installed on a motor vehicle are just part of a complex interconnection of vehicle control systems and a modern vehicle is designed for optimum operation when all systems are intact and adjusted to the specifications developed by each manufacturer. The maladjustment of parameters, the changing or removal of components and/or destructive acts such as misfuelling will mean that the owners of such vehicles are not receiving the performance for which they have paid a considerable amount of money.

For example, misfuelling is frequently cost related. The cost differential between leaded and unleaded fuel may mistakenly lead vehicle owners to feel that they will save if they use the cheaper leaded gasoline. However, the economic penalties which accompany misfuelling can outweigh any immediate fuel cost savings. One study projected the cost penalty for increased maintenance from misfuelling over 80 000 km to be at least $700. The fuel cost savings over the same period were estimated at $300, for a net loss to the vehicle operator of $400.(6) Misfuelling will also permanently damage costly emission control components. For example, a catalyt's ability to convert harmful pollutants can be totally destroyed by repeated misfuelling and the device may plug completely, rendering the vehicle inoperative. A catalytic converter is an expensive device with original equipment replacements often costing $500 or more.

An information campaign directed at both the public and the vehicle service industry can therefore be a useful tool in combating tampering. The media campaign could be similar to the 1986/1987, joint Environment Canada - P.A.C.E., Automobile Public Awareness Campaign. However, it is important that agencies first enact anti-tampering/anti-misfuelling legislation.

This legislation plus an information program are important steps in a campaign against tampering; however, in areas where excess emissions from motor vehicles are and remain a concern, some form of inspection and maintenance program is suggested as a technique to reduce emissions.

7.0 RESEARCH OPPORTUNITIES

Although inspection and maintenance programs have been in operation in parts of the U.S.A. since the early 1970s, there are several research opportunities in connection with I/M, particularly with respect to the application of those programs in an urban Canadian environment.

7.1 Identification of Emission Control Components

As a result of differences in the federal vehicle emissions standards, particularly model years 1981 through 1987, the present composition of the in-use fleets in Canada and the U.S.A. vary considerably in the area of installed emission controls. Many popular vehicle models are unique to Canada (with respect to the emissions controls) and there are problems related to identifying the control components originally installed.

There is, therefore, a need to refine a data-base for component identification which would be suitable for use with computerized exhaust gas analyzers in this country. To assist an agency implementing I/M, there is also a need to develop component data-base software for use with both the present computerized analyzers and for the more advanced devices which are under development.

The analyzers currently used in the more advanced I/M programs do not allow an inspector to input false emissions test results and the systems proposed in the U.S.A. for 1990 and beyond will combine that capability with a list of the emissions control components originally installed on most makes of vehicles.

In California they are also developing a bar code system for component identification. The bar code would be added to a vehicle label at the time of manufacture and would contain all the emissions component and exhaust emissions specifications that would be required as part of a vehicle inspection and emissions test. There is a need to develop a similar system (or to adapt the California system) for use in Canada.

7.2 Engine Diagnostics - Standards for Interrogation

At present many of the new light-duty vehicles equipped with computer controls have built-in diagnostics which allow the computer to make continuous or periodic checks of a vehicle's systems including its emissions controls. In some cases, small lights also allow the computer to report to the driver that somewhere in the vehicle there is a malfunction which should be checked by a mechanic. Many of these computers subsequently allow a mechanic to interrogate the computer to determine which system is causing the problem and the nature of the fault.

Some of the manufacturers have questioned the validity of the idle exhaust emissions test as employed in most I/M programs. Because of the many errors of omission and commission which occur (particularly for

vehicles with computer controls), they feel that the idle exhaust emissions test should not be used. One manufacturer suggests that an interrogation of a vehicle's computer diagnostic systems be used in place of the idle emissions test.

This idea has merit; however, before it could be universally implemented two major issues would have to be resolved. At present there is no standard for onboard diagnostic software; moreover the onboard computer systems and their software are proprietary to the manufacturers. Manufacturers are unlikely to allow possible competitors access to the secrets of their systems. There is also no universal hardware link to allow an I/M computer to physically connect to an onboard computer.

There is a need to develop universal diagnostic standards for vehicles with computer controls along with the hardware for allowing easy and affordable access to the computer diagnostics by licensed I/M facilities.

7.3 Canadian Cost-Effectiveness Studies

From the results of the original studies of I/M programs, the U.S. EPA judged I/M to be a cost-effective method of addressing excess vehicle emissions. In an effort to research the cost-effectiveness of urban I/M programs in Canada, Environment Canada contracted a preliminary study on the topic, but because of the many variables involved the results were of questionable validity.

Because of less catalytic converter penetration into the Canadian in-use fleet, the older EPA cost-effectiveness data may still apply. However, there remains a research opportunity for the development of a valid cost-effectiveness model for Canadian urban settings and reliable cost-effectiveness data.

8.0 SUMMARY

In Canadian urban areas where excess emissions from motor vehicles are contributing to local ambient air problems, steps should be taken to reduce the incidence of tampering with emissions control systems. The first steps in addressing the problem of tampering are the establishment of anti-tampering/anti-misfuelling legislation and the implementation of a information campaign directed at both the public and the vehicle service industry.

The information program should stress the effectiveness of the emissions control systems on modern automobiles and the damage both to the environment and to the vehicles which can result from tampering. Education and retraining programs directed at new mechanics and future vehicle owners should also be considered. These information/education programs should stress not only the adverse environmental aspects of tampering, but the improved vehicle operation and the long term economic savings from operating a well-maintained, untampered vehicle.

In areas where tampering continues to be a significant problem, a form of vehicle emissions control system inspection is suggested as an technique for reducing excess emissions. An agency intending to implement I/M will have to research the most desirable I/M options for their particular Canadian urban setting.

9.0 REFERENCES

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TABLE 1 - EMISSION CHANGES RESULTING FROM TAMPERING
(Environment Canada Laboratory Test Results) (1)

Controls on Vehicle	# Cars	Control Disabled	HC			CO			NOx		
			B	A	A/B	B	A	A/B	B	A	A/B
			(g/mile)			(g/mile)					
3W+EGR+OS *	2	3W	0.30	1.95	6.5	2.83	11.65	4.1	0.80	2.92	3.7
	3	OS	0.24	0.39	1.6	2.17	4.94	2.3	0.58	1.19	2.1
	3	EGR	0.24	0.23	1.0	2.17	2.17	1.0	0.27	0.46	1.7
3W+EGR+	2	EGR	0.36	0.34	0.9	4.83	4.58	0.9	0.71	1.71	2.4
AI+OS **	2	OS	0.36	1.31	3.6	4.83	30.50	6.3	0.71	0.31	0.4
OC+EGR+AI **	7	AI	1.05	2.43	2.3	13.81	34.18	2.5	1.87	1.79	1.0
	7	OC	1.05	2.63	2.5	13.81	27.36	2.0	1.87	2.60	1.4
	7	EGR	1.05	0.99	0.9	13.81	11.0	0.8	1.87	4.47	2.4
	7	OC+AI	1.05	3.02	2.9	13.81	35.71	2.6	1.87	2.54	1.4
OC+EGR **	6	OC	0.57	2.79	4.9	6.16	9.78	1.6	2.15	2.55	1.2
	6	EGR	0.57	0.60	1.1	6.16	6.64	1.1	2.15	4.26	2.0

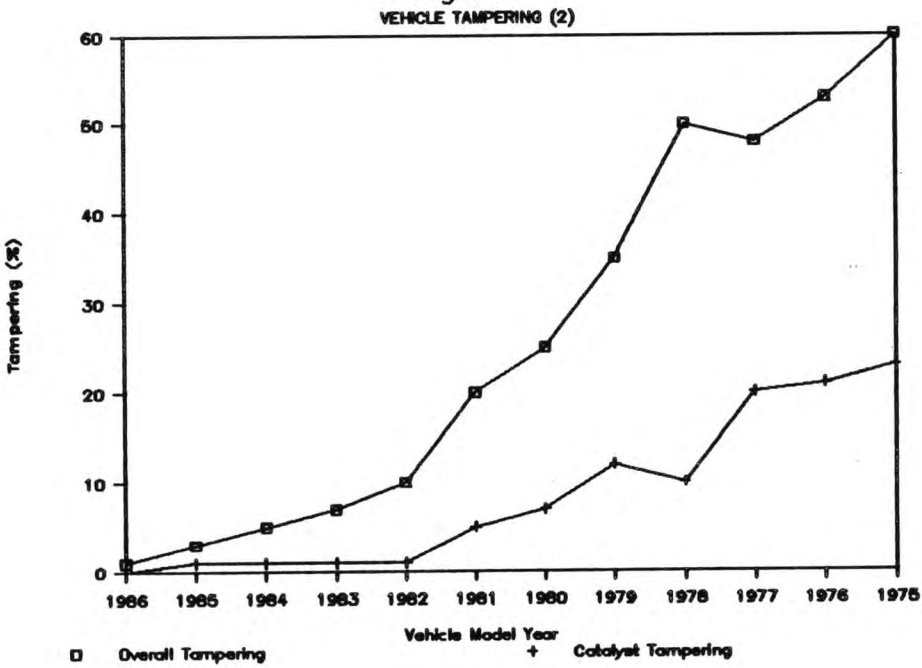
B = baseline untampered emissions
A = emissions after tampering
3W = three-way catalytic converter
OC = oxidation catalytic converter
OS = oxygen sensor
EGR = exhaust gas recirculation system
AI = air injection system
g/mile= mass emissions in grams per mile
* - U.S.A. 1981 specification vehicles
** - Canada 1975 specification vehicles

TABLE 2 - U.S. EPA VEHICLE TAMPERING SURVEY RESULTS

SURVEY YEAR	TAMPERED (%)	ARGUABLY TAMPERED (%)	MALFUNCTIONING (%)	OK (%)
1978	19	48	2	31
1979	18	47	2	33
1981 *	14	45	3	38
1982	17	38	1	44
1983	25	30	3	42
1984	22	29	4	46
1985	20	27	1	52
1986	20	25	1	54

* sample size much smaller than for other surveys.

Figure 1


VEHICLE TAMPERING (2)
Tampering (%)
60
50
40
30
20
10
0
1986
1985
1984
1983
1982
1981
1980
1979
1978
1977
1976
1975
Vehicle Model Year
Overall Tampering
Catalyst Tampering

Design Considerations in the Development of a Vacuum Insulated Freight Container

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1.0 INTRODUCTION

Insulated cargo containers are in common use for the shipment of perishable goods and frozen foodstuffs. Within Canada, for example, almost 10 million tonnes of perishables are transported annually, while globally the figure is much greater. Insulated containers can be designed to permit working temperatures below 0 F (-18C) however, with age, deterioration of both the insulation and the refrigeration equipment occurs resulting in an inability to retain low temperatures for extended periods of time. The consequent financial loss due to spoilage or loss of premium quality can be quite substantial. For example spoilage of 1% of a container load of salmon steaks or lobster tails could amount to around $4,000.

The development of the flash freezing of foodstuffs using cryogenic fluids such as liquid nitrogen results in a better tasting, superior quality product. In order to capitalise on this advance however there is a clear need for an equivalent improvement in storage and transportation facilities to allow working temperatures of say -40^{o}F (-40^{o}C) to become the norm.

The converse problem, that of maintaining a relatively high cargo temperature in conditions of sub-zero ambient temperatures is of concern to shippers of paint, wine and fruit juice concentrates, etc; The annual loss to the Canadian economy due to cargo spoilage from either of the above causes is difficult to quantify but is believed to be substantial. Transportation rates for the shipment of temperature sensitive "reefer" containers are very high due to the need to provide on-hand maintenance personnel to attend to them, and the high insurance premiums due to the risk of spoilage. A factor of six over the cost of shipping a "regular" container between Vancouver and a European port is fairly common.

There would thus appear to be a need for a freight container unit which could maintain cargo temperatures for considerable time periods irrespective of ambient conditions. Ideally such a container should function without the need for an external power source to minimise maintenance and maximise the use of "conveyances of opportunity". For example, a self sustaining reefer container could be shipped by any cargo vessel plying the desired route rather than be dependent upon a container ship specially equipped to handle the powering requirements of a conventional unit.

From the outset it was believed that the thermal performance criteria could be met using vacuum insulation since cylindrical tanks with

hemispherical ends using such insulation are used regularly in the transportation and storage of liquid air products. It was not known however if a vacuum insulated container of rectangular configuration could be designed and built at a price competitive with mechanically refrigerated containers.

Having defined the problem one of the authors (I.R. McAllister) conceived the idea of using doubly curved tensioned membrane panels secured to a rectangular skeletal framework to provide the basic structure (see Fig. 1). McAllister (Ref. 1) developed the concept further by performing some initial structural calculations to determine preliminary sizes and thicknesses for the various members and deduced likely heat loss rates based upon published evaporation losses from liquid air storage tanks (ref. 2). A patent search revealed that the proposed solution was unique and therefore patentable. United States patent number 4646934 was awarded in March 1987 to Chevy Development Corporation of Vancouver.

2.0 CONCEPT EVALUATION

In this paper the authors report upon a feasibility study to design, construct and safely operated a 40 foot I.S.O. vacuum insulated container. This concept evaluation was performed by Det norske Veritas, an international ship classification Society, whose principal objectives were to examine safety aspects and determine the technical feasibility of a vacuum insulated freight container having due regard for the desire of near term construction.

The following design criteria were established:

* the external dimensions of the container should comply with I.S.O. requirements
* the tare weight of the container should not exceed 20,000 lbs.
* the structural adequacy of the container should comply with or exceed I.S.O. requirements
* the container should be able to preserve warm or cold cargo temperatures to within a 40°F (20°C) rise for periods of at least 28 days with no external energy requirement. (This would enable trans-ocean shipments.)
* operational use of the container should not create an undue safety or toxic hazard
* the choice of materials and their mechanical properties and the requisite manufacturing technology should be currently available.

It should be noted that although maximising cubic carrying capacity is an important factor for an operator the scope of the study was restricted to proving the principle rather than obtaining an optimal solution. Thus structural adequacy, thermal performance, safety considerations and the drawing and maintenance of a suitable vacuum formed the principal areas of investigation and hence define the scope of this paper.

3.0 STRUCTURAL CONSIDERATIONS

To assist the designers of freight containers and to ensure compliance with a plethora of international standards Det norske Veritas published its

"Rules for Certification of Freight Containers". (Ref. 3). Receipt of a certificate of compliance offers the assurance to both owner and prospective insurer that the unit has been designed and built so as to meet or exceed a minimum acceptable standard of performance and is thus suitable for use in intercontinental trade.

From a structural viewpoint each member of the container has to withstand the forces arising from the design loads which are specified in terms of stringent test requirements. For example, each container has to be capable of carrying at least 5 tiers of fully laden containers on top, with an additional factor of 1.8 to represent the static equivalent of assumed dynamic conditions. There are also detailed requirements for lifting loads and end and side wall pressure loads, while floor strength has to be such as to resist the wheel loads from forklifts. Some of these loading scenarios are illustrated in Fig. 2.

In addition to these service loads a vacuum insulated container has to accommodate substantial pressure loads caused by the vacuum as well as those due to thermally induced forces. In order to make these latter forces manageable and still permit the operator maximum flexibility over his choice of operating mode (i.e. warm or cold cargo), the inner container has to have freedom of longitudinal movement. In addition, a system of prestressed inter vacuum supports ("standoffs") is required to enable both transverse thermal movements and load transfer between inner and outer shells to occur. (Fig. 3). Both of these considerations are addressed later in the paper.

It is well known that a curved membrane can be a very effective structural element when its ability to sustain tensile loading due to pressure is used to the full. Low pressure examples include hot air balloons and blimps while a high pressure example would be a propane tank.

In the present concept a rectangular skeletal ring framework is used in conjunction with a number of doubly curved membrane panels to provide both the vacuum containment system and the structural form of the container. The vertical members of the framework can be thought of as posts while their horizontal counterparts may be referred to as beams. It is clear that when the space between the inner and outer container structure is evacuated the atmospheric pressure forces on the external structure will act inward while those on the internal structure will be outward. The relative strengths of these forces are dependent upon the areas on which they act nevertheless these forces being opposite can be used to offset each other to some extent.

Consider the reactive forces shown acting on the outer curved panel (Fig. 4a), and suppose two such panels to be adjacent. They will exert both a horizontal force on the common beam to which they are joined, and an inwardly directed vertical force (Fig. 4b). However as can be seen in this figure the counterpart inner adjacent panels while imposing a similar type of horizontal force to their common member, will also exert an outwardly directed vertical component of force thus minimizing the net thrust in this direction. These out of balance forces are transmitted between the inner and outer container by means of the inter vacuum supports which are located at a number of discrete points on each ring frame. In order to reduce heat transfer however the number of supports have to be kept to a minimum.

Of equal importance is the direction of the resultant forces acting on the inner and outer longitidunal edge beams (Fig. 5). The fact that both resultants act in the same sense is a considerable help since under no circumstances should the inner and outer structural frameworks touch.

4.0 STRUCTURAL ANALYSIS

The first attempt at analysing the membrane panels was to utilize the equations commonly associated with the analysis of thin cylinders under uniform pressure. This was an acceptable approximation and enabled preliminary panel thicknesses and overall dimensions to be determined. In order to progress the structural assessment further however a detailed analysis of the membrane panel was undertaken while simultaneously investigating the three dimensional response of the skeletal framework to applied load.

The depths of the outer and inner walls of the container provide physical limits to the maximum "sag" of a membrane panel while the rectangular edge geometry and dimensions of the supporting frame impose further constraints. Since a membrane tries to equilibrate any imposed loading by changing its geometry it was very important to define the initial geometry of the panel. The ABAQUS non linear finite element program (Ref. 4) was used to perform the requisite analyses for a number of panel aspect ratios and initial sags and Fig. 6 illustrates a typical initial geometry. Defining such a shape and then subjecting it to a uniformly distributed pressure load of one atmosphere ensured that in each case the amount of bending stress induced was a minimum and that the membrane was performing in an efficient manner. A panel thickness of 3.5mm in conjunction with a sag of 102mm was found to be adequate in keeping the maximum stress in the panel below 28 MPa, - well below the yield stress of 125 PMa for a 5083 Aluminum Alloy. (The preliminary structural analysis had indicated that aluminum would have a strength/weight advantage over steel). A shallower sag reduces overall wall thickness however membrane stresses are increased.

Interestingly the maximum deflection of a typical panel having a 4" (102mm) sag was quite small, of the order of 1mm. More importantly the corners of the panel experience small compressive stresses which if left unattended would appear as local wrinkling in the real structure. The edge reactive loads on the panel were applied to a three dimensional frame idealisation of the skeletal structure to enable the stresses in the support members to be established. (See Fig. 7 for a 1/8th idealisation of the framework for symmetric load conditions). As mentioned earlier inter vacuum supports are used to transfer load between the inner and outer walls of the container and their stiffness characteristics had to be incorporated in the frame model. The VERITAS space frame program NV5040 enables a number of load combinations to be calculated simultaneously hence it was possible to examine the effects of container stacking loads both in isolation and in addition to the vacuum pressure and thermally induced loads. These latter type of loads were applied to the structure as prescribed thermal deflections. For example a 50^{o} C difference in internal and ambient temperature conditions results in a relative movement of 3mm in the transverse directions. The direction of movement depends on the operating

condition selected. Fig. 8 illustrates the combined effects of a cold cargo causing shrinkage of the inner container posts, prestressing of the 3 inter vacuum supports, and the applied vacuum load.

Prestressing the inter vacuum supports appeared to be the only acceptable way of keeping the stresses in the framework down to acceptable levels while allowing the operator maximum flexibility of usage. Even so the stresses at the ends of the beam members were close to yield. Since this effect was quite localised there was no necessity to increase the thickness of the hollow section beams and posts over their entire lengths, rather it was sufficient to add 5mm thick doubler plates in the higher stressed areas. The various structural analyses indicated that the amount of prestressing induced in the inter vacuum supports had a dramatic effect on the stresses experienced by the framework. A compressive pre-load of 100 kN (25000 lbf) per support resulted in acceptable stress levels although again it should be pointed out that the optimum number and location of these supports was not addressed in this study. Figure 9 illustrates the bending moment diagram appropriate to the deflected shape shown in Fig. 8. One possible configuration for a compliant inter vacuum support is shown in Fig. 10. Here a saddle type arrangement is used to span across the width of the post/beam member thereby increasing the section modulus locally by providing additional thickness. To be effective the spring stiffness of the standoff should be about half that of the members it spans between. This enables the variation of the preload, as a result of thermal movements, to be as small as possible. The use of compliant springs may also be a bonus operationally, since they could help absorb shock loads, while their considerable uncoiled length significantly increases the heat path and thus reduces the heat transferred between the inside and outside of the container.

The design requirements for these inter vacuum supports is addressed more fully in Section 8.0.

5.0 THERMAL DESIGN CONSIDERATIONS

In order for the container to fulfill its function of transporting goods within a specified temperature range and without an external energy supply the heat leakage into or out of the inner vessel has to be minimal. The direction of the heat leakage is dependent upon which of two operating modes are in effect that is, either the movement of frozen product say held at around -40°C, with much higher external temperatures or the transportation of such products as wine or paint at room temperature when the ambient temperature might fall to around -40/50°C.

Heat leakage can have 3 basic modes, convection, conduction and radiation. The creation of a vacuum space between the inner and outer walls of the container effectively limits any convective heat leakage to the vicinity of the door seal where a limited amount of air flow can occur. Conductive heat transfer also requires contact at a molecular level, it can therefore still occur within the evacuated space although with high levels of vacuum gas conductance is quite small. The inter vacuum supports and the vacuum seals constitute the major potential source of conductive heat leakage since they are connected to both the hot and cold surfaces of the container. To keep this leakage to a minimum requires the use, where possible, of a long heat path, minimum cross sectional area, and thermal

breaks, all of which have to be consistent with maintaining mechanical strength.

Radiative heat leakage could have been significant for the container however it was mitigated considerably by using a multi layered radiation barrier such as is common to cryogenic liquid storage vessels. This consists of interleaving layers of reflective metal foil with a bridal veil material in order to form a blanket which is then attached to the inner wall of the vacuum space by means of 'Velcro' pads. The conductive heat path in the blanket is limited to the extremely small area occupied by the knots in the woven veil. The mechanical strength of the insulation can be further improved by using an aluminized Mylar film rather than foil. This concept was developed further when considering the choice of vacuum sealing materials since there was a requirement to keep the conductive heat leakage of the seals to a minimum (Section 8.0).

6.0 THERMAL ANALYSIS

The basic equations of heat transfer are well known to the mechanical designer so it is considered inappropriate to restate them here. Instead we have chosen to present those less common equations associated with multi layer radiation and gas conductance.

6.1 Radiation Leakage

The fundamental equation for heat transfer by radiation from a perfect black body radiator is the Stefan Boltzman law.

$$Q_r = \sigma A T^4 \qquad (1)$$

where Q_r = rate of emission of radiant energy (W)

A = the surface area of the emitter (m^2)

σ = Stefan Boltzman constant 56.7×10^{-9} $Wm^{-2}K^{-4}$

T = absolute temperature of the emitting surface ^oK.

Most bodies including aluminised Mylar are not perfect radiators and hence emit radiation at a lower rate governed by the material emissivity ε thus,

$$Q_r = \sigma \varepsilon A T^4 \qquad (2)$$

The introduction of a number of shields between two parallel surfaces at different temperatures T_o and T_i causes the radiation energy to bounce back and forth between the shields. It can be shown (Ref. 5) that if the inner and outer surfaces of the vacuum closure are assumed to have the same area and the emissivity of each barrier shield is the same then:

$$Q_r = \frac{1}{n+1} \sigma A \left(\frac{\varepsilon}{2-\varepsilon} \right) (T_o^4 - T_i^4) \qquad (3)$$

It can be seen from equations (2) and (3) that the heat radiation is directly proportional to the emissiivity of the surfaces and inversely proportional to the number of barrier shields used. Applying equation (3) to the present container concept and assuming the use of 20 Mylar shields aluminised on both sides one can determine an approximate heat leakage as follows:

Assume: Outer wall temperature = +27°C (81°F) = 300°K
Inner wall temperature = -40°C (-40°F) = 233°K
A surface area = 1456 ft^2 = 135.2m^2

Sheldahl (Ref. 6) quote an emissivity ε of their double sided aluminised Mylar of 0.05 although other sources quote aluminised shield emissivities in the range 0.03 - 0.04.

$$Q_r = \left(\frac{1}{20+1}\right) \times 5.67 \times 10^{-9} \times 135.2 \times \left(\frac{0.05}{2-0.05}\right) \times (300^4 - 233^4)$$

$$= 48.2\ W$$

Converting this heat leakage to a heat transfer rate/day for comparison with the calculated heat loss from cryogenic storage tanks of comparable surface area (pro rated for a different inner wall temperature) one finds:

$$Q_r = 0.356\ \text{Watts/m}^2 = 2.7\ \text{BTU/ft}^2\text{/day}$$

This compares with 5.84 BTU/ft^2/day for the storage tank although it is important to remember that the latter figure is a TOTAL heat loss not just that due to radiation.

6.2 Heat Leakage by Gas Conductance

Although the word "vacuum" literally means empty in the original Greek, it is impossible to completely evacuate a given volume. The materials used for containment will steadily outgas over a period thereby permitting some gas conductance to take place. If the pressure is low enough however, heat leakage from this source can be made acceptably small. The Kinetic theory of gases applies if the Knudsen number is $\gg 1$. This non dimensional quantity is given by the ratio of the mean molecular free path of the residual gas and the distance between the vacuum walls that is,

$$K_n = L/S$$

The mean free path L is related to the gas pressure p and the temperature T by the formula

$$L = \frac{k}{P} \times \frac{1}{1 + \frac{T_y}{T}} \qquad (4)$$

where K and T_y are constants for a particular residual gas. For air Kaganer (Ref. 7) gives $K = 8.42 \times 10^{-3}\ N/m^2$ and $T_y = 113°K$.

Assuming a vacuum pressure of 1×10^{-4} torr (0.0133 n/m^2 or 2.0×10^{-6} psi) and a temperature of 20°C within the void then L has the value of 457mm. The Knudsen number is thus much greater than 1 for any conceivable insulation layer thickness. Roth (Ref. 8) has shown that the heat conductance for polyatomic gases in a vacuum space, bounded by surfaces at different temperatures T_o and T_i is given by

$$E_o = \Lambda_o \alpha \left(\frac{273}{T_i}\right)^{0.5} (T_o - T_i) \qquad (5)$$

where α is known as the accommodation coefficient and Λ_o is the free molecular conductivity at 0°C and is given by

$$\Lambda_o = \frac{\gamma+1}{\gamma-1} \times \frac{1.47 \times 10^{-2} \text{ Watts/cm}^2\,^\circ\text{C Torr}}{M^{0.5}}$$

For air the adiabatic index = 1.4 and M = 28.98

Hence $\Lambda_o = 1.64 \times 10^{-2}$ Watt/cm^2°C Torr

The heat transfer per unit area between two surfaces at 27°C and -60°C by residual air at 10^{-4} torr and an accommodation coefficient of $\alpha = 0.8$ will be,

$$= 1.64 \times 10^{-2} \times 0.8 \left(\frac{273}{213}\right)^{0.5} (300-213) \times 10^{-4} \text{ W/cm}^2$$

$$= 1.29 \text{ W/m}^2$$

or a total heat loss from container surface of 135 m^2 of 174 W (595 BTU/hr).

Clearly these calculations are upper bounds since the introduction of the thermal barrier shields effectively reduces the temperature difference between the outer wall and the outermost shield. The calculation of individual barrier temperatures is no easy matter however. Indeed, experiments conducted by Shu et al Ref. 9 indicate that the temperature at a given barrier varies as the vacuum pressure varies. It is also highly dependent on the accommodation coefficient which is directly influenced by surface preparation. Figures 11 and 12 have been extracted from the Shu paper and illustrate in the first instance the effect of vacuum pressure on the temperature distribution in multi layered insulation. Figure 12 illustrates the marked improvement in thermal performance of a number of layered configurations as the overall vacuum pressure reduces. It is clear that gas conductance is a significant source of heat leakage except for high levels of vacuum i.e. betweem 5×10^{-3} and 2×10^{-4} torr. However, as will be seen in Section 9.0 these levels of vacuum are well within present operating practise.

7.0 LONGEVITY OF CARGO STORAGE

The heat leakage into or from the container varies as the inside and outside temperature difference changes. Clearly the ambient temperature conditions also vary throughout any 24 hour period, however for the purposes of quantifying estimates for the longevity of cargo storage a constant

reference temperature has been used. It is further assumed that once steady state conditions have been achieved the heat transmitted through the container walls will be equivalenced by a change in the bulk temperature of the cargo and the internal shell structure. Stacking arrangements within the cargo space should encourage this to happen although it is reasonable to suppose a temperature gradient throughout the cargo will occur. Provided the product nearest the walls does not experience a significant change in temperature then little or no spoilage should occur.

The enthalpy of the cargo and the internal shell structure is gradually changed as the heat leakage at each prescribed temperature difference occurs. As a rather extreme example consider the transportation of food product stored at -60°C (-76°F) given an outside temperature of 30°C (86°F). A simple spreadsheet program was written to itemise the heat leakage due to gas condustance, seals and inter vacuum supports. Frozen foodstuffs have a range of thermal properties, however a specific heat of 0.45 BTU/lb/F is fairly typical. Assuming a cargo load of 40,000 lbs. and an internal shell weight of 8,000 lb. the enthalpy of the inner volume at a bulk temperature of -60°C (-76°F) is readily found. Table 1 illustrates the heat leakage and accumulated time in days for the bulk temperature to rise by 40°C, i.e. 53.5 days, quite sufficient time for a trans Atlantic or Pacific Ocean journey. An exercise assuming a low ambient temperature and warm cargo produced a similar cargo longevity. Note that in the first example the inner shell was first brought to the temperature of the stored product. This increases the total enthalpy by about 11% with a corresponding effect on storage time. Precooling the inner container gradually prevents thermal shock and can be achieved by surrounding the door opening with a skirt while allowing the low temperature in the loading bay to circulate within the container. A cheap alternative is simply to place platelets of dry ice in the container and allow gradual cooling to take place. The resulting CO_2 atmosphere would have to be purged before permitting loading access. The safest means however is to simply undercool the product and allow the shell to gradually reach an equilibrium temperature with the cargo. Undercooling by -10°C is quite sufficient to produce the longevity of storage mentioned above.

8.0 DESIGN OF SEALS AND INTER VACUUM SUPPORTS

An absolute prerequisite for adequate thermal performance is the maintenance of a high vacuum and this in turn made the end closure or seal a critical component in the design.

The "end closure" is equivalent to the neck of a dewar or thermos flask in that it has the following principal requirements:

1. The end closure must provide a vacuum seal for the annular vacuum insulating space. The seal must be suitable for high vacuum service, dictating qualities of low leakage, low permeation and low outgassing. For a 10 year period between pumpdown times, a total leakage and permeation rate of 4×10^{-8} ATM cm^3/S is acceptable. Arbitrarily allowing half of this in the end closure gives a target leak rate of 2×10^{-8} ATM cm^3/S.

2. The end closure must minimize heat transfer between the inner space and the outside environment.

3. The end closure must withstand relatively high temperature differentials between the inner and outer shell (approximately $90^{\circ}C$). It must maintain its sealing and structural integrity while subject to this thermal condition as well as to isothermal conditions. The longitudinal deflection of the internal shell may be up to 28mm (for $\Delta t = 90^{\circ}$ C assuming the shell material is aluminum). Up to half of this total deflection may have to be absorbed at the vacuum wall end closure.

4. The end closure must not interfere with suspension and sealing of the container door while taking up a minimum of space in the lateral directions.

A number of vacuum closure concepts were considered including a metal bellows arrangement which would have satisfied the low permeation and heat leakage requirements but would have been prohibitively expensive to fabricate and install. While some elastomers and polymers meet the permeability requirement and retain their mechanical properties at low temperatures their thermal expansion rates are quite different from that of aluminum and so might induce large thermal strains. After examining such exotic applications as the lining of spacesuits and the sealing of liquid fuel propellant in space vehicles the use of a metallised foil/polymer appeared to meet all the necessary requirements (Fig. 13).

Aluminum is such a good permeation barrier that even a very thin foil will provide adequate protection. Very thin layers of metal however must be supported and protected against tearing, buckling, creasing, abrasion, puncture and corrosion. The metal layer, if bonded intimately to an appropriate polymer, can be thus protected. Foil-polymer laminates are used extensively in food packaging to prevent oxygen and moisture permeation. Pinholes occur in thin foils and this has been a concern in the packaging industry. However tests on the effects of pinholes (Ref. 10) have shown that they do not pose a significant problem for foil-polymer laminates. This is because the polymer effectively seals the pinholes. The area of each pinhole is so small that the gas permeation through the polymer at these locations, is extremely low. For example, Union Carbide was able to provide a long term vacuum seal using a lead-mylar laminate (Ref. 11).

Further protection against pinholes can be achieved by the adhesive laminating of two thin foils together.

The design of the inter vacuum supports (standoffs) was touched upon earlier both from a structural and thermal viewpoint. Both tensile and compressive methods of support are possible although the limited space available favours the use of a compression member. Given the need to trade off strength with low heat transfer the concept of a unit of merit comes to the fore. Thus a parameter obtained from the ratio of the lowest yield strength of a material to its mean thermal conductivity over the same temperature range, σ_y / k, should be maximised.

During the course of this study considerable effort was expended in compiling information on thermal contact resistance and this has led the authors to propose an alternative compressive material. Hardened stainless steel plates about 0.5mm thick and having a rough surface finish would be separated by a fibreglass mat with a compressed thickness of about 0.5mm. A stacked arrangement of 25 such pairs approximately 25 mm thick would be quite low in cost and likely to have a thermal conductivity in high vacuum of the order 0.3 $Wm^{-1}K^{-1}$ at 500 MPa compressive loading. The expected σ/k merit value of 1,670 $MNKm^{-1}W^{-1}$ compares to 1,250 $MNm^{-1}WK^{-1}$ for a fibreglass-epoxy composite. Ceramic plates would be a further improvement on stainless steel provided they could be loaded uniformly to prevent fracture. This material selection process has to be considered in conjunction with the requirements to provide a compliant spring support such as is shown in Fig. 10.

9.0 VACUUM DRAWING AND LEAK DETECTION

In order to make allowances for outgassing, permeation and leakage the initial vacuum specification was of the order of 10^{-4} torr. In order to reach this level within a reasonable time period a pumping system capable of achieving pressures in the order of 10^{-5} torr is required. Once all the materials including the layered consulation are initially outgassed the pressure rise due to protracted outgassing is unlikely to be a problem unless very high temperatures are experienced. Vacuum industry experience (Ref. 12) indicated that a pumping speed of 100 m^3/hr should be sufficient for present purposes. The most economical method of achieving low pressures is to use a Roots pump in conjunction with a vapour diffusion pump. Such a system if connected to a clean empty chamber could reduce the pressure to 10^{-4} torr in under 2 hours. However since the inter vacuum space is of an irregular shape and contains polymes and metal foil the pumping time could be expected to be of the order of several days. In itself this poses little problem since mass production of containers would require the provision of a number of pumping units so that there would be an almost continuous supply of evacuated containers.

Leak Detection is essential during the production of the container and as far as possible all components would be leak tested prior to final assembly. However testing of the membrane panel welds is only possible after construction of the vacuum wall is complete. Visual inspection and x-ray inspection of critical areas would follow assembly while a rigorous leak detection procedure can be fully automated using a tracer gas such as helium. Purpose designed leak detection are available from several leading manufacturers.

10.0 MANUFACTURING AND MAINTENANCE

As a result of the preceding analysis a number of different materials and fabrication techniques have been identified. Since the latter are generally related to the specifics of the construction process they were not evaluated in detail. Nevertheless considerable thought was given to making

the form of the structural sections "production Kindly" (see Fig. 14). In the case of the mid beams and mid posts they are readily available as a standard extruded hollow section. The outer corner posts and edge beams have a more complex shape and would have to be fabricated rather than extruded. An appropiate brake forming procedure however can minimise the amount of welding needed. Equally, provided the handling facilities exist, an entire side panel could be pressed out, rather than individual membrane panels, thus the total amount of welding in one container could be reduced from 2Km to about half that value. Not all of this welding has to be of the highest integrity rather only those welds which are located in the evacuated space. Careful design can keep the length of this welding to a minimum.

Container maintenance is a worldwide concern with inspection and repair facilities available throughout the world. Most damage occurs through mechanical handling and loading of the containers. A vacuum insulated container is more vulnerable to the effects of a wall penetration by say a fork lift. For this reason care has been taken to line the inside of the container with a tough G.R.P. sheet while the "dimples" of the outer membrane wall are protected by the use of a urethane foam. In total these items only add 170 kgs to the mass of the container while increasing its structural integrity immensely. Since there is no mechanical refrigeration plant to be serviced the maintenance of a vacuum insulation container has the potential of being less of a problem than a conventional reefer unit.

11.0 CONCLUSION

The creation and maintenance of a high vacuum is the initial element in the development of a vacuum insulation container. The results of this study indicate the technical feasibility of constructing such a container using presently available materials and construction methods. The performance figures quoted are based on theoretical analysis and would require experimental verification, however there is a distinct possiblity that such tests would improve upon rather than invalidate the theoretical work. While the target weight for the structure was met comfortably there is scope for considerable optimization preferably as part of a detailed construction study. More development work including a test program is required on the metalised polymer seal to achieve a cost effective seal of high integrity. In the meantime an alternative polymeric substance XYDAR is available which meets the technical requirements but requires a major demand in order to reduce its cost. In summary, the needs of the market place and the evidence generated in this study warrants further development of the concept.

ACKNOWLEDGEMENTS

The authors would like to thank Chevy Development Cooperation of Vancouver and Det norske Veritas (Canada) Ltd. for permission to publish this paper. All views and expressions are those of the authors and not necessarily those of Chevy Development or Det norske Veritas.

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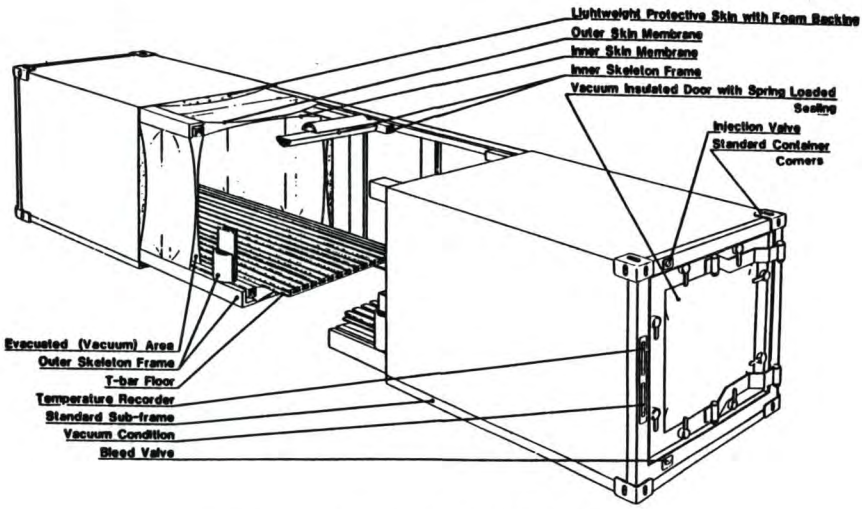
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TABLE I

Heat Flux Balance for a Full Container Initial Bulk Temperature - 60°C Ambient Temperature 30°C

Temperature T2	Q-Radiation	Q-Scale	Gas Conduction	Q-Standoffs	All Q	Time
-60	47.39	91.00	145.83	166.00	440.22	23.95
-59	47.10	80.10	144.21	164.16	435.57	24.21
-58	46.81	79.20	142.59	162.31	430.91	24.47
-57	46.51	78.30	140.97	160.47	426.24	24.74
-56	46.21	77.40	139.35	158.62	421.58	25.01
-55	45.90	76.50	137.73	156.78	416.91	25.29
-54	45.59	75.60	136.11	154.93	412.23	25.58
-53	45.27	74.70	134.49	153.09	407.55	25.87
-52	44.95	73.80	132.87	151.24	402.87	26.17
-51	44.63	72.90	131.25	149.40	398.18	26.48
-50	44.30	72.00	129.63	147.55	393.49	26.80
-49	43.97	71.10	128.01	145.71	388.79	27.12
-48	43.64	70.20	126.39	143.87	384.09	27.45
-47	43.29	69.30	124.77	142.02	379.39	27.79
-46	42.95	68.40	123.15	140.18	374.67	28.14
-45	42.60	67.50	121.53	138.33	369.96	28.50
-44	42.24	66.60	119.91	136.49	365.24	28.87
-43	41.89	65.70	118.29	134.64	360.51	29.25
-42	41.52	64.80	116.66	132.80	355.78	29.64
-41	41.15	63.90	115.04	130.96	351.05	30.04
-40	40.78	63.00	113.42	129.11	346.31	30.45
-39	40.40	62.10	111.80	127.27	341.57	30.87
-38	40.01	61.20	110.18	125.42	336.82	31.31
-37	39.63	60.30	108.56	123.58	332.07	31.76
-36	39.23	59.40	106.94	121.73	327.31	32.22
-35	38.83	58.50	105.32	119.89	322.54	32.69
-34	38.43	57.60	103.70	118.04	317.78	33.18
-33	38.02	56.70	102.08	116.20	313.00	33.69
-32	37.61	55.80	100.46	114.35	308.22	34.21
-31	37.19	54.90	98.84	112.51	303.44	34.75
-30	36.76	54.00	97.22	110.67	298.65	35.31
-29	36.33	53.10	95.60	108.82	293.86	35.88
-28	35.90	52.20	93.98	106.98	289.06	36.48
-27	35.46	51.30	92.36	105.13	284.25	37.10
-26	35.01	50.40	90.74	103.29	279.44	37.74
-25	34.56	49.50	89.12	101.44	274.62	38.40
-24	34.11	48.60	87.50	99.60	269.80	39.08
-23	33.64	47.70	85.88	97.75	264.98	39.80
-22	33.18	46.80	84.26	95.91	260.14	40.53
-21	32.70	45.90	82.64	94.07	255.31	41.30
-20	32.22	45.00	81.02	92.22	250.46	42.10
					TOTAL BTUS	89.91



CHEVY VACUUM INSULATED SHIPPING CONTAINER

Fig. 1 General arrangement of a Vacuum Insulated Container

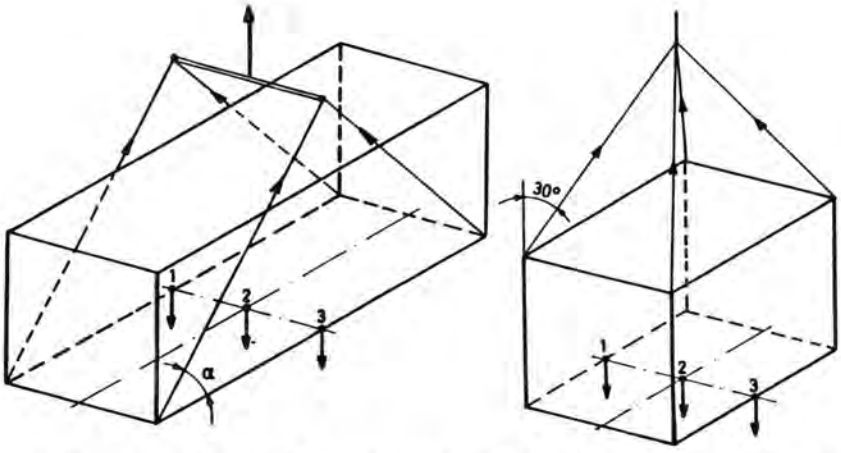


Fig. 2 **Various Loading Tests prescribed in Det norske Veritas Rules for Certification of Containers**

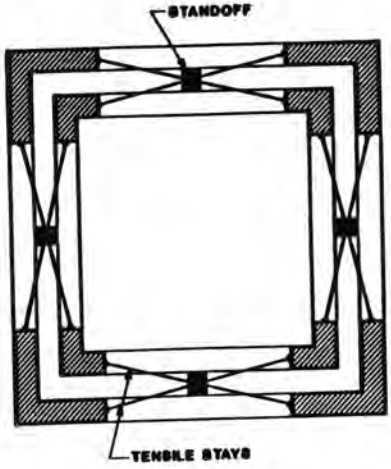


Fig. 3 **Schematic of the Inter Vacuum Supports**

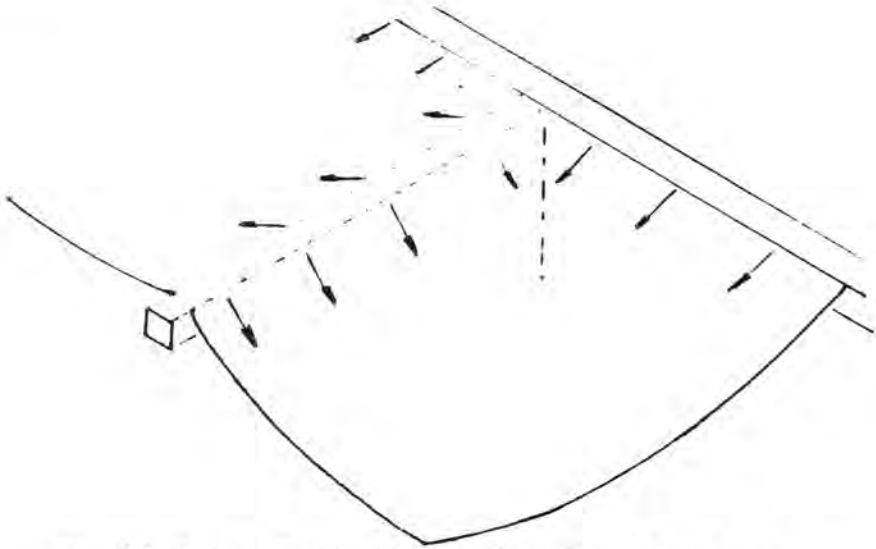


Fig. 4(a) Reactive Forces acting on an Outer Curved Panel Support

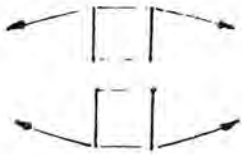


Fig. 4(b) Reactive Forces Acting on an Inner Curved Panel Support

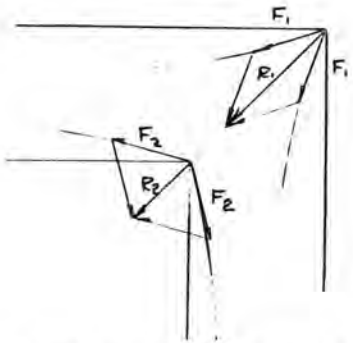


Fig. 5 Force Diagram Illustrating the Reaction Resultant Between Inner and Outer Longitudinals



PILOT	
NV5040	Job Ident: MEMBRANE SURFACE Data File: MEM Sign.: ALAN Date: 14/2/87

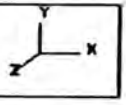
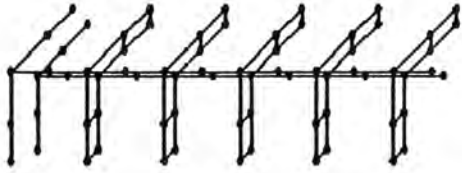


Fig. 6 **Plot of One Quadrant of an Equilibruim Surface for a Membrane Panel**



PILOT	BEAM ELEMENT ANALYSIS MODEL
NV5040	Job Ident: CONTAINER DOUBLE SKIN FRAME ANALYSIS MK3 STOF 3KN/mm Data File: STRU3 Sign.: ALAN Date: 25/1/86

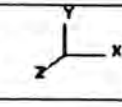


Fig. 7 **Structural Idealisation of 1/8th of the Inner and Outer Skeletal Framework.**

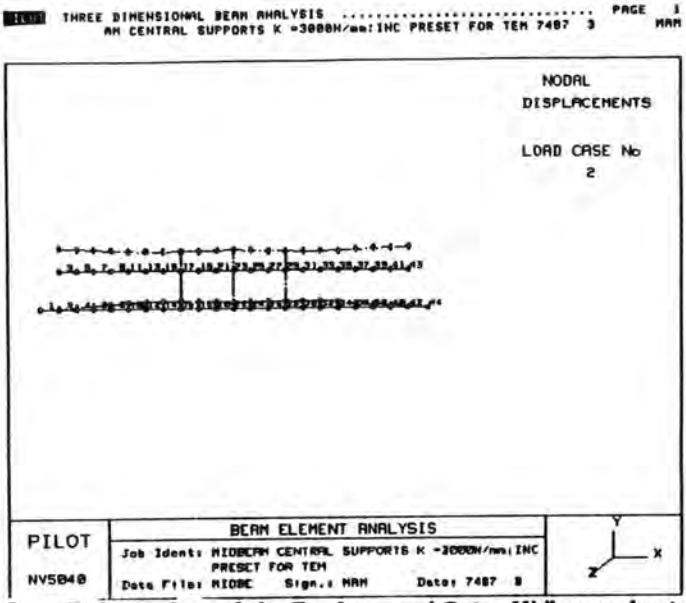


Fig. 8 **Deformations of the Top Inner and Outer Midbeams due to Applied Loading and Temperature Shrinkage of the Inner Beam End Supports**

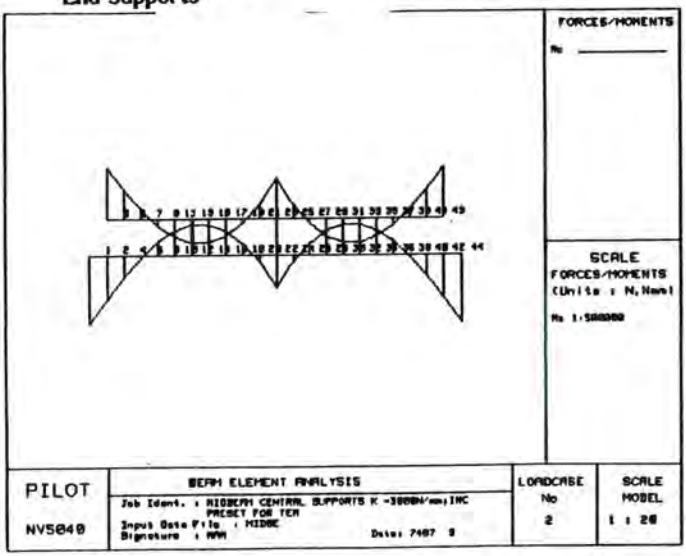


Fig. 9 **Bending Moment Diagram for Load Condition described in Fig. 8.**

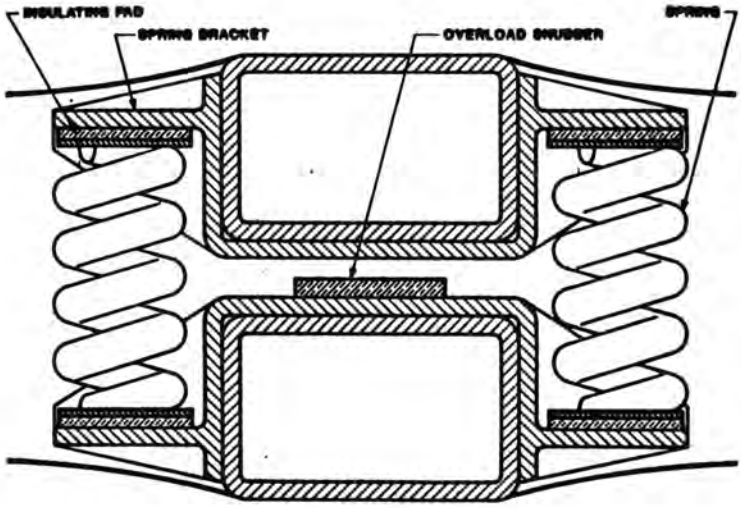


Fig. 10 Spring Type Stand Off

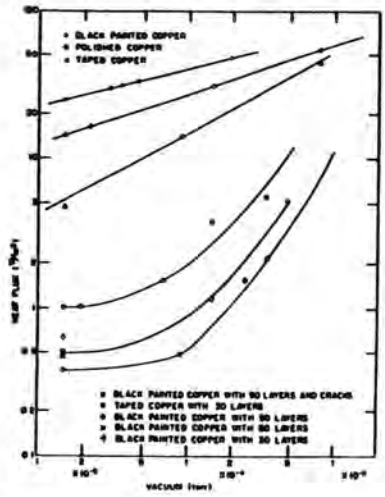


Fig. 12 Heat Flux as a Function of Vacuum Pressure

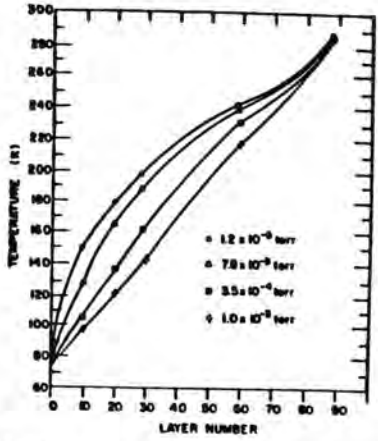


Fig. 11 Temperature Distribution in Multi Layer Insulation as a Function of Vacuum Pressure

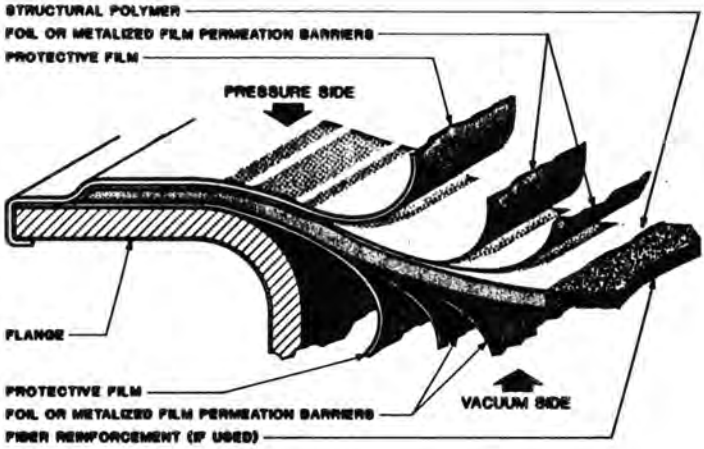


Fig. 13 Lamination and Lay Up of a Metallised Polymer Seal

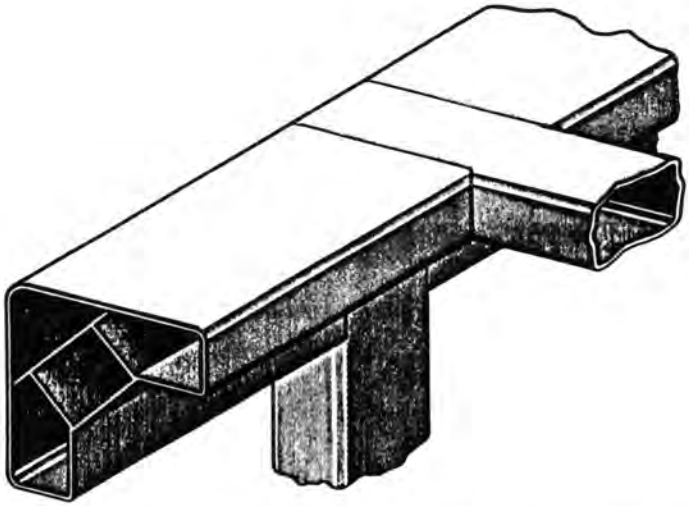


Fig. 14 One Possible Longitudinal Beam Detail and Joint Configuration

L'INTERMODALISME ET L'ACHEMINEMENT DES TRAFICS MARITIMES DE LIGNES RÉGULIÈRES

par

Michel Archambault
Transports Canada
Direction de l'Analyse économique

RÉSUMÉ

L'industrie du transport maritime international de marchandises générales a subi depuis le début des années 1980 des modifications majeures. A l'arrière-plan de ces changements, aussi bien organisationnels que technologiques, l'on retrouve l'adoption croissante d'une nouvelle approche aux problèmes de la distribution des produits:le transport intermodal.

Bien que la participation des transporteurs maritimes à l'acheminement intérieur des trafics puisse varier, il n'en demeure pas moins qu'une nette tendance se dessine. Les transporteurs de lignes intègrent de plus en plus à leurs services maritimes, le transport intérieur des conteneurs qu'ils expédient outre-mer.

Une pierre angulaire de l'approche intermodale se retrouve dans le développement de réseaux de trains unitaires de conteneurs. Ces trains unitaires permettent d'assurer des liens ferroviaires directs et rapides entre les ports majeurs de conteneurs et les divers grands centres de production et de consommation. Du point de vue strictement économique des transports, l'exploitation des trains unitaires favorise une plus grande concentration des flux de trafics et ainsi, accentue le phénomène de concentration des services de lignes. Il s'agit d'un processus déjà amorcé et clairement observé depuis l'introduction des premiers porte-conteneurs cellulaires.

Il ressort de cet article que l'évolution de ces développements, incluant le redéploiement des armements qui se caractérise de plus en plus par des accords de partage de capacité de chargement des navires, ne pourra qu'accroître le caractère international de l'offre des services de lignes. Cette offre tend de plus en plus à considérer le marché nord-américain comme un seul et grand marché à desservir.

1 - TRAFICS MARITIMES DE MARCHANDISES GÉNÉRALES EXPÉDIÉES VIA LES PORTS MAJEURS DU CANADA.

En 1987, les ports de Vancouver, Montréal, Halifax, Québec et Saint John ont manutentionné un volume total de 20,2 millions de tonnes métriques de marchandises générales. A lui seul, le port de Vancouver englobait 43% de l'ensemble de ces trafics.

Une nature généralement distincte caractérise les marchandises générales manutentionnées aux ports de Montréal et Halifax par rapport à celles chargées/déchargées aux autres ports majeurs du Canada (Figure 1). En 1987, plus de 80% des marchandises générales transitant par ces deux premiers ports majeurs correspondaient à des trafics conteneurisés. Aux ports de Vancouver et Saint John à peine 30% et 20% de leur trafic respectif de marchandises générales ont été l'objet d'une conteneurisation. Depuis 1979, le fret conteneurisé ne représente plus qu'une activité très marginale au port de Québec.

Il est important de souligner qu'au cours des six dernières années, le volume de marchandises générales non-conteneurisées et manutentionnées aux ports de Montréal, Saint John and Halifax a démontré une relative stabilité. Au port de Montréal ces trafics totalisent en moyenne un peu plus d'un million de tonnes métriques, au port de Saint John, ils avoisinent les 900 mille tonnes alors qu'au port d'Halifax, le fret non-conteneurisé totalise généralement le demi million de tonnes annuellement. Toutefois, au cours de la même période, le volume total de conteneurs manutentionnés à ces trois ports s'est accru de 51%, passant de 5,6 million de tonnes en 1982 à un peu plus de 8,5 million en 1987.

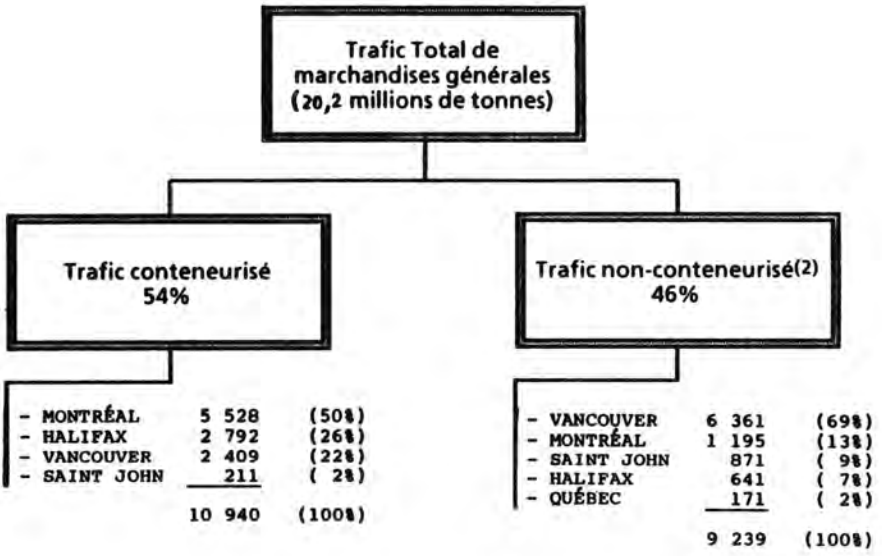
A l'égard du port de Vancouver, l'ensemble des trafics de marchandises générales se sont accrus très significativement au cours des dernières années. La croissance du fret conteneurisé a été plus que remarquable, passant de moins d'un million de tonnes en 1982 à près de 2,5 millions en 1987, soit un accroissement de 171% au cours des cinq dernières années.

La répartition des trafics de conteneurs manutentionnés aux cinq ports majeurs du Canada, entre les années 1970-1987, permet de mettre en évidence que les paysages portuaires ont considérablement changé depuis la seconde demi des années 1970 (Tableau 1).

L'un des principaux facteurs explicatifs de ces changements se retrouve dans l'introduction et l'exploitation de porte-conteneurs de grande taille. Ce facteur n'a cessé depuis la fin des années 1970 d'exacerber

Figure 1

LE TRANSPORT MARITIME OCÉANIQUE DE MARCHANDISES GÉNÉRALES AUX PORTS MAJEURS DU CANADA(1)
(000, tonnes métriques)
1987



Les chiffres ayant été arrondis, la somme des composantes peut ne pas correspondre aux totaux.

(1) C'est-à-dire, dans le cadre du transport océanique de marchandises générales, les ports de Halifax, Saint John, Québec, Montréal et Vancouver.

(2) Le groupe des marchandises non-conteneurisées comprend entre autres les produits expédiés selon le système d'expédition "Ro-Ro".

Source: Transports Canada, Direction de l'analyse économique à partir de données inédites transmises par Ports Canada.

Tableau 1

VOLUMES DE CONTENEURS MANUTENTIONNÉS
AUX PORTS MAJEURS DU CANADA,
1970-1987
(000, tonnes métriques)

	1970	1974	1978	1982	1986	1987
Saint John	82	409	921	987	546	211
	(5)	(8)	(14)	(15)	(6)	(2)
Halifax	228	1 548	1 762	1 419	2 265	2 792
	(14)	(30)	(28)	(22)	(23)	(26)
Montréal	818	1 610	2 225	3 236	4 942	5 528
	(50)	(31)	(35)	(49)	(51)	(50)
Québec	272	776	579	---	---	---
	(17)	(15)	(9)			
Total	1 400	4 343	5 487	5 642	7 753	8 531
	(86)	(85)	(86)	(86)	(79)	(78)
Vancouver	230	791	917	889	2 000	2 409
	(14)	(15)	(14)	(14)	(21)	(22)
Total can.	1 630	5 134	6 404	6 541	9 753	10 940
	(100)	(100)	(100)	(100)	(100)	(100)

Source: Transports Canada, Direction de l'Analyse économique à partir de données inédites transmises par Ports Canada.

le phénomène de rationalisation des services maritimes de lignes régulières. Les premiers signes d'une recherche de concentration des trafics de conteneurs se sont manifestés en seconde demi des années 1970 et ont conduit, en 1978, au transfert des services maritimes réguliers de conteneurs du port de Québec à celui de Montréal.

Aujourd'hui, le processus de rationalisation des services conteneurisés de lignes régulières affecte plus particulièrement le port de Saint John. D'une part de marché qui entre la fin des années 1970 et le début des années 1980 avoisinait les 15%, le trafic maritime de conteneurs de Saint John ne représentait plus en 1987 que deux pourcent du trafic total canadien. Une relocalisation au port d'Halifax des activités de la très grande majorité des compagnies maritimes de lignes, offrant des services conteneurisés en provenance et à destination des divers marchés du Pacifique, s'est effectuée au cours des cinq dernières années.

Il en résulte que si la structure portuaire canadienne - en regard des services maritimes internationaux de conteneurs - pouvait se caractériser entre les années 1969 et 1978 par cinq ports majeurs, elle ne se définit plus en 1988 qu'à partir de trois ports majeurs.(1)

C'est que la conteneurisation avec l'accroissement majeur de la taille des navires et les impératifs opérationnels de viabilité économique qui y sont liés ont conduit à une remise en question complète des escales et itinéraires assurés jusqu'alors. De plus, se situant dans le contexte international des échanges outre-mer du Canada et des États-Unis, l'industrie du transport maritime a subi depuis le début des années 1980 des changements organisationnels majeurs.

En bref, les armements actuels des transporteurs de lignes se composent de navires très efficaces et spécialisés dont la capacité de chargement peut facilement transporter entre 2000 et 4000 conteneurs. L'économique d'exploitation de ces armements a impliqué que de nombreux transporteurs, tout en devant harmoniser leurs intérêts avec ceux des chargeurs (i.e., l'assurance d'une fréquence régulière et adéquate à des ports désignés), ont dû procéder à un regroupement de leurs activités pour rationaliser leurs services.

Pour certaines compagnies de lignes ce regroupement a consisté en une intégration horizontale de leurs activités et ainsi constituer de grandes lignes maritimes. Les cas de ACL, Canada Maritime et OOCL ne sont que quelques-uns des consortiums ainsi créés.

Pour d'autres, l'approche a plutôt reposé sur des ententes commerciales de coopération visant à l'établissement de services coordonnés ou joints tel le 'St.Lawrence Coordinated Service' des compagnies Canada Maritime et ML Containerline, le 'Pacific Europe Express' offert par les transporteurs Hapag-Lloyd, CGM et Intercontinental Transport BV ou encore, le 'Medamerica Express' des compagnies Spanish Line et Italian Line.

De plus, depuis l'exploitation des premiers services autour-du-monde (en 1984), on observe une nette progression d'ententes commerciales entre compagnies de lignes visant l'affrètement (pas nécessairement réciproque) d'une capacité donnée de chargement des navires que les transporteurs participants exploitent généralement sur des routes maritimes différentes ou encore, dont les itinéraires comportent des combinaisons différentes de ports d'escale. Nul doute que de telles ententes commerciales (dites 'Slot Chartering Agreements') ont donné et donne toujours lieu à une rationalisation supplémentaire. Deux avantages directs de ces accords particuliers d'affrètement pour les compagnies de lignes sont (1) d'escompter un meilleur taux d'utilisation de leurs porte-conteneurs et (2) d'accroître l'éventail des marchés internationaux qu'elles peuvent prétendre desservir sans devoir pour autant modifier leurs armements respectifs. En outre, il est raisonnable d'avancer que pour certains transporteurs, l'adoption d'une telle stratégie de marché leur a permis (à tout le moins) de protéger leur situation concurrentielle face à la nouvelle concurrence des services autour-du-monde.

En résumé, la formation de consortium, l'exploitation de services joints/coordonnés et la réalisation d'accords inter-lignes d'affrètement d'une capacité de chargement constituent trois stratégies - non exclusives les unes des autres - pouvant être adoptées par les différentes compagnies de lignes pour réduire le nombre de leurs ports d'escale et s'assurer de la viabilité commerciale de leurs activités. Par contre, ces changements organisationnels reliés aux activités proprement maritimes des transporteurs de lignes ne peuvent à eux seuls expliquer la relative concentration des trafics maritimes de lignes à un nombre restreint de ports canadiens et américains.

2 - TRANSPORT INTERMODAL ET NOUVEL ENVIRONNEMENT CONCURRENTIEL

Des études récentes, et d'autres moins récentes, ont clairement démontré que les transporteurs de lignes raisonnent en termes de chaînes de transport. Comme l'exprimait, il n'y a pas si longtemps,

Monsieur Harvey M. Romoff, '...containerization is a system and its costs and service effectiveness must be measured on a system basis".

Les prérogatives de la rentabilité financière et économique du transport de conteneurs ont impliqué que l'efficacité des réseaux de transports terrestres pouvant relier une zone portuaire est devenue un critère important du choix des ports d'escale. Les transporteurs de lignes nécessitent d'une plus grande pénétration sur les marchés intérieurs.

Dès le début de l'introduction des premiers armements spécialisés de conteneurs, il y a eu un besoin d'ajustements logistiques et organisationnels des systèmes de transports intérieurs à pouvoir développer une capacité et capabilité d'acheminer sur de longues distances des volumes élevés et réguliers de fret conteneurisé. C'est dans ce contexte qu'un grand nombre de compagnies de lignes ont été portées à s'impliquer de plus en plus au niveau de la distribution intérieure des conteneurs qu'elles expédient outre-mer. Une telle approche de la part des transporteurs de lignes vise (1) à exercer un plus grand contrôle sur les coûts du transport intérieur et (2) à pouvoir offrir aux chargeurs, un service intermodal intégré qui soit couvert par un contrat et un prix unique de transport.

Une pierre angulaire des stratégies intermodales retenues par les transporteurs de lignes a été et demeure les services ferroviaires de trains unitaires adaptés au transport de conteneurs (Figure 2).

L'économique d'exploitation des trains unitaires de conteneurs est fort similaire à celle des transporteurs de lignes, en particulier depuis l'introduction des navires de deuxième et troisième génération. Aussi bien les transporteurs maritimes que ferroviaires nécessitent d'un volume élevé, régulier et balancé de fret pour tirer avantage des économies d'échelle et de densité de trafic reliées au transport par conteneurs.

C'est ainsi qu'en étroite collaboration avec les chemins de fer, l'adoption de l'approche intermodale de la part des compagnies maritimes a permis dans une large mesure de réduire l'acuité du problème de dispersion des trafics et de là, a grandement favorisé le processus de rationalisation de leurs services de lignes.

Au Canada, les entreprises de transport ont pû, dès les premières années de l'introduction des conteneurs, chercher à adopter l'approche intermodale. C'est en 1974 que les premiers tarifs intermodaux, pratiqués par une

Figure 2

PORTE – CONTENEURS CELLULAIRES ET TRAINS UNITAIRES

Tous deux requièrent

- Densité des flux de trafics
- Flux balancés et réguliers de marchandises
- Recherche d'un temps minimal d'expédition
- Efficacité des acheminements terrestres et maritimes des conteneurs

Solutions opérationnelles adoptées

- Rationalisation du nombre de ports desservis
- Développement de corridors majeurs d'expéditions
- Établissement de centres intérieurs de changement des marchandises adaptés au transport intermodal

Support organisationnel

- Efforts conjoints de co-ordination et de co-opération:
  - Tarification ferroviaire temps-volume des conteneurs en provenance et à destination des principaux ports canadiens
  - Services intermodaux co-ordonnés maritime-ferroviaire
  - Tarification intermodale pratiquée par les compagnies maritimes de lignes régulières

D'où

D'une simple approche "port-à-port", les transporteurs maritimes visent de plus en plus à offrir un service "porte à porte", et à pratiquer une tarification intermodale, couvrant la totalité des coûts du transport des produits de leur point d'origine au point de destination finale.

Source: Transports Canada, Direction de l'analyse économique.

conférence maritime, furent déposés à la Commission canadienne des transports, soit dix ans avant l'adoption du 'Shipping Act of 1984' des États-Unis. Toutefois, la déréglementation en 1981 des services ferroviaires américains, assurés dans le cadre d'un acheminement intermodal continu, et le passage du nouveau Shipping Act ont grandement favorisé des développements majeurs à l'égard des services intermodaux rail-maritimes.

Sans prétendre que le transport intermodal de conteneurs soit le facteur à l'origine de l'acheminement des commerces outre-mer canadiens et américains via des ports non-nationaux, il demeure toutefois un fait indéniable: les dévelopements continus de ce nouveau concept de transport ont accentué l'ampleur du phénomène des acheminements trans-frontaliers des commerces océaniques canadiens et américains. Les données présentées au Tableau 2 démontrent que ces acheminements trans-frontaliers constituent une partie intégrale de la nouvelle réalité concurrentielle du transport maritime de lignes régulières en Amérique de Nord.

Un examen comparatif du volume total de trafic américain transitant dans des ports canadiens et du trafic canadien chargé et déchargé aux ports américains suggère que les transporteurs de lignes desservant des ports canadiens maintiendraient leur compétitivité par rapport à leurs homologues opérant à partir de ports américains. Une situation constrastée prévaut toutefois d'un pays à l'autre.

Aux États-Unis, la très grande majorité des trafics outre-mer expédiés via des ports canadiens (essentiellement Montréal) impliquent le commerce extérieur américain réalisé avec des pays d'Europe de l'Ouest. Les statistiques sur ces trafics manutentionnés à des ports canadiens montrent que le phénomène touche aussi bien les volumes à l'exportation qu'à l'importation. Néanmoins, depuis le début des années 1980, les volumes à l'importation excèdent ceux à l'exportation.

Au Canada, le phénomène des trafics détournés implique très majoritairement notre commerce extérieur réalisé avec les pays du Pacifique. Un examen comparatif des données de 1982 et 1985 (Tableau 3) démontre clairement que les répercussions du phénomène sur le port de Vancouver se manifestent particulièrement en regard des trafics à l'importation. Entre 1982 et 1985, le tonnage total des trafics de lignes canadiens déchargés à des ports américains du Pacifique a pratiquement doublé, s'accroissant de 91%. A l'export, les trafics détournés se sont également accrus mais dans des proportions nettement moindres, soit de 13% au cours de la même période.

Tableau 2

TENDANCES RÉCENTES DU PHÉNOMÈNE DES DÉTOURNEMENTS

IMPORTANCE RELATIVE DES TRAFICS CANADIENS MANUTENTIONNÉS À DES PORTS AMÉRICAINS	1982	1985	1986	1987
•Nombre de conteneurs (000,UEV)	100,5	127,6	146,7	96,1*
•Pourcentage du trafic total canadien	17,8	17,2	17,8	N/A

IMPORTANCE RELATIVE DES TRAFICS AMÉRICAINS MANUTENTIONNÉS À DES PORTS CANADIENS	1982	1985	1986	1987
•Nombre de conteneurs (000,UEV)	100,2	148,0	180,8	147,6*
•Pourcentage du total de conteneurs manutentionnés au Canada	17,8	19,1	21,1	N/A

* Trois premiers trimestres de 1987

Source: Transports Canada, Direction de l'analyse économique à partir de données transmises par Revenue Canada et Ports Canada.

Tableau 3

TRAFICS CANADIENS DE LIGNES RÉGULIÈRES
MANUTENTIONNÉS A DES PORTS AMÉRICAINS
(000, tonnes métriques)

	Atlantique				Pacifique			
	Exportation		Importation		Exportation		Importation	
	1985	1982	1985	1982	1985	1982	1985	1982
Amériques du Sud et Centrale	99,1	104,0	8,8	15,0	1,1	8,0	23,6	10,3
Pays d'Europe, de la Méditerranée/Mer Noire	36,5	51,2	39,1	66,1	0,5	10,8	9,6	20,1
Afrique	6,4	14,0	0,8	9,2	0,1	0,3	0,1	0,2
Golfe Persique, Mer Rouge et L'Inde	29,5	36,0	1,3	0,6	0,5	1,0	1,8	0,2
Malaysie et Indonésie	28,4	38,5	32,2	10,7	1,8	3,9	2,4	6,9
Australie, N.Zélande	4,3	22,2	--	0,4	17,7	2,4	48,4	4,6
Extrême Orient-Sud	26,2	46,9	20,8	15,6	93,2	73,2	235,4	112,9
Extrême Orient-Nord	36,3	36,6	13,2	6,3	144,4	129,3	368,7	205,5
Total, Pays du Pacifique	95,2	144,2	66,2	36,6	257,1	208,8	654,9	329,9
Ensemble des trafics	226,7	349,4	116,2	126,3	259,3	228,9	690,0	360,7
Variations en pourcentage	-24%		-8%		+13%		+91%	

Cette situation particulière du port de Vancouver tendrait à résulter de trois facteurs principaux: (1), le schéma des rotations de la plupart des armements conteneurisés exploités sur le Pacifique (2), la disponibilité au port de Vancouver [contrairement aux ports américains de Seattle et Tacoma] d'un volume élevé de marchandises générales à l'exportation et (3), l'établissement de micro-ponts terrestres très concurrentiels reliant entre autres les ports de Seattle et Tacoma avec les principaux marchés du centre-nord du continent.

L'importance de la hausse des trafics détournés à l'importation impose que l'on s'attarde plus particulièrement sur ces trafics. Les résultats d'une étude américaine portant sur les trafics canadiens de conteneurs en provenance des pays d'Asie et d'Australie, mais déchargés à des ports américains, permettent de bien décrire les répercussions de l'intermodalisme aux États-Unis sur l'activité du port de Vancouver. Cette étude portait sur l'ensemble des mouvements de navires observés au cours du mois de novembre 1987.

Un des résultats fort pertinent de cette étude est de démontrer qu'un nombre relativement restreint de compagnies de lignes engloberaient une forte proportion du trafic total canadien détourné vers la côte ouest américaine. Sur un nombre total de 35 compagnies, 13 transporteurs de lignes comptaient à eux seuls pour 90% du nombre total de conteneurs canadiens en provenance des marchés d'Asie et d'Australie et expédiés via des ports américains du Pacifique. Par ailleurs, un examen des services intermodaux offerts par ces 13 compagnies a permis de constater que dix d'entre elles avaient contracté auprès de compagnies ferroviaires américaines des services de trains unitaires de conteneurs gerbés ("double-stack"). Ces dix transporteurs de lignes avaient transporté plus de 70% du nombre total de conteneurs canadiens déchargés dans des ports américains de la côte du Pacifique. Seulement trois de ces compagnies ne desservaient pas le port de Vancouver. Toutefois, à elles seules, elles englobaient pas moins de 45% de ces trafics canadiens ainsi détournés.

Un autre résultat pertinent de cette étude américaine est que plus de la moitié des trafics conteneurisés canadiens en provenance des pays d'Asie et d'Australie et détournés via les ports américains du Pacifique étaient destinés aux marchés de l'est du Canada.

Une interprétation de ce dernier résultat est qu'il est fort vraisemblable, étant donné que les marchés d'Extrême Orient ont constitué par le passé une forte proportion des trafics conteneurisés du port de Saint John, que les développements de l'intermodalisme aux États-Unis aient également eu des répercussions sur ce port des provinces Maritimes.

Les statistiques sur les trafics canadiens détournés via les ports américains de la côte Atlantique, entre les années 1982 et 1985, tendent à renforcer cette dernière proposition. En effet, les baisses marquées des trafics totaux canadiens détournés via les ports américains de la côte Atlantique (24% à l'exportation et 8% à l'importation) ne concernent pas particulièrement ces marchés mais plutôt, ceux d'Europe de l'Ouest, de la Méditerranée et de la mer Noire. En regard des marchés d'Océanie, on aura noté que la baisse des trafics détournés à l'Est est plus que compensée par une hausse marquée des trafics détournés à l'Ouest.

Il appert donc que l'adoption de l'approche intermodale par les compagnies de lignes régulières compte pour une large part des modifications majeures observées au cours des dernières années dans les structures portuaires canadiennes et américaines. Aujourd'hui le concept et la technologie du transport intermodal sont de plus en plus intégrés dans les activités des divers transporteurs maritimes et terrestres. Cette situation ne peut qu'accentuer le caractère international des services de lignes.

Note de la page 5:

(1) Une tendance similaire est observée aux États-Unis. En 1985, quatre ports de la côte Atlantique et cinq autres de la côte du Pacifique regroupaient à eux seuls plus des trois quarts de nombre total de conteneurs manutentionnés aux États-Unis.

3 - CONCLUSION

Deux changements organisationnels ont caractérisé l'industrie du transport maritime de lignes régulières au cours des dernières années. D'une part, l'offre des services maritimes de lignes se caractérise par une plus grande coordination entre les transporteurs de lignes qui conduit même, dans certains cas, à un regroupement de leurs activités. Que ce soit par le biais de la formation de consortium, d'une exploitation de services joints ou encore, la réalisation d'accords inter-lignes d'affrètement d'une capacité donnée de chargement, l'une des conséquences de ce comportement de marché des transporteurs de lignes est l'établissement de réseaux de services de transport maritime international.

D'autre part, les compagnies de lignes intègrent de plus en plus à leurs activités maritimes la distribution intérieure des trafics qu'elles transportent outre-mer. Certaines d'entre elles cherchent même à s'intégrer verticalement en prenant en charge la gestion commerciale du transport intérieur de leurs trafics. L'une des conséquences directes de ces développements intermodaux est l'établissement de réseaux de transport intérieur intégrés aux routes maritimes internationales.

Les statistiques les plus récentes sur le phénomène des détournements et le niveau d'activités des ports canadiens montrent que dans l'ensemble une offre diversifiée et concurrentielle de services maritimes caractérise toujours les services maritimes de lignes régulières desservant le Canada. Cependant, si effectivement dans l'ensemble la situation est favorable, il n'en demeure pas moins que l'environnement est très concurrentiel et dynamique. Les créneaux actuels que les ports canadiens peuvent exploiter à l'avantage des chargeurs canadiens ne sont pas à l'abri de la concurrence internationale.

L'exploitation des porte-conteneurs de troisième et quatrième génération combinée au développement continu et de plus en plus efficace des acheminements intermodaux conduisent à une nouvelle ère de concurrence. D'une concurrence qui autrefois pouvait s'articuler en termes de zones portuaires, l'intermodalisme du conteneur impose aujourd'hui une concurrence qui s'articule en termes de réseaux intégrés de transport.

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Notes de l'auteur:

L'auteur tient à remercier la collaboration de Bernard Bisson de Ports Canada, qui nous a communiqué les statistiques inédites sur les flux de trafics portuaires. L'auteur assume toutefois la responsabilité des erreurs et omissions que pourrait contenir le présent article.

IN PLACE OF OCEAN BILLS OF LADING: NEW SHIPPING CONTRACTS FOR A CHANGED SHIPPING INDUSTRY

by

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Introduction

The bill of lading has been the ordinary and usual form of contract for the carriage of goods by sea for over two hundred years. It was well known to merchants before the 1780s when it was recognized and absorbed into the common law of England by the famous case of Lickbarrow v. Mason.[1] But today, its years are numbered. No longer is the ocean bill of lading the only choice of carriage agreement, indeed in some trades it has already become virtually extinct. Its replacement is now official policy. Trade organisations such as the International Chamber of Commerce, the International Chamber of Shipping and the Economic Commission for Europe have gone on record with the recommendation that the use of bills of lading in ocean movements should be avoided unless essential.[2]

These changes in documentary practices raise a number of significant questions. Among them are: (1) why is the billing of lading being replaced; (2) what are the new forms of shipping contracts; and (3) what are the legal consequences of these changes? This paper will address these questions, giving emphasis to their legal aspects.

Replacement of the Bill of Lading

A variety of developments in the shipping industry have combined to render the ocean bill of lading increasingly obsolete. In fact, so great have been the changes in ocean transportation in the past thirty years, that the industry today operates in a completely different environment. Technological innovations have permitted enormous improvements in ship design, navigational equipment and operational efficiency. The results are safer, speedier and more reliable shipping services. In addition to the improvements in ships, huge advances have been achieved in cargo handling through the introduction of methods of

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[1](1787), 2 T.R. 63, 100 E.R. 35 (K.B.).

[2]E.g. E.C.E. Working Party on Facilitation of International Trade Procedures, "Measures to Facilitate Maritime Transport Document Procedures: Recommendation No. 12", UN/ECE/TRADE/WP.4/INF.61/1979.

unitization, especially containerization. The results are simplified and accelerated cargo movements. Indeed, transit times on some containerized liner services have been cut so drastically that the goods can now travel faster than their associated documents. For instance, on the North Atlantic route between Canada and Europe a container of goods is likely to reach the discharging port before the air-mailed bill of lading. Since the bill has to be surrendered to the carrier before delivery may be made, this documentary process is no longer convenient. Both the carrier and the cargo owner are put to extra cost and delay either to await the bill of lading or to secure release of the goods by other means.

Fortunately, complimentary to the changes in shipping, methods of documentary processing have also been transformed. Greatly simplified and standardized paper routines together with the facility to produce photocopied material has streamlined the handling of carriage documents. More recently, the advent of computers as a common business tool has caused a veritable revolution in trade data exchange. Electronic transmission of the contents of a carriage contract can now replace the paper document completely. It is these developments in data processing that have permitted the creation of new forms of shipping contracts in substitution for the increasingly inconvenient bill of lading.

New Forms of Shipping Contracts

The first documentary improvements were directed to simplifying the bill of lading itself. Short form and blank back bills have been in use for many years now. As their names suggest, the lengthy clauses containing the carrier's conditions of carriage are substantially omitted from the document. The short form may carry a few of the most pertinent ones, generally on the back side; the blank back form literally has nothing on its reverse side. The terms of the carriage contract are invoked by a brief incorporation clause on the face of the document which generally refers to the carrier's standard conditions of trade to be found in its offices. Short forms and blank back bills record on their face all the customary details of a particular movement and therefore resemble in appearance a standard receipt for the goods being carried plus an incorporation of contractual conditions by reference.

The benefits to be obtained from using these documents are the efficiencies they permit in paper processing. Having reduced the contents of the bill to a set of data specific to the particular movement of goods, all of which is expressed on a single sided form, advantage can be taken of modern methods of office procedures, such as snap sets of documents and overlay and photocopied production. Pressing the efficacy of these changes to the full, the U.N. Economic Commission for Europe has declared a U.N. Layout Key for Trade Documents which standardizes the size, the format and the information

of all documents customarily used in international trade.[3] These are aligned one on top of the other so that a single typed master is all that is necessary to replicate a complete set of originals. In consequence a large reduction in the significant cost of documentation per movement can be achieved.

Sea waybills represent a relatively recent attempt to adopt the form of waybills well known in air transport and some land modes to ocean carriage. A unique feature of the ocean bill of lading is that, since it is a document of title to goods, it must be surrendered against delivery. While this function is useful when goods are to be traded while in transit, it is also the cause of much hindrance to commerce when the documents are late in arriving at destination. A sea waybill looks like a blank back bill of lading and acts similarly as a receipt for the goods and as a contract for their carriage, but it is not capable of negotiation as a document of title. Consequently there is no need to present a sea waybill at destination in order to receive the goods. The consignee has only to identify himself to the satisfaction of the carrier as the party, or his agent, named in the waybill in order to have the cargo released to him. In this way the late arrival of documents does not delay delivery. Indeed, no document is required at destination since the carrier learns who is to be the consignee upon loading and has only to verify the receiver's identity in order to discharge the goods. Hence, the use of sea waybills in place of bills of lading can expedite the delivery of goods by sea to the benefit of carrier and cargo owner alike.

Electrodocs are a contemporary development and have yet to be put into full operational use. They are so new in fact that the name "electrodoc" has not yet passed into general commercial usage. It is, however, a commendably suggestive nomenclature. Electronic communications have made possible the transmission of trade and transport data without documents. The message electronically transmitted is the electrodoc. Thus the same information that would be contained in a bill of lading may in principle be expressed in electronic impulses within a computer system and may be accessed by anyone with a connected and compatible terminal.

The widespread acquisition of computers for business office purposes makes electronic communications between traders, carriers, and their agents an imminent development. Already in transportation, trans-Atlantic liner companies have computer-linked their offices and all their port agents on both sides of the ocean. They no longer use documents intra-corporately but transmit all their cargo manifests and instructions electronically. The next step towards concluding inter-corporate carriage agreements by teletransmissions only awaits the international standardization of existing technology. A large number

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[3] In Canada, a Canadian Trade Document Alignment System based on the U.N. Layout Key was adopted by the Canadian General Standards Board in December 1982.

of pilot projects in this direction are under way[4] and work is well advanced at the Economic Commission for Europe in drawing up standards of compatibility for trade data interchange.[5] The momentum for change is growing rapidly for it is evident to everyone involved that the instantaneous teletransmission of transport data will be infinitely more efficient, convenient and economic than paper documents like bills of lading.

Legal Consequences of the New Shipping Contracts

Since the new shipping contracts are intended as replacements, it is essential that they fulfill the functions expected by the shipping industry and previously supplied by the bill of lading. Whether the new forms achieve their commercial purposes is one part of the enquiry. Whether they will be recognised and enforced at law is, perhaps, an even more important question. Since the bill of lading has been the sole standard both for commercial practice and legal regulation, it is appropriate to examine the new shipping contracts against the functions of that document and the current law surrounding it.

The ocean bill of lading, it may be recalled, has three functions. It acts as a receipt for the goods shipped, as evidence of the contract of carriage, and as a document of title to the cargo while at sea. All three functions continue to be commercially necessary in overseas trade, though the use of bills as documents of title by which to sell the goods is now very much diminished. The new shipping documents are principally intended to effect the first two functions and so it is to these that most attention will be directed.

A. As Receipts

The carrier's receipt for the goods being shipped has traditionally been supplied by the data on the face of the transport document. The purpose of a receipt is to provide a record of the shipper's goods in possession of the carrier. It details the quantity, marks, description, weight or volume, and the apparent condition of the cargo, as well as the identities of the shipper, the carrier and the receiver. It may be used as evidence by the cargo owner to prove his right to the

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[4]The North American grocery industry, for instance, is already operating on teletransmitted purchase orders and invoices. The universal product codes on food items in supermarkets are symbols of this development. The field of international maritime trade is replete with acronyms of projects, such as Mercator, ODETTE and CEFIC. In Canada, customs clearance experiments are currently in progress in two places, the port of Montreal and the airport in Vancouver. These projects involve electronic data interchange between importers, exporters, carriers, customs, agents, brokers and government officials.

[5]See E.C.E. Working Party on Facilitation of International Trade Procedures, "Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT)", ISO Standard 9735, UN/ECE/TRADE/WP.4/R.513 (Dec. 1987).

goods. As short form agreements and sea waybills provide a documentary face similar to the standard ocean bill of lading, they are able to function as receipts in precisely parallel ways without further consideration. Electrodocs cannot. Since the medium of their communication is not paper but electronic impulses, they do not display carriage data in a documentary form.

Computers, however, are particularly good at creating, keeping and transferring records amongst different data bases. There are no technical obstacles to teletransmitting normal transport data so there should be no difficulty in employing electrodocs to fulfill the shipping industry's need for a receipt. The main concern, therefore, is whether the law will recognise and accept an electrodoc as an effective "electronic receipt". Though law is concerned with acts and events, very often it operates upon them by way of their form. Thus in trade matters many of the legal controls on commercial dealings are expressed in terms of the documents in which they have traditionally been accomplished. But any law written according to the paper medium will obviously obstruct the use of electronic transmissions.

Unfortunately paper tied laws are plentiful at this time. Some refer to a specific document; thus the Bills of Lading Acts[6] name the bill of lading and thereby exclude other forms of carriage contract. Other laws call for a written form or notice; for instance the carrier must provide a notice in writing under the Canada Shipping Act in order to retain his lien on landed goods.[7] Sometimes the law specifies requirements in such a way that it imposes the use of a paper document; thus the Hague Rules, the international uniform rules for ocean transportation, grant the shipper of goods a right to demand from the carrier a statement of the particulars of the cargo in a bill of lading.[8] At other times the law implies the existence of a paper document; for instance the Customs Act demands the production of an "original" record.[9] The statute books are evidently full of restrictive laws that will impede the use of electrodocs. In the end, reform of all commercial laws referring expressly or implicitly to paper transactions will be necessary.

B. As Contracts of Carriage

In contrast to the receipt function of the face of the transport document, the contract of carriage is usually evidenced by the fine print on the backside. Few commercial people spend much time reading the lengthy and plentiful conditions of carriage, which explains in part why short form and blank back documents are readily accepted in

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[6]R.g. R.S.C. 1970, c. B-6.

[7]R.S.C. 1970, c. S-9, s. 667.

[8]See Carriage of Goods by Water Act, R.S.C. 1970, c. C-15, Schedule, art. III.

[9]S.C. 1986, c.1, s. 40 and SOR/86-1011.

the shipping industry. But the lawyer's business is greatly concerned with the interpretation and effects of these clauses, and so their omission from the new shipping contracts raises a number of serious legal questions. Among those in need of examination are: (1) what are the terms of the contract? (2) who are the parties to the carriage? and (3) how is the shipping agreement proven?

1. Terms of the Contract

Neither blank back documents nor sea waybills express the terms of the carriage contract, rather they attempt to establish an agreement by reference to the carrier's standard trading conditions found elsewhere. The conditions are invoked by means of an incorporation clause placed on the face of the document amongst the carriage data. The critical question is what legal force such incorporation clauses may have. Two problems seem to occur: one concerns the reference to the carrier's standard terms and the other involves the application of international laws such as the Hague and Hague/Visby Rules.

a. Carrier's Standard Terms

The crux of the problem is whether the incorporation of the carrier's standard conditions by reference is sufficient to bind other parties. It might be doubted whether legal consequences could attach to a cargo owner who was ignorant of the contractual terms allocating the risks associated with the movement of his goods. Although the law looks for an agreement to found a contract, it is prepared to read a concurrence of intentions out of a situation. Thus if the shipper and carrier have had previous dealings, carriage according to the carrier's standard conditions may be inferred. If the parties are involved in their first transaction together but the cargo owner is by profession a shipper, exporter or importer, then the standard conditions of the trade may be implied.[10] Hence the lack of notice of standard terms and conditions is usually irrelevant between contracting parties who are participants in the shipping business.

An exception is made when the incorporated terms are unusual in the trade. Then notice to the cargo owner is essential and the kind of notice required is relative to the degree of surprise and onerousness of the term being relied on.[11] The requirement is founded in reasonable business efficacy. "It is impractical for a shipper to be compelled to make a detailed study of all the fine print clauses of the carrier's regular bill on each occasion before it ships out a

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[10] George Mitchell Ltd. v. Finney Lock Seeds Ltd., [1983] 1 Lloyd's R. 168 (C.A.), aff'd. [1983] 2 All E.R. 737 (H.L.); and British Crane Hire v. Ispwich Plant Hire, [1974] 1 All E.R. 1059 (C.A.).

[11] Crooks v. Allan (1879), 5 Q.B.D. 38; and Spurling v. Bradshaw, [1956] 1 W.L.R. 461.

package."[12]

b. The Hague Rules

The Hague Rules, or their amended version the Hague/Visby Rules, are internationally agreed rules for the carriage of goods by sea. They create minimum standards of responsibility for sea movements of cargo and thus provide a settled, uniform distribution of risks and liabilities in ocean transportation. The Hague Rules have the force of law within the scope of application established by the implementing legislation in each country. In Canada, the Carriage of Goods By Water Act[13] mandates the Hague Rules' operation in contracts of carriage covered by bills of lading for goods being exported, but not imported, by sea. The statutory effect of the Rules is to override any express term of the carriage contract that diminishes the carrier's liability established by them.[14]

Even when the Hague Rules do not apply by statute, carriers frequently incorporate them by reference, often as a clause in their standard conditions. For instance, the application of the Rules might be extended to containers carried on deck or to goods in the carrier's charge before loading or after discharge. The carrier benefits by his exposure to the risks of loss being limited to a low level of liability per package.[15] When contractually incorporated, the Hague Rules have no statutory priority but, in principle, are coequal with the carrier's other conditions. Then conflicts between the Rules and the carrier's terms are possible and problems of contractual interpretation may arise.

Courts in different countries seem to have adopted different approaches to these problems and to have reached varied results. In Canada it has been said "the maker of the bill ought not to benefit from any ambiguity of his own creation."[16] Thus express clauses of the carrier's making that are intended to lessen his liability under the Rules should be construed against him. For instance, in the case of The Doroty[17] the carrier's clause that defined the rate for assessing liability according to customary freight units (an American practice) in place of shipping units (the Canadian interpretation of the Hague Rules) was disallowed. The carrier had to pay at the Hague Rules rate

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[12]Per Anderson J. in Encyclopaedia Britannica Inc. v. The Hong Kong Producer and Universal Marine Corp., [1969] A.M.C. 1741, at 1750.

[13]R.S.C. 1970, c. C-15, s. 2.

[14]Ibid., Schedule art. III (8).

[15]Ibid., Schedule art. IV (5).

[16]Per Dubé J. in Atlantic Consolidated Shipping Co. Ltd. v. The Doroty, [1979] 1 F.C. 283, at 297, aff'd. [1981] 1 F.C. 783.

[17]Ibid.

of liability for the rotting fish he delivered.

In the United States, one line of cases at least follows the principle of contract construction that a more specific provision should be advanced over a more general term. In shipping situations, this approach will generally result in a preference for the carrier's express conditions over the Hague Rules since they are likely to have been drafted very precisely to take account of the existing Rules.[18] The English courts' approach, arguably, is to resist the incorporation of those articles of the Hague/Visby Rules which are inconsistent with the express terms in the carriage document.[19] The carrier's conditions are preferred, perhaps, because their deliberate expression better shows the parties', or at least the carrier's, contractual intentions.

These approaches expose a sharp distinction in judicial policy. The Canadian readiness to sever the carrier's terms that are inconsistent with the Hague Rules, which he has also chosen to invoke, respects the public policy supporting those Rules. They are meant to be internationally determined uniform minimum standards of conduct and responsibility between carriers and cargo owners. By promoting the parties' inferred intentions, the American and English perspectives uphold the private law principles of freedom and integrity of contract. The weakness of this stance may be that the freedom of contract being supported is really the power of the carrier unilaterally to dictate the terms of carriage. The imbalance in the contracts resulting from similar lopsided bargaining power was precisely the reason why the Hague Rules were originally concluded more than sixty years ago.

The use of sea waybills poses a further problem respecting the operation of the Hague Rules. Since the Rules themselves are expressed to apply to contracts for the carriage of goods by sea "covered by a bill of lading or any similar document of title",[20] there is considerable doubt whether they ever apply to waybills with statutory force and priority. Technical legal arguments can and have been made that sea waybills might be included as documents of title, or that other substantive Rules can be interpreted so as to circumvent the apparent limitations of this language,[21] but none are guaranteed of success.

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[18]E.g. Pannell v. U.S. Lines, [1959] A.M.C. 935, 263 F. 2d 497; and Commonwealth Petrochemicals Inc. v. Puerto Rico, [1979] A.M.C. 2772.

[19]See Anglo-Saxon Petroleum Co. v. Adamastos Shipping Co., [1958] 1 Lloyd's R. 73 (H.L.).

[20]Supra n. 13, Schedule art. I(b).

[21]See Comments of the Committee on Carriage of Goods of the Maritime Law Association of the United States regarding C.M.I. Uniform Rules for Incorporation into Sea Waybills or Other Similar Documents at 2-4 (January, 1988); and W. Tetley, "Waybills, the Modern Contract of Carriage of Goods by Sea" (1983), 14 Jo. Mar. L. & Comm. 465, at 471-473.

These arguments have not been tested in the courts in part because sea waybills commonly incorporate some version of the Hague Rules along with the carrier's standard conditions of carrier. Consequently, the shipping community tends to think there is no problem, but, as previously shown, there is considerable uncertainty about how the Hague Rules will operate contractually. Further, carriers are not bound to incorporate the Hague Rules: to the contrary they may choose to employ a jurisdiction clause that selects as the governing law and courts the legal system of some country where the Hague Rules do not operate.[22]

The uncertainty over the statutory impact of the Hague Rules equally exists with regard to electrodocs. The making of the problem seems to have been inadvertent. The new shipping contracts were not in use when the Hague Rules were written and so the Rules were drafted in terms of bills of lading. However, there is no reason why the new forms should not be subject to the Rules since they are intended to play the same role with respect to the carriage contract as the bill of lading.[23] This objective could be achieved by an amendment to the Carriage of Goods by Water Act so as to extend the Hague Rules to all kinds of shipping contracts, documentary and electronic,[24] but so far no such proposal has been presented to Parliament.[25] Meantime, the distinct commercial advantages of the new shipping contracts to both carriers and cargo owners will require creative ingenuity on the part of the courts in order to maintain a fair balance in the allocation of marine risks and cargo liability on occasions of dispute.

2. Parties to the Carriage

The shipping contract is agreed between the shipper and the carrier for the purpose of carrying the cargo to the consignee. There is no doubt that the shipper and the carrier are parties to the contract since they made it, but the position of the consignee, as the ultimate beneficiary of the carriage, is less certain. The usual commercial intent is that the consignee at some point in time during

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[22]See e.g. Argo Company of Canada Ltd. et al. v. Argonaut Marine Inc. (The Regal Scout) (1983), 148 D.L.R. (3d) 412 (F.C.T.D.). But courts do not always enforce such choice of law clauses.

[23]Cp. the Hamburg Rules which are expressed to apply to contracts of carriage by sea without regard to form. See arts. 2, 1(6) and 14(3).

[24]Always excepting charter parties.

[25]In part, no doubt, because the Department of Transport is undertaking a wider review of the Act as to whether the Hague Rules should be replaced by the Hague/Visby or the Hamburg Rules. The English Parliament in the course of adopting the Hague/Visby Rules went some way when it enacted the curious provision that they shall have the force of law in a sea waybill if it "expressly provides that the Rules are to govern the contract as if the receipt [waybill] were a bill of lading". See U.K. Carriage of Goods by Sea Act 1971, 1971, c. 19, s. 1(6).

the transit, frequently when he pays for the goods, shall take over the rights and responsibilities of the contract with the carrier in place of the shipper. This substitution of the consignee for the shipper as the contracting party on behalf of the cargo has important effects. It grants the consignee rights of control over the goods, either to demand their delivery or to redirect their movement by the carrier. It also binds the consignee directly to the carrier for any outstanding freight or other charges payable. The transfer of the shipper's interests in the carriage contract is therefore crucial to empower the consignee with respect to the goods.

As it happens, the courts long ago decided that the law did not recognise attempts to transfer contractual rights to strangers to the original agreement,[26] apparently because they were regarded as too personal in nature to suffer the change. Thus the shipper could not effectively transfer the carriage rights, even though he had separately sold the goods themselves, to the consignee. Such a consignee would be in the untenable position of being an owner of a cargo over which he had no lawful control.

Fortunately the legislatures came to the rescue. As long ago as 1855 the British Parliament passed the original Bills of Lading Act[27] which has since been copied in other jurisdictions, including Canada.[28] The effect of these acts is to permit the assignment of the rights and responsibilities of a shipper arising under a bill of lading. The consignee under a bill of lading is thereby protected. Since short forms and blank back documents are simplified types of bills of lading, consignees under these shipping agreements are also assured of becoming full parties to the carriage contract. But the Bills of Lading Acts do not extend to other types of shipping contracts and so consignees under sea waybills and electrodocs will be exposed to the risks that they might not be able to direct delivery of the goods or sue the carrier for misdelivery. Conversely the carrier might discover that he cannot pursue the consignee upon the terms of the contract for payment of freight or charges, and may not rely upon the limitation of liability, including the Hague Rules, that he deliberately incorporated into the shipping agreement.

In light of these legal risks, some carriers have added a term in their sea waybills by which the parties purport to grant themselves the power to transfer their interests contractually.[29] These clauses rely on the basic principles of contract law and equity that the intentions of the parties should be given effect, but there is no certainty that the legal proscription of assignment can be so easily overridden. An

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[26] Thompson v. Dominy (1845), 14 M. & W. 403, 153 E.R. 532.

[27] 18 and 19 Vict., c. 111.

[28] Supra, n. 6.

[29] E.g. the standard conditions for sea waybills drafted by the General Council on British Shipping.

alternative legal argument, which has met some success,[30] is to imply a separate contract between the consignee and the carrier, on exactly the same terms as the original shipping agreement, as a result of the acts of delivery of the goods and payment of the freight charges.

The legal uncertainty surrounding such a basic commercial function as the transferability of the carriage contract remains unsatisfactory and demands legislative reform. So much so, the Comité International Maritime, the original author of the Hague Rules, has struck an international subcommittee for this very purpose. Draft Uniform Rules for Incorporation into Sea Waybills or Other Similar Documents and draft Uniform Rules for an Electronic Bill of Lading, Waybill or Other Transport Document are now under active discussion. They are intended to resolve the problems raised here, amongst others, by the provision of model rules which will be presented for adoption by the C.M.I. at its assembly in 1990, and thereafter will take effect through enactment by national legislatures.

3. Proof of the Carriage Contract

The shipping agreement itself is generally regarded as the best evidence of the terms of carriage.[31] Under the Hague Rules, a bill of lading is prima facie proof of receipt by the carrier of the goods it describes until rebutted by the opposing party.[32] The new shipping contracts in documentary form may safely constitute proof on the same basis. But uncertainties surround electrodocs because they lack documentary character. At bottom, the question is how the law will regard electronically generated evidence. Two aspects of the electrodoc seem troubling: the first involves the authentication of the carriage contract, and the second concerns the proof of its contents.

a. Authentication

The usual form of authentication of a documentary carriage contract is by signature. Typically the signature is an autograph but it may be impressed with a rubber stamp or a corporate seal, or by perforating or embossing the document. The purpose of the signature is to acknowledge authorship and responsibility for the contract.[33] It is executed by deliberately making a personal mark.[34] In other words, the

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[30] See Brandt v. Liverpool, Brazil & River Plate Steam Navigation Co. Ltd., [1924] 1 K.B. 575; and The Aramis, [1987] 2 Lloyd's R. 58 (Q.B.).

[31] Sewell v. Burdick (1884), 10 App. Cas. 74, at 105; Crooks v. Allan (1879) 5 Q.B.D. 38; The Ardennes, [1951] 1 K.B. 55.

[32] Supra n. 13, Schedule art. III(4).

[33] Nasmith Co. v. Alexander Brown Milling Co. (1905), 9 O.L.R. 21.

[34] Caton v. Caton (1867), 11 L.R. 2 H.L. 127.

signature personalizes the shipping document. Computer systems permit the application of comparable individualization to an electrodoc.[35] They afford the use of unique personal signs with at least as much security as the risk of forged signatures.[36] The commercial need for authenticity of an electrodoc being thus satisfied, the question outstanding is whether the law will accept such "electronic signatures".

The courts have not taken exception to any form of authentication of documents, even when the imprint is indecipherable.[37] The critical feature is that the act of marking the document is done with intent to authenticate it.[38] In other words, any mark is enough as long as it is made with intent to sign. By analogy, an electronic signature ought to be equally acceptable.[39] An electrodoc may be implanted with a unique electronic sign which is no more than a particularly sophisticated mechanical mark and so should be sufficient, provided it can be proved.[40]

b. Proof of Contents

Proof of a shipping contract expressed in an electrodoc cannot be made simply by production of the item on which it is inscribed, as in the case of documentary agreements. While the contents of a bill of lading or a sea waybill may be read directly from the document, computer tapes and diskettes provide no intelligible evidence. Electronically stored records are machine readable only and print-outs are at best copies, not truly original evidence. Worse, the output may be the result of processing the stored data into quite different

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[35]See the proposal for the use of alphanumeric codes in the draft C.M.I. Uniform Rules for an Electronic Bill of Lading, Waybill or Other Transport Document (1987).

[36]See E.C.E. Working Paper on Facilitation of International Trade Procedures, "Authentication of Trade Documents: Recommendation No. 14", para. 23 (1979).

[37]Cf. Re United Canso Oil & Gas Ltd. (1980), 41 N.S.R. (2d) 285 (N.S.S.C.).

[38]Caton v. Caton, supra n. 34.

[39]Cf. the Hamburg Rules art. 14(3) which would permit the signature on a bill of lading to be made electronically if not inconsistent with the law of the country where it is issued.

[40]The electrodoc may run up against a legal requirement that its authentication must be in written form. This obstacle is comparable to problems over the form of electrodocs as receipts as discussed earlier and will require similar legal reforms. The Customs Cooperation Council has been much concerned with this possibility and has called for international action to give electronic signatures the same status as holographics ones.

material and not the reproduction of copies at all.[41] The law, consequently, faces a novel problem concerning the value to be ascribed to an electrodoc as evidence to prove the contents of the carriage contract.

At the outset, a basic legal distinction must be recognised between the admissability and reliability of evidence. In general, only direct and relevant evidence is admissable. Even when admissable, evidence must be weighed for its credibility. The use of electrodocs will raise issues both as to their admissability and credibility as evidence.

Admissable evidence is typically testimonial: hearsay is excluded. By definition, electronically generated evidence does not have the desired oral source. But the rule against hearsay has a great many exceptions, including one in favour of business records which has since been elaborated by statute. The Canada Evidence Act[42] permits the introduction of "business records" where oral evidence of the same matter would be admissable. When the record is unintelligible, a transcript prepared under the oath of the record maker is acceptable. If an electrodoc can be regarded as a record, then there is an opportunity to introduce it successfully in evidence under this rule.

Much depends upon how far the statutory definition of a "record" can be stretched beyond its ordinary meaning. Since the Act includes as a "record" any "tape or other thing on or in which information is written, recorded, stored or reproduced",[43] there is good reason to anticipate that electrodocs will fall within the permissible limits of the statute. This conclusion is supported by the analogous application of the Act to computer records in criminal cases.[44] However, the Canadian Evidence Act was enacted well before computers became a common part of commercial life and clearly does not accommodate electronic data comfortably. Reform of the Act would be the most appropriate solution and is in fact overdue. Examples of suitable legislation are available in other countries,[45] and new uniform rules of evidence have

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[41] See C. Tapper, "Evidence from Computers" (1974), Ga. L.R. 562.

[42] R.S.C. 1970, c. E-10, s. 30. And see K. Chasse, "The Conditions Precedent to the Admissability of Computer Printouts are Far from Clear" (1985), 2 Can. Comp. L.R. 55.

[43] Ibid. s. 30(12).

[44] R. v. Vanlerberghe (1976), 6 C.R. (3d) 222 (B.C.C.A.); and R. v. McMullen (1979), 47 C.C.C. (2d) 499 (O.C.A.).

[45] U.K. The Civil Evidence Act 1968, c. 64; and S. Aust. The Evidence Amendment Act 1972.

been proposed in Canada[46] but have failed to pass through Parliament.[47]

The reliability of electrodocs, even when admitted as evidence, cannot be presumed. Errors in hardward, softward, programming and human operation are all possible and will each affect a computer system and its output.[48] Many defects will produce readily noticeable failures in the system, but others will generate apparently flawless, but in fact faulty, data files or hard copies in which the mistakes may be very hard to detect. There is also the fear that a lack of computer security against unauthorized usage may permit deliberate interference with any part of the system. Electrodocs are open to all these risks of electronic communications.

In the circumstances, one might expect there to be standards by which to check and to maintain the accuracy and security of computer systems. In the computer industry itself, indeed, many procedures and safeguards have been devised and recommended for these purposes. But the law has not so far developed criteria for testing the reliability of electronic evidence. The Canada Evidence Act is silent on the matter,[49] and a Canadian court has even cast doubt on the need for scrutiny.[50] This casual attitude contrasts starkly with the comparatively sophisticated approach adopted in, for instance, American courts,[51] and the concern of a number of international trade organisations.[52]

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[46]See the Report of the Federal/Provincial Task Force on Uniform Rules of Evidence (1982). And see K. Chasse, "Computer Printouts-Designing Provisions for the New Canada Evidence Act" (1985), 2 Can. Comp. L.R. 129.

[47]See Bill S-33 (1982), which lapsed with the dissolution of Parliament.

[48]See Tapper, supra n. 41; and J.J. Roberts, "A Practitioner's Primer on Computer-Generated Evidence" (1974), 41 U. Chicago L.R. 254.

[49]Cf. R.S.C. 1970, c. E-10, s. 29 which accepts bank records as prima facie evidence. But consider the analogy of the rules governing expert opinion evidence: See K. Chasse, "Computer Printouts and the Rules of Evidence" (1986), 4 Can. Comp. L.R. 69.

[50]R. v. Bell and Bruce (1982), 26 C.R. (3d) 336 (O.C.A.).

[51]E.g. King v. ex rel. Murdock Acceptance Corp. (1969), 222 So. 2d 393 (Miss. S.C.).

[52]See the Council of Europe, "Recommendation No. R(81)20, on the harmonization of laws relating to the requirement of written proof and to the admissability of reproductions of documents and recordings on computers"; and the I.C.C. draft Uniform Rules for Communication Agreements, ICC Doc. No. 374/1.

Conclusion

In the eighteenth century it took a long time for the law to recognise the merits of maritime trade practices and to give full endorsement to the use of bills of lading. The law had radically to revise how it treated dealings in goods in overseas trade. Viewed formerly as physical transfers of property pure and simple, they became documentary transactions in which the papers symbolized the goods. Now in the late twentieth century a changed shipping industry has once more developed new shipping arrangements, the most forward of which is certainly the application of electrodocs. These changes present another challenge to the law. It must once more move its fundamental premises, this time away from paper based concepts represented by the ocean bill of lading into the modern electronic medium. It is to be hoped that the law can meet the challenge of the new shipping environment, and to do so rather faster than it did two hundred years ago. There are some positive signs that it can be adapted, but greater and quicker reforms, especially with regard to electrodocs, are necessary to complement the pace of change within the shipping industry.[53]

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[53]Official recommendations to this end have been addressed to every country by the United Nations. See the Report of the U.N. Commission on International Trade Law on the work of its eighteenth session, 40 U.N. GAOR, Supp. (No. 17) para. 360 (1985).

A SHIP'S FLAG - WHO CARES ?

A paper for The McGill Law School course on Maritime Law II
February 1, 1988, Author John L. Eyre

INTRODUCTION

Cunard is in the hotel business,the U.S.Lines are bankrupt. Ship owners in Greece, Norway, Japan and Germany rush to flag out. That means abandoning their home flags and placing their ships under convenience flags (FOCs) such as those of Liberia and Panama. These FOCs already fly on forty percent of the world fleet , and their ships carry about sixty percent of all ocean freight. The decline of " establishment nation " shipping flags will continue. Who should worry, and what can be done ?

I. CONVENIENCE FLAGS (FOCs) ARE CHEAPER AND BETTER

As a service industry shipping is judged on levels of cost and efficiency. The costs of owning and running a typical ship range from a high under the U.S. flag of 11.4 million dollars a year to 3.6 million under the Liberian flag, lower under others.

TABLE I ANNUAL COSTS FOR OWNING AND OPERATING ONE BULK CARRIER
(30,000 dwt., Seaway fitted, add 000 to all figures)

COST ITEM	Flags of U.S.A.	CANADA	LIBERIA (FOC)
Finance	$ 4,500	$ 1,596	$ 1,476
Crew	2,800	1,500	500
Fuel	1.200	1,200	1,200
Stores	300	130	110
Maint/Repair	600	160	130
Insurance	380	210	120
Admin/O'head	240	70	35
Taxes	1,264	609	10
Total	$ 11,374	$ 5,475	$ 3,581

Source, Author's data bank,assuming Canadian and FOC ships built in Asia in 1983, US ship in USA, Taxes figured as 50% of before tax profit of 25%, all figures in 1987 US dollars.(endnote 1.)

In the weak 1987 open market this ship could earn four million dollars a year. The USA ship survives because AID, military, government financed grain/food, domestic and other cargos are reserved, that is not able to use open markets. The Canadian ship has no chance since she has no subsidies or protective devices. A shipping company usually operates ten or

more vessels. Costs for fuel, terminal.and port services are constant regardless of flag. However, crew costs are a variable upon which the profits usually depend. There is an enormous spread in these.

TABLE II ANNUAL CREW COSTS,- VARIOUS FLAGS-In millions of US$

USA	$ 2.8	FOC/Liberia	$ .5
Canada	1.5	Taiwan	.45
Japan	1.3	Greece	.4
Norway	1.2	Philippines	.35
Belgium	1.1	Poland	.3
England	.8	China	.26

Source, as for Table I

Rich country seamen's unions claim that FOC crews are poorly paid and unskilled. This is true for marginal ships and owners under such as the Cyprus flag. However,the great mass of deep sea commerce is carried by ships with crew costs of about a half million dollars a year. These are generally competent and well paid by the standards of the home countries of their officers and seamen. Canadian and US seamen's unions cannot compromise on deep sea ships without weakening their case for big crews on protected Great Lakes and coastwise ships.

The standard ship of year 2000 will have few seamen aboard. In an attempt to save some ships for their flag, the Japanese are, with union consent, experimenting with crews of about twelve.

Shipowners pay nominal taxes to FOC flag nations and usually own their vessels through separate companies in tax havens such as Bermuda and Switzerland. In addition to avoiding taxes they gain complete secrecy in the movement of their money. A Canadian Task Force on Deep-Sea Shipping (2) attempted to remove the tax obstacle under the Canadian flag by proposing a category of International Shipping Corporations (ISCs) which would receive special tax treatment. Clarkson Gordon, an accounting firm, has tried to elaborate, but there is little hope. First no government can give massive tax exemption to one industry without facing " me too " demands from other business interests. Secondly a ship owner who has enjoyed the secrecy and other benefits of Bermuda headquaters and an FOC flag will not endure the agony in haggling with tax people, Federal, Provincial, State and local.

Many nations allow owners to build, insure, repair, store, and fuel their ships wherever is cheapest and best. Some, the USA and Canada for example, place restrictions or duties on building or repair work done overseas. Canada and the USA have their own Coast Guard ship inspection requirements which have the effect of increasing capital costs. FOCs generally rely on established international classification societies such as LLoyds and the American Bureau of Shipping. Until recently US ships receiving

subsidy or preferences were by law built in US shipyards. There costs are triple those in good Asian yards and building times double. This explains the high US flag finance figure in Table I.

Low cost crews in Table II have in some cases been low on skills, but they seldom strike. Carefully chosen Asian officers are excellent. Though the cheapest, Chinese and Polish crews maintain their ships well. Entirely apart from cost, many ship managers prefer crews from Asian and non market countries.

II POLITICS ARE DIFFICULT UNDER ESTABLISHMENT FLAGS (OECD)
(Meaning Europe,Scandinavia,North America and Japan)

Politics rank in importance with money. If rich country ship owners saw any hope in solving their labour and tax problems at home they would not flee to FOCs and tax havens. Because the struggles consume so much time and money, most take the easy way out. Shipping is not front page news, and the person in the street does not know or care much about merchant marine policy. Thus big decisions are made in back rooms and through quiet discussions. Ship owners who receive subsidies and preferences prefer it that way. In open politicing they are outnumbered by their poorly organized opponents, the cargo owners. Gradually the maritime world is developing two different types of shipping politicians, one that manipulates for help at home and another that concentrates on international structures.

Every ship at sea is touched by political facts. If she is Liberian her owner has decided not to fly the flag on his passport. If built in a rich country yard, she enjoyed some form of subsidy. US operating differential subsidies pay mainly for crew. Cargo for Venezuela must be vetted by a complex government allocation scheme. If charts, navigation gear and crew tickets are right, she satisfies a variety of international conventions and need not worry about Port State Control. About a third of all ships at sea are owned by governments, for example fleets of the Russians and their affiliates, big lines such as Lloyd Braziliero and the National Shipping Companies of Australia, India, New Zealand, France, Venezuela, Argentina etc. One party governments in Africa own most of their ship lines.

Strangely, maritime political debates do not feature labour/management differences. Most maritime lobbies (PACs or political action committees) are combinations of ship and/or yard management and labour people. The big struggles center on three issues, namely:

1. Ship versus cargo
2. Regulation vs deregulation
3. Government help (subsidy and protection) vs competition

The responsibilities of ship owners are at issue in worldwide debates over the Hague, Visby and Hamburg rules. Shipowners fight

for the old Hague rules which set low claim payment limits and give them broad defences,- even when there is negligent navigation and mismanagement of a ship. Ship owners are so well organized that they have prevented an updating of these archaic rules, even in the face of united efforts by cargo owners. Another issue negotiated in back rooms involves the rights of Liner Conferences or cartels. Canadian agents for European and Japanese owners have been skilled in modifying current shipping anti trust law.

The US and Canadian Coast Guards have regulations more strict than those of Lloyds, ABS and the other respected international ship classification societies. These can add millions to the capital cost of a ship. Intermodal container shipping received a boost when the U.S. Shipping Act of 1984 allowed APL (The American President Lines) to quote rates and issue bills of lading on through shipments between Asia and points anywhere in the USA. Similar green lights will come more slowly in the European Common Market.

Most public of all are appeals for subsidy and protection. The US Merchant Marine Act of 1936 established differential payments to equalize US and foreign costs for ship operations and construction. At that time the differences in both categories were about thirty percent. Today (per Table I) the differnces are three hundred percent. The medicine has made the patient much worse. Similar stories can be told in Brazil, India, France, Australia and New Zealand. After World War II there were two dozen solid U.S. Flag shipping companies. Today only six survive.

Everywhere budget conscious governments are cutting back on ship and yard subsidies. Retreating maritime lobbies base their pleas on three issues;

1. Their national economies
2. Defence
3. Pride in the flag

Only the third has merit. Countless impartial studies (3) have established that a national shipping line that requires subsidy and protection is a net minus factor in the balance of payment account. This is true mainly because rates are increased and services decreased to protect the home flag, and the cargo owners suffer.

Merchant marines have always been seen as a " Fourth Arm " of defence. However the realities of modern warfere have driven shipping and the military far apart. Supertankers, big bulk carriers and containerships do not fit the needs of today's war plans. The merchant ship of the future will carry less than sixteen, mostly officers and trainees. In the event of a war these will stay aboard. Shipping is no longer a training ground for the Navy. As in the last war, crews must come from small craft (fishing, tugs, pleasure boats etc) and through training.

One magic move might evade political obstacles. Semi detached flags offer shipowners in England, Norway and France a chance to still fly the home banner without rewriting tax and labour laws. In France, for example, starting in June 1986, bulk carriers could be registered in the Antartic territory of the Kerguelen Islands and employ crews three quatrers composed of foreign nationals,but with at least four French officers. Playing political games with merchant ship flags is not new. At the start of World War II Pres. Roosevelt used Liberian and Panama flags to assist the Allies before the American people were prepared to declare war. The Liberian flag looks a bit like the US flag, and Liberia was a virtual USA colony during the days of it's Presidents Tubman and Tolbert. Flags of the Dutch Antilles have been a handy compromise for some Benelux shipowners. In todays Persian Gulf fighting President Reagan arranges cosmetic adjustments to put twelve Kuwait tankers under the US flag.

Norway promotes their Oslo based NIS (Norwegian International Ships' Register) with no nationality requirements on manning or equity capital. But Norwegian owner,Erling Naess, originator of the idea, has elected to keep his base in Bermuda. These semi detached flags are compromises which may stem or speed up the flood of flagging out. It is too soon to tell. They do have one great virtue in that they tend to carry over the international convention ratifications of their parent nations.

We have argued that OECD ship owners must either fly convenience flags or obtain help from their governments in the form of tax exemptions, subsidies and protection. We will argue that cargo owners care more about rate and service levels than they do about flags. Obtaining government assistance has proved expensive, time consuming and in the end self defeating. Thus if they opt for FOCs, ship owners have a large stake in making the international all flag system as good as possible.

III AN INTERNATIONAL POLITICAL STRUCTURE EXISTS FOR ALL FLAGS

A ship under the Cyprus flag does not pay much attention to her national safety rules. Some flags are more insurable than others as shown by the loss figures below;

TABLE III PERCENT OF FLEETS TOTALLY LOST
(Per annum, 1975 to 1985 averaged)

Malta	4.86
Cyprus	1.59
Greece	.88
Panama	.81
Liberia	.40
U.K.	.20
Japan	.12
USA	.10
Norway	.02

Source The International Shipping Federation 1987 endnote 4

Since flag states like Panama and Liberia do not entirely supervise their fleets, there must be a structure that does.The international trading community must somehow have a substitute for the fading influence of individual rich country flag states. Those who care most about this are the customers, owners of cargos increasingly carried by FOC ships.

A WHO CARES ?

(1.) The Shipper/Cargo Owner

The wrecks of the ARROW and the AMOCO CADIZ taught oil companies a lesson. Old time traffic managers cared mostly about the lowest rate. Now they know that any ship that they own or charter can put them in trouble financially and in the public eye. They care about the skills of the officers,and the standards of owners and managers. Charters and contracts of affreightment were once made in the bar at India House or over festive lunches in London. Now decisions are made by directors of distribution, computer loving specialists who factor in inventory,insurance and all other related costs. Shipper decisions are scientific, hard nosed and with little thought about flag sentiments. Behind the large corporations are the farmers, miners and factory workers workers who should care most, but are poorly organized. Big shippers such as DuPont, Krupp, Shell and the aluminum companies are active in the International Chamber of Commerce division that promotes maritime issues. They also are heard in maritime convention bodies such as the International Maritime Committee.

(2.) Those Who Serve The Industry

Officers, seamen, banks, shipyards, insurers, attorneys, stevedores, ports, ship chandlers and oil companies, the list is long. Ships are moving objects, and some shipowners dislike paying bills. When the U.S. Lines round world system went bankrupt owing over a billion dollars, the creditors list read like a " who's who " of the maritime world. These care about the flag and who lies behind it. They must have some system for collecting their bills.

(3.) The Environment

Ships once routinely flushed their tanks at sea and blew their stacks in port. Public outcries over oil pollution and dumping at sea have forced a painful review of international maritime law. Oil companies once thought that they could limit exposure by incorporating ships separately in tax havens and flying FOC flags. Now they understand that a coherent set of international conventions must function regardless of flag.

(4.) Shipowners

Ships today are owned by banks, oil companies, real estate developers, steel mills, pension funds and insurance companies. Many of these lack understanding of the maritime world. For this reason they care more than most about a rational system.

B. ORGANIZATIONS AND FORA

The courts of Malta. Liberia, Cyprus and Panama will not be trusted to decide important maritime cases. School children are taught that a ship is an extention of the nation whose flag she flies. This, however, means little in selecting a forum for settling disputes or debating new arrangements. There are four widely different types of international control systems.

(1.) Maritime Courts

" Until three or four centuries ago, the LEX MERCATORIA, of which maritime law was a major part, extended beyond the boundaries of individual nations, being based as it was on such universally accepted edicts as the ROLES OF OLERON and the CONSOLATO DEL MARE.

A truly international law would avoid conflict of laws and a truly international maritime law would avoid conflict of maritime laws. This was true up to the sixteenth century....."

William Tetley,QC. endnote 5.

Most shipping nations have maritime courts, and there are commonly accepted ground rules. These courts respect the substantive law of a nation where a contract is made. After a collision courts everywhere will apply the substantive law of the nation where the event occured. Always, however, the procedural laws of the forum (where the trial is) are applied.

There are many exceptions. Few nations exactly agree on what is procedural. Questions of public policy (often re seamen's wages) are decided by the forum. Courts are not kind to a manipulator who maneuvers to evade one set of laws for another. Whenever possible British courts favor shipowners and USA courts look after cargo owners. In France, Quebec and New Orleans Civil Codes (of Napoleonic origin) are harder on shipowners who pollute.

Against this confusing background International Conventions have been devised to create order.

(2.) International Conventions

In September 1910 in Brussels two historic agreements were drafted, one on collisions and one on salvage. Since then, often in Belgium, many good Conventions have been drafted and ratified to cover Carriage of Goods at Sea (Hague Rules), Limitation of Shipowners Liability, Sovereign Immunity and Pollution. In 1948, IMCO (The International Maritime Consultive Organization) now known as IMO, an agency of the United Nations began studying and drafting conventions. These activities seldom drew distinctions between flags. They were mainly to solve technical, legal and operating problems-not political or economic ones. In about 1960 another U.N. agency, UNCTAD ((6) the United Nations Committee on Trade and Development) began to develop conventions that were intended to promote the shipping flags of Third World nations. This effort was part of the UNCTAD mission to create " A New World Economic Order ". Naturally the shipping establishment (OECD known at the U.N. as Group B) resisted. The struggle raised questions about the purposes of an International Convention. In a Meredith Memorial Lecture at McGill University on 27 September 1986, Prof. William Tetley, Q.C. provided an answer as follows;

" What is the purpose of an international convention? Why attempt to adopt such a convention? In other words what are the advantages of an international convention over individual national laws adopted by individual nations?
Perhaps the answer may be summarized in three principles; (1) Uniformity of Law, (2) Certainty of law, and (3) Justice, or a just solution to the problems requiring resolution.."

Judged by these standards, UNCTAD's conventions fail. Their masterpiece is called a Code of Conduct for Liner Conferences. Adopted in 1974, this entered into force in 1986. It is a long confusing document which, without exactly saying so, allocates general cargo shipments on a 40-40-20 basis.That means that every nation must be allowed to carry under its flag 40% of it's conference liner general cargo while allowing outsiders to carry 20%. Most Third World countries supported it as did Russia and the other non market nations (Group D). The latter proceeded to ignore it in their own shipping arrangements. Many Latin American nations, Brazil for example, supported the Code but continued as before to demand 50% for their flags. Some of the Group B establishment countries (Norway,Germany and Denmark) have adopted, but under the " Brussels Compromise" made an exception of trade with Group B nations. Thus in practice the Code only applies to conference trade to and from certain Third World (Group of 77) nations, about 15% of all general cargo movements.

It may not be fair to judge the Code by the Tetley standards, since, apart from the title, it has little to do with law or justice. It is a political and economic effort.

UNCTAD's other major effort has been a " Convention on

Conditions for Registration of Ships " adopted on February 7, 1986, but not yet (or likely to be) in force. This began as an attempt to phase out FOCs, and in the process to promote the Third World fleet of bulk carriers and tankers. After seven years of expensive emotional meetings the UNCTAD staff realizes that eliminating FOCs wont help Group of 77 developing nations. Thus a convention has emerged which tries to set standards for convenience flags. While the objective is good, the document has few friends. Labour interests in rich and poor nations dream of eliminating FOCs because of the crew cost numbers in Table II. They reject the final document because it accepts and legitimizes FOCs. Russia, China and the Comecon countries have never hesitated to employ FOC vessels. They seem to have lost interest in the struggle to eliminate them. The establishment Group B nations are unhappy about the whole effort, especially the attempt to create a " Genuine Link " between flag and the ownership/management of ships.

Even UNCTAD's worst enemies must admit that the link between flag and owner must have some substance. Otherwise the flag is a meaningless decoration and an invitation to abuse of crews and customers. Having this in mind, cargo owners enter ship markets with care, especially when they are offered a ship with a high risk flag. (See Table III)

(3.) The Market

The Baltic ship exchange may not seem like a regulatory forum, but it functions as one. Important charterers, Shell Krupp, Esso ,Cargill and the steel companies pick and choose in one of the purest of free markets. They avoid ships and owners with poor records for safety,bill paying or abuse of seamen. In this they are aided by a flood of computerized marine credit analysts such as MRC (Marine Reporting Co.) and TSA Marine in Oxford, U.K.

(4.) Others

Shipping is blessed with many outfits that function as regulators. Annoyed by the slowness of courts, disputants turn to arbitration in London or New York.The International Transport Federation (ITF), a London based labour organization, monitors FOC ships all over the world. When they detect that a crew has been abused they detain their ship. Left wing waterfront workers in Australia, France and New Zealand help them as do waterfront churchmen of all denominations. The ITF issues "blue cards" to approved FOC ships. A ship with such a card can trade anywhere and is worth more on the Baltic. Lloyds Register and ABS (The American Bureau of Shipping) are classification societies that can in their inspection proceedures influence a ship's value. Port State Control is a recent device intended to discipline shipowners who fail to maintain ships or pay bills. These are samples drawn from a long list.

CONCLUSION

To tell the truth, everybody cares about their flag and ships. Canadians do not like the idea of a zero deep sea fleet. The British shipping press bemoans the Union Jack's decline. Americans worry when Old Glory is artificially planted on a dozen Kuwaiti tankers. Twenty years ago the Canadian government gave two ships to the Caribbean West Indies. They were poorly designed, politically managed and great money losers. But on any beach in Tobago, St. Lucia or Barbados you could hear local people say proudly;

" Those are OUR ships."

On the other hand a farmer in Iowa has reason to complain when he loses business because a merchant marine second mate earns over a hundred thousand dollars for six months at sea.

Tax havens bother people. Some Norwegians criticize their countrymen who have fled to tropic islands. Why should one industry be tax free while others carry the load?

It will take a generation to sort this out. Rich countries will wind up with ships run like jumbo jet freight planes, just a few officers aboard . These may be stockholders in the owning company, and their wives and children may join them at sea. Less rich countries will have less automation and larger crews doing maintenance at sea. No one will pay more than a half million dollars a year (1987 US$) for a crew. Somehow a way will be found to tax the industry.

In the meantime everyone should care about the painful process of creating order,- about Prof. Tetley's uniformity, certainty and justice in a political system for all flags. This is painful because it takes years of meetings and patient persuasion to draft a good convention and longer to get it ratified and in force. France, England and her FOC satellites have good records in this regard. Canada and the U.S.A. do not.

ENDNOTES

1. Transmode Consultants Inc. (21 St. Clair Av. Suite 1001, Toronto, Ontario,M4T-1L9, Canada) is a research group in which the author is a director. They and the author keep and daily upgrade data banks on ship and terminal costs. These cover a variety of ship and port types worldwide. Table I assumes no subsidies or favorible financing, ie covers pure costs.

2. The TASK FORCE ON DEEP SEA SHIPPING report was prepared for Canadian Minister of Transport in April 1985. Its membership included four prominent Canadian shipowners, and they concluded that there are not enough economic benefits to warrant a Canadian flag deep sea ship subsidy/protection program.

3. A 1984 U.S. Congressional Budget Office study considered proposals to require that some USA bulk cargo exports be moved on U.S. flag ships.Their conclusions were similar to those of the Canadian Task force. Quietly the World Bank has been saying the same things to its clients. Recently UNCTAD feasibility studies for Third World shipping aspirants have followed suit.

4. The International Shipping Federation in London publishes and updates a comprehensive GUIDE TO INTERNATIONAL SHIP REGISTERS.

5. MARITIME LIENS AND CLAIMS by William Tetley Q.C., published by Business Law Communications Ltd Ltd. of 53 Fleet Street, London, U.K.. The quotation is from page 522 at the start of his chapter on Conflict of Maritime Laws (Choice of Law) Prof. Tetley teaches the course at McGill Law school for which this paper was prepared.

6. Sr. Juan E. Oribe Stemmer of Roque Graseras 680, Montivideo, Uruguay provideds an interesting account of the early political jockeying between IMCO ,the shipping establishment, and the Third World on the scope of IMCO conventions. He notes that there is no rule against IMO (then IMCO) involvment in economic matters and that they are not easy to separate from technical ones. His paper is entitled A NEW ECONOMIC ORDER FOR POSTWAR SHIPPING AND THE LINER CONFERENCE SYSTEM, THE INTERNATIONAL MARITIME CONFERENCE, 1948. It appears at page 5 of Volume 14, Number 1 Jan/March 1987 of MARITIME POLICY AND MANAGEMENT,published by Taylor and Francis in London. This excellent journal is largely organized by the faculty of the Department of Marine Studies, Univ. of Wales Institute of Science and Technology (UWIST) Cardiff CF1 3EU,UK.

THE WESTERN GRAIN TRANSPORTATION ACT, THE NATIONAL TRANSPORTATION ACT, AND PUBLIC CHOICE THEORY:

Can the Value of Western Branch Lines Be Determined?

Paul D. Earl[1]

Introduction

Market forces have not been allowed to operate in shaping the railway branch line network in Canada. This has been particularly true in Western Canada, where, for many years, the statutory rates on grain, combined with prohibitions against differential rates between main and branch lines and restrictions on the abandonment of lines, inhibited the development of a system making a more balanced use of rail and truck. Regulation of both rates and abandonment have arisen partly because transportation has qualities characteristic of "public goods" and partly in response to the perception of the monopolistic position occupied by the railways.

Where market forces are prevented from coming into play, other means must be found for allocating resources. Usually this involves government decisions made through either political or regulatory means. It is the discipline of "public choice" which studies these non-market decision making procedures. The field entails, inter alia, studying how decisions on supply, price and financing of public goods are made.

Public choice theory is a complex field, and one that has tended to make use of difficult and theoretical mathematical formulations. Nevertheless it does provide valuable tools of analysis, and ways of looking at problems which can be of use to practitioners in the fields of public policy.

This paper has two objectives:

First, to review the environment in which public decision making on western branch lines takes place, and in particular to review the changes that have been made in this environment by recent legislation;

Second, to examine a specific potential application of public choice theory to the issue of the abandonment of western branch lines which are used primarily for the movement of grain.

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It is worthwhile however to begin this discussion with a review of some of the relevant aspects of welfare economics and public choice, and to highlight some of the characteristics which branch lines share with public goods.

Welfare Economics and Public Choice

There are two fundamental concepts of welfare economics that are relevant to this discussion. The first is that more is better: more shoes, refrigerators, automobiles, public services and goods of every variety. In the language of welfare economics, as a society attains more goods, its "social welfare" increases. In fact, economists who work in the area of welfare economics and public choice speak of a "social welfare function" which, conceptually, is a way of expressing mathematically the total economic wellbeing of society. No one has ever been able to write such a mathematical equation, but it provides, for those in the field, a useful way of talking about how well off a society is.

A second basic concept centers on the manner in which goods may be substituted, one for another. From a totally utilitarian point of view, some goods seem intuitively to be nearly perfect substitutes. A pound of beef may be equal in nutritional value to a pound of pork, but a steady diet of beef generates a desire for ham or poultry which in turn may push up the price of these products. Economists use the familiar notion of concave shaped indifference curves to express this phenomenon.

It follows from this second concept that the value of a good, as measured by what one is willing to give up to obtain it, might differ quite markedly from the cost of producing it. This concept is of significance in discussing the value of branch lines to their users, particularly in Western Canada. Farmers have certain perceptions about matters which enter into their decision making calculus in delivering grain. These perceptions extend to such things as the value of grain handling and transportation facilities to community viability, the impact of road damage on taxes, and the actual level of farm trucking costs. Given these perceptions, a local branch line or elevator may be of much more value to farmers than would be indicated by a technical determination of how much it would cost farmers to haul their grain further if the facility were removed.

The differing values which people put on goods cannot always be expressed in the market place. The class of commodities known as "public goods" do not lend themselves to being traded, and accordingly different mechanisms must apply to their supply and pricing. A pure public good is a commodity that, once provided, is freely available to all, and whose consumption by one person does not subtract from another's access to it. There are not many purely public goods. Radio and television transmissions are among the better examples. Once a receiver is purchased, programs may be consumed in unlimited amounts without further cost, and without detracting from one's neighbour's ability to receive the same

programs. Military defence is another example. Once defence is provided at a given level, it is available to all, and is not subsequently purchased on an individual basis as are private goods like boots and shoes.

Transportation facilities bear some of the characteristics of public goods. Roads for example, once provided, are available for all users and, over rather broad ranges of traffic, one person's use of the road does not prevent another from using it too. Railways are more like private goods in the sense that individual access is purchased individually, but the pricing and subsidy systems which are in place for branch lines also gives them some qualities of a public good. Once there, a branch line is available to all at a legislated price which is no different from that paid on more efficient, but perhaps less conveniently located lines elsewhere, and one shipper's use of the line does not prevent a second from buying the service too. Moreover, the presence or absence of branch line service, in common with other public goods, is decided not in the market place but by collective decisions of the community through political and regulatory means.

Public choice theory deals with the formulation of "voting rules" for making decisions about the supply and pricing of public or non-market goods. And the essence of public choice decision making is the matter of determining the preferences or desires of citizens who are prevented, for one reason or another, from expressing their views through a market system.

Legislation enacted over the last few years has substantially changed the environment of the public decision making process for branch lines, and in particular for "grain dependent branch lines"[2] in the West. Western interest groups which are, or may soon be, affected by this legislation have varying degrees of knowledge about the nature of these changes. The next section therefore addresses the first objective of this paper, viz., to review the recent legislation.

Changes Introduced by the WGTA and the NTA

Both the Western Grain Transportation Act (WGTA) and the new National Transportation Act (NTA) have been instrumental in changing the decision-making environment on grain dependant branch lines. Each of these is examined separately here.

For many years, dating back to at least the 1950's, branch line abandonment was seen in Western Canada as an attempt by the railways to escape from their obligation to provide adequate rail

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[2] The category of branch lines which are grain dependent was created by the Western Grain Transportation Act. Broadly speaking, these are lines where the proportion of grain traffic is in excess of 60 percent. The costs of such lines are recovered by the railways from grain rates set under the Act.

service. Moreover, the railways were correctly seen as the primary beneficiary of abandonment. Their costs went down, whereas virtually everyone else suffered: local farmers had to haul farther; communities lost both a transportation link and the associated tax revenue and employment; provinces and municipalities had to provide for added truck traffic on the roads; and the rest of the grain producers gained nothing because of the fixed Crow's Nest Pass rates on grain.

The WGTA has changed all that. First, the railways are recompensed for the costs of keeping grain dependent branch lines in operation. There are still, of course, efficiencies to be gained, and because the revenues are shared but the costs are not, a railway which abandons a line will have its costs fall more than it revenues. Accordingly, the railways have been vigourous in pressing for changes to permit greater abandonment. Nevertheless, it must still be admitted that the financial spur to abandonment has been blunted as far as the railways are concerned.

At the same time, the WGTA has changed the incidence of costs and benefits of abandonment on the various affected parties. An 1985 report released by the Senior Grain Transportation Committee (the so-called "ACSE report") put the matter in dramatic terms:

> The major finding from the analysis is that the retention of a high cost branch line results in farmers in general and the federal government incurring costs in the millions to save local farmers and municipalities on the line costs in the hundreds of thousands. [P. i; underlining in the original.]

From the point of view of public choice theory, the WGTA has changed the potential alliances. A new community of interest has been created which includes the majority of grain farmers (those not located on light traffic density lines), the federal treasury, and the railways, all of whom now stand to gain from abandonment. The elevator companies which handle the grain also join this community of interest to some extent, because of their interests in closing low handling elevator points, many of which are located on light branch lines. (It should be appreciated, however, that the commonality of interest is not absolute. Many high handling grain points, which both producers and elevator companies would wish to see retained, are located on low traffic density branch lines.) On the other hand, producers and municipalities located on branch lines still stand to suffer from abandonment, and both they, and the federal and provincial politicians who represent them, continue to have a lively interest in retention.

The ACSE report was an in depth analysis of the new financial pressures brought into play by the WGTA, and the way in which various parties' interests were influenced by them. It concluded that there were both "winners" and "losers" in the branch line abandonment process, and recommended procedures for capturing some of the savings realized by the winners, and using these captured

funds to pay for the losses of those who suffer. The debate over these recommendations is dealt with later in this paper.

The WGTA is not the only recent legislation that has changed the decision making environment for branch line abandonment. The new NTA has introduced a new set of rules governing the abandonment process itself. It is probably fair to say that very few of the western grain interests have yet come to grips with the implications of this legislation. Of course it is also true that parts of the legislation are specifically excluded from applying to grain. It is possible therefore that more legislation may come forward to deal with grain lines. Even if it does not, however, the new NTA does provide sufficient regulatory machinery for dealing with abandonment of grain lines, and it is therefore appropriate to review the changes which this act has made. The most pertinent are as follows:

Firstly, the government no longer has the power to protect lines from abandonment applications. This power has been one of the key instruments employed by the government in respect of lines servicing grain shippers, and many of the lines in Western Canada are so-called "frozen", or protected lines, on which abandonment applications cannot be made. Existing abandonment prohibition orders are kept in effect, and although it is technically possible for them to be terminated earlier than their present expiry date, there is no provision to allow for their extension.

The second major change is that the new Act embodies what is referred to as "reverse onus". This means that when a railway applies to abandon a line, it is incumbent upon shippers and other interested parties to object to the abandonment application. Under the old legislation the Canadian Transport Commission (CTC) was required to determine whether the line should be abandoned; under the new, the National Transportation Agency is obliged to abandon a line where the application is unopposed. The "reverse onus" aspect of the legislation has been widely recognized and discussed in relation to trucking, but its application to branch lines has not, as far as the author is aware, received much public attention.

Where an abandonment is opposed, the casual observer of an abandonment hearing may not see very great differences between the new and old abandonment processes. If hearings are held, the railway would still present the case for abandonment, and the parties opposing would present the case for retention. The Agency would then render a judgement as to whether the line should be retained or abandoned. However, these surface appearances would mask some very substantial differences from the old procedures.

First, under the old legislation, a line which did not incur a loss was not eligible for abandonment consideration. Only lines which were uneconomic could be considered. Under the new legislation, both uneconomic and economic lines are candidates for abandonment. Moreover, the Agency has no discretion with respect to uneconomic lines. Where the line is uneconomic and has no

likelihood of ever becoming economic the Agency must issue an abandonment order. If the shipper feels that the public interest demands that the line be kept, notwithstanding the loss, his appeal is no longer to the regulatory body but to the Governor in Council, which may then delay the abandonment order for up to five years.

An economic line is treated by the Agency in a fashion similar to the way uneconomic lines used to be treated under the old legislation, viz., the Agency must consider the public interest in reaching a decision. The public interest factors to be considered by the Agency are largely the same as they were under the old legislation, but are slightly expanded to include specific reference to transportation facilities which the railway may be willing to provide in lieu of the line, and the extent to which alternate transportation facilities may be more economic than the branch line.

Where an economic line is not considered necessary in the public interest, and is to be abandoned, the permissible timing of the abandonment has also changed. Whereas the old legislation permitted the CTC to set a date up to five years from the date the order is issued, the new permits a time of only one year.

In cases where an application to abandon the line is denied on grounds of public interest the CTC was formerly required to review the line every five years; under the new law, the Agency is required to conduct a review every three years.

Another area of significant change lies with the policy tools made available to the Minister and cabinet to intervene in the abandonment process. The Act provides cabinet with three specific points of intervention. First, as described above, the Governor in Council may, on the appeal of a shipper, vary the date of an abandonment order, and may delay it by up to five years. When the cabinet exercises this prerogative, the Agency is automatically required to conduct a study on the traffic on the line, and the subsidies to be paid in respect of the line. This study is then forwarded to the Governor in Council, thereby permitting cabinet its second point of intervention, viz., to declare the line economic. This is a substantial deviation from the previous legislation which reserved technical economic decisions of this nature to the Commission. Where the Governor in Council finds the line to be (or likely to become) economic, it is then able to "remit" the application back to the Agency, which must then review the line every three years.

The third, and potentially most interesting point of intervention available to the cabinet is the ability given to the Minister to enter into agreements with certain interested parties to pay "contributions to assist in the transition to improved transportation facilities" where the Minister is convinced that shippers would suffer "significant economic harm" from abandonment (s. 175(6)). Interesting as this section may be however, it is also specifically excluded from application to grain dependent

branch lines, and is therefore largely irrelevant to the branch line problem in Western Canada.

Table 1 summarizes the major differences between the new and old legislation. Figure 1 illustrates the new abandonment procedure in the form of a flowchart.

There are two open questions which pertain to the matter of how the abandonment of grain dependent branch lines might be handled in the future. The first is the degree to which the provisions of the NTA which are reviewed above will apply. The exclusion of certain innovative parts of the Act from application to grain suggests the possibility of new legislation, perhaps with entirely different provisions, to deal with grain dependent lines. Should this transpire, the degree to which the existing legislation might be appropriated into the new is open to speculation.

The second open question is how loss will be determined on these lines. The costs of any specific grain dependent line are recovered by the railways from their total grain revenues, but are not necessarily recovered directly from the revenues earned on that line. It may be that either regulation or legislation will be introduced that will require these lines to be considered as profitable, even if, under the normal procedure, they would show a loss.

This second question is quite critical. A uneconomic line must be abandoned by the Agency regardless of public interest considerations; only in the case of economic lines are public interest considerations weighed. However, because the cost of these lines are recovered by the railways from total grain revenues, it might be argued that they are <u>all</u> economic, and therefore public interest must be considered in every case where the application is opposed.

It is obvious from this review of recent legislative changes that an interesting battle is brewing over the future of western branch lines. One of the early rounds of that battle will centre on the nature of the abandonment process itself which is not yet fully defined in legislation.

In the past, the opponents of abandonment have been united, and the bargaining strength has rested on their side. However, the increasing appreciation that other farmers are now paying the cost of retention will bring new forces to bear on the public decision making process. Already, the work of the "ACSE committee", referred to above, has initiated a new debate in Western Canada about the possibility of compensating the "losers" from branch line abandonment from the saving achieved by the "winners". A brief summary of the state of this debate is in order.

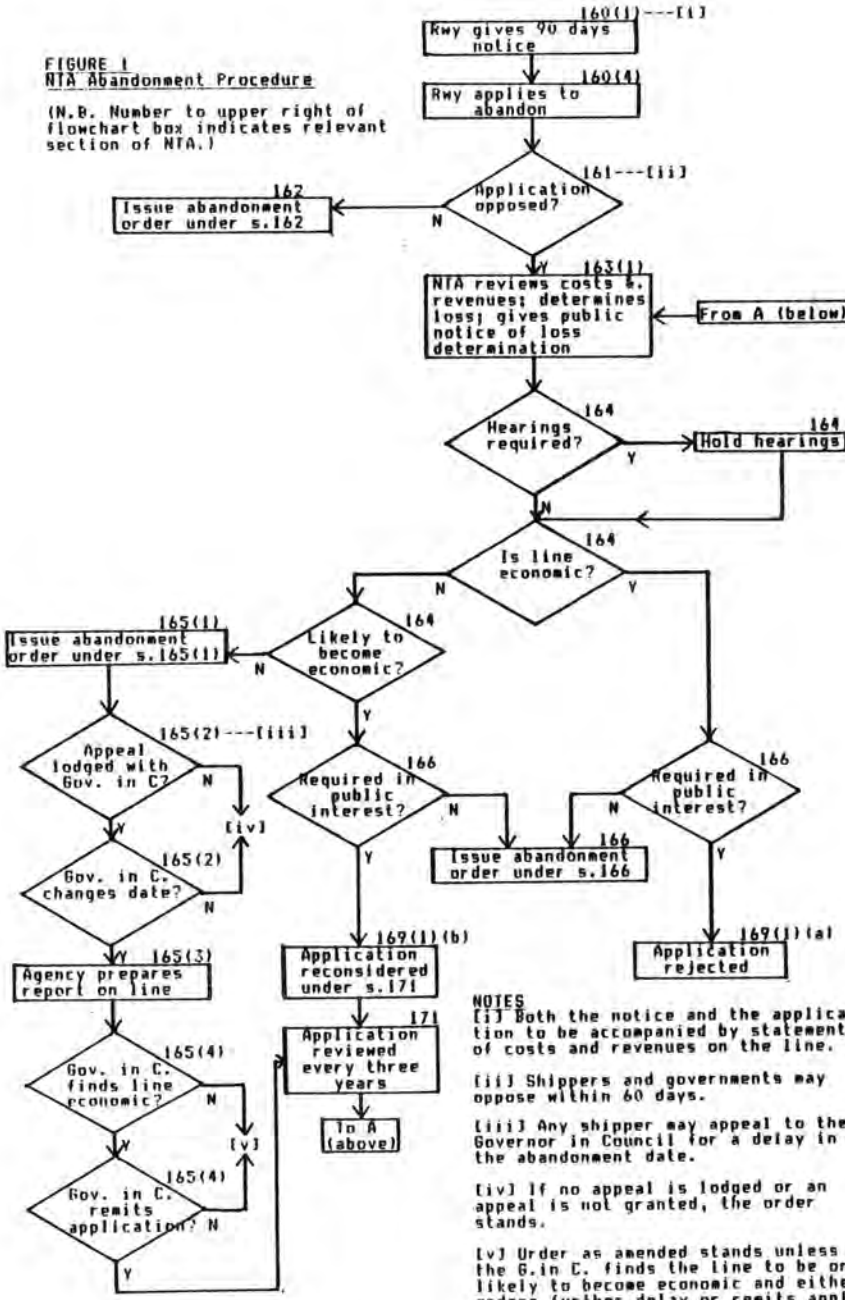
Table 1

Difference Between Old and New
Legislation on Branch Line Abandonment

Provision for:	Old Legislation	New Legislation
1. Freezing lines	- Governor-in-Council able to protect lines from abandonment application	- No protection from abandonment available (but existing freeze orders are extended)
2. Onus	- Onus is on railway to prove abandonment should be permitted	- Onus is on interested parties to oppose abandonment
3. Uneconomic lines	- Uneconomic lines required in the public interest to be retained	- Uneconomic lines must be abandoned without consideration of public interest - Shipper can appeal to Governor-in-Council, which can delay abandonment up to five years - Governor-in-Council, after report by Agency, can declare a line economic
4. Economic lines	- Applications on economic lines are rejected	- Economic lines are abandoned unless required in the public interest
5. Abandonment dates	- Up to 5 years from application	- Up to 1 year from application
6. Reviews of retained lines	- Every 5 years	- Every 3 years
7. Alternative transportation	- No assistance	- Governor-in-Council may provide assistance for development (except for grain lines.)

FIGURE I
NTA Abandonment Procedure

(N.B. Number to upper right of flowchart box indicates relevant section of NTA.)



NOTES

[i] Both the notice and the application to be accompanied by statement of costs and revenues on the line.

[ii] Shippers and governments may oppose within 60 days.

[iii] Any shipper may appeal to the Governor in Council for a delay in the abandonment date.

[iv] If no appeal is lodged or an appeal is not granted, the order stands.

[v] Order as amended stands unless the G.in C. finds the line to be or likely to become economic and either orders further delay or remits application for consideration under s.171.

Compensation for Loss

When a branch line is abandoned and local producers must haul their grain further, the costs associated with the extra haul are borne by the local few, while the dispersed many (the federal government and all grain farmers in general) reap the benefits. It is a classic public choice problem in that the costs imposed on the few are low in total but high per capita. Similarly, the benefits from abandonment are high in total, but small per capita. The ACSE report, for example, found in a case study that the extra trucking costs for local producers amounted to about $290 thousand, or approximately $2. per tonne of grain hauled to the sample branch line; the total benefit was $2.4 million, but spread over the roughly 30 million tonnes delivered by all producers would have been in the order of $0.08 per tonne. In this situation the losers have a high incentive to oppose abandonment, whereas the winners have a much smaller incentive to encourage it. However, when this situation is multiplied by many miles of branch line, and when the possibility exists of secondary costs savings arising from more efficient train operation, then the savings to the majority begin to become significant. This fact is becoming more widely known and appreciated.

Recognizing on the one hand the large savings to be achieved, but on the other the depth of resistance to abandonment, the ACSE committee proposed what appears on the surface to be a simple solution. A portion of the savings achieved would be captured through a surcharge on grain freight rates, and placed into a special fund. This fund would then be used to compensate the "losers" from abandonment for their extra costs. Local farmers would be compensated for additional trucking costs; provinces and municipalities would receive compensation for added wear and tear on the roads.

This apparently simple idea does, however, have some problems associated with it. The more important of these are as follows:

First, there is the problem of justifying compensation for extra haul arising from abandonment of a branch line but not for closure of a grain elevator. Elevator companies have pursued a vigourous elevator closure program over the past fifteen years or so, and no compensation has been paid. From the producers' point of view, of course, there is no difference between an extra mile of haul arising from abandonment and one arising from an elevator closure.

A second, and related problem is compensation for past abandonments. There is a perceived injustice to compensating producers who lose their local service today, and doing nothing for those who were similarly affected last week.

A third difficulty arises in the area of road costs. There is no question that the added truck traffic on the roads causes some additional damage. The provinces and municipalities who are responsible for road upkeep argue with some justice that they too

should receive compensation. The problem lies in determining how road costs should be calculated and assigned. The differences between the figures prepared by the provinces and those by other researchers are extremely large.

Fourthly, there a number of technical difficulties in determining just how trucking compensation should be calculated in order to be fair. Perhaps the most obvious question here is how the program should be structured so that farmers are not encouraged to haul to branch lines in hope of receiving a compensation payment.

So a vigourous debate is going on in Western Canada at the moment over these questions, and it is going on against the background of changes in the policy environment discussed earlier in this paper. Part of this debate has taken the form of a series of studies on individual branch lines, attempting to determine the levels of benefits and costs associated with various options for change, and to determine the incidence of these costs: who wins, and who loses, and by how much.

The feature of these studies that is of greatest concern in this paper is that the determination of the level of "hurt" imposed on the "losers" has in every case been approached by technical analyses of <u>costs</u>. So many tonnes of grain hauled so many extra miles in such and such kinds of trucks costs so much. Pay the producer the calculated sum, and his opposition to abandonment is implicitly assumed to evaporate, and justice is implicitly assumed to have been done.

The trouble is, that the perceptions at the farm level are different. Opposition to branch line abandonment arises not simply because there is an economic cost associated with loss of local service, but because the producer places a <u>value</u> on the presence of the line and the grain elevators which is higher than measurable economic costs. If a personal recollection can be allowed into an otherwise technical paper, the author well remembers attending hearings of the Hall Commission of Inquiry on branch lines in 1975, and hearing children coached to memorize and recite locally composed poems about the dire effects that would ensue if abandonment were allowed to occur. The chief commissioner of the inquiry loved it. But professional economists and policy advisors simply quail before such displays.

Given the depth of feeling that exists, and the many perceptions of what is entailed for the local community in abandonment, the approach of offering the adversely affected grain farmer compensation which reflects only the costs of added trucking can be expected to be met with much resistance. The Senior Grain Transportation Committee currently has six branch lines under study using basically the approach developed by the ACSE report, and has suggested compensation of a flat rate of $3 per tonne plus an additional $0.15 per tonne mile after 10 miles of incremental

distance. This offer has reportedly not been met with great enthusiasm in the meetings held so far.

This then, brings us to the second objective of the paper, viz., to examine a specific application of public choice theory to the problem of grain dependent branch lines. The discipline of public choice provides the concept of "demand revealing processes", by which is meant a procedure for determining, in the absence of a market, how much a particular public good or service is worth to those who use it, and to those who must pay for its provision.

A Framework for Application of Public Choice Theory

The desire for locally available service is not unique to branch lines and grain elevators, nor even to public goods. People want local convenience stores for the urgently needed litre of milk, local bus service for those times that the car breaks down, local schools for their children and so on. In a market situation like that governing the location of convenience stores, consumer preferences are revealed through the price mechanism. However, in the case of public goods, demand for a product is not so easily identified. Public referenda are one way of determining demand and have some limited direct application. Urban residents are often polled directly on street improvements, and a "majority rule" voting procedure often determines whether a street is paved or a sewer put in. But typically, a more amorphous approach is necessary, and elected officials must determine whether public services should or should not be provided, and at what level, based on representations made to them by their constituents, analyses carried out by public servants or consultants, or their own private information sources.

In the case of grain dependent branch lines, the most direct procedure for determining their value is to ask farmers how much they feel they would need by way of compensation to relinquish access to the service. However, this approach runs squarely into one of the key problems in designing a demand revealing process, namely eliciting truthful responses from those who are pressing to have public goods provided. It is no more than common sense to point out that if someone else is paying, a person will be liberal in his estimate of the value of having his own road paved, whereas the same person will have a quite modest assessment of the need to pave someone else's road at his tax expense. The trick in demand revealing processes then is to present options to the voters in such a way that they have no incentive either to understate or overstate the value of the good.

Methods have been developed to elicit truthful responses. One of these is the so-called Clarke mechanism (Tideman & Tullock, 1976). Under this procedure, the respondent is asked how much tax he or she is willing to pay for a specific public good or service. A respondent who understates his preference, stands the risk of the good not being provided. Overstating one's preference on the

other hand brings the risk of being taxed more heavily for its provision.

Of course, the Clarke mechanism presupposes that differential tax rates can be charged, and that taxes will be levied on individuals or communities in proportion to the values that they placed on the services prior to their being provided. If such differential taxes cannot possibly be levied, and the user knows it, then those who stand to gain most will over-value the service when they vote.

The situation with demand revealing procedures becomes more complex when the public good in question also has about it an element of public "bad": undesirable effects which will be incurred by only a small segment of the population. A considerable amount of work in this area has focussed on the case of waste disposal sites. Everyone wants to get rid of garbage, but mostly they want to do in someone else's backyard. The Clarke mechanism was found to break down when one policy option (one's own backyard) actually has negative values associated with it.

The branch line abandonment problem is not unlike the waste disposal citing problem in that, if all producers were asked the value of branch line abandonment, those in whose "backyard" the abandonment might take place would place a negative value on it; those on main lines (assuming a level of knowledge and awareness of the cost to them of retaining branch lines) would tend to place a positive value on it. Branch line producers would tend to over value line retention (or place an unduly large negative value on abandonment); main line producers would tend to over value abandonment (or place an unduly small negative assessment of the impact that abandonment would have on the other person).

What is required therefore is to develop a technique of measuring the actual "demand" for branch line services in such a way that the tendencies to over- and under-value the service will cancel out, and a fair determination can be made of the compensation levels at which producers would be willing to relinquish them. Such a level of compensation would be such as to cover not just the additional costs engendered by abandonment, but the value of the perceived loss. It may be impossible to do this on the basis of a single experiment, but the following more limited and modest aims seem to be attainable:

1. To compare the <u>costs</u> of branch line abandonment with the <u>valuation</u> placed upon branch line service by producers.

2. To determine how the valuation placed upon branch line service varies as the perceived threat of abandonment increases.

In order to accomplish the foregoing objectives, the following methodology is proposed:

1. Several groups of farmers would be selected to answer questionnaires. Six groups would probably be the minimum number, even for indicative results. Groups should contain 10 to 15 farmers.

2. The groups would be selected from lines of different traffic density and cost levels and hence of varying susceptibility to abandonment. They would range from the poorest of branch lines, where the question of abandonment has been in the air for some time, to main lines where abandonment will not take place. Regardless of the number of groups actually selected, at least one group should be drawn from a main line and at least one from a line whose abandonment is not in doubt.

3. To each group, a different abandonment scenario would be proposed. These scenarios would differ in the severity of the proposed program. One group might be asked to consider a total abandonment of 7000 miles, a second, of 4000 miles, a third of only 2000 miles, and so on. The intention would be for each group to feel a different intensity of threat to its own specific branch line. Thus, for example, the main line group or groups would not feel threatened no matter what the level of abandonment proposed; in fact, the more severe the abandonment level, the more they would benefit in potential rate reductions. Likewise, the most threatened would always feel themselves at risk because their line might be abandoned anyway. But in answering the questions, each individual group in between the extremes would feel a different degree of threat, depending upon the actual traffic density on its line, and the severity of the abandonment program being presented to that group.

4. Each group would then be asked questions about the level of compensation they feel farmers should receive for loss of their branch line. It is apparent then that main line producers would in fact be asked to consider how much compensation <u>other farmers</u> should receive; producers on the worst line would be considering how much <u>they themselves</u> should receive; other groups would variously be answering for themselves or for others, but with varying perceptions of whether they might be winners or losers. The higher the traffic density on their own line and the less severe the abandonment scenario presented to them, the more they would be potential winners, and the more they would feel themselves to be assessing the value of lines for others. Similarly, the lower the traffic density on their own line, and the more severe the abandonment proposal put to them to consider, the more likely they would be considered losers, therefore the more likely they would be assessing the value of the line to themselves.

The results of the questionnaires would then be analyzed in three ways. First, the average responses overall could be compared to the calculated costs of abandonment as estimated using the techniques employed in the ACSE report. This would give some notion of how producers in aggregate value branch line retention, and also how values compare with costs.

Secondly, comparisons could be made between groups to determine whether the compensation recommended varies by the degree of risk which participants feel to their own line, and if so, by how much. Low variability between groups might be an indication that producers were answering truthfully without being swayed unduly by considerations of personal gain or loss.

Finally, the variability in the valuations within each group would be analyzed. Low variability within groups might indicate that there is some degree of consensus as to the value of line retention, and may be used as a basis for other experiments designed to refine the information and thus eventually to determine acceptable compensation levels.

Concluding Comments

What follows from the discussion in this paper is necessarily more suggestive than conclusive. However, some comments can be made under four heads:

First, the review of the changes in the regulatory environment for branch lines suggests that the bargaining strength of those favouring retention is diminished. The "reverse onus" feature of the NTA, combined with the potential of grain farmers not located on branch lines to gain from abandonment, has put those who favour retention on the defensive, and has split the common front which formerly existed among retentionist forces.

Second, it has been demonstrated that branch line abandonment presents a classic problem in the field of public choice analysis, in that: (a) the operation of the market has been suspended in determining the supply and price of the "product" (branch line service); (b) the environment for public decision making is changing rapidly, and thus presents shifting opportunities for new alliances to influence the abandonment process; (c) technical analyses of the costs of providing, or of removing, branch line services do not represent the value placed on them by grain farmers; and (d) it presents the classic problem of eliciting truthful responses on how much a public good may be worth because those who respond are not those who pay, and those who pay are not those who benefit from the provision of the good.

Third, it has been demonstrated that the discipline of public choice can bring a different perspective to the analysis of transportation policy issues. Moreover, it has been shown that a public choice technique (demand revealing process) can be developed for application to a specific problem (abandonment of grain dependent branch lines).

Fourth, in presenting this paper for public discussion, it is hoped to achieve two things:

(a) To stimulate some response among interested parties in the proposal for examining how farmers might value branch

lines. If the proposal can be refined through some critical comment, and can be implemented, valuable information to assist in the development of public policy might be gained.

(b) To stimulate specialists in other areas of transport policy research to examine more closely the discipline of public choice for approaches to problems in their particular fields.

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Rationalization of the Prairie Rail Network
- A CP Rail Perspective -

Over the last 25 years, branch line rationalization has been a very confrontational process, pitting the railway on the one hand against grain companies, farmers, community constituents and elected Federal and Provincial representatives on the other.

Nonetheless, a surprising amount of trackage has been removed from the network over the last several years. Since 1975, CP Rail has abandoned 1240 miles of prairie branch lines. While this may appear to some to have been too easily achieved by the railway, there are examples where over 25 years have passed since CP Rail first applied to abandon a line which is still operating today. Branch line abandonments have been hard fought!

Some of the confrontation has subsided over the last few years brought on by an industry-wide rationalization of the elevator system, and more recently by a recognition of the tangible benefits from rail network rationalization. The primary catalyst behind the recent interest in rail rationalization has been the enactment of the Western Grain Transportation Act (WGTA).

Prior to the WGTA taking effect in January, 1984, the rates charged for the movement of grain for export, or domestic or international shipment east of Thunder Bay, were set at the 1896 level by statute. The freight rates in effect until the passage of the WGTA were commonly called the "Crow Rates".

When the government froze the grain rates in 1925, no one anticipated the inflationary pressures of the coming decades. Although the frozen rate levels were compensatory for many years, ultimately the Crow rates began to burden the railways with heavy annual losses and grain became an undesirable segment of the railways' commodity portfolio.

In the late 1950's the railways began to press the Federal Government to address the Crow rate problem and instituted deferred maintenance policies on grain-related branch lines in order to minimize the losses being incurred. The railways were also unable to justify associated investments in covered hopper equipment for grain, for example, due to the losses being incurred.

Amendment to the Railway Act in 1967 addressed part of the problem for the railways since it provided for branch line subsidies for uneconomic operations. Under sections 256 and 258 of the Railway Act, the railways were entitled to claim compensation from the Government for the actual losses incurred in the operation of uneconomic lines.

The branch line subsidies probably deferred the necessity of resolving the Crow rate issue but they were not a long term answer to the problem. The railways were still losing money hauling grain and were still unable to justify the huge capital investments needed to restore the branch lines to an acceptable operating standard.

In recognition of the inadequacy of railway revenues under the Crow rates to support any discretionary capital spending on grain, the Federal Government undertook two major capital funding programs designed to improve the grain transportation system.

The first initiative was the purchase or long term lease of new covered hopper cars for the movement of grain. Between 1972 and 1985, the Federal Government provided a total of 15,192 covered hopper cars to the industry through purchase or long term lease, representing an investment of some $600 million in grain.

To augment the Federal Government's capital initiative, the Saskatchewan and Alberta Governments each provided another 1,000 covered hoppers and the Canadian Wheat Board injected a further 2,000 cars into the system, bringing the total grain fleet provided to both railways to 19,192 cars.

The second Federal Government initiative, the Branch Line Rehabilitation Program, began in 1977 under which the government committed over $1 billion to upgrade the condition of grain-related branch lines.

While these capital programs were instrumental in improving the basic infrastructure in support of the grain movement, they did not eliminate the recurring losses being absorbed by the railways. A long term solution to the Crow situation was required. The answer was the elimination of the Crow rates, accomplished through the WGTA which provided a rate mechanism tied to the total costs associated with the movement of grain.

The freight rates established under the WGTA are designed to cover the combined total costs of both railways for the movement of grain. The total cost is calculated by summing three component costs for each railway; the costs related to line haul (volume variable costs), the costs related to the grain branch line network (line-related costs); and

other railway costs which cannot be allocated to any particular movement or user (contribution to constant costs).

The line-related costs include depreciation and cost of capital on track assets, roadway maintenance, and property taxes. The WGTA cost base only includes line-related costs for "grain-dependent" lines. Section 40(2) of the WGTA sets out two tests for the determination of "grain dependency". First, the grain tonnage on the line must be at least 60% of the total tonnage moved on the line. Secondly the revenue less volume variable cost on non-grain traffic must not exceed the line-related costs. These calculations are based on an average of the three immediately preceeding calendar or crop years.

The WGTA annual rate scale reflects increases or decreases in an index of railway line-related costs and, of course, any additions or deletions to the list of grain-dependent branch lines based on the tests described earlier.

The enactment of the WGTA heralded significant changes for grain transportation in Western Canada. For producers, it meant exposure to transportation costs from which they had been insulated under the Crow rate regime.

The WGTA includes a formula for the determination of the Government and shipper share of the rate of cost change for the movement of grain. Beginning with the 1986/87 crop year and all subsequent years, the shipper pays the first 6% of any cost change. This means that Western farmers are likely to benefit most from any reductions in cost. When cost reductions can maintain the rate of cost change between 0% and 6%, all the savings flow directly to producers.

The key to cost reductions lies with reduced line-related costs. Volume variable costs represent a large proportion of the total costs of moving grain but the ability to reduce volume variable costs is often tied to increased capital investment to enable the railway to achieve the desired operating efficiency. The selective rationalization of branch lines, however, not only reduces line costs but is usually associated with complementary reductions in volume variable costs when the origin of the grain can be transferred to more cost-effective lines. These associated benefits will be discussed in some detail later. Let us first examine the line-related cost reduction potential.

Between 1984/85 and 1987/88, there was a net reduction in grain-dependent trackage of 273.3 miles. From year to year each railway may see the addition or deletion of certain track segments from their grain-dependent network as a consequence of a number of events including abandonments, line

transfers, or a change in status of a line in terms of grain-dependent eligibility.

There is little prospect, in the long term, for savings in line-related costs unless there is a reduction in grain-dependent mileage. Basically, a line may be removed from the grain-dependent list for one of two reasons; either a significant increase in profitable non-grain traffic alters the line's grain-dependent status or the line is abandoned.

The prospects for reducing grain-dependent mileage through a change in traffic mix are tenuous at best. The development of non-grain traffic is clearly outside the control of the railway or the grain industry. In most cases, rural grain-dependent trackage has little prospect of generating enough non-grain traffic to alter the status of the line.

In fact, chances are that over the longer term, more lines which are currently non-grain dependent will meet the grain dependency test than the reverse. CP Rail non-grain dependent branch lines include a number of lines where the non-grain traffic represents non-renewable resource traffic such as sulphur, liquified petroleum gas, and saltcake. As these resources deplete over time, grain volumes will constitute a larger percentage of the traffic mix and the lines will become grain-dependent.

If Western farmers are to decrease the line-related cost base, it will have to come about as a consequence of line rationalization. But if all the costs of moving grain, including the line costs for grain-dependent trackage are covered under the WGTA, why are the railways interested in line rationalization?

There are three principal reasons. First of all, the railways are genuinely concerned about the producers' ability to pay ever-increasing transportation costs when the selling price of grain is set by the world market demand/supply for grain. Since the Federal Government share of the total cost of moving grain is largely fixed under the WGTA, the increased cost of grain transportation will generally come out of the farmers' pockets. The economic viability of grain farming impacts on production levels and grain rail shipments decline with reduced production. When they are being compensated to do so, the railways want to move as much grain as possible; a pre-requisite to which is a healthy farm economy.

Secondly, the railways are still burdened with trackage which is not eligible for Federal rehabilitation funding, but which is in need of up-grading. If these lines are not abandoned, the railways will be required to fund the capital improvements necessary to allow continued operation.

The railway-financed up-grading costs would be eligible costs under the WGTA but the capital costs would be recovered only over the depreciable life of the assets which may be as long as 50 years, depending on the type of investment being made. Rail line rehabilitation is also very expensive, requiring huge amounts of capital. With a limited ability to internally generate existing capital requirements, the railways would be faced with having to defer other capital projects which are needed.

Some lines requiring up-grading were excluded from the Rehabilitation Agreement since the prevailing traffic volumes did not warrant the expenditure of the funds required from the Federal Government. It follows, therefore, that these lines have not been rehabilitated already since their long term future is uncertain. Without any assurance that the lines will remain for the 50 years required to recover the investment, the railways are understandably reluctant to expend the capital. Furthermore, CP Rail does not believe the cost of capital rate regulated under the WGTA is sufficient for grain.

The third motivation for each railway to seek elimination of high cost branch lines relates to the WGTA "competitive dynamic". Since WGTA freight rates are based on the total cost of moving grain for both major railways, the railway with the lowest cost characteristic enjoys a higher contribution level to constant costs. Elimination of high cost branch lines reduces one railway's costs versus the other railway, thereby improving the former's contribution level.

What do we mean by "rationalization"? The Concise Oxford Dictionary defines rationalization as "scientifically reducing/eliminating waste of labour, time, or materials". To many, the term "rationalization" is viewed as recent railway jargon intended to be a less offensive way of referring to abandonment. The Oxford dictionary definition, however, more accurately reflects CP Rail's view on rationalization. There are ways of reducing waste which do not necessarily translate into abandonment of local service.

The selective introduction of short line regional carriers is a way of reducing waste by substituting a local carrier who may enjoy better utilization of labour and materials on a section of track than a national carrier can, while still maintaining rail service to the communities along the line. Short line operators have expressed an interest in operating certain CP Rail lines, including grain-related branch lines, which we have under study.

The critical consideration in examining the potential for short line operations as a long term service alternative is

the fiscal viability of the short line. It would not serve the interests of the communities, the grain companies, or the railway to see a short line operation set up, only to fail to provide the service required.

The communities need to be satisfied that the service alternative will be as good or better than they had with the former carrier. The grain companies require some comfort that the short line operator has the financial backing and the necessary experience to run a good operation. If the viability of the short line is at risk from the perspective of the grain company, they lack the confidence necessary to plan into the future for their own elevator operations.

The railway is similarly interested in the short line's viability since failure of a short line which the railway had promoted would work against the railway's ability to consider sale of trackage to short line operators in other areas.

Short lines may also be considered as interim or transitional options to immediate abandonment. In this case, a short line may be solvent in the short or medium term but unable to generate the necessary cashflows to finance major track up-grading programs which are inevitable at some point in the future. While this concept may be unattractive to the local people who would prefer long term rail service, it may be better than immediate abandonment or further deterioration of the track to the point where the line is no longer marketable to a short line at all.

The important thing is that everyone must be aware at the outset of the term of the option. If a short line is contracted to operate for a given period, the grain companies, farmers, and various governments can plan accordingly.

Line transfers between the two major railways are another way of rationalizing the network. As in the case of short lines, there are areas where one of the major carriers can take-over an operation from the other and operate it in a more cost-effective manner. In 1979, a three-party agreement between CP, CN, and the Federal Government was put together which was designed to reduce system costs through line transfers in conjunction with rehabilitation of some line segments and abandonment of other trackage.

The transfer of a 52.3 mile segment of the CP Rail Colonsay Subdivision in north-central Saskatchewan to CN Rail in November, 1987 was an example of one of the lines included in the agreement. With the construction of an 8.5 mile CN Rail connection, CP Rail was able to abandon 34.9 miles of track. This 34.9 mile abandoned segment was used exclusively as an overhead route for grain off the balance of the

subdivision; it did not originate or terminate any traffic.

The trackage abandoned by CP Rail had light steel which restricted the operations to box cars only. The cost of the new 8.5 mile connection was less than the alternative of relaying rail on 34.9 miles and now the line (known as the CN Imperial Subdivision) is handling covered hoppers. The line transfer, therefore, resulted in reduced capital costs and lower volume variable and line-related costs under the WGTA.

Another potential form of rail rationalization under study is the so-called "roadrailer" concept. A roadrailer is essentially a power unit capable of travelling over the highway or over the rail. The unit is operated like a conventional rail locomotive by hydraulically-lowered steel flanged wheels. The idea is to make more efficient use of motive power by moving the unit between rail lines in relative proximity to each other by highway. The Government of Saskatchewan has supported the roadrailer as an alternative to abandonment. They are quite anxious to test the technology and the Federal Government has indicated some support for testing the concept through the use of System Improvement Reserve Funds.

CP Rail believes there may be applications for the roadrailer technology, but also feels the line candidates should be closely scrutinized to ensure its implementation will be a lower system cost alternative.

Proponents cite one of its biggest advantages as being the unit's lighter weight as compared to conventional rail motive power. They contemplate roadrailer operations on a lower standard of trackage and see it as a substitute service on lines which have not been and are not scheduled to be up-graded. While the roadrailer power unit may not be as heavy as conventional motive power, weight restrictions placed on a line by a railway relate, as well, to the maximum allowable gross weight of individual rail cars. That is, a 220,000 pound maximum gross weight line restricts the gross weight of the car (tare weight) and freight (content weight) to a total of 220,000 pounds.

There are a number of branch lines, including those already proposed for roadrailer operations, where the track condition is such that the roadrailer operation would necessarily require the continued use of box cars or light-loaded covered hoppers. We would, therefore, see the perpetuated use of partially-loaded equipment. What particularly concerns CP Rail is that the roadrailer would interchange the light-loaded cars to CP Rail for furtherance to port. The inefficiency of under-loaded equipment is not restricted to the roadrailer branch line. The light-loaded cars must be

moved through to port, resulting in inefficient train operations for the major carrier beyond the interchange with the roadrailer.

If the roadrailer technology is tested and works, there may be situations where cost savings can result. The roadrailer option must be seriously scrutinized, however, to ensure that the apparent advantages locally are not out-weighed by other cost increases throughout the balance of the system.

Other service alternatives under consideration in the industry may involve abandonment of rail operations but they do not mean all service is abandoned. Off-track elevators with commercial custom trucking programs to railhead transfer facilities are an example. Farmers would deliver to their local elevator the same as they always have. Only the transportation interface between the local elevator and tidewater would change.

From the railway's perspective, off-track elevators would facilitate the railway objective to abandon high cost branch lines. Elevator companies hold differing views on the concept, however. While some grain companies believe off-track elevators could reduce costs immediately and act, in the longer term, as satellite facilities feeding large inland grain terminals, others see off-tracks as transitional options only. The latter feel off-track facilities will ultimately be by-passed by farmers who will deliver directly to larger agri-centers, making off-track elevator investment high risk in nature.

Some momentum seems to be building for off-track elevators, nonetheless, based on the experience gained with such projects as the Federally funded off-track experiment on the CN Inwood Subdivision in Manitoba. Off-track elevators are being maintained at Fisher Branch and Broad Valley with commercial truck delivery to Arborg on the CP Rail Arborg Subdivision. From all accounts, local farmers are very pleased with the new system.

Selective branch line rehabilitation is another form of rationalization. By taking full advantage of the benefits which flow from the rehabilitation of a rail line, we are able to reduce waste in labour and materials. Since the Federal Rehabilitation Program began in 1977, CP Rail has seen a marked improvement, for example, in our ability to fully utilize the existing covered hopper capacity.

At the end of 1983, CP Rail was operating about 32% of its grain-dependent trackage at fully loaded covered hopper car capacity. At the end of 1987, CP Rail was capable of handling fully loaded hoppers on 77% of its grain-dependent network. Table I below provides a snapshot of what has

happened over the last five years.

Table I

CP Grain-Dependent Miles
by
Operating Capacity

Year End	Limited to 263K	Limited to 220K	Box Cars Only (#)	Total Miles
1983	1149.8 (31.9%)	1795.4 (49.9%)	656.2 (18.2%)	3601.4
1984	1522.3 (43.0%)	1418.4 (40.1%)	599.8 (16.9%)	3540.5
1985	2139.8 (57.6%)	930.0 (25.1%)	642.6 (17.3%)	3712.4
1986	2291.4 (63.2%)	671.3 (18.5%)	665.4 (18.3%)	3628.1
1987	2685.7 (77.0%)	327.5 (9.4%)	474.2 (13.6%)	3487.4

includes non-operated segments

Increasing the carrying capacity on covered hopper lines from 220,000 pounds gross weight to 263,000 pounds gross weight and the elimination of box car only lines have been major contributing factors in improving the utilization of CP Rail's grain equipment. In 1983, the average unload weight per carload at export position for CP Rail (for the six major grains) was 74.354 tonnes. In 1987, the average was 82.603 tonnes per carload, or an 11% improvement. If CP Rail had been averaging 82.603 tonnes per car in 1983, we could have shipped the same 16.9 million tonnes with 1,025 fewer cars. At a cost of about $62,000 each for new covered hopper cars today, that represents a significant capital saving.

Since 1977, some lines have been rehabilitated, the cost of which may not have been economically justified in relation to other service alternatives. In the early years of rehabilitation, some lines were up-graded not necessarily because they were high volume lines, but simply because those particular lines were in such need of extensive re-

pair that the railway would not have been able to operate on them any longer without immediate attention.

Rehabilitation is very expensive and the cost must be justified in relation to other alternatives. CP Rail believes there are still some lines on which the present and projected traffic density warrants rehabilitation of the line.

Having examined some of the rationalization options, what makes a particular branch line a candidate for line rationalization? Very simply ... when its present or projected future cost characteristics are out of line with the costs of alternative transportation modes. If a line is high cost in nature, we should be seeking out lower cost alternatives.

But how do we know if a particular line is "high cost"? The starting point is to express the current costs of maintaining and operating the line in terms of the work accomplished. In the railway industry, we express work performed in "tonne-miles". A tonne-mile is the movement of one tonne of traffic a distance of one mile.

When CP Rail ranked its prairie branch lines in terms of their cost per tonne-mile of work performed on the basis of 1984 costs and operations, we found a very wide range of costs. Moving grain off a few of our branch lines with heavy traffic volumes per mile of track costs as little as 3 cents per tonne-mile, while some light density track segments experienced costs over $3 per tonne-mile. The average cost was just under 13 cents per tonne-mile.

The ranking was done on 89 branch lines, or branch line segments which were then divided into four groups, or quartiles, from highest cost to lowest cost. The summary results are shown in Table II:

Table II

Summary of CP Rail Train Run Cost Ranking
by Quartile ; 1984 Costs and Operations

	Total Miles *	Total Tonnes	Average Density (tonnes per mile)	Average Cost (cents per tonne-mile)
Q I	560.4 (11.7%)	552,955 (3.2%)	987	103.7
Q II	1,243.2 (26.0%)	2,658,063 (15.3%)	2,138	25.6
Q III	1,585.6 (33.2%)	5,221,572 (30.1%)	3,293	11.2
Q IV	1,391.8 (29.1%)	8,910,596 (51.3%)	6,402	4.1
	4,781.0	17,343,186	3,628	12.7

* Note the ranking includes grain dependent and non-grain dependent track miles.

The table above illustrates that there is a disproportionate amount of under-utilized trackage in the CP prairie network which is above average cost.

The individual line ranking was intended to indicate the comparative cost of one branch line versus another and to illustrate the relative range of costs in the operation of the CP Rail branch line network. We also believe the ranking can be useful in providing a focus for rationalization potential, although a detailed cost comparison of retained rail service versus other transportation options would be required to establish the net system cost/benefit of a change in operation.

There are a couple of areas where railway costs are not well understood and which warrant discussion. The first example is the difficulty some people have in accepting that the railways incur costs even if they do not operate over a particular piece of track.

If the railway is required to keep a section of track al-

though it is not used in rail operations, there are clearly no volume variable costs incurred by the railway. Line costs are incurred, however, regardless of whether the line is used or not. If a line has not been used in several years and has little prospect of being used again, there is probably very little track maintenance performed on the line. The railway is required, however, to control weeds and maintain existing fences along the right-of-way and to maintain road crossings. There are also property taxes to be paid which are included in line costs.

Even if the track is not used, if it cannot be abandoned the railway is denied the opportunity to salvage the track assets. In most cases, the non-perishable track components (e.g. rail, anchors, tie plates, etc.) are reuseable and have a market value. Where materials are not reuseable, the steel can be sold at scrap prices. The other factor, of course, is exposure to future costs. At some point, the line will have to have some maintenance and the railway may have to put some capital into the line.

The second issue on railway costing that warrants attention is the comparatively small reduction in cost which results from selective elevator closures along a line as compared to closure over an entire line (or at the end of a line) which can allow some line abandonment and elimination of line costs.

When a station is closed along a line, the opportunity to reduce variable rail operating costs is limited. All that happens is that a stop along the run is eliminated ... the basic train run remains unchanged. Very often the grain delivered to the station that was closed shifts to adjacent stations along the same line. There is, therefore, no change in power allocation, fuel consumption, or car maintenance. The current collective agreement with the running trades provides for crew compensation on the basis of running miles, with a limit on the number of hours before the crew is required to book rest. Since the train run length has not changed, there is no impact on crew wages either.

Basically, variable operating costs reflect the volume shipped and elevator rationalization along a line does not alter the volume of grain to be moved, it simply redistributes the volume among the remaining stations. Closure of an elevator along a line will result in some reduction in switching costs and maintenance avoidance on the siding, but these savings are relatively insignificant. In most instances, the railway is required to seek the permission of the Government to remove the siding, even when it is no longer required. If the Government accepts representations that the siding may be used at some point in the future and

disallows its removal, the railway is denied the salvage proceeds as well.

Rail line abandonment, on the other hand, involves several efficiency benefits which flow from line rationalization, all of which result from the redistribution of the available grain to other lines.

When a branch line is removed, the grain will flow to another adjacent line increasing the second line's volume and thereby improving the cost-effectiveness of the second line by spreading its line-related costs over a larger base of traffic. The incremental volume on the second line may also involve only a marginal increase in volume-related costs. It may be that the train service frequency on the second line would allow the grain to be handled by the same crew assignment with only a marginal increase in power and fuel consumption.

If the adjacent line enjoys more frequent service, or if an improved service frequency is justified by the increased volume, the cars are spotted/lifted more often, reducing the "idle time" on the equipment used. Turnaround times between loads translates directly into the number of loads (and the amount of grain) that a covered hopper can do in a given period. Improved car utilization can, therefore, result in reduced fleet demand and avoid or defer capital acquisitions, the cost of which would be included in the WGTA cost base.

What order of savings are available through line rationalization? The Senior Grain Transportation Committee has identified a potential reduction of over $3 per tonne on the shipper share of WGTA freight rates by 1990/91 (over all WGTA grain shipped) on elimination of 2000 miles of grain-dependent branch lines (based on certain volume projections and estimated annual rail cost increases). The total branch line network (including non-grain dependent lines) for both railways is about 11,000 miles today. The elimination of grain-dependent trackage reduces the WGTA eligible costs, thereby resulting in lower WGTA freight rates.

CP Rail estimates indicate that increasing the loading capacity on branch lines from 220,000 lb. to 263,000 lb. through selective rehabilitation can produce savings of $3 per tonne, on average, for the grain shipped off those lines.

The system savings available through alternatives such as off-track elevators or short line rail operations cannot be defined without a thorough specific analysis of the particular local application. We do know, by example, that an

analysis of the Inwood off-track experiment indicated a net reduction of some $32 per tonne of grain originating at Fisher Branch or Broad Valley. These savings reflected reduced rail costs partially off-set by trucking and second elevation cost increases.

Most of the rationalization alternatives discussed can be implemented without any direct impact on local producers. Very often, however, the lowest system cost option will be abandonment of the rail line with farm gate trucking to a more distant alternative delivery point with rail service. In this case, while the abandonment of low density branch lines will result in a reduction in eligible WGTA costs which are reflected in lower WGTA freight rates, producers currently using the line will experience an increase in cost to truck grain to the alternative delivery point. The WGTA rate reduction is enjoyed by all producers in the prairies, whereas the increased trucking costs are borne by the producers locally affected by the abandonment.

In order to allow the system to benefit from the WGTA reduction without local producers being hurt, a compensation package for local producers has been recommended by the Senior Grain Transportation Committee (SGTC) to the Minister of Transport. The package is designed to defray the incremental trucking costs to the year 2000.

Producer reaction to the compensation package has not been encouraging. It has been criticized as being inadequate and administratively flawed. At the time this paper was written, no decision had been made by the Minister with respect to this issue.

There is another important issue about which CP Rail has serious concerns. The Final Rehabilitation Agreement of 1984 identified a number of lines which were to receive rehabilitation funding which have not been done to date. Producers along these lines feel they have been promised the up-grading of their line in order to guarantee rail service in perpetuity. Various studies have demonstrated that other transportation options are more cost-effective than proceeding with the rehabilitation. To the local people along the lines, however, rehabilitation has been committed and that is all they are interested in.

It is critical, from a railway perspective, that the balance of the rehabilitation program be absolutely defined. If lines are not to be rehabilitated, then the lines must be abandoned. If rehabilitation is to be carried out on some remaining lines, then the work should be scheduled immediately in order to allow the operating efficiency gains to be realized as soon as possible. Procrastination on rehabilitation just avoids inevitable decisions, creat-

ing uncertainty for the railways, the grain companies, and all levels of government.

Opportunities exist to significantly reduce the cost of grain transportation and handling. Current world grain prices and escalating farm input costs demand that all levels of government and the private sector focus immediate attention on identifying these opportunities and capitalizing on them without delay.

CP Rail has witnessed an increased understanding among system participants of each others problems and concerns and an increased willingness to work together to find equitable solutions. A large measure of our success as an industry in making real gains in the area of system cost reductions will require a concerted effort to de-politicize the issue of branch line rationalization. It will also require, to the greatest extent possible, that we put aside our partisan interests in order to permit these savings to be achieved.

CP Rail remains confident that progress is being made. CP also believes that we have only scratched the surface of potential savings which can be realized in the near term if the will is there to forge ahead.

RATIONALIZING GRAIN HANDLING AND TRANSPORTATION: THE BRANDON AREA REVISITED

A. G. Wilson[1]

In 1973 a detailed study of the grain handling and transportation system in what was identified as the Brandon Area was initiated under the auspices of the Canada Grains Council (1974). This area, bounded on the west by the Saskatchewan boundary, on the north by the CP Rail line passing through Minnedosa and on the east by Portage la Prairie, was deemed to hold forth the prospect of "having most of the conditions which would be encountered in developing alternative transportation systems within an area". The area was served by main lines operated by CP Rail and Canadian National Railways and by light density lines on which the freight movement consisted primarily of grain.

Specifically, the study addressed elevator location and relocation, the effect of additional distance from the farm to the elevator, the road system required to service current and future needs for the truck transport of grain, the rail systems in the area and the impact of any changes on the producer, the communities and municipal governments, the elevator industry and the railways. The study was based on the 1971/72 crop year.

Several recommendations were made as a result of the study. These were that the least cost grain handling and transportation system be allowed to evolve, that the costs incurred be reflected in the charges assessed for the services provided, that producers receive compensation for any increased costs experienced and that the rights of way for rail lines abandoned be retained by the crown. These recommendations followed detailed examination of several system configurations with the one judged to be lowest in cost being where only the CP Rail and Canadian National Railways main lines and the CP Rail secondary main line were retained to service the needs of the area.

Producers, during meetings held to discuss the research, raised numerous issues. Amongst these were the impact of additional distance of haul upon producer costs and road expenditures, the effect on elevator operations and costs and the

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consequences for rural communities arising from rail line abandonment and elevator rationalization.

Subsequent to the study the grain dependent branch lines between the CP Rail main line and secondary main line were progressively abandoned, the Canadian Transport Commission authorizing the last of the group to be abandoned on December 30, 1980. No compensation was provided to any of the affected parties.

An assessment of the impact of the rail line abandonments and elevator rationalization which took place in the area was initiated by the University of Manitoba Transport Institute in 1987. It was believed that the changes which occurred would be representative of those which would prevail elsewhere under similar conditions. At the same time the merit of the recommendations made in the earlier study could be judged by their results when put into practice. The area for the purposes of the assessment was extended to include the towns and municipalities served by the Rossburn Subdivision of Canadian National Railways.

In the study particular attention was given to the impact of branch line abandonment and rail rationalization upon communities in the area, and also to the impact upon the tax bases of municipal governments. Data on road and highway construction and maintenance expenditures were collected to ascertain if such expenditures were related to rail line abandonment. The additional trucking costs arising from the abandonment of the lines were calculated. Finally the impact of the rationalization which took place in the rail and elevator plant upon elevator costs was determined. The data assembled provide insights into how producers and others in the area have been affected by this rationalization.

Area Profile

The population of the Brandon area has remained relatively stable over time increasing by only 2.0 per cent between 1981 and 1986 to 118,368. The urban population in the area increased by 3.7 per cent to 72,934. Meanwhile the rural population declined by 0.7 per cent to 45,434. As a result the rural/urban population relationship declined from a proportion of 39.4/60.6 to 38.4/61.6. Population changes in the two cities, Brandon and Portage la Prairie, accounted for most of the total population increase over the period.

The average size of farm in the area in 1986 was 763 acres, the size of farm varying significantly among rural municipalities. Over half (55 per cent) of the 6,744 farms in the area had cattle and calves, the average number per farm being 81. A much smaller proportion, slightly over 11 per cent of the farms, had hogs with the average number of hogs per farm being 758. Livestock operations are therefore specialized. There are a substantial number of large farms (those of 1,120 acres and over) in the area; they account for over 21 per cent of all the farms. On average, in excess of 6 persons were on each farm. Gross sales per farm in

1986 while varying widely between farms, averaged $79,600. The area was well supplied with trucks there being an average of 2.2 trucks per farm. The area, while having a large livestock farming component, must be considered as a specialized grain production area. There were 6,127 Wheat Board permit holders, the average quota area per holder being 660 acres. These permit holders represented 25.6 of the total number in the province and accounted for 27.5 per cent of the quota area.

Communities

Some producers have contended that rail line abandonment leads to the demise of service centres. The Grains Council study examined the situation in detail in 1971 and provided bench mark data on the services available in towns and villages within the area. These service centres have been classified as follows: "complete" (those having more than 30 services); "full" (those with 16 to 30 services); and "minimum" (those with 15 or less services). The ten "complete" centres located on the railway lines remaining experienced, in general, an increase in the number of services offered between 1971 and 1986 with one centre being reclassified from being "full" to "complete". The number of "full" centres in 1986 was 4. The number of "minimum" service centres remained constant over the period. However, the number of services offered by these centres substantially declined. A somewhat different situation prevailed for those centres located on the abandoned rail lines. By 1986 only one of the five "complete" service centres existing on these lines remained in this category, the remainder being relegated to a "full" status. The "full" centre in 1971 had become by 1986 a "minimum" centre. The other "minimum" centres continued to exist in 1986, albeit with a reduced number of services. Much of the reduction was due to the removal of rail and elevator facilities. The data reveal that services are being concentrated in a limited number of convenience centres, four major towns in the area being in a "growth" phase with the other centres experiencing a relative decline. Rail line abandonment could not therefore be held responsible for the decline in the convenience centres on these lines, except those directly related to the railway and elevator system. These findings are consistent with those of Stabler (1985) in his study of trade centre viability. Indeed, any decline in the convenience centres appeared related to the centralization of the school system and the greater mobility of the local population associated with an improved road system and almost universal ownership of a personal vehicle.

Roads and Highways

A comprehensive network of roads and highways exists in the Brandon area. This network services the needs of both the local rural and urban populations while providing a link with outside areas. The province assumes responsibility for the construction and maintenance of the trunk highways and roads, there being 12 of the former and 45 of the latter in the area. This network is complemented by a large number of other roads constructed and

maintained by local municipal governments which include rural municipalities, cities, towns, villages, and one government district. The trunk highways and provincial roads and also many of the municipal roads are maintained on a year round basis. Operation of the school system depends on a well maintained road system.

One of the issues raised by provincial and municipal authorities is that they must bear any additional highway and road costs associated with rail line abandonment. They continue to argue that an onerous burden is being placed on their budgets and compensation should be federally provided for the additional costs experienced. The magnitude of these costs continues to be a matter of debate since no method of establishing these costs has been agreed upon by all the affected parties.

Any additional costs arising from rail line abandonment should be reflected over time in the magnitudes of highway and road expenditures within the area in which abandonments occurred relative to other areas. The general quality of the highways and roads has improved over the period between the Grains Council study and this study as a result of upgrading and new construction. Consequently, any changes in the proportion of the construction and maintenance expenditures between the Brandon area where the abandonments primarily occurred and other parts of the province should provide insights into the effect of the abandonments on these expenditures. The expenditures incurred by the province and also by the municipal governments can be taken as indicative of those required to sustain and in many cases improve the existing highway and road network. Data were collected on these expenditures over the 1975 to 1985 period to enable a before and after rail line abandonment comparison to be made.

1. Highway Construction Costs

Most of the highway construction in the Brandon area over the period was designed to expedite the flow of through rather than local traffic. Consequently, highway construction expenditures were found to have no apparent relationship with rail line abandonment. Between 1975 and 1985 the proportion of provincial highway construction expenditures in the province occurring in the Brandon area varied from the 46.8 per cent registered in 1976 to the 9.9 per cent registered in 1985, the average for all years being 23.1 per cent.

2. Highway Maintenance Costs

Grain constitutes only one of the commodities moved on the highway system. Consequently, any additional grain movement can be expected to have only a minor proportional effect on maintenance costs. The proportion of total highway maintenance expenditures occurring within the Brandon area varied from 15.7 per cent in 1978 to 21.6 per cent in 1982 and averaged 18.1 per cent over the whole period. The expenditure pattern suggested that maintenance

expenditures were influenced by factors such as weather conditions more than to any increase in the grain traffic. Indeed, this pattern had no apparent relationship to the volume of grain deliveries.

3. Provincial Road Construction Expenditures

Substantial sums are spent annually on the construction of provincial roads. Expenditures within the Brandon area varied widely between 1975 and 1985. The pattern of expenditures was such as to reflect priorities other than any needs for road improvement as a result of abandonment. Over the period 11.2 per cent of all provincial road construction expenditures occurred in the Brandon area this proportion varying from 6.6 per cent in 1976 to 15.3 per cent in 1977.

4. Provincial Road Maintenance Expenditures

Maintenance expenditures are related to the volume of traffic carried on the roads. However, such expenditures are influenced to a greater degree by weather conditions in the winter and particularly in the spring break-up period. The increase in provincial road maintenance costs in real terms suggests a higher standard is being achieved over time. While maintenance costs in the Brandon area increased by 12.3 per cent over the period they increased by 23.5 per cent elsewhere in the province. Maintenance costs were found to bear no relationship to rail line abandonment, such expenditures as a proportion of the province as a whole being 14.8 per cent in 1975 while averaging 13.9 per cent over the data period.

5. Transportation Expenditures by Municipal Governments

Expenditures on transportation constitute a major drain on the budgets of municipal governments. Rural municipalities spend nearly one quarter of their budgets on transportation. Such expenditures are required to facilitate the movement of farm products to market and the delivery of farm supplies. The consolidation of schools with its requirement for the daily busing of students nonetheless appears to the dominant factor influencing expenditures on roads. The proximity of dwellers results in villages spending only about one sixth, and cities and towns about one eighth of their budgets on transportation. Since most of the grain traffic follows municipal roads for at least part if not all the entire journey to the elevator, any impact of rail line abandonment should be reflected in the transportation expenditures. Data for such expenditures by each level of municipal government were collected for the 1975-1985 period and assembled such that expenditures in the Brandon area where the abandonments occurred could be compared to those in other areas. Abandonment causes a change in the direction of flow and in the volume of flow to a particular location. A comparison of the expenditures by rural municipalities in the Brandon area with those in other areas, however, failed to support the premise that abandonment gave rise

to higher expenditures on the road system. Furthermore, the proportion of the total expenditures of Brandon area rural municipalities absorbed by transportation remained relatively constant before and after the abandonments. Indeed, the highest proportion, 27.6 per cent, occurred in 1976 during the pre-abandonment period while a low of 25.0 per cent was registered in 1981 after the major abandonments occurred. When expenditures of all municipalities in the Brandon area were aggregated they were found to average 10.7 per cent of those of all municipalities in the province over the period. Variations between years were relatively minor (See Table 1).

The concerns of the municipal and provincial governments with respect to abandonment giving rise to additional road expenditures appear to have been unfounded in the Brandon area. Road expenditures in the area did not increase relative to other areas in which abandonment did not occur. Grain represented only one commodity moving by truck. Other commodities moved by truck both prior to and after the abandonments. Any additional use of the roads for the movement of grain had a negligible effect on the level of road and highway construction and maintenance expenditures.

Municipal Taxes and Branch Line Abandonment

Elected municipal officials argue that their operations are significantly affected by the reduction in assessment which occurs when a rail line in their area of responsibility is abandoned. Data on municipal assessments were found not to be available over a period of years. Data are, however, maintained with respect to the taxes imposed by the various levels of municipal government, ie. cities, towns, villages, rural municipalities and local government districts. The taxes imposed over time can be assumed to reflect the need to provide acceptable levels of services to the various groups of ratepayers. The levels of taxes imposed should therefore support any required local road upgrading and also maintenance which may arise from abandonments within the area under the jurisdiction of each municipal government. A comparison of the taxes imposed by the various levels of municipal government within the Brandon area with those outside the area should therefore yield an insight into the impact of rail line abandonment.

1. Taxes Imposed

A review of the taxes collected by Brandon area cities, towns and villages and those by similar municipal governments in other parts of the province indicates that the level of these taxes increased significantly in all areas over the 1975-1985 period. However, the relative rate of increase differed by level of government. The level of taxes in the Brandon area relative to other areas showed little variation over the data period. Municipal governments in the area accounted for 10.3 per cent on average of all the taxes imposed by municipal governments in the province. This proportion was remarkably constant by year, the

proportion falling slightly during the years in which the abandonments occurred and rising at the end of the period. During this time, cities accounted for 44.2 per cent, rural municipalities 40.7 per cent, towns 11.3 per cent and villages 3.0 per cent of the total taxes imposed within the Brandon area, the one local government district accounting for the remainder.

The data indicate that rail line abandonment has had a negligible effect on the level of taxes imposed. Any impact of rail line abandonment should be reflected in the level of taxes imposed in view of the significant share of municipal expenditures represented by transportation.

2. Taxes Paid by Elevator and Railroad Companies

Municipal governments contend that rail line abandonments within their area of jurisdiction affect their tax base. Since taxes are imposed on railroad property and on elevator facilities, abandonment of a rail line and the subsequent closure of any elevators on that line reduce the tax base of the affected municipal government. Data on the taxes paid by elevator and railway companies on facilities within the Brandon area were therefore collected to ascertain the impact of abandonment on the tax bases of the various levels of municipal government over the abandonment period, 1978-1986 (See Table 2). It was recognized that there would be differential impacts on the respective tax bases since for towns and villages abandonment could be complete while for rural municipalities traffic from the abandoned line could be diverted to another line within the same municipality, thereby giving rise to an increased assessment on the remaining facilities.

Taxes collected by towns and villages from railway and elevator companies represent a minor but significant share of the total. For those towns and villages in the Brandon area where elevator and railway facilities were removed approximately 5.83 per cent of the tax base was lost. This had a negative impact on their municipal governments and for those towns and villages could only intensify their declining ability to service the needs of their communities, such communities already tending to suffer from the trend to consolidation of service centres in the area. For those towns and villages in which abandonment did not occur, taxes on railway and elevator property represented 4.48 per cent of total taxes in 1978, this proportion falling to 3.91 per cent in 1986. The two cities in the area were not affected by the abandonments, rail and elevator taxes representing only 1.59 per cent of the total in 1978, this proportion dropping to 1.23 per cent at the end of the period. Those rural municipalities affected by abandonment received a larger share of their taxes from railway and elevator property in 1978 than other rural municipalities, 3.95 per cent as compared to 3.72 per cent, these proportions decreasing to 2.57 per cent and 2.71 per cent, respectively, in 1986. Those rural municipalities where abandonments occurred tended to have excess railway and elevator facilities initially, the loss of some of

these being offset by increased use of those remaining and/or those upgraded. Data for towns and villages and also the rural municipalities serviced by the Canadian National Railways Rossburn Subdivision (an area included in the Brandon area for the purposes of this study) were also collected. Rural municipalities in the subdivision collected 4.23 per cent of their taxes from railway and elevator property in 1978 with this proportion falling to 3.61 per cent in 1986. The towns and villages on this subdivision received 9.24 per cent of their property taxes from railway and elevator facilities in 1978 but this proportion fell to 5.48 per cent by 1986.

The data indicate that the taxes paid by railways and elevator property constitute a significant but declining share of the total collected (See Table 2). Abandonment affects the tax base of the towns and villages relatively more than rural municipalities. In the case of the latter, removal of the redundant facilities tended to be offset by greater use of those remaining, many of these being upgraded. Furthermore, any loss of the tax base of the affected towns and villages was onerous in view of the continuing consolidation of service centres. Towns, villages and rural municipalities have a greater dependence on railway and elevator property as a source of taxes than the cities of the Brandon area. The rural municipalities which obtain the major share of their revenue from taxes on farm property are in a better position than towns and villages with respect to abandonment. In some cases, producers may indeed reap overall benefits from consolidation and therefore be in a position to offset the tax losses arising from abandonment.

Abandonment and Producer Hauling Cost

Rail line abandonment and elevator closures give rise to greater hauling distances on the part of the affected grain producers. The impact of such abandonment and closures upon producer hauling costs was therefore estimated (See Table 3). The imputed extra distance of haul from the closed delivery point to the nearest remaining elevator point was calculated and multiplied by the average deliveries to the closed elevator point over the previous ten years to obtain an indication of the extra hauling requirements. This was in turn multiplied by the formulae developed by Meyer and Sparks (1987) to obtain an estimate of the additional hauling costs associated with the closures. The abandonment of rail lines in the Brandon area gave rise to additional producer hauling costs of approximately $345,000 in 1986 under the assumption they used 2 axle farm trucks for delivery. If 3 axle trucks were used the costs would fall to $271,600. The first figure can be considered a maximum and the latter a minimum. Closure of elevator points on the remaining lines also gave rise to additional hauling costs. These were estimated as being about $56,500 using 2 axle trucks and $44,450 using 3 axle trucks in 1986. The total additional trucking costs associated with rail and elevator rationalization were therefore estimated to lie within a maximum of $401,600 and a minimum of $316,000 in 1986.

Such additional costs gave rise to the contention that producers should be paid for the additional costs experienced. Such arguments are based on the assumption that the original configuration of the system was ideal and should be effectively perpetuated even though some producers may have been receiving an unjustified consumer surplus based on that configuration. The arguments of producers are directed more towards the change affected by rail line abandonment than to the continuing consolidation of the elevator system even though the latter accounted for 14.1 per cent of the total additional hauling costs in 1986. The data presented are aggregate data, individual producers experiencing a greater, equal or lesser impact on their hauling costs according to location.

Elevator Costs

Substantial consolidation of the elevator system has occurred since the time of the Brandon area study. There were 92 elevator points at which grain was received during the 1973/74 crop year. By the 1985/86 crop year the number had declined to 62. Of the points lost 27 were located on rail lines which were abandoned during the interval. There was a net loss of three points located on the remaining lines, elevator consolidation giving rise to additional point closures, some of which were offset by elevators constructed at new delivery points.

Grain deliveries greatly increased during the 1973/74 to 1985/86 period, being 830,100 tonnes in the former year and 1,728,000 tonnes in the latter year, an increase of 108.2 per cent. Over the same period elevator capacity in aggregate declined from 341,070 tonnes to 288,170 tonnes, a decline of 15.5 percent. Branch line abandonment gave rise to a reduction in elevator capacity of 43,530 tonnes or 82.3 per cent of the overall reduction of 52,900 tonnes. The remainder of the reduction, 9,370 tonnes or 17.7 per cent, was associated with elevator rationalization along the remaining rail lines.

Jeffrey (1985) made a major study of the structure of elevator costs in the prairie provinces. He developed formulae for estimating elevator costs by province based on elevator receipts and the turnover ratio (receipts/capacity). His cost formula for Manitoba elevators was used to estimate elevator costs by delivery point for each year over the 1973/74 to 1985/86 period. Since Jeffrey's formula was based on the calendar year 1984, the costs estimated were subsequently adjusted to 1986 using the G.N.E. implicit price index. The costs were aggregated for all delivery points by year. On the basis of 1986 dollars, for all elevators in aggregate, the estimated costs of operation were $10,891,730 in 1973/74 and $11,571,510 in 1985/86 and varied from a low of $9,413,853 in 1980/81 to a high of $11,571,510 in 1985/86.

When the total estimated elevator costs are divided by the receipts of the elevators in aggregate the average cost per tonne handled is obtained. On the basis of 1986 dollars the cost per

tonne declined from $13.12 during 1973/74 to $6.70 in 1985/86 (See Figure 1). This decline was associated with the decline in total elevator capacity and the increase in average receipts per elevator. It should be noted that the cost per tonne as calculated in this manner does not reflect any improvement in elevator efficiency which may have occurred prior to and after 1984. Since improvement in efficiency has no doubt arisen as some elevators have been upgraded and new construction has also taken place the true cost per tonne would therefore have been higher than indicated for 1973/74 and lower than indicated for 1985/86.

The relationship between elevator cost per tonne handled and elevator capacity and receipts was explored using regression analysis. The relationship was found to be linear in logarithms, the estimating formula as derived expressed in logarithms being

$$C = -3.965135 + 1.176442X_1 - 0.620018X_2$$

where: C = cost per tonne handled
X_1 = elevator capacity in tonnes
X_2 = elevator receipts in tonnes.

Over 99 per cent of the variation in cost was accounted for by variations in capacity and receipts, $R^2 = 0.9906$. Since the formula is in logarithmic form the "b" coefficients represent elasticities. In other words, a one per cent increase in elevator capacity will increase average elevator handling cost by 1.176442 per cent and a one percent increase in elevator receipts will decrease average costs by 0.620018 per cent.

Under the elevator cost regime arising from rail line abandonment in combination with elevator consolidation the savings in aggregate were significant. If the same volume of grain had been handled in 1973/74 as in 1985/86 total elevator handling cost would have been $22,671,360 as compared $11,571,510, a saving of $11,099,850 or 49.0 per cent. Based on the regression formulae 53.5 per cent of the saving or $5,938,420 arose from the reduction in elevator capacity and 46.5 per cent or $5,161,430 from the increase in elevator receipts. Since 82.3 per cent of the reduction in elevator capacity occurred as a result of branch line abandonment savings in elevator costs arising from this source were $4,887,320. The estimated additional producer hauling costs using two axle trucks were approximately $345,079.75 or 7.1 per cent of these savings. While the calculation may be somewhat tenuous it is apparent that the savings in elevator costs far exceed any additional hauling costs to the producer. The saving arising from the consolidation of the elevator system along the remaining lines of $1,051,100 is approximately 1.86 times the aggregate additional producer hauling cost.

Assessment

A study of the Brandon area yields important insights into the effect of rail line abandonment upon an area largely dependent upon the rural community for support. The area is becoming increasingly

urban in nature as farm size continues to increase. Grain production remains the prominent type of agricultural endeavour though this is supplemented by a specialized livestock component. Concentration of the convenience centres serving the area remains underway as also is the case in other parts of the province. Rail line abandonment cannot be held as primarily responsible for the decline in several of these centres, consolidation of the centres being underway previously.

Any additional traffic arising from the flow of grain or greater hauling distances appears to have had little impact on provincial highway and road construction expenditures. The same situation appears essentially true for highway and road maintenance. The proportion of total rural municipal government expenditures on transportation in the province represented by those municipalities in the Brandon area remained essentially constant during the abandonment period.

A comparison of the municipal taxes imposed in the Brandon area with those in other areas revealed little difference between these areas, there being no indication that taxes were positively influenced by abandonment. Taxes paid by elevator and railway companies were found to represent a limited but significant source of municipal revenue. Losses in tax revenue from this source had more impact on towns and villages than on rural municipalities, many of the losses of the latter being offset by additional taxes paid by remaining elevators and rail lines. The proportion of the total taxes collected by all municipalities received from elevator and railway companies declined over the period.

Producers experienced additional trucking costs as a result of rail line abandonment in the Brandon area. Such costs, however, represented only a very small share of the gains from the elevator consolidation associated with abandonment. Elevator costs as a result of this consolidation fell markedly.

The study reveals that many of the concerns expressed by producers during the Grains Council discussions were unfounded. Rail line abandonment has given rise to major savings in aggregate. These savings have not been equally shared by those affected. This continues to be reflected in local attitudes toward the changes which have occurred.

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Table 1

Proportional Transportation Expenditures by Municipal Governments within Years by Area, Manitoba, 1975 to 1985

Area	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	All Years
	per cent											
Rural Municip.												
Brandon Study	26.9	27.6	25.2	27.0	26.3	25.9	25.0	26.0	26.2	25.3	25.8	26.1
Other	73.1	72.4	74.8	73.0	73.7	74.1	75.0	74.0	73.8	74.7	74.2	73.9
Province	-	-	-	-	-	-	-	-	-	-	-	-
Cities												
Brandon Study	4.4	5.6	4.9	6.2	4.7	5.1	5.3	5.6	5.1	3.9	5.5	5.0
Other	95.6	94.4	95.1	93.8	95.3	94.9	94.7	94.4	94.9	96.1	94.5	95.0
Province	-	-	-	-	-	-	-	-	-	-	-	-
Towns												
Brandon Study	18.8	20.8	18.3	17.4	17.3	17.6	18.3	18.3	16.4	18.9	15.8	17.9
Other	81.2	79.2	81.7	82.6	82.7	82.4	81.7	81.7	83.6	81.1	84.2	82.1
Province	-	-	-	-	-	-	-	-	-	-	-	-
Villages												
Brandon Study	22.9	23.7	18.3	15.2	13.7	18.5	13.7	15.2	16.8	15.8	24.2	18.0
Other	77.1	76.3	81.7	84.8	86.3	81.5	86.3	84.8	83.2	84.2	75.8	82.0
Province	-	-	-	-	-	-	-	-	-	-	-	-
L.G.D.												
Brandon Study	1.9	2.2	3.0	3.3	3.7	2.2	2.3	3.2	5.5	3.4	2.7	3.0
Other	98.1	97.8	97.0	96.7	96.3	97.8	97.7	96.8	94.5	96.6	97.3	97.0
Province	-	-	-	-	-	-	-	-	-	-	-	-
A.M.G.												
Brandon Study	10.6	12.5	10.7	11.9	10.6	10.6	10.7	11.0	10.8	8.5	11.0	10.7
Other	89.4	87.5	89.3	88.1	89.4	89.4	89.3	89.0	89.2	91.5	89.0	89.3
Province	-	-	-	-	-	-	-	-	-	-	-	-

L.G.D. = Local Government District
A.M.G. = All Municipal Governments
Source: Statistical Information, Annual, Department of Municipal Affairs, Manitoba.

Table 2

Taxes Paid by Elevator and Railway Companies to Cities, Towns, Villages and Rural Municipalities[1] Classified by Abandonment Status in Relation to Total Tax Imposition, 1978-1986

	1978	1979	1980	1981	1982	1983	1984	1985	1986
	per cent								
Rural Municipalities Affected by Abanondment	3.95	3.05	2.96	2.83	2.75	2.60	2.56	2.57	2.57
Towns and Villages where Abandonment Complete	5.97	5.20	4.74	1.51	1.26	0.81	0.46	0.24	0.14
Rural Municipalities not Affected by Abandonment	3.72	3.29	3.12	3.09	2.92	3.00	2.91	2.81	2.71
Cities Not Affected by Abandonment	1.59	1.50	1.41	1.39	1.32	1.36	1.36	1.32	1.23
Towns and Villages Not Affected by Abandonment	4.48	4.30	4.19	4.26	4.14	4.02	3.98	3.97	3.91
Rossburn Subdivision Rural Municipalities	4.23	3.96	3.71	3.90	4.16	3.74	3.66	3.58	3.61
Rossburn Subdivision Towns and Villages	9.24	6.32	6.21	6.34	5.95	5.68	5.85	5.82	5.48
Park Local Government District	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

1 Author's calculations based on data from railway files and Statistical Information, Manitoba Municipal Affairs.

Table 3

Additional Producer Hauling Costs Associated with Rail Line Abandonment and Elevator Rationalization, 1986[1]

	Two Axle Trucks	Three Axle Trucks
	dollars	
Remaining Lines		
Main Lines	37,994.00	29,905.36
Rossburn Subdivision	18,482.75	14,547.91
Total	56,476.75	44,453.27
Abandoned Lines		
Mineota Subdivision	114,466.00	90,097.04
Lenore Subdivision	58,322.00	45,905.68
Varcoe Subdivision	36,300.00	28,572.00
Neepawa Subdivision	8,349.00	6,571.56
RapidCity Subdivision	127,642.75	100,454.39
Total	345,079.75	271,600.67
Total All Lines	401,556.50	316,053.94

[1] Calculated using Meyer and Sparks formulae

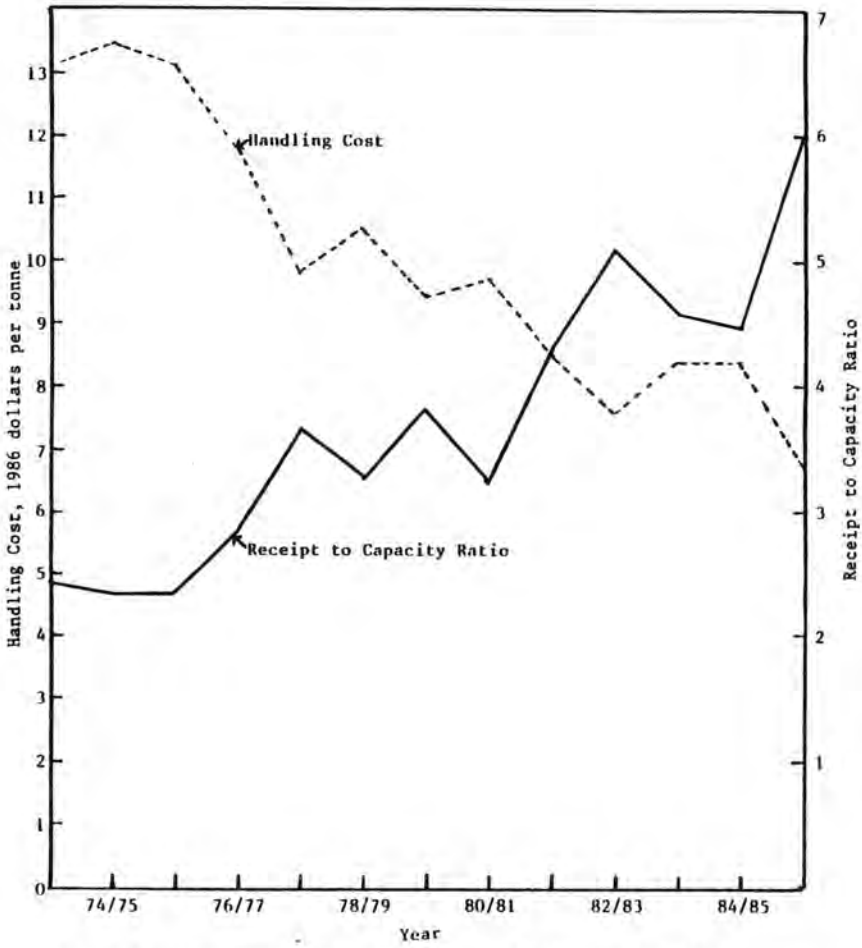


FIGURE 1: Elevator Handling Costs and Receipt to Capacity Ratio, Brandon Area.

PRINCIPLES OF RAIL PASSENGER COST AND COMPENSATION; SOPHISTICATED COSTING, BUT WHAT IS MISSING?

1) INTRODUCTION

The past year has seen the passage of the National Transportation Act, and the transformation of the Canadian Transport Commission into the National Transportation Agency.

In this context this paper considers some costing/compensation principles relevant to the partial regulation of an industry. It then reviews the rail passenger regulatory environment in the context of these principles, and considers implications for cost and compensation in future rail passenger legislation.

2) WHY REGULATION OCCURS

Although government regulation - legal, environmental, and social - influences the functioning of the entire economy, there are specific sectors of the economy where influence is much more pervasive. Typically, these are sectors where there is an essential service, or absence of competition, or where social benefits and costs are such that the government obliges a different level of output than would voluntarily be provided.

The government intervenes, in short, whenever there is a public interest deemed worthy of protection. Modes of transportation have invariably appeared in the regulated sector.

3) WHAT REGULATION COVERS

Any regulated industry is typically subject to:

i) control of entry (and exit)
ii) control of price
iii) control of level of service
iv) an obligation to serve.

4) MINIMIZING EXTERNAL IMPACTS OF REGULATION

There is an infinite variety of regulatory intervention. However, regardless of the way in which regulation occurs, it should be designed so as to minimize scope and degree of regulatory intervention, and repercussions upon unregulated activity.

An extremely important responsibility is to minimize distortions of resource allocation arising from regulation. In an industry such as rail transportation, which is only partially regulated, regulatory practice should be neutral in its impact upon non-regulated activities. Where the service required is uneconomic (for instance the provision of rail passenger service), this can be achieved by providing a subsidy sufficient to ensure that the regulated body is neither better nor worse off - i.e. is kept whole - as a result of the regulated activity it is obliged to perform. This is done by compensating for differential cost, the incremental cost of providing the activity and the cost which would be avoided absent the required activity.

5) REGULATING PERFORMANCE

Compensation for differential cost must be complemented by specification of a desired level of service. It is not appropriate to give the regulated body the autonomy to decide the level of differential cost it shall incur. There must also be consideration of quality, reliability and economy of regulated performance, to ensure a value for money linkage between differential cost incurred and service provided.

Because of the absence of competition, differential cost should represent only the bench mark for compensation of reasonably efficient service. Incentive payments and penalties are needed to supply what the market place cannot, namely motivation for the supplier to provide quality service. These principles seem to have been recognized in the provision of rail passenger service in the U.S. The legislation and agreements governing charges to AMTRAK by operating railways generally prescribe incremental cost as the benchmark for compensation, and give significant scope for incentive payments and penalties.

6) REGULATION OF RAIL PASSENGER SERVICE IN CANADA

In light of the above, consider regulation of rail passenger services by the Canadian Transport Commission. The Railway Act empowered the Commission to control entry,

price and service, for railways under its jurisdiction. The power accorded the Commission to determine the 'price' of rail passenger service was broad, as indicated by Section 261(7) of the Railway Act:

> '(7) In determining the amount of any actual loss for the purposes of section 260 or this section, the Commission may include therein or exclude therefrom such items and factors relating to cost and revenues as to the Commission seem proper.'

Pursuant to this Section, the Commission conducted an investigation in 1968 into railway costs and costing. This investigation resulted in the Commission's Cost Order R-6313 (subsequently the Railway Costing Regulations), which defines eligible costs. The investigation also resulted in the CTC's adoption of a sophisticated railway costing system.

The Railway Costing Regulations respect the regulatory principles of neutrality by defining cost to be:

> 'in relation to a passenger-train service, for the purpose of calculating actual loss, the costs that after allowing a reasonable period of time for adjustment to the new condition, would have been avoided or would be avoided by a company in the carriage of passengers by the service if, in any financial year, the company did not operate the service irrespective of when or in what manner or by whom such costs were incurred;'

These avoidable costs are the differential costs of rail passenger service. Compensation for these costs keeps the railways whole and - in the economic sense of the word - indifferent to the service they are obliged to provide.

However, the railways did not actually receive full compensation for these costs. Section 261(4) of the Railway Act states:

> 'The Commission shall examine the claim and shall certify the amount of the actual loss, if any, that in its opinion was attributable to the service and the Minister of Finance, on the recommendation of the Commission, may, in respect of the loss, cause to be paid out of the Consolidated Revenue Fund an amount not exceeding eighty per cent of the loss as certified by the Commission.'

The intent of subsidizing only 80% of the loss, and forcing the railways to absorb the other 20%, may have been to incite the railways to minimize cost incurrence, that is, to be efficient. Unfortunately, this significant departure from regulatory principles would tend to cause a number of distortions:

a) Railways receiving only 80% of their loss were not being kept whole. The 20% of loss denied compensation had to be recovered by the railways from other sources, resulting in cross-subsidization, and distortions in resource allocation.

b) Since they were not being kept whole, the railways minimized the level of activity they were obliged to perform, eliminating discretionary expenditure and minimizing non-discretionary expenditure. The eventual outcome was obsolete facilities, outdated practices, and unreliable service. An example is the Spadina and Montreal Coach Yards, where, until VIA constructed its own facilities, passenger cars were maintained and serviced outdoors year-round, using antiquated facilities, machinery and practices.

c) Since they were not being kept whole, the railways had an incentive to segregate and neglect rail passenger activities and to devote energy and resources to economic freight activities. The ultimate consequence was the creation of VIA, that is, the virtual complete segregation of freight from passenger.

d) While railways would have an incentive to minimize cost incurrence, they would also have an incentive to maximize the level of CTC-approved cost. Evidence of this would be frequent and ongoing initiatives to change costing methodologies in the railways' favour. VIA has seen frequent instances of this.

e) To the extent that a railway has a number of areas where cost reductions are possible, those where the government subsidizes 80% of the loss are of lesser priority. The following quotation gives an instance. 'The situation was different in the railways' freight operations. There, altered work rules permitted cost reductions. Specifically, fireman positions were eliminated in the early 1960s and trainman positions were cut in the late 1970s. Both reductions were made because of recognized redundancy. Similar changes were not sought for passenger-rail service, despite the equal and logical applicability of such measures.' ('Transportation in a Resource Conscious Future', Science Council of Canada, 1982, page 39).

f) If compensation for 80% of loss was considered an effective alternative to verification of the efficiency of cost incurrence, there would have been a tendency by railway and CTC officials to concentrate upon regulatory cost determination issues and to disregard cost effectiveness. Although CTC rail passenger cost determinations for the period 1978 to 1986 exceeded $2.5 billion, there were few disallowances of cost submissions on grounds of inefficiency.

g) In a similar vein, the regulatory body might also have been influenced. Recognizing that the 20% of loss denied compensation amounted to tens of millions of dollars per annum, the regulator may have been inclined to leniency in its determinations. This could have occurred by the regulator accepting cost not in strict compliance with the requirement of avoidability as defined in the Railway Costing Regulations. For instance, the regulator could have deemed cost to be avoidable, rather than oblige proof of avoidability, or could have accepted variable cost in lieu of avoidable cost.

In summary then, the distortions introduced by a policy of compensating for only 80% of loss may have been so significant as to defeat the purpose of the policy. What may ultimately have resulted is a rail passenger system that functioned as efficiently as its obsolete plant and outdated practices allowed.

When VIA assumed responsibility for rail passenger service in 1978, the level of its compensation to the railways was set at 100% of CTC-approved cost, plus incentives. The CTC was not a party to the negotiations which resulted in this agreed level of compensation, and would no doubt have advised that whatever incentive for cost effectiveness there had been under a regime which compensated for 80% of loss, was now entirely nonexistent. Whatever disincentive there had been was now compounded.

7) THE CTC'S MANDATE FOR EFFICIENCY

Subsidization of 80% of loss had been the primary means by which the CTC incited efficiency. However, the power given the Commission under the Railway Act to exclude from loss 'such items and factors relating to cost... as to the Commission seem proper' permitted the Commission to disallow cost for any reason, including inefficiency.

When the subsidy of rail passenger loss increased from 80% to 100%, the CTC addressed effectiveness of cost incurrence directly, although only in a few instances. The will and intent to consider cost effectiveness in all cost determinations seemed to be missing. One reason for this may have been that the railways argued forcefully and effectively that any audit for efficiency would be an invasion of railway management prerogatives. The CTC was sensitive to this argument.

Ultimately, however, any regulation is typically an invasion - getting a body to do what it would not otherwise do. Achieving neutral regulation is a goal, but is almost unattainable. Moreover, a regulatory policy of not auditing for efficiency may be a policy to condone inefficiency.

8. SOPHISTICATED COSTING

The Railway Act, the Costing Order, and the associated CTC costing system all came into being in the late 1960's. At that time, rail passenger service was an integral part of the total operations of CN and CP, and the costing system treated it as such. Costs were apportioned to users by means of standard measures of activity, on the assumption of a uniform rate of cost incurrence throughout the railway.

This assumption may have been valid at that time. It is no longer valid, because of the cumulative effect of the distortions mentioned previously. Moreover, with the creation of VIA, the railways were formally relieved of responsibility for investment in rail passenger plant and services.

How does this affect the CTC's costing system?

In the case of investment, the costing system apportions a number of CN/CP capital costs to users by means of the very measure of activity - labour dollars, switching minutes - which the investment is intended to reduce. In today's environment, this means that the segment of CN/CP which receives the least investment - namely activity on behalf of VIA - is charged as if it received the most. The consequence is that VIA is penalized twice: the regulatory environment created incentives for CN/CP activity on behalf of rail passenger to be undercapitalized, and hence unproductive, while the sophisticated costing system charges VIA for a significant degree of CN/CP capital investment purely because VIA receives no benefit from the investment!

It is not clear which segment of CN/CP is being cross-subsidized. If as a result of underinvestment the rail passenger segment tends to be more labour intensive than the freight segment, the proration of CN/CP system-wide overheads between freight and passenger on a basis which includes labour but excludes capital could easily result in the passenger segment absorbing freight costs.

There appears to have been a failure to conduct periodical critical reviews of the costing system, its underlying hypotheses, and the incentive "signals" it emitted, to determine whether they remained valid in a rapidly changing environment.

9) WHAT IS MISSING?

There is more missing than a commitment to ensure that whatever regulated activity the railways perform is done efficiently. Unless the regulatory environment incites the right activity - through incentives to ensure quality, reliability and economy of service, incentives to invest - any efficiency monitoring will merely ensure that efficiency will not decline as rapidly as it otherwise would.

The rail passenger regulatory environment introduced distortions and so did the costing system. The regulatory environment is changing. It is time to consider whether the costing system should change too.

The costing system, despite its sophistication, tolerates inefficiency and cross-subsidization, and accepts prorations of and proxies for cost in lieu of the cost itself. Because it is used to segregate or apportion system total railway costs between economic and uneconomic, unregulated and regulated segments, the resulting apparatus is complex to administer and interpret.

For instance, the CTC has advised that the costing methods and techniques used by CN and CP in developing their charges to VIA are the same as those adhered to by the railways for all regulatory purposes.

Can a single system used for all regulatory purposes - for variable costing of economic traffic, and avoidable costing of uneconomic traffic - always send the correct regulatory messages?

Can a single system develop the correct costs for all users of railway services, from the shipper who requires one box car per annum, to VIA, which has its own rolling stock, maintenance and fuelling facilities, train crews and administrative personnel, and yet still pays CN/CP hundreds of millions per annum?

Now that VIA is an operating railway in almost all senses other than ownership of the track, is it still appropriate to determine CN/CP charges to VIA using a costing system which prorates shares of railway system overhead costs down to individual commodities and cars? Is it not simpler and more effective to oblige CN/CP to identify the actual costs they would avoid absent VIA?

Can politicians and bureaucrats correctly use the costs developed by the system, when they may not know what these costs mean, and may be too intimidated by the complexity and sophistication of the system to find out?

9) CONCLUSION

There appear to be significant distortions caused both by the present rail passenger regulatory environment, and by the CTC's costing system. The combined impact of distortions in the regulatory environment and the regulatory apparatus have the potential to increase significantly the actual rail passenger cost base, and to increase the perceived cost base even more.

The CTC's legacy is a sophisticated costing system. Even if it provided the railways and regulators with the correct "signals", in the past, it is not clear that it does today, or does so in an effective manner. There is merit in a thorough and critical review of the entire cost determination process and costing system, to determine whether it meets regulatory requirements.

11) ESSENTIAL ELEMENTS OF REGULATION

Study of regulatory principles and review of CTC rail passenger regulatory practices suggest the fundamental importance of:

- Concise and coherent policy objectives and directives: all participants in the regulatory process need to know what regulatory intervention is intended to achieve, and what their role is. A significant problem in the present regulatory environment is that VIA falls between stools. It is unclear who is in charge. CN, CP and VIA have joint responsibility for the provision of rail passenger service, and the Cabinet, Transport Canada, Treasury Board, and the CTC/NTA all have some role in regulation.

- Simplicity and directness of intervention: to assure that the reason for intervening, and the result of intervention are highlighted.

- Neutrality of intervention: eligible cost of imposed public service is the differential cost of provision of this service. This keeps the railways whole. Control of the regulatory cost base is best achieved by placing the onus of demonstration of cost eligibility upon the parties seeking compensation.

- Basing compensation upon both cost and performance standards: Incentives and penalties are essential in order to ensure that the railways are attentive to quality, reliability and economy of service, not merely cost of service. In the free market, whether a company makes or loses money depends upon its price and its product. When a regulated body performs an imposed public duty, the quality of its management should also be tested by the same principles of potential for profit, and risk of loss.

A regulatory environment which interprets differential cost consistently and in accordance with regulatory principles establishes a fair benchmark for compensation based on cost, cost effectiveness, and quality of service. Such a benchmark will induce parties to explore mutually beneficial agreements to share resources and cost, with a resulting benefit to the public interest.

The Feasibility of a Charter Air Service for the American Hockey League Utilizing Dash-8 Aircraft ;

by Prof. B.G.Bisson
M.Mazerolle
UNB Transportation Group

Introduction

The identification of two sets of circumstances lead to the realization that some feasible travel alternatives may exist for the thirteen franchises operating in the American Hockey League during the 1986/87 schedule. First, the need for improvement in the current system of transportation between game locations was identified, especially for those teams moving into and out of the Maritimes (sixteen hour bus rides are not uncommon). These trips undoubtedly have an impact on player performance. Second, the opportunity now exists for the utilization of an air service that would economically improve the level of service offered by the transportation scheme. A fleet of twelve Dash-8 aircraft is currently providing scheduled air services in Atlantic Canada. The opportunity to provide charter services as a means of increasing aircraft utilization will be critical to their success. Figuratively, then, both the ailment and the cure appear to exist and the problem remaining is only to define how best to administer the remedy.

Objectives

The objectives of this investigation were similar to those of the majority of transportation planning exercises, ie. to optimize the level of service to the users of the transportation system consistent with economic considerations. Appropriate bench-marks were established against which proposed alternative were measured.

Cost of any transportation alternative is clearly a major factor in determining its attractiveness. Transportation cost for all AHL franchises consists primarily of three main components :

i) travel cost
ii) daily meal allowances
iii) accommodations

The need to minimize the above costs defines some of the heuristics which any alternative travel scheme must meet. Transportation resources (ie. aircraft or bus) must be utilized in the most effective manner possible, so as to reduce travel costs. The scheduling of movements must be done in an efficient manner to keep time spent on road trips at a minimum, and as a result minimize meal and accommodation costs.

In addition to cost considerations, a transportation system must also be evaluated by the level of service which it offers to its user, in this case the AHL franchises. The two criteria which were be used to measure the level of service are :

i) convenience offered by the system
ii) travel time required to complete a movement

Scope

The first phase of the study involved an investigation of the American Hockey League and its play schedule. If a transportation system is to be effective and efficient in its application it must be well matched to the demands and constraints placed upon it by its users. The 1986/87 AHL regular schedule was used as a case study.

After the AHL and its system of operation had been defined in significant detail, phase two of the project was initiated. During this phase, attempts were made to fit an air charter service within the system of movements defined by the 1986/87 regular season play schedule. This was a labour intensive task with many limitations dictating the degree to which a charter air service, centered in the Maritimes, could be integrated with the normal team movements. One major constraint was that the aircraft would be used only during off-peak periods when they would normally be idle. Under these constraints, the daily load factors (percent of loaded miles) for the aircraft were optimized and conclusions about the acceptability of such an application were drawn.

Phase three of the project involved an investigation of how the scheduling of games could be altered in a manner which would be more conducive to the utilization of charter air services. This stage of the investigation eliminated many of the constraints considered in phase two. Finally, the travel scenarios developed in phase three were evaluated based on cost and level of service in comparison to the travel system presently being used.

Phase I - Background Investigation

During the 1986/87 regular season the American Hockey League was composed of thirteen active franchises located in Eastern Canada and Northeastern United States. This phase of the investigation studied the factors which influence and describe how these teams move from one play location to the next. Several types of information are necessary to adequately describe travel in the AHL, starting with team locations, travel distances and game scheduling. Table 2 gives a summary of the league as it operated during the 1986/87 season.

Team	Location
Northern Division	
Adirondack Red Wings	Glenns Falls, NY
Fredericton Express	Fredericton, NB
Maine Mariners	Portland, ME
Moncton Golden Flames	Moncton, NB
Nova Scotia Oilers	Halifax, NS
Sherbrooke Canadiens	Sherbrooke, PQ
Southern Division	
Baltimore Skipjacks	Baltimore, MD
Binghamton Whalers	Binghamton, NY
Hershey Bears	Hershey, PA
New Haven Night Hawks	New Haven, CT
Newmarket Saints	Newmarket, ON
Rochester Americans	Rochester, NY
Springfield Indians	Springfield, MA

Table 1 : AHL Franchises (1986/87)

It is necessary to have an understanding of existing travel patterns of AHL franchises before alternatives can be successfully developed. The league currently schedules road trips of single and multiple game duration. Teams on single game (one day) road trips generally stay within their own geographical area of the league. (eg. Maritime teams generally play each other through a series of these single game road trips. Charter buses are typically used for travelling to and returning from the road game on the same day.). The opportunity to replace this component of team travel with charter air service is limited because of the short sector distances as well as the good economic performance of a bus under such an application.

Road games which require a team to leave its geographical area are typically grouped, lessening the total amount of travel required. Positioning flights

(typically on scheduled commercial service) are widely used when teams travel from one region of the league to another. A charter bus is taken from the positioning location to the various play locations and stays with the team during the entire road trip. A team's return home is usually on a scheduled commercial flight from the initial positioning location.

Two factors relative to existing travel patterns suggest that Dash-8 charter air services have the potential to economically compete with the current system. The positioning flight on scheduled commercial airlines are very expensive. Secondly, the chartered buses used by teams costs a minimum of $600.00 per day irrespective of mileage. If the teams can be moved on the Dash-8 for their longer road trips, the per mile expense may be greater, but saving can be gained from not having to pay for an under-utilized bus for extended time periods.

The Dash-8 Aircraft as a Travel Alternative

The operating characteristics of the Dash-8 are particularly well suited to moving professional hockey teams. The maximum payload of the Dash-8 is given as 7824 lb. This allows 300 lbs total weight for each of the twenty six members of a typical AHL travelling party, with ample seating.

The maximum cruise speed is another crucial factor in evaluating the suitability of this aircraft for the proposed usage. If the system is to be truly feasible, the mode used must have the capabilities to access all game locations from the Maritimes within an acceptable period of time. The maximum cruise rate (MCR) of the Dash-8 is 500 km/h. This gives a flying time between Halifax, Nova Scotia and Newmarket, Ontario of approximately two and one quarter hours.

Phase II - Evaluation of the 1986-87 Game Schedule

The use of Dash-8 charter air service by AHL teams would result in an improvement in the level of service by reducing the number of miles travelled by a team as well as travel time. The main limitation placed upon the usage of air charters is that the cost of a proposed service should not increase the overall travel expense of the teams.

There are twelve Dash-8 aircraft operating within Atlantic Canada. The aircraft are available to the AHL franchises during periods when they are not being utilized for scheduled services (10:00 pm to 6:00 am daily). This period is well suited to the demands of team movements. Teams travelling after night games, are well served by this evening period while teams

travelling the day before play can also easily be accommodated.

Having the aircraft well positioned within the Maritime provinces is essential to reduce the empty seat miles (dead-head) to a minimum level. At the time of the study that aircraft were over-nighted at Sydney, Moncton, Saint John, and Halifax. These locations are critical in that they must be the start and end points for all proposed air networks.

The most critical measure of the viability of an air service is Load Factor, defined as:

$$\text{Load Factor} = \frac{\text{Total Loaded-Miles}}{\text{Total Miles}}$$

Maximizing the Load Factor for a particular set of movements is critical to economic viability. Therefore, for everyday of the play schedule, Load Factor was maximized subject to the constraints set down by the league and the aircraft operator.

The exercise attempted to replace bus and commercial air movements with charter service. All probable alternatives were investigated on a daily basis. Movements which could not be assigned to air charter, were assumed to be made on a bus. The results, based solely on maximizing load factor were very poor, mainly because of the unbalanced movements into and out of the Maritimes. The average load factor for the six week period of the actual 1986/87 schedule was 0.35. This would inflate the per-mile cost charged to the user to approximately three times the normal air charter rate of $6.50 per mile. No attempts were made to coordinate bus and air charter service so as to reduce dead-head travel by buses resulting from charter utilization. It was observed that the optimum air scenario was uneconomical. Therefore, any allowances for coordination with bus service would only worsen the situation.

The conclusion from this phase of the investigation was that air charter service is not economical to the AHL under the present scheduling and team movement scheme. This indicated that if a charter service is to be utilized to alleviate the travel burden in the AHL, significant restructuring of the league schedule would be necessary. The next phase of the study was geared to developing a set of scheduling rules that would be acceptable to the league from a hockey operations viewpoint, while allowing for an economical utilization of a Maritime based charter air service.

Scenario Development

Several network schemes were developed. The most attractive concept involved dividing the league into three geographical regions (see Figure 1). With this concept, there are three travel requirements which concern the Atlantic Canada teams. These movements include :

i) travel of Eastern Zone teams to the Western Zone and vice-versa;

ii) travel of Eastern teams to the Southern Zone and vice-versa;

iii) travel of Eastern Zone teams within their own region.

The majority of an Atlantic Canadian teams' travel budget is spent playing the seventeen road games in the southern division. Based on this fact, the majority of work was centered on developing a means of moving efficiently between these two regions.

Eastern-Southern Division Scenario

It was found that the key to developing a balanced travel network operating out of Atlantic Canada was to have two eastern teams on the road while the other two remain at home to play those teams rotated into the region. A description of this scenario is presented below.

On the first day of the rotation all teams in the western sector must travel by bus to the southern sector for their first scheduled game of the road trip (see Figure 2). This positions two teams at all four locations in the southern sector, more specifically : Binghamtom, Hershey, Springfield and New Haven. The air charter system transports all teams for the next scheduled play. Two air-loops utilizing two Dash-8 which originate and terminate in the Maritimes, accommodate the movements as described below.

The first Dash-8 begins at its base of operation , Moncton, where it transports the Golden Flames to their next play location, Springfield. The Dash-8 then picks up the western region team which was positioned at Springfield, in this case the Utica team. This team is transported to its next play location, Hershey. Here, the aircraft turns around, returning to Fredericton with the Newmarket Saints who are then positioned to play the Fredericton Express. The rotation is completed by dead-heading the aircraft from Fredericton to Moncton where it began. A second similar loop would operate out of Saint John and Maine. The movements of these aircraft are outlined in Figure 3. The travel loops represent a balanced travel rotation with minimal dead-heading required in the positioning movements.

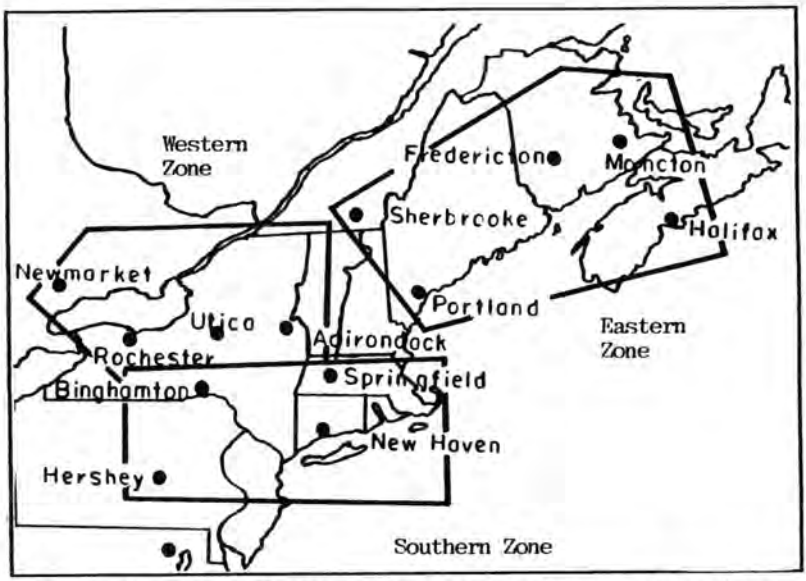


Figure 1 - The AHL Divided Into Geographical Regions

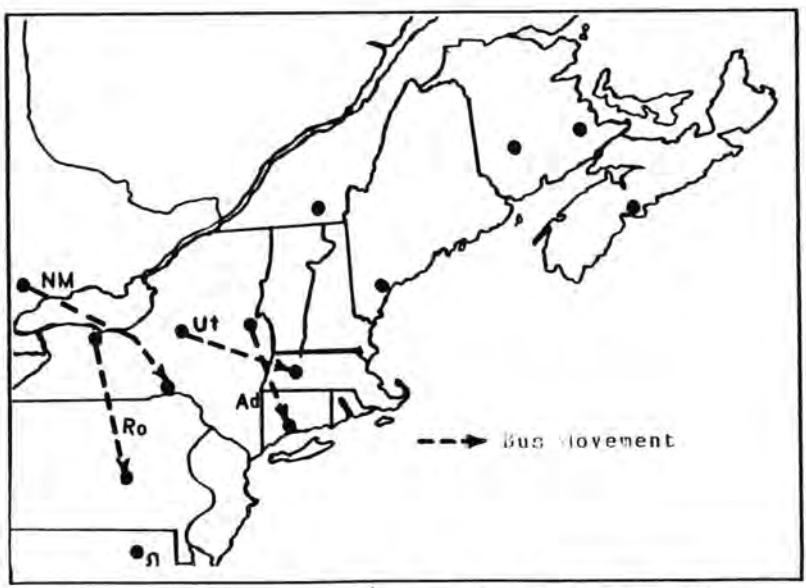


Figure 2 - First Movement in Team Rotation Scheme
(Positioning Movement)
Note : Abbreviations refer to the team being moved.

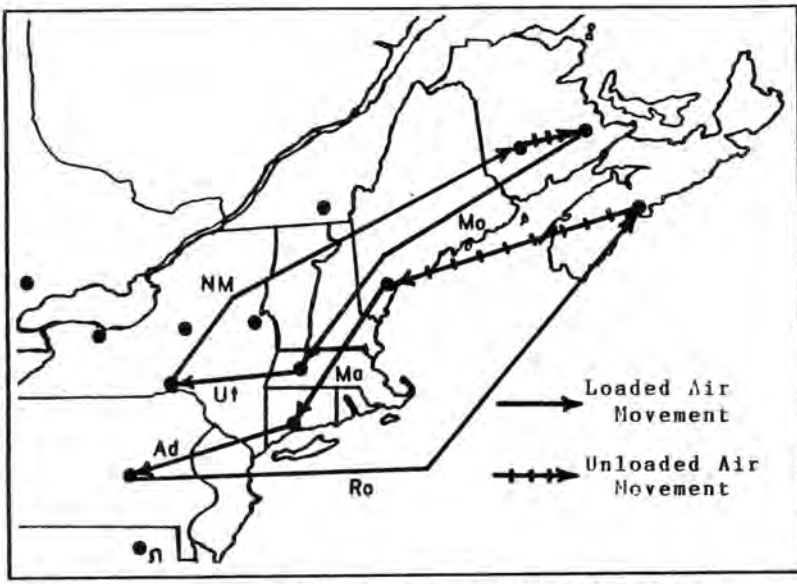


Figure 3 - Second Movement in Team Rotation Scheme (Air Loops)

The teams involved are now scheduled to play back-to-back games where they have been positioned. The next significant feature of the scenario is used following these games. The relative geographical proximity of the three pairs of locations involved (ie. Fredericton-Halifax, New Haven-Springfield, Hershey-Baltimore) allows for a short journey to position the teams for their next scheduled play. Savings are achieved on the movements between these cities by both teams (which are essentially switching locations) using the same vehicle. Travel in the south could use locally chartered buses while the Maritime switch has the potential of being another balanced Dash-8 charter service route. Teams are again scheduled to play back-to-back games where they have been positioned (see Figure 4).

The next series of team movements are exactly the same as the first series of air loops. Two pairs of southern division teams are taken to and from the eastern zone and the eastern teams are moved to their third southern division location (see Figure 5). Back-to-back games are then scheduled after which the teams again switch between the three city pairs (see Figure 6).

A third repetition of the air loops will return all teams to the position where they entered the transportation system (see Figure 7). For the eastern

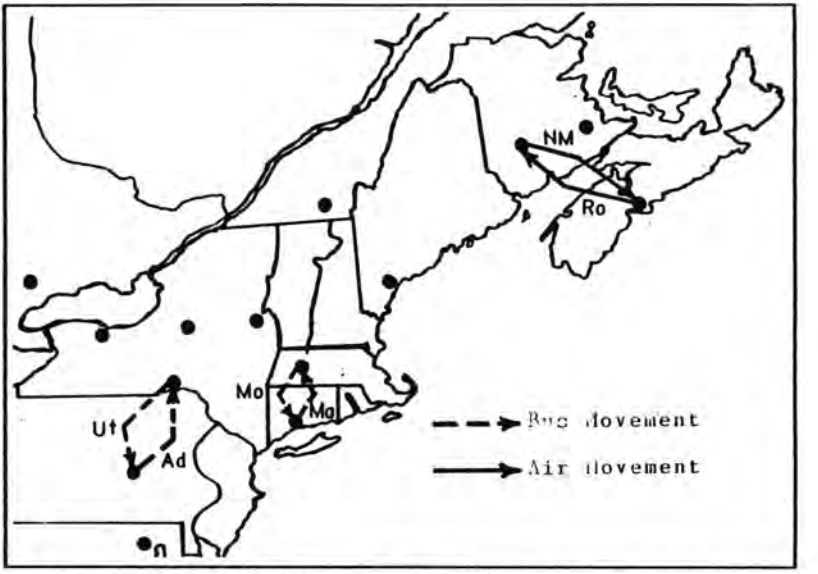


Figure 4 - Third Movement in Team Rotation Scheme
(Team Exchange)

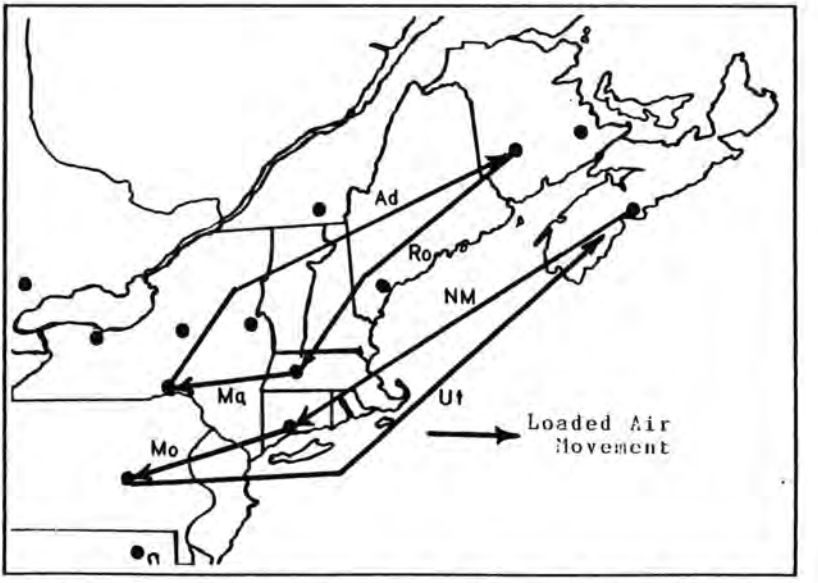


Figure 5 - Fourth Movement in Team Rotation Scheme
(Repetition of Air Loops)

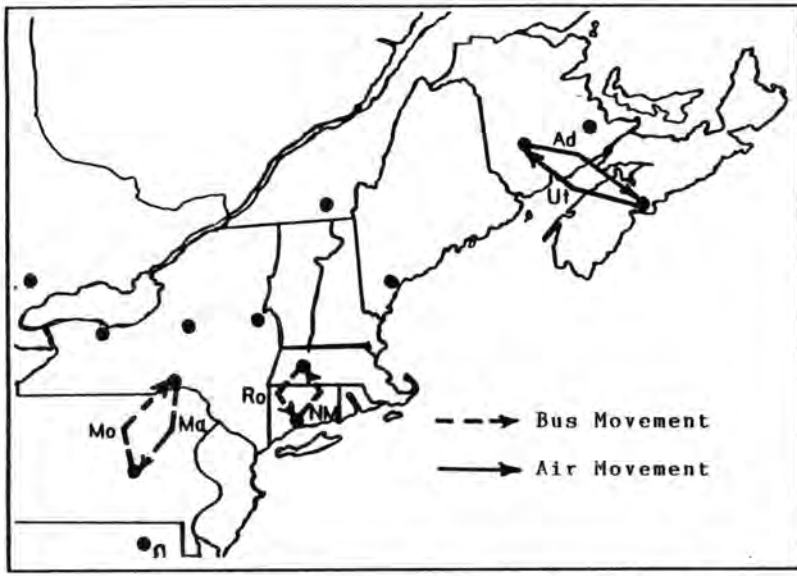


Figure 6 - Fifth Movement in Team Rotation Scheme
(Team Exchange)

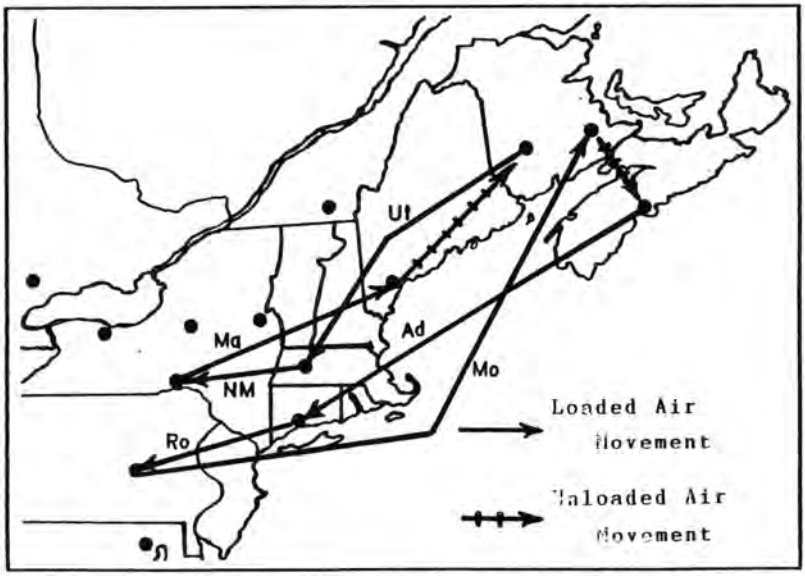


Figure 7 - Sixth Movement in Team Rotation Scheme
(Air Loops which returns eastern teams home)

teams, Maine and Moncton this means returning home, while southern teams will have one additional movement to return home.

The system described above would result in two of the eastern teams completing all play in the southern zone and all four teams from the western region completing half of their games in the eastern region. Repetition of the entire process, with Moncton and Maine remaining at home and Fredericton and Halifax on the road, will complete all play of eastern teams in the southern zone and all play of western zone teams in the east.

In order to accommodate eastern team road games in the western zone and southern teams road games in the eastern region, a similar network concept can be utilized. In this case the scenario would begin by moving the four southern zone teams to the four cities in the western zone. Then, two eastern teams would be scheduled to rotate through the western zone cities while the southern zone teams rotate through the western zone and two eastern cities. (Note : Sherbrooke would replace Maine as the fourth eastern team under this rotational scenario.) This will complete all play between the eastern teams and the eight southern division teams.

This phase of the investigation was successful in replacing a large percentage of bus movements with air travel. All parameters required by the aircraft operator as well as the league have been accommodated.

Evaluation of Network Concepts

The proposed system was evaluated based on cost and level of service in comparison with the present system. The Fredericton AHL franchise was used as a case study with the team's actual travel expenses being supplied and their travel times were estimated based on their current mode of travel. The required travel throughout a hypothetical season was accumulated so that all play requirements under the proposed scheduling would be met. The proposed alternative was evaluated based on operating characteristics and costs of the Dash-8 service and charter bus.

Cost of operating the proposed schemes for northern teams within the northern zone are almost identical to those under the existing system. However, dramatic savings are realized when teams travel into or out of this northern zone. Total travel costs for teams making these trips were estimated at $52,000 a reduction of 44%. This translates into a reduction in a teams total travel cost of 23%.

Level of service of the two systems (existing and proposed) were evaluated based on two criteria:

i) travel hours
ii) number of road trip nights

The existing system was evaluated on a per road trip basis for a representative team and travel times were assigned based on the operating characteristics of the transportation modes. A similar analysis was completed for the proposed system. In summary, the existing systems requires approximately 222 hours with forty-four road trip nights per team. The proposed system requires a total travel time of 100 hours and reduces the number of road trip nights by seven. This represents a reduction in average travel time per game from 4.5 to 2.25 hours (a 50% decrease).

Recommendations and Conclusions

The analysis does not incorporate all desired league operations practices. For example, the scheduled back to back games are not desirable from a marketing point of view. Also modifications are necessary so that teams which have league seniority get the play days which they demand. Variation to the network concept can be incorporated without compromising the validity of a charter air service. The original objective of the study was to increase level of service without substantial increase in travel cost. A nearly perfectly balanced transportation system was developed in the study, the performance of which far exceeds the original objectives. Variations can be made to the system to incorporate additional league practices. Such variations would not render the transportation system unacceptable.

Not all teams benefit equally from the system. The teams in the southern division who have the additional expense of positioning trips at the beginning and end of the rotational scenarios. A travel cost pool should be investigated as a means of providing incentives to modify the league scheduling approach.

The evidence presented suggests that Dash-8 charter air service can be made viable with appropriate game scheduling.

Acknowledgements

The authors of this paper would like to acknowledge the Fredericton Express Hockey Club and Air Atlantic Ltd. for their assistance in this project.

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MULTI-MODAL PASSENGER TERMINAL STUDY FOR CALGARY

SITE ANALYSIS AND SELECTION

J.D. Thomson and M.A. Sargious

ABSTRACT

The City of Calgary has shown considerable interest in developing a multi-modal passenger terminal, MPT, in the CBD since the late 70s. Previous studies proposed a facility that would accommodate a VIA Rail terminal, intercity bus terminal, local transit (buses and LRT) and a pre-boarding shuttle bus service to the airport.

However, the proposals were never implemented due to disagreements among the carriers. Recently the Greyhound bus company has relocated to a new terminal located at the edge of the CBD, and VIA Rail has since attempted to obtain a new terminal site, but has been unsuccessful.

Since VIA Rail is still in search of a new terminal, the possibility for a shared terminal still exists. The major objective of this study was to investigate the possibility of relocating the VIA Rail station to the new Greyhound terminal, by providing a simple platform for VIA Rail passengers on a siding off the CP main line adjacent to the Greyhound facility. The existing Greyhound terminal could then serve as a MPT with a few minor renovations to accommodate VIA Rail requirements. The proposal would also involve extending the light rail transit system to the Greyhound terminal.

Besides the possibility of converting the new Greyhound terminal into a MPT, the study explored other possible terminal locations. One of these locations was found to be more suitable for a multi-modal terminal than the exiting Greyhound terminal. However, the construction of a new building at this preferred location would require government financing, since the carriers may not have the funds or the desire to finance the construction.

INTRODUCTION

Experiences with multi-modal passenger terminals (MPTs) in other urban centres in Europe and the U.S. indicate some very encouraging results. Most carrier operators experienced operating cost savings of 15-20%. The operating costs for the facility may be higher than that for a single mode terminal, but the costs to the individual carriers were usually reduced. Public response to the implementation of a MPT was usually positive because of the increase in efficiency and convenience, (Ref. 3). Multi-modal transit centres reduced the distance travelled by the transit vehicles and by the passengers and they reduced the

frustrated level of the passengers, (Ref. 5).

Initial cost of design and construction of a MPT will probably be higher than that for a single mode terminal, but the increased working efficiency of the terminal will make it more cost effective in the long run, (Ref. 5).

Increases in the order of 15-20% in ridership can be expected when a multi-modal terminal replaces single terminals (Ref. 2). This is because the success of a transportation system depends upon passenger satisfaction, which occurs when there is convenient, coordinated scheduling, which is usually the case in a MPT. In the past, most carriers operated single-mode terminals that were run with little regard for the passengers welfare. There was usually little coordination between arrival and departure times fo different modes. There was also a lack of long-term parking facilities at long distance carrier terminals, and local bus systems were not concerned with headways and meeting times. However, if passenger needs are well served, ridership and profits tend to increase. Passenger convenience is now recognized as a very important factor in the success of a transportation system.

Passengers, carriers, and localities are starting to demand more from public transportation. They expect efficient and convenient service. Well designed MPTs can provide efficiency, greater safety, more convenience, and height ended community awareness, (Ref. 3).

In Europe the concept of multi-modal terminals is fairly old. In some cities all modes of transportation operate out of one single facility. Buses, trains, transit, taxis, cars, bicycles, and boats all converge to one terminal. Often the local airport is integrated into the system through bus or train service from the multi-modal terminal.

The European attitude towards public transportation is that it should be complementary rather than competitive. Trains are generally used for fixed, medium distance routes in high density corridors, while buses are used for flexible, shorter routes in less dense areas; (Ref. 1). MPTs in Europe are very successful and efficient, and the concept of multi-modalism continues to prosper in European countries.

In the U.S., as in Canada, tradition has separated the terminals for competitive reasons, both between and within modes. For this reason, there are only between 100 and 200 MPTs that include three or more modes, of which at least one is an intercity carrier, (Ref. 5).

POTENTIAL ADVANTAGES OF MULTI-MODAL PASSENGER TERMINALS

- An overall reduction in employee requirements which, in turn, would reduce the carrier's operating costs.

- Further reduction in operating costs since the facility is supported by more than one carrier as illustrated by the Oceanside, California MPT which resulted in operating cost savings of 15-20% for the carriers, (Ref. 2).

- Larger passenger volumes within the terminal offer a larger market for the "extra" services such as restaurants,

concessions, taxis, etc.

- Improved service to the passenger through improved schedule coordination, ease of transfer between modes, and improved terminal facilities.

- Potential increase in passenger volumes as illustrated in table (1).

Table (1) - Comparison of Passenger Volumes Before and After the Implementation of a MPT in Oceanside, California (Ref. 2)

	PASSENGER VOLUMES			
	Before the MPT (1980)	After the MPT(1)	% Increase Due to MPT	1995 Estimate (2)
CARRIER	YEARLY	YEARLY		YEARLY
AMTRAK	165,000	231,000	40	547,500
GREYHOUND	350,000	Substantial Increase		Total Intercity 474,500
TRAILWAYS	7,500	Substantial Increase		
N.C.T.D.	Not avail.	Not avail.	15	1,825,000
TOTAL	-	-	-	2,847,000

(1) Two months after the facility has opened.
(2) Values were given as estimated boarding for 1995 (Ref. 2).

COMPARISON BETWEEN CANADA AND EUROPE

Canada and Europe share the same concerns about energy, inflation, the environment, safety and the unconstrained use of the automobile. However, when transportation is considered, most comparisons between Canada and Europe indicate major differences between the two systems. This is due to differences in geography, population density and climate. There are also differences in transportation networks, policies, regulations and attitudes, (Ref. 1). One of the major differences is in the use of public transporation. Table (2) highlights the differences between the Canadian and European transportation systems.

In Europe, the various modes using a MPT serve different purposes. There is the intercity rail as well as the system serving the local city and the surrounding satellite towns. The latter is usually comprised of inter-urban bus, commuter rail and

Table (2) - Comparison Between Canadian and European Modal Trip Selection (Ref. 1)

TRIP TYPE	EUROPE	CANADA
Short haul inter-city trips of up to 320 km.	Mainly rail and some bus.	Almost all buses.
Mid-range trips of 320-800 km.	Mostly rail.	Fly or take the bus.
Long-range trips of more than 800 km.	Rail and air evenly shared.	Virtually all by air.

city transit, (Ref. 1).

In Canada there is considerable competition between intercity air, rail and bus that is not a factor in Europe, where transportation policies seem to be designed to enhance modal integration, (Ref. 1). Another difficulty arises due to the ownership of the various modes. In Canada, the rail line (VIA Rail) is a crown corporation that is owned and operated by the Federal Government. On the other hand, the bus industry is run either by private enterprise, as in Alberta, or run by the provincial government, as in Saskatchewan. This lack of continuity in the ownership of the modes not only leads to a lack of co-operation but even results in strained relationships between the carriers. This is especially true between the private bus carriers and VIA Rail. Greyhound often complains that they, a privately owned company, are subjected to unfair competition by VIA Rail.

STUDY OBJECTIVE

The main objective of this study is to determine the feasibility of implementing the MPT concept in Calgary and to arrive at the most desirable location for such a facility.

THE INTERCITY GROUND TRANSPORTATION SYSTEM IN CALGARY

The City of Calgary is Canada's third largest city in terms of geographic size and has a population of about 640,000. The passenger surface movement between Calgary and other locations is accommodated by:

(1) VIA Rail is the largest passenger rail service in Canada, and the only one serving Calgary with 1 east and west bound transcontinental stop per day at the Calgary terminal.

The present VIA Rail terminal is located in a major development comprised of retail shops, commercial offices, and a large parkade. The parkade extends over the tracks and provides coverage to the passenger loading platform.

The terminal does meet the present needs of VIA Rail except

during the peak periods such as at Christmas and during the summer. However, the company believes that the terminal is located in an undesirable location. The site itself is acceptable with regard to its location in the CBD, but the station is located in the basement of the complex and VIA Rail would like a facility with a more visible profile.

The rail company does not have any present plans for moving the Calgary terminal, especially after the cancellation of the dayliner to Edmonton. In spite of this, the rail company is open to any possiblities for relocation of their Calgary terminal. The company is very interested in the concept of MPTs. However, the benefits of such an endeavor would have to be proven before they would consider the implementation of the concept.

VIA Rail stated that the concept of relocating outside the CBD is a possibility that should not be ruled out. However, it is still the basic policy of the company to stay in the CBD.

(2) Greyhound is the largest intercity bus operator in Alberta, with a fleet of 415 regular route buses. Presently Greyhound has approximately 90% of the intercity and rural routes in Alberta. It also serves the charter bus market through its subsidiary, Brewster Transport, which has 55 motor coaches serving this market.

Greyhound's route system in Alberta is comprised of a linear network of interprovincial routes, the Calgary-Edmonton corridor, and a network of hub-and-spoke rural routes radiating from Edmonton and Calgary, (Ref. 7).

The bus company indicated that it would be unlikely that they would be willing to move out of their new terminal, in the forseable future. However, it is willing to consider sharing the terminal with VIA Rail but now with Red Arrow.

(3) Pacific Western Transportation Ltd. (PWT) is a privately owned and operated company. PWT's operation is comprised of three separate departments serving separate areas and functions. Two of these serve the charter bus market. The third is a scheduled bus service between Calgary-Red Deer-Edmonton, and between Edmonton and Fort McMurray through the Red Arrow express luxury bus service.

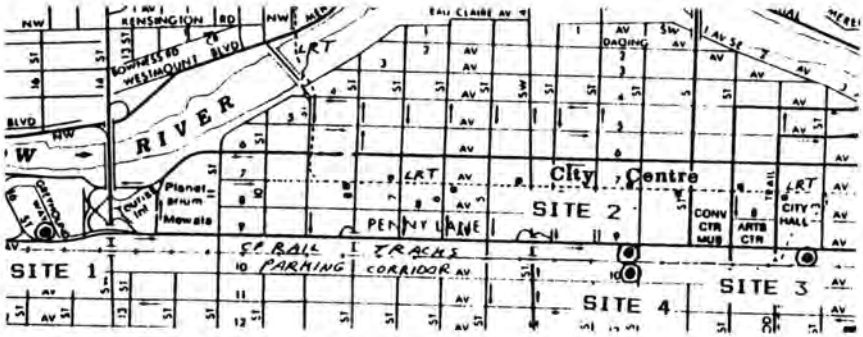
The Red Arrow service was approved by the Alberta Motor Transport Board in 1978, provided it offered a different service from the existing intercity bus service. The difference is achieved through the use of lower capacity, luxury style coaches with food and beverage service. This bus express service operates out of hotels and is targeted to serve the auto and air travellers. The Red Arrow service is comprised of thirteen 25 seat capacity buses.

PWT would consider sharing a terminal with VIA Rail but into with Greyhound since Greyhound is in direct competition with the Red Arrow Express service. PWT does not have any plans to change their present terminal arrangement in Calgary.

CALGARY SITES EXAMINED IN THIS STUDY

This study examined the four sites listed below:

Site 1 - The New Greyhound Terminal
Site 2 - The Old Post Office Site,
Site 3 - 8 Avenue and 3 Street S.E.
Site 4 - 10 Avenue and 1 Street S.W.



The following is a list of the major criteria that were considered in the site selection process.

- Availability of sufficient space.
- Present land use and site details.
- Surrounding urban context.
- Vehicular and pedestrian access.
- Proximity to the CP Rail tracks.
- Proximity to the LRT line and stations.
- Parking availability.
- Existing terminal facilities.
- Costs.

EVALUATION OF THE SITES

The four sites were evaluated according to how each site satisfied the above criteria:

(1) AVAILABILITY OF SUFFICIENT SPACE

All four sites are large enough to contain a multi-modal terminal. In the case of the old Post Office site, the existing structure would have to be demolished to accommodate the required bus carrier facilities. However, the existing structure could accommodate a VIA Rail terminal.

(2) PRESENT LAND USE AND SITE DETAILS

The new Greyhound terminal, site 1, has some advantages in this category since a terminal facilitiy is already present. However, major renovations and additions would be required before VIA Rail could also use the facility and space is limited. Additions include, increased parking facilities, increased office space (for VIA Rail), a baggage sorting and delivery system to the trains, a covered rail platform and a covered walkway over 9 Avenue South to join the platform to the terminal.

The old Post Office site, site 2, is still being used to serve its original function. Therefore, this location is virtually eliminated as potential site for a MPT.

At the present, sites 3, and 4 are both surface parking lots.

These two sites offer the best alternatives with regard to this category.

(3) SURROUNDING URBAN CONTEXT

The Greyhound terminal site is considerably lacking in this criterion. The site is located well out of the CBD, which removes it from the centre of activity in the city. It is also isolated from the surrounding area by heavily used roads. The neighborhood consists mainly of industrial plants and a large auto retailer, all of which retract from the desirability of this location as a potential MPT.

The old Post Office site is located well within the CBD. This site is surrounded by hotels, offices and retail shops. Overall this site is in an excellent location for a MPT.

Site 3 is located on the fringe area of the CBD and is located in an area considerd to be rundown and in decay. To the east and south of the site are the railroad spur lines and some industrial plants. However, in recent years many additions and major projects have been added to the areas to the west and north of this proposed site. These include: the new Municipal Building, the Performing Arts Centre and the Olympic Plaza. Also to the south east is the exhibition ground which contain the Olympic Saddledome, and the Lindsay Park athletic centre. The recent proposal to host the World Exposition in Calgary within the next couple of decades, with the site being located in the area of the proposed MPT, adds to the desirability of this location. The terminal could be integrated into the expo design and could remain as a permanent legacy of the expo after the event had ended.

Site 4 is located in the transition zone between the CBD and a residential area, in what has become a parking corridor along 10 Avenue. Overall, the site is not located in a very central or desirable location. Being on the south side of the tracks seems to separate it from most downtown activity even though the site is only one block south of the old Post Office site.

Therefore, according to the surrounding urban context category, site 3 is the best.

(4) VEHICLE AND PEDESTRIAN ACCESS

The new Greyhound terminal has the most convenient access of all the sites due to its location outside of the CBD. It is in close proximity to the major arterial routes which means that the carriers themselves have easier, faster trips in and out of the city. Furthermore, the patrons who drive to the terminal have an easier trip. However, this isolated location means that the possiblity of walking to the terminal is very small for the majority of residents and workers in the CBD due to the distance and the isolation caused by the roads surrounding the terminal.

The location of the old Post Office site in the CBD on 9 Avenue South would result in fairly major inconveniences to any vehicles trying to access the terminal. These problems would be especially clear during rush hours. Also, due to the small size of the site and its proximity to a major traffic turning corner, vehicle flow in and out of the site would be difficult. Therefore,

access to this site is not easy and could prove to be a major drawback if it were to be selected.

Site 3 has a considerable advantage over the other proposed sites located in the CBD. This site could be considered to be in the CBD, yet it is still far enough away from the main core to not suffer from the same traffic congestion that the other core sites suffer from. Also, the large size of the site, would reduce traffic flow problems in and out of the facility.

Site 4 suffers from some of the same traffic access problems as the old Post Office site due to its close proximity to the latter. However, the situation is not quite as bad since 10 Avenue is available for use and the large size of the site allows for easy access. Therefore, traffic access is not a big concern with regard to this site. As a whole, when both vehicle and pedestrian traffic are taken into account, site 3 is superior.

(5) PROXIMITY TO THE CP RAIL TRACKS AND REQUIRED FACILITIES

There are four main rail lines running through the downtown core in an east/west direction. These tracks are numbered 1 to 4 from north to south with tracks #1 and #2 used by the passenger trains.

The important facilities that are required at a VIA Rail terminal are: train loading platforms, safe access to tracks #1 and #2 from the terminal, adequate track facilities, signaling, platform lighting and train servicing facilities (air, steam, battery charging and water).

The proposal to locate the VIA Rail terminal at the new Greyhound terminal suffers from its greatest deficiencies in this area. There are virtually no rail terminal facilities in existance at this location. Therefore, the implementation of a VIA Rail terminal at this location would require the construction of all the previously stated facilities.

The old Post Office site is probably the most well equipped of all the proposed sites. This is due to the building's previous function. The facility was equipped to receive mail deliveries by the train. Therefore, a platform is already present that could function as a passenger loading platform. The site is located on the north side of the tracks adjacent to track #1. However, if access to track #2 is needed, an over - or underpass would still be required. No new spur lines are needed since they are already present. Also, the train servicing facilities that are already present at the existing terminal could be used since the sites are very close together.

Site 3 also lacks the required facilities for a VIA Rail terminal. All facilities required for the operation of a a passenger terminal would be required, including new spur lines. Also, to successfully construct the new spur lines, some existing CP Rail trackage would have to be moved. Therefore, there is the additional cost of compensating CP Rail for the loss of this track, (Ref. 8).

One of the major drawbacks of using site 4 is that it is located on the south side of the tracks. Thus access to the assigned passenger tracks is only possible by crossing tracks #2, #3 and #4. This involves the costly consruction of an either above

or below ground access. The existing platform located at the old Post Office site could be used as the passenger boarding platform for this site since it is located on the south side of the tracks opposite of the old Post Office site.

Converting the passenger trains from the north side to the south tracks is a possiblity. However, this would involve increased costs since new platforms, servicing facilities, possible signal changes, relocation of some track, relocation of locomotive fuel and water facilities and possible relocation of the present car washing facilities would be needed, (Ref. 8).

Therefore, the old Post Ofice site is the best according to this criteria.

(6) PROXIMITY TO THE LIGHT RAIL TRANSIT LINE AND STATIONS

In Calgary a multi-modal terminal should include the light rail transit, LRT, since it has become an important and integral part of the local transit service system. Only two of the proposed sites have potential to integrate the LRT: the new Greyhound terminal, and site 3. The remaining sites are all located in the CBD and are at least two or more blocks from the existing LRT stations on 7 Avenue South.

The south leg of the LRT passes through the centre of site 3. However, the LRT has gone underground at this point to cross the CP Rail Tracks. Therefore, a project involving the construction of a LRT station below grade makes this proposal costly.

The second site that could accommodate a LRT station in the terminal is the new Greyhound terminal site. Presently the LRT does not come near the site. However, the proposed west LRT leg is planned to pass right along the south side on eastbound Bow Trail, and is estimated to be implemented sometime between 1990 and 2005.

Due to the uncertainty of the West leg LRT addition site 3 offers the most advantages with regard to this category.

(7) PARKING AVAILABILITY

The new Greyhound terminal was built with an open roof top parking lot, that is mainly used for passenger drop-off and pick-up. The cost is free and the lot is located close to the passenger waiting area for the buses. However, there is a maximum time limit of 30 minutes for use. Approximately 15 of the stalls are available for extended use, but the cost is fairly high, $5.00 per day, and $10.00 overnight. These parking facilities seem to be adequate for the present volumes experienced. However, Greyhound is presently experiencing employee parking shortages. Employees presently park in a leased vacant lot adjacent to the terminal on the east side. There is presently no enough room for all the employees to park in this lot and the situation may be aggrevated if VIA Rail is moved to the Greyhound terminal. However, the potential for increased parking capacity is present. The most obvious site for such a facility would be the existing employee parking lot. The cost would probably be split between the carriers. The City might consider helping to finance such a project if a park-and-ride system could be implemented for the future LRT leg to the CBD.

The old Post Office site could possess some parking difficulties due to the small size of the site. However, there is potential to make room for approximatley 48 parking stalls on site. The potential also exists to acquire the existing parking lot to the west of the site. This facility holds approximately 50 vehicles. Also, there are numerous parking facilities in the immediate vicinity of the site.

The concern for adequate parking facilities is even less for sites 3 and 4. The large size of these sites allows for extensive parking development, and the potential for City financing also exists due to the location of these sites on the designated "parking corridor".

Therefore, according to this criteria sites 3 and 4 are the most desirable.

(8) EXISTING TERMINAL FACILITIES

The existing Greyhound terminal is the only site that satisfies this criteria to any extent. Passenger waiting areas, ticket facilities and most other terminal amenities are already presnt in the Greyhound terminal and can be used by VIA Rail passengers. Improved baggage handling facilities and increased administration space for VIA Rail would still be required. However, some problems may exist in moving baggage and passengers from the terminal to the platform on the south side of 9 Avenue.

(9) COSTS

The following cost estimates are based on previous studies done for the City of Calgary, (Refs. 4 and 8).

Table (3) - Summary of Cost Estimates[1]

	Site 1	Site 2	Site 3	Site 4
Full MPT with VIA Rail, Greyhound and Red Arrow.				
- Building Cost	$ 21.00[2]	$ 8.80	$ 8.50	$ 8.50
- Track Infrastructure	5.97	1.00	5.97	0.20
TOTAL	26.97	9.80	14.47	8.70
MPT with VIA Rail and Red Arrow				
- Building Cost	-	3.29	4.55	4.76
- Track Infrastructure	-	1.00	5.97	0.20
TOTAL	-	4.29	10.52	4.96

[1] In millions of 1987 dollars.
[2] Includes cost of existing structure and estimate of additions required by VIA Rail.

Therefore, according to the cost analysis, site 4 is the best if Greyhound is included and site 2 is the best if Greyhound is not

included.

(10) CARRIER'S OPINION REGARDING SITE LOCATION

(a) VIA Rail has long-term goals of locating all of their terminals on high profile sites in the city centre. Three of the proposed sites discussed in this report were considered as possible sites for a VIA Rail terminal in the 1984 report done by VIA Rail, (Ref. 8). These were sites 2, 3 and 4. One of the major factors why VIA Rail disregarded sites 3 and 4 as possible terminal locations was their undesirable locations. Sites 3 and 4 are both located on the fringe of the CBD. Conversely, one of the major reasons for selecting the old Post Office site (Site 2) by VIA Rail as the preferred location was its location in the CBD, (Ref. 8).

VIA Rail would consider relocating to the new Greyhound terminal. However, the new Greyhound terminal is not in the CBD and accordingly would not be the most desirable alternative according to VIA Rail. In spite of this VIA RAil is interested in the concept of multi-modalism. The company was keen on operating out a of a shared terminal with Greyhound when the proposal was first raised in the late 70s.

(b) Through discussions with Greyhound it was determined that the likelihood of Greyhound moving to another terminal site is very small. The new existing Greyhound terminal facility was opened in early 1986 at a very substantial cost.

The reason why the proposal for a multi-modal terminal suggested in the late 70s and early 80s was abandoned was because Greyhound rejected the idea and proceeded to plan for their new facility.

(c) Red Arrow does not have any opinions with regard to a possible location for a MPT. Red Arrow's present plans do not consider any possibility of relocating their present operation.

SUMMARY OF SITE EVALUATION

Table (4) includes a summary of the analysis discussed in the previous section. The rating assigned to each site for each criteria is based on the data and opinions stated previously in the report. However, the ratings are very subjective.

The analysis is based on four different ratings: excellent, good, fair and poor. The qualitative rating system has also been equated to a numbering system in order to obtain a quantitative overall "best" site. The numbering system is as follows:

- excellent (exlt) = 3 points,
- good = 2 points,
- fair = 1 point,
- poor = 0 points.

The table is meant more as a guide rather than an accurate analysis procedure. To make such an analysis more legitimate, many participants and authorities should fill out such a table. This would give a good indication of the factors to consider, their relative importance, and perhaps the overall most desirable site.

From this table and the preceeding analysis it can be concluded that site 3 is the most desirable location for a MPT.

RECOMMENDATIONS AND CONCLUSIONS

Site Selection

Based on the analysis of this report, the best site for a MPT is site 3. This site is very close to the CBD, holds potential for the integration of the LRT, is a large empty lot ready for development, is located in an area that is becoming a centre for business and culture and is the most easily accessible site located near the CBD.

Participating Companies

Since Greyhound is not interested in moving from their new facility, future MPT proposals should consider the competing smaller carriers such as Red Arrow, to participate in a MPT with VIA Rail.

The possibility of involving a major developer into the project should also be considered. A terminal that is part of a major office/commercial development would project a more positive and vibrant image to the travelling public. The possiblity for financial support of the facility is also present with this alternative.

Track Facility Requirements

As indicated previously, major renovations would be required to the existing trackage system to accommodate a passenger terminal at site 3. Extensive track and signal renovations, additional lighting and service facilities (air, steam, water, battery charging and fueling) would be required at this site. Estimations of the costs involved for these facilities are given in table (5).

Vehicle and Pedestrian Access

The implementation of a MPT at site 3 would not create any considerable increase in traffic on the surrounding road system. The estimated volumes are not that large and they would be spread out fairly evenly throughout the day.

However, if a commercial develepment, and/or a large parking structure is included in the project, traffic increases may justify improvements to the surrounding street system. Access to the terminal would have to be from 9 Avenue South only, which is a one-way eastbound arterial, as illustrated in fig. (1). Reassigning the 3rd Street East as a northbound one-way arterial would allow the distribution of the traffic exiting the terminal to either 5th or 6th Avenues, both of which are the major routes out of the CBD as shown in fig. (1).

A +15 walkway is recommended to be constructed from the proposed terminal, across 9 Avenue to the Municipal Building.

Parking Facilities and Access

The use of this site would ensure the integration of the LRT into a MPT facility. Therefore, consideration should be made to construct a major parking facility at this location. The people working in the CBD could use the LRT as a shuttle service into the downtown core. The parking facility would also serve the terminal's requirements and the surrounding facilities, such as the Muncipal Building, the Performing Arts Centre, the Exhibition Groundings and the Collisium.

Table (4) - Summary of Site Analysis

CRITERIA	Site 1	Site 2	Site 3	Site 4
Proximity to Tracks	good (2)	exlt (3)	good (2)	good (2)
Additional Track Facilities Required	fair (1)	good (2)	poor (0)	good (2)
Proximity to LRT	poor (0)	poor (0)	exlt (3)	poor (0)
Existing Terminal Facilities	good (2)	fair (1)	poor (0)	poor (0)
Size of Site	good (2)	fair (1)	exlt (3)	exlt (3)
Present Availability of Site for Development	good (2)	poor (0)	good (2)	good (2)
Available Parking	fair (1)	fair (1)	good (2)	good (2)
Potential for Additional Parking	fair (1)	good (2)	exlt (3)	exlt (3)
Vehicular Access	exlt (3)	poor (0)	good (2)	fair (1)
Potential for A Full MPT	exlt (3)	fair (1)	good (2)	good (2)
Surrounding Urban Context	poor (0)	exlt (3)	good (2)	fair (1)
Cost Effectiveness	good (2)	fair (1)	poor (0)	fair (1)
Potential for an Airport Shuttle Bus	poor (0)	good (2)	good (2)	poor (0)
Surrounding Urban Context	poor (0)	exlt (3)	exlt (3)	fair (1)
TOTAL	19	20	26	20

Connection to the Light Rail Transit System

Even without the construction of a LRT station directly under the proposed terminal, the existing stations on 7 Avenue are within reasonable walking distance to the site. These existing stations serve all three of the LRT legs and with the implementation of a +15 walkway from the terminal to City Hall the trip would be entirely indoors.

Airport Shuttle Bus Service

At present, evidence suggests that there is very little transfer between modes. In Calgary a previous attempt to use an airport shuttle service at the Greyhound Terminal demonstrates this fact. However, most evidence regarding the lack of multi-modal trips is based on separate terminal examples where the existing terminal links have been poor. Perhaps with a MPT, the resulting increased ease of intermodal transfer will increase the occurance of multi-mocal trips. Therefore, the need for a shuttle bus service should still be considered. For this reason it is recomended that a small cost efficient van system be used and if the demand increases then a bus could be substituted.

Cost Details

The cost details given in table (5) were obtained from construction cost estimates done in previous studies, (Refs. 4 and 8). The total estimated cost, excluding land acquisition and site

Table (5) - Cost Estimate for a MPT at Site 3

ITEM	1987 COST
50,000 ft^2 terminal @ \$122.06/ft^2	\$ 6,103,125
Shared Amenity Spaces 20,000 ft^2 @ \$122.06/ft^2	2,441,250
Parking for 120 vehicles @ \$10,000 (above ground).	1,171,800
SUB-TOTAL	9,716,175
INFRASTRUCTURE - TRACKS	\$ 1,135,050
- SIGNALS	987,000
- SERVICING FACILITIES	2,467,500
- PLATFORM AND LIGHTING	394,800
- RELOCATION OF CP RAIL TRACKAGE	987,000
SUB-TOTAL	\$ 5,971,350
TOTAL	\$ 15,687,525

development is approximately $15.7 million for site 3.

Possible Financing

Since the carriers themselves do not have the ability, nor the desire to finance the construction of a MPT, other sources must be found. The most obvious source of external financing would be from the governments. This study recommends that the municipal, provincial and federal governments combine their resources to help finance the proposed project. The inclusion of a commercial development within the project would also help with the financing.

As an incentive for government to assist in financing the project, the terminal could be implemented into the proposed Calgary energy Expo 1998 which is proposed for the area surrounding the terminal. A modern, efficient MPT integrated into the site and the theme of the expo facilities could be used to illustrate to the rest of Canada, and the world how progressive and innovative Calgary is with regard to transportation, city planning and energy conservation.

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INTERNATIONAL LOGISTICS

OPPORTUNITY FOR THE 90's -- BE READY

N.James Cowan

Business is Becoming More Global

- Progressive companies are targeting a worldwide marketplace
- Products are becoming more common worldwide with changes in buying power
- Sources/manufacturing are being dispersed worldwide
- Trade barriers are dropping
- Documentation process is becoming simplified
- Instantaneous, electronic data is becoming available

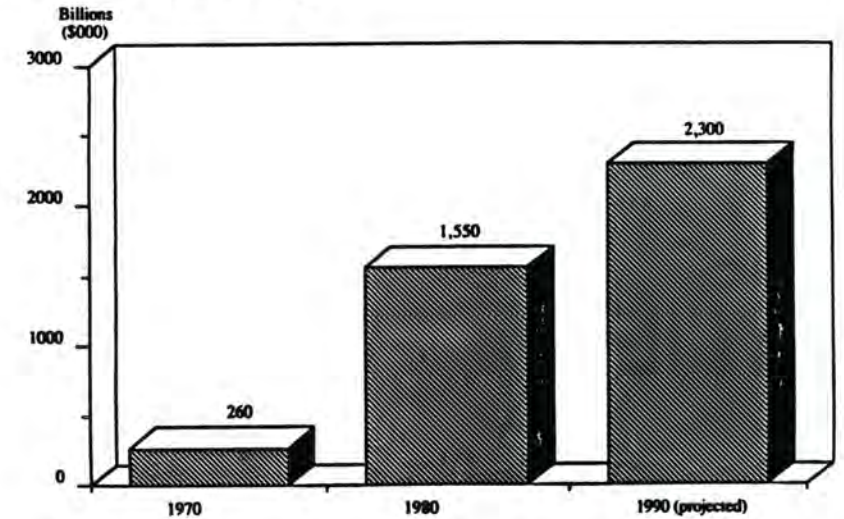
Successful companies of the 1990's will operate integrated worldwide logistics systems.

Integrated Logistics Worldwide

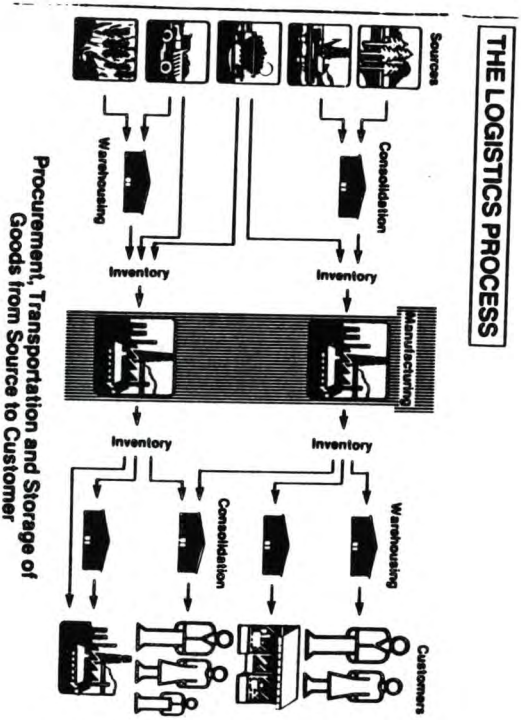
- Logistics includes all material flow from raw materials to the final customer
- International logistics which includes international transportation is complex
- Logistics costs are affected by global sourcing decisions as companies try to:
  - Source raw materials globally to reduce costs
  - Optimize the productivity/labour cost matrix
  - Obtain superior technology
  - Satisfy counter trade requirements
- Logistics costs are affected by global marketing decisions as companies try to:
  - Expand their customer base
  - Diversify risk

Business is Becoming More Global

Free World Trade is Growing



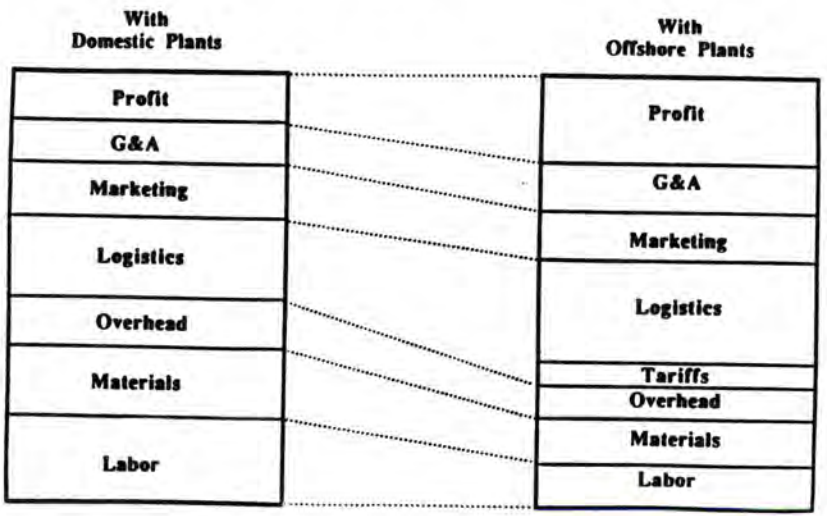
Note: Excludes minerals fuels


THE LOGISTICS PROCESS
Sources
Consolidation
Warehousing
Inventory
Inventory
Manufacturing
Inventory
Inventory
Warehousing
Consolidation
Customers
Procurement, Transportation and Storage of
Goods from Source to Customer

Integrated Logistics Worldwide

Relative Cost of Worldwide Logistics is Larger

- Cost structure of a Canadian manufacturer



Key Issues

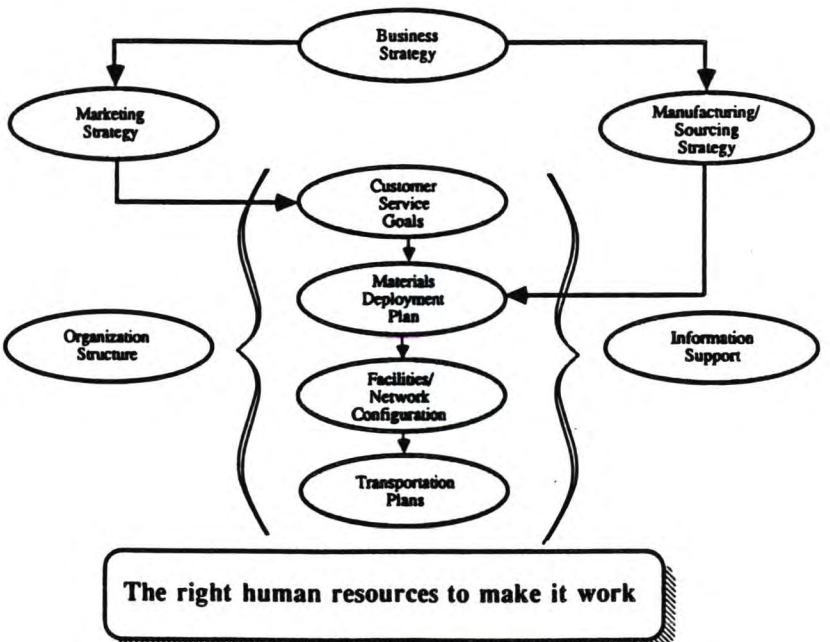
- Do we understand our business objectives?
  - Marketing strategy
  - Customer service strategy
  - Overall operations strategy
- Is our logistics organization up to the challenge?
  - Structured properly
  - Placed in the organization properly
  - Has a senior executive
  - Has a logistics plan
  - Knows international transportation
- Will increased global sourcing bring significant improvements?
- What is blocking competitive pricing?
  - Historical patterns
  - More rigorous make or buy decisions
  - Leveraged productivity gains
- What are the risks?
  - Currency
  - Political unrest

Strategy

- Organize the business along product lines, not country lines
- Improve logistics organization practices and people
- Increase outsourcing
- Improve information technology

However, optimized global sourcing is a continuous process, not a strategy

Developing a Global Logistics Strategy for the 1990s



"Competitive Analysis" Approach for Global Sourcing

- Select high value parts and components for existing new models for investigation
- Capture product specs, price information, and other relevant data in a database
- Identify potential vendors in selected countries
- Solicit provisional quotations from new sources
- Screen part numbers/quotations for feasibility
- Compare current prices and quotes
- Estimate landed costs between source countries
- Recommend sourcing strategies

Managing International Transportation

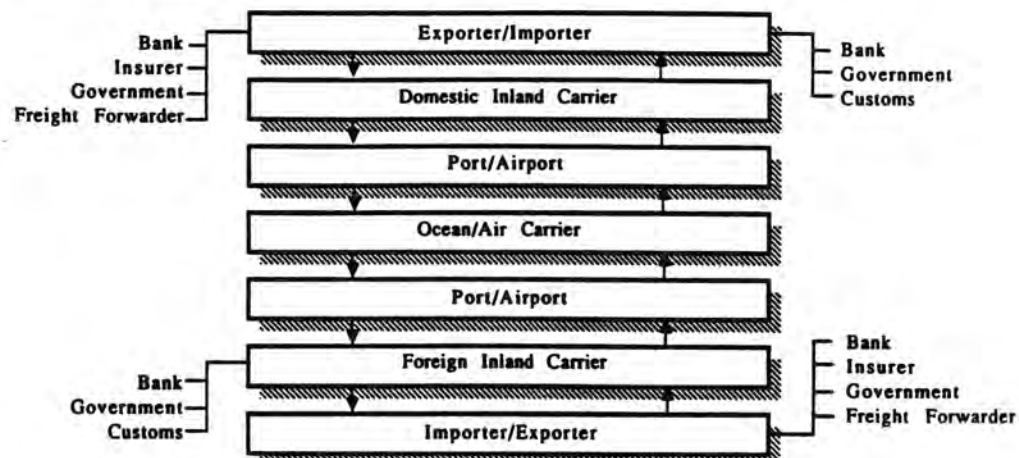
Is international transportation really that different than domestic transportation?

- Two primary modes
  - Ocean
  - Air
- Significantly longer distances and transit times
- Wide variation in cost, based upon modal choice and service requirements
- Many rates and service alternatives
- More paperwork and formalities
- More difficult to manage

Overall, it is not that different, just more guises and specializations.

Managing International Transportation

International Transportation has Many Players



Managing International Transportation (Cont'd)

Typical actions to improve international transportation

- Establishing greater "control" over international transportation costs through knowledge and interaction
- Limiting number of carriers and service agents to increase concentration
- Consolidating shipments to improve productivity
- Exercising companywide leverage in negotiating
- Entering into associations, service agreements or contracts to control and guarantee service and costs

Summary

- Business will be conducted on a truly global basis
  - Trade barriers will be reduced
  - All companies will target most affluent markets
  - Manufacturing/sourcing will migrate to lowest total cost alternatives scattered throughout the world
- To link worldwide operations, international logistics will be more important
  - Customer service fulfillment will be increasingly critical for market penetration
  - Logistics will become an even larger component of landed cost
  - Transportation will become increasingly more important within the logistics mix

Integrated global logistics will create a competitive advantage in the 1990's.

Implications of Free Trade for the Canadian Transportation Industry

by
Adil Cubukgil, Richard Soberman and Peter Yee
Transmode Consultants Inc.

1. Introduction

All modes of transportation were dealt with during the free trade negotiations but excluded from the final agreement. The so called "Transportation Annex", a document that received wide circulation in the U.S. but was not so readily acknowledged by the Canadian authorities, would have not only secured free trade in transborder markets but also created significant opportunities for the carriers of each country to draw on the domestic markets of the other. Whether this Annex was ever part of the original draft agreement, transportation is specifically excluded from the scope of the final accord.

Transportation was an important element in the negotiations not only because it facilitates trade but also because it constitutes a significant source of economic activity itself (representing 6.5% and 7.3% of GNP in Canada and the U.S., respectively). In principal, free trade in transborder transportation services is achievable with economic deregulation. This has been the case with marine transport, will be achieved in terms of truck transport as a result of already legislated changes, and remains an objective of bilateral negotiations in air transport. If included in the free trade agreement, the ongoing process of liberalization could have been accelerated in transborder markets, but more importantly, carriers of both countries could have secured significant opportunities in penetrating the domestic markets of each other. The latter is prohibited in the marine mode by the Jones Act, and in all other modes by immigration and customs statutes which restrict the mobility of foreign equipment and drivers for the purposes of domestic movements.

The purpose of this paper is to review key factors that affect the relative competitiveness of U.S. and Canadian carriers, and to assess market opportunities that could have been opened up through the free trade negotiations. The paper relies heavily on a previous study conducted for Transport Canada to assist the federal government in preparing its negotiating position during the negotiations.[1] Although the original study covered all five transportation modes (truck, rail, marine, air and bus), this paper deals with only those modes where the trade agreement could have made a substantial impact – marine, truck and air. In the case of rail, little could be achieved through free trade since access to new markets is basically constrained by existing infrastructure; further liberalization can be achieved only through regulatory means (e.g. by the U.S. government adopting the same competitive access provisions introduced by the new National Transportation Act in Canada). In the bus mode, little could be achieved through free trade until differences in economic regulations are resolved; major reforms are required in Canada prior to any free trade considerations.

2. Marine Transportation

A significant tonnage is involved in water-borne transborder commerce between Canada and the U.S. (about 72 million tonnes). The Great Lakes markets account for about 60% of this total, of which Canadian carriers have a very large share.[2] Canadian carriers also handle respectable tonnages on both Atlantic and Pacific coasts (probably more than half the total transborder movements); since other flags of registry also participate in these markets, the share attributed to U.S. carriers is relatively small. Although Canadian carriers already dominate transborder markets, they face significantly greater opportunities in the U.S. domestic trade with respect to both Great Lakes and coastal shipping (estimated at about 90 million and 300 million tonnes, respectively).

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[1] Transmode, A Study of the Competitiveness of Canadian and U.S. Transportation Under Free Trade, Transport Canada (1987)

[2] United States General Accounting Office, U.S. – Flag Share of the U.S./Canada Trade on the Great Lakes, (May, 1986).

The United States protects its domestic trade by requiring that all cargo moving between U.S. ports be carried by vessels that are domestically built and registered, as well as being owned and crewed by Americans. Canada also has some restrictions but does not require that the vessels be built in Canadian shipyards. (Foreign built ships entering the domestic trade, however, must meet Canadian construction standards and pay a 25% import duty). Furthermore, Canada does not place ownership restrictions on domestic trades, allowing Americans to own and operate Canadian vessels in Canadian domestic markets. During the free trade negotiations, various options could have been pursued to secure reciprocal market access, including full cabotage rights in the other country's coastal markets, restricted ports of call or ownership/ investment accessability. With full cabotage rights, Canadian vessels could carry cargo between any two U.S. ports and U.S. vessels could do likewise between Canadian ports, creating "head-to-head" competition between Canadian and U.S. fleets. Under these conditions, certain sectors of the Canadian shipping industry would do well while others might be vulnerable to competitive pressure.[3]

The strength of the Canadian carriers is evident in the Great Lakes where they operate more efficient vessels (i.e. seaway-sized bulkers and south-unloaders) and have a more competitive cost structure. The U.S. fleet is managed largely by captive owners who have difficulty utilising their vessels efficiently. It is evident that Canadian lakers will able to compete successfully in the U.S. Great Lakes market, particularly in the trades where seaway-sized vessels are involved. The U.S. Great Lakes market accounts for about ninety million tonnes annually. In the trades involving large U.S. lakers, Canadian seaway-sized vessels will be disadvantaged due to higher unit costs. The larger, more efficient vessels, however, belong to captive fleets whose owners are following a global trend of divesting their ships and beginning to rely on independent, more efficient shipping companies. This provides Canadian shipowners with a timely opportunity to invest in large vessels; they could only do this, however, if they were permitted to engage in U.S. domestic trades.

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[3] Peter Yee, The Competitive Position of Canadian and U.S. Coastal Fleets in a Free Trade Environment, Transport Canada, International Shipping Policy Branch (1987).

The Canadian fleet on the Atlantic coast, which handles primarily petroleum products and, to a smaller extent, resupplies to communities and off-shore rigs, is in a less secure position than the Great Lakes fleet. It appears that Canadian vessels are more costly to own and operate than U.S. vessels and, therefore, cannot be priced competitively. If this is the case, then Canadian vessels, particularly tankers, operating in the Atlantic coasting trade will be subject to competitive pressure. The tonnages that are at risk, however, are relatively small, about 8 million annually.

On the Pacific coast, British Columbia's towboat and barge industry will compete with the U.S. west coast operators. Both industries at the present time use union crews to man towboats, but a growing number of U.S. operators are using non-union crews as well. British Columbia's towboat and barge operators can compete with U.S. operators when the latter use union crews, but the cost advantage tilts towards U.S. operators when non-union crews are used. Although U.S. towboat operators with non-union crews will be able to price more competitively than Canadian operators, there is a problem with respect to equipment, since British Columbia's barge fleet consists primarily of log barges and chip barges. Thus, in the short run, British Columbia's barge industry may not face imminent U.S. competition. In the long-run, U.S. operators may decide to invest in log and chip barges but, in the meantime, British Columbia's barge industry may adjust to the new environment by reducing labour and other costs. The coastal market of British Columbia accounts for 19 million tonnes annually.

A variation on "cabotage" is a "restricted ports of call" scenario whereby the vessels of one nation could carry the cargo of another nation between any predetermined pair of ports in the other nation. The difference between this and "full cabotage" is the limited degree of geographic access available to each nation's shipping fleet. This option would give the Canadian fleet the opportunity to secure access to U.S. cargo between selected ports of call, while at the same time offer some protection for domestic markets from U.S. competition.

The significance of the "restricted ports of call" option is in terms of backhaul opportunities for transborder commerce. The Canadian laker fleet

has a growing number of vessels with ocean capability. At the present time, these ships are able to tie in the lake trades with ocean trades to maximize vessel utilization. For instance, a lake-ocean vessel could venture from the lakes to the maritimes to load gypsum and sail southward to a U.S. port to unload the cargo. The vessel could then proceed to another U.S. port to load up with phosphate rock and return to Canada. However, the tonnage of the U.S. bound movement would be much larger than that of the Canadian bound movement and, therefore, the vessel would return empty on most of the trips. With some access to U.S. coastal trades, the same vessel could improve the backhaul payload as it makes its way back to Canada by transporting bulk commodities, such as sulphur and sand and gravel, between two predetermined ports. This option could open up these and other trading opportunities, such as Alaskan oil on the West Coast, which are now not possible. The U.S. Atlantic coastal trade amounts to about 105 million tonnes annually, while the Pacific coastal trade amount to about 60 million tonnes.

Even without "cabotage", free trade negotiations could have helped correct the inequitable arrangement concerning the ownership of vessels by nationals of another country. At present, Canadians are not allowed to own U.S. shipping companies as ownership is restricted to U.S. citizens. However, Canada has no such restriction and U.S. nationals (as well as other foreign nationals) are allowed to own Canadian shipping companies. In addition, Canada allows U.S. built vessels to be flagged under Canadian registry subject to a 25% import duty while the United States does not allow Canadian (or other foreign yard) built ships to be registered for U.S. domestic trades. The free trade agreement could have enhanced "investment accessability" by removing the U.S. restrictions in order for both nations to achieve parity with regard to maritime investment and ownership opportunities.

This scenario has two important implications: first, Canadians could own U.S. shipping companies and operate the fleet in the domestic trades; and second, Canadians could transfer Canadian built vessels (i.e. existing assets) to U.S. registry. The first would allow Canadians the opportunity to invest in U.S. shipping companies at a time when shipping assets are undervalued as a

result of the depressed shipping market. Since shipping is a highly capital intensive industry, this opportunity would enable Canadians to acquire U.S. vessels at low cost before an upturn in the shipping market begins. With reference to the second implication, by allowing Canadian vessels to be transferred to U.S. registry, existing Canadian vessels would be able to ply on U.S. domestic trades. Since Canadian built ships have relatively lower capital costs (because of relatively lower yard prices), Canadian owned shipping companies in the United States operating Canadian built ships would have a cost advantage over U.S. vessels in U.S. domestic trades.

3. Truck Transportation

Canadian carriers earn about 14% of their total revenue from transborder operations; in Ontario (where almost 60% of international revenue is generated) this share is as high as 20%. Since 1980, Canadian carriers have enjoyed free entry to interstate markets in the U.S., and it appears that over this period they have increased their share of transborder business.[4] This trend has been due primarily to the success of large truckload carriers in expanding into new markets and taking advantage of rapidly growing southbound traffic. Although Canadian regulatory requirements still continue to inhibit the entry of American carriers, the largest general freight carriers have already gained access into major Canadian markets. Despite the overall shift in favour of the Canadian carriers, these large American carriers have increased their share of less-than truckload (LTL) business.

Under the recently enacted Motor Vehicle Transport Act, economic entry barriers across the border will be removed altogether over the next few years. Although the Act is not expected to have much impact on the structure and performance of the Canadian industry[5], economic deregulation will encourage the entry of new American carriers into transborder markets. Under increased competition, Canadian carriers' prospects will depend on

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4 A. Cubukgil, "Transborder Trucking between Ontario and the U.S.: An Assessment of Recent Trends", Canadian Transportation Research Forum Proceedings, June 1987, St. John's, Newfoundland, pp.582-596.

5 A. Cubukgil and R. M. Soberman, The Impact of Proposed Regulatory Reform on Extraprovincial Trucking, Transport Canada (December 1986).

their ability to retain their cost advantages and overcome some of the difficulties posed by market geography. With respect to the latter, the recent free trade negotiations provided significant opportunities through enhancing driver and equipment mobility.

A great deal of discussion during both the regulatory reform and free trade debates focussed on the cost competitiveness of Canadian carriers. The subject remains a controversial one but, even in the absence of detailed study and analysis, a number of general observations can be made. Although fuel costs are higher in Canada, Canadian carriers enjoy a linehaul cost advantage mainly due to labour costs that compare favorably to the U.S. industry standard at the prevailing currency exchange rate[6]. This advantage is particularly significant for truckload carriers that compete mainly on the basis of linehaul costs. In LTL markets, scale and network economies play a more important role, in respect of which the larger American carriers should command an advantage. Carrier size plays a smaller but nevertheless important role in truckload carriage as well, mainly in terms of marketing ability and dispatching efficiency. Large TL carriers in Canada, however, enjoy a longer tradition and more dominant market presence than their U.S. counterparts. They do not appear to be disadvantaged in any way compared to large American TL carriers, which are only newly emerging after the proliferation of TL markets by small carriers following deregulation.

Apart from operating cost and efficiency considerations, market geography has a significant bearing on the relative competitiveness of Canadian and U.S. based carriers in transborder markets. Compared to Canadian markets, American markets are more dispersed and shipping distances from the border much longer. The large American LTL carriers have extensive networks throughout the U.S. and can easily extend "single line" service to major Canadian centers, while the ability of Canadian LTL carriers to expand into the U.S. is more limited. Some Canadian carriers have been trying to expand their terminal networks in the U.S.; such expansion only becomes feasible with greater volumes of domestic traffic. At the present, U.S. domestic traffic can be handled only by American drivers and equipment. If

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6 Trimac, Comparative Cost Differentials Between Canada and U.S. Based Intercity Trucking Operations, Transport Canada (1987).

Canadian carriers could secure some "cabotage rights" (i.e. ability to use Canadian drivers and equipment for U.S. domestic traffic), they would have greater flexibility in integrating their operations. Although their ability to draw on U.S. domestic traffic would still be limited (since they could never duplicate the geographical coverage larger U.S. carriers offer), greater driver and equipment mobility would enhance their competitiveness.

Since truckload shipments do not generally require terminals, carriers are not constrained as much as LTL carriers by their networks or the traffic density they can generate in serving a particular area. On any particular lane, operating efficiency is largely dictated by the carrier's ability to minimize empty backhaul by balancing loads in both directions. In this respect, market geography poses a significant 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, for example, travel much shorter distances from the border to their destination. If they cannot find international traffic going back, they can return to the border 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 do not have the option of balancing this longer portion of their trip with U.S. domestic traffic. Neither can they reposition their equipment for a return transborder trip, a practice allowed under customs regulations but not immigration laws.

Some of the successful Canadian truckload carriers have tried to overcome this disadvantage by employing more U.S.-based drivers and vehicles, which clearly represents a loss of economic activity to Canada. If these carriers had the flexibility to use Canadian drivers in the U.S., they would have the added advantage of a more integrated fleet operation. Moreover, both driver wages and owner operator rates are more favorable in Canada. Canadian operators are preferred over their U.S. counterparts on grounds of reliability as well, probably due to the much longer history of the owner operator practice in Canada than in the U.S. For truckload carriers, therefore, there is a very strong case to be made in favour of labour and equipment mobility.

This mobility could be brought about by full "cabotage" rights, or partially, by achieving the same degree of flexibility for labour as currently exists for equipment. The ability to reposition equipment for the next international shipment would allow Canadian carriers to draw on U.S. domestic traffic for an intermediate backhaul shipment (e.g., to Buffalo), or more effective route triangulation (e.g., Toronto to Memphis, Tennessee to Atlanta, Georgia to Toronto).

Although enhanced equipment and labour mobility would favour Canadian carriers, there appears to be some reluctance on the part of the Canadian trucking industry to support the concept. The underlying fear is that in an attempt to enhance the Canadian carriers' operating flexibility in the U.S., Canadian domestic markets would be opened up to American carriers altogether. This fear stems from the belief that Canadian domestic markets are equally vulnerable to U.S. domination as transborder ones. It should be recognized, however, that east-west interprovincial markets are not mere appendages of the U.S. markets that they could be so easily penetrated by U.S. carriers. The fear of U.S. domination of intraprovincial markets is not warranted either. These markets are local in nature, and are very difficult to penetrate by non-resident carriers.

4. Air Transport

Transborder operations represent about 15% of passenger revenue earned by Canadian airlines. In 1986, Canadian carriers operated 38 transborder routes and American carriers operated 64 routes, accounting for 28% and 72% of total seats respectively.[7] There are significant differences between the transborder route structures of Canadian and American carriers. In addition to their non-stop service on high density routes, American carriers also operate a number of multi-stop routes that have short transborder connections to Canadian cities. The viability of these routes often depends on the availability and level of domestic traffic between intermediate U.S. cities. Since Canadian carriers cannot handle U.S. domestic traffic, they

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[7] Roger Roy et al, Free Trade and Transport Services, Canadian Transport Commission (1986).

cannot operate such routes; instead, they concentrate on non-stop service in conjunction with longer haul routes which have viable levels of origin-destination traffic.

Despite domestic deregulation in both countries, transborder services are still subject to entry and price controls through bilateral arrangements. Efforts have been underway since 1984 to liberalize the provision of transborder air services. The original Canadian proposal was to work towards an integrated North American system concept but through a staged approach, which would provide an opportunity for Canadian carriers to overcome their disadvantages with respect to size and route structure. The American counter-proposal was an "open skies" concept across the border, permitting any Canadian or U.S. airline to operate scheduled service from any point in one country to any point in the other. The recent free trade negotiations provided another platform to consider these and other options. In all cases, an underlying concern has been the competitiveness of each country's airlines from a cost standpoint, but the relative advantages or disadvantages of each scenario are based mainly on considerations of market geography.

A previous study had concluded that Canadian airlines had higher costs than what has been the trend for U.S. airlines of comparable size.[8] Comparison of the same average operating cost estimates at the prevailing currency exchange rate, however, suggests that in 1985 Air Canada and CP Air had lower costs than the major U.S. carriers operating on transborder routes (i.e. American, United, Eastern and USAir). There are, however, lower cost U.S. carriers that can become potential contenders for transborder routes. Although system-wide average cost estimates may not be entirely appropriate for assessing relative competitiveness of carriers on specific routes, the necessary data for a more detailed analysis are not available. In general, however, Canadian carriers do not appear to have an apparent cost disadvantage that would raise any serious concern about their ability to compete. Concerns pertaining to market geography, on the other hand, are more significant.

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8 William A. Jordan, Comparative Analysis of Airline Performance in Canada and the United States, York University (1987).

As noted above, American carriers operate a number of multi-stop routes that have short transborder connections to Canadian cities as the final leg of the journey. Under free entry, American carriers would find other opportunities to extend their multi-stop domestic routes to Canadian cities, most of which are close to the border. Alternatively, they could extend short-haul service to Canada from their own hubs near the border (which are, of course, fed with traffic from many other points on their network). Without the ability to draw on U.S. domestic traffic on multi-stop routes (or major U.S. hubs that they can feed from other points), Canadian carriers are confined to major routes which provide viable levels of transborder origin-destination traffic. However, they already have rights to most such routes where non-stop service can be justified. Thus, under free entry, Canadian carriers would be disadvantaged by geography, allowing American carriers to integrate transborder routes into their domestic system more easily.

Under an open and integrated North American system concept, this geographical disadvantage disappears. The entire U.S./Canada market would naturally be opened up to the carriers of both countries, allowing any carrier to operate from its own home-base without any immigration and customs restrictions in the other country. It was in recognition of the obvious geographical disadvantage of Canadian carriers that the integrated North American system concept was proposed during the bilateral negotiations in 1985. Although the concept was favoured by Canada as a long-term objective, however, the proposed approach was a staged one, providing an opportunity for Canadian carriers to overcome their disadvantages. Concerns underlying Canada's reluctance to move to an open system immediately and without any safeguards were twofold. First, without any adjustment mechanisms to allow Canadian carriers to consolidate their market position, it was feared that the much larger U.S. carriers could quickly take over principal Canadian markets. Second, without specific measures taken to facilitate their entry, it was feared that Canadian carriers might not be able to penetrate U.S. markets where access to major airports was seen to be hindered by capacity constraints.

Americans had very different concerns about a fully integrated North American system with "cabotage" rights. The concept has legislative

implications with respect to both immigration and customs, but more importantly, the U.S. government was (and continues to be) concerned about the multi-lateral implications of granting Canada "cabotage" rights. There are carriers from other countries who are seeking local traffic rights in the U.S. in order to be able to extend their trans-Atlantic or trans-Pacific routes. The bilateral trade negotiations provided an opportunity to discuss more limited cabotage options which would alleviate other multilateral concerns while, at the same time, dealing with concerns about Canadian airlines' ability to compete.

One option was to secure limited "cabotage" rights on extensions of transborder routes. If Canadian carriers were allowed to carry U.S. domestic traffic between U.S. cities en route to/from a Canadian point (i.e. a transborder route with an intermediate U.S. point), they could develop routes similar to those served by U.S. carriers. Although they would not have major hubs in the U.S. to draw on, they could at least have the opportunity to operate multi-stop routes with intermediate U.S. traffic. The drawback of partial cabotage is that reciprocal rights offered to American carriers might expose some of the domestic routes in Canada. If American carriers can successfully integrate Canadian city pairs (e.g. Toronto-Ottawa, Toronto-Montreal) into their transborder route structures, they will be able to expand on their transborder services (more cities and higher frequency) and at the same time, compete with Canadian carriers for non-stop service routes in Canada. While this may increase competition on such routes, it is not clear that American carriers would have any clear advantage over Canadian carriers that are already established on these routes. Moreover without preclearance in the U.S., the only way American carriers can mix transborder and domestic passengers on a Canadian route (e.g. Toronto-Montreal) is by clearing all transborder passengers at the first port, a practice which would obviously cause a great deal of inconvenience to continuing passengers.

Another version of restricted cabotage could have involved freedom to operate between any two points in one country through an intermediate point in the other. This would have allowed Canadian carriers to handle U.S. domestic traffic through a Canadian city, and American carriers to handle Canadian domestic traffic through a U.S. city. The advantage of this

scenario for Canadian carriers is the ability to tap the larger east-west traffic in the U.S. For example, by integrating its New York-Toronto and Toronto-San Francisco routes, Air Canada might be able to handle New York-San Francisco traffic. Given the added inconvenience of the detour through Canada, Air Canada is likely to capture only the price sensitive end of the market by offering discount fares, but at least the resulting increase in passenger volumes may allow the airline to increase flight frequency on the two transborder routes, which in turn will help to strengthen its competitive position. Taking advantage of the same freedom, American carriers might also be able to handle Canadian east-west traffic by offering lower discount rates through their major hubs near the border (e.g. Toronto-Vancouver traffic through Chicago); this is a concern that has been expressed by the Canadian airline industry.

The overall impact of this particular partial cabotage scenario is difficult to ascertain, since it is difficult to determine both the extent of east-west traffic (if any) that could be diverted through a point in the other country and the positioning by either country's airlines to take advantage of the new opportunities. It should be noted, however, that American airlines will not be able to capitalize on this opportunity without having preclearance at the intermediate U.S. stop (i.e. in Chicago for mixing transborder passengers with Canadian domestic passengers). Since Air Canada supported this scenario, the airline probably saw the potential gains in the U.S. to be greater than its exposure in domestic markets.

5. Conclusions

It is evident from the above discussion of all three modes that Canada has forgone significant opportunities by excluding transportation from the negotiated free trade deal. The ability to handle domestic movements (generally referred to as "cabotage" rights) would have improved Canadian carriers' competitiveness in transborder markets, as well as created new market opportunities. Although there has been some resistance from industry ranks (mainly from trucking associations), a free trade deal providing greater access to transportation markets would have definitely been

in the interest of the Canadian transportation industry.

In the marine mode, access to U.S. markets would have been a significant stimulus to Canadian shipowners at a time when the Canadian Great Lakes shipping market offers little prospect for growth. If Canadian carriers had "cabotage" rights, or at least opportunity to call at certain ports, they would have been able to participate directly in U.S. coastal trades. Alternatively, they could have benefitted from the removal of ownership restrictions by operating U.S. vessels or transferring Canadian vessels to U.S. registry. However, the U.S. lobby in support of the Jones Act proved to be too powerful to overcome during the trade negotiations. If the Canadian industry associations (e.g. Dominion Marine Association) were more organized and persistent in their lobbying efforts in both Ottawa and Washington, the outcome might have been somewhat different; at least, "investment accessability" might have been secured.

In truck transport, entry barriers to transborder markets are in the process of being removed. The balance of traffic will shift in the favour of new American carriers in LTL markets where they have a comparative advantage. New entrants will also create greater competition for the Canadian truckload carriers that have been expanding their market share in the last few years. Although these carriers are quite competitive in terms of their operating costs, they do suffer a backhaul problem due to market geography. The free trade initiative provided an opportunity to overcome this disadvantage, if in the process Canadian carriers could secure the freedom to handle U.S. domestic loads incidental to their transborder movements. Despite the resistance from some of the industry associations (which was somewhat puzzling and perhaps part of their overall strategy to slow down the process of economic deregulation), equipment and driver mobility would have greatly enhanced Canadian carriers' ability to compete under entry deregulation.

In air transport, market geography puts Canadian carriers at a serious disadvantage under an "open skies" concept that involves free entry to transborder routes without any "cabotage" rights. An integrated North American system concept, on the other hand, appears impractical due to multi-lateral implications. A more practical scenario might involve local

traffic rights on extended transborder routes, in other words, "limited cabotage". This would overcome Canadian carriers' geographical disadvantage, while putting them at little risk in their own markets, particularly in the absence of preclearance facilities in the U.S. The free trade negotiations provided an excellent platform to secure this arrangement but, failing that, there is at least the opportunity to pursue the matter through the bilateral negotiations, a convenient mechanism that does not exist with respect to other modes.

Free Trade and International Pricing Considerations in the Pacific Rim Aviation Market

by Daniel W. Akins and Karen L. Sackett

One prominent feature of airline deregulation in the U.S. has been the emergence of a complex array of fares under which the relationship between costs and fares has become obscured. Although deregulation was ostensibly designed to bring fares in line with costs, benefitting consumers and allowing only the most efficient carriers to survive, the most noticeable effect of deregulation has been the proliferation of a wide variety of fares and ticketing schemes. The lack of discipline in airline pricing today is not surprising given the industry's inexperience in pricing their services in an open and competitive market and the former fare assignments under regulation.

Formerly under regulation, the Civil Aeronautics Board (C.A.B.), in addition to determining routes, had the responsibility for setting airline fares to ensure that the airlines weren't taking unfair advantage of their quasi-monopoly positions and charging exorbitant fares. The C.A.B. accomplished its fare-setting tasks through Domestic Passenger Fare Investigations, which were essentially an application of a cost based formula designed to ensure all carriers serving a particular market could recoup costs and expect a reasonable level of profit.

A direct relationship between price, cost and reasonable levels of return is, however, no longer the rule in the industry, which recoups costs through sophisticated yield management programs designed to manipulate demand in order to cover costs. It is well recognized that the most successful carriers in the U.S. market have yield management programs which extract consumer surplus by segmenting the demand curve in accordance with the price sensitivity of the traveling public. The aim of this type of program is revenue rather than profit enhancement through the extraction of maximum revenues from the inelastic, typically business-oriented customers and stimulation of demand through lower fares targeted to the more price sensitive discretionary travelers. The key to successful yield management is to properly construct barriers to ensure that the high fare

customers don't slip into lower fare categories. The enforcing agent operating here is the somewhat confounding, often counter-intuitive advance purchase rules which accompany most lower fares.

Internationally, pricing is still governed by government-to-government agreements which contain capacity and pricing restrictions. The standard bilateral agreement governing airlines provides that "all rates to be charged . . . shall be established at reasonable levels, due regard being paid to all relevant factors, such as costs of operation, reasonable profit, and the rates charged by any other airlines as well as the characteristics of each service.[1] Under these bilateral agreements, fares must be accepted by both the governments of the originating and destination nation. In practice this means that airlines attempting to cut fares or improve service on international routes are often met by foreign government intervention to force the more competitive airline to align its policies with those of its own airline. The result is that the least efficient airline on a given route can dictate the level of fares and services and, in effect, bring its competitor down to its own level.

Despite the phasing out of regulation in the U.S. and other national markets, airlines have failed to adopt cost-related rather than demand-related pricing. In the deregulated U.S. environment this has resulted in the proliferation of predatory pricing practices, since fares not related to costs are often discriminatory. Proponents of airline deregulation in the U.S. initially argued that predation would not be a problem, since airline markets were perfectly contestable. Because of the mobility of airline capital equipment and the lack of production of economies of scale at the firm level, many economists mistakenly believed that victims of predation could simply withdraw their capacity from the market, refuse to operate below cost, then reenter once the competitor raised its prices.[2]

The number of economic casualties experienced by airlines following U.S. deregulation have, of course, lead to a major reexamination of contestability theory. More importantly, the U.S. experience with deregulation has caused other nations to be increasingly wary of deregulation of their own national markets. Current proposals by

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[1] A. U.S. Standard "Bermuda I" Agreement, Article 10, Paragraph A, February 16, 1981.

[2] Levine, Michael E., "Airline Competition in Deregulated Markets: Theory, Firm Strategy, and Public Policy," Yale Journal on Regulation, Vol. 4: 393, 1987.

the U.S. to extend free trade principles to the airline sector by bringing it under the auspices of GATT have also been greeted by a general lack of enthusiasm.[3] Many smaller nations oppose international deregulation because they fear the effects of free competition on their national carriers, often a symbol of national prestige. Opposition to international deregulation is misplaced, however, to the extent that its most probable feature would be the prohibition of predatory fares and the imposition of pricing discipline on all airlines operating across national borders.

If current trade talks continue to make progress on this front, the pricing of transportation services would be subject to the dispute mechanisms under GATT which are designed to prevent such unfair practices as predatory pricing, or "dumping." The practice of dumping -- or selling at a lower price in one national market than in another -- is prohibited under international and national laws designed to protect domestic industries who feel they have been injured by low priced foreign imports.[4] When engaged in intentionally, dumping is usually part of a larger scheme to secure a foothold in a foreign market. By selling abroad for a brief period at prices below marginal (but not necessarily average) cost, foreign competition may be eliminated and the dumper can raise his prices above marginal cost.

Firms engaged in continuous dumping, on the other hand, operate under the assumption that its costs over the long term will be cheaper if it manufactures a large number of items in order to realize maximum economies of scale. Since the overproduction might be a burden upon domestic prices, the foreign producer may wish to dump abroad permanently in order to maintain its domestic price structure. A sustained profit from the firms overall sales will thus be ensured for as long as the average prices charged customers exceed the average cost of production.

When dumping is unintentional, firms may unknowingly cross-subsidize markets, product lines or classes of customer, often due to a inadequate cost-accounting system. Although such charges are usually made with respect to manufactured goods such as semiconductors, more recently this terminology has been applied to airline pricing practices. Quantas, for example, has long

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[3] Feazel, Michael, "New GATT Negotiations Could Give Impetus to Airline Deregulation," Aviation Week and Space Technology, September 8, 1986, p. 58.

[4] See also Jacob Viner's classic study on dumping, Dumping: A Problem in International Trade, New York: Augustus M. Kelley, 1966.

complained that U.S. airlines dump excess capacity on their trans-Pacific routes. Quantas claims that such unfair practices have damaged its profitability, since the trans-Pacific route between Australia and North America is vital to its survival, but not essentially to the viability of United nor Continental.[5]

Because of the inherent instability of airline prices, the airline industry is particularly vulnerable to charges of dumping. Airlines have a great incentive to resort to marginal pricing since excess capacity (empty seats) cannot be inventoried for sale at a later time. The instant the flight attendant closes the cabin door on the aircraft the remaining capacity on each flight is lost. Since the short-run marginal cost of filling the seat and transporting one extra traveler is almost nil, the airline is better off selling the seat cheaply and earning some revenue than to let the seat go unoccupied. Thus, selling this excess capacity has the advantage of guaranteeing revenue from the portion of the aircraft which is usually remains unsold.

In order to prevent revenue loss, due sale of these discounted seats to travelers already prepared to buy higher priced seats, the airlines target only a select number of seats per flight at lower fares, and usually place restrictions on such sales such as advance booking requirements and cancellation fees. This phenomena, although rational from the airline's perspective, is somewhat contrary to free market pricing strategy.

Generally in markets where the supply of goods is completely perishable at a given time, the price a seller is willing to accept varies directly with the demand for the product in relation to supply, as well as the remaining shelf-life of the product. For an extended period prior to the point of perishability, demand and supply factors command most of the pricing considerations. Market price results from the interaction of the benefit of the product to the consumer at the cost of the product to the supplier. However, as the product approaches perishability, the seller would be expected to lower prices to market clearing levels so as to induce buyers to purchase the product before it perishes. The market force invoked is no longer the interaction of consumer benefit and supplier cost, but only on stimulating demand to attract some revenue from a product which would soon lose market value. In such an instance, cost to the supplier are no longer cost of production, but the unrealized revenue foregone should the supply not sell completely.

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[5] Stove, Vincent W. "Quantas Report A Record Profit Despite 'Dumping'", Journal of Commerce, August 7, 1987, p. 5B.

Day-old bread and holiday-related merchandise are good examples of products which experience such pricing phenomena. However, since both can be inventoried for later sale and thereby do not completely lose their value in an instant, price reductions aren't as drastic as would be expected, say, if bread were to spontaneously combust in twenty-four hours. In relation to airlines, one would expect the market supply of remaining empty seats on a particular flight to be offered for a pittance immediately prior to its departure when the commodity is effectively lost. Of course, if word got out that airlines were selling seats for a pittance immediately prior to departure, airlines could be expected to soon have very few advance bookings for their flights at higher prices, but would instead be swamped with unpredictable last-minute demand for seats at low fares. At least some of these last-minute travelers would have normally paid higher fares, thus the airlines revenue would not be maximized. The underlying concept here is that under U.S. deregulation, airlines have found themselves in a highly competitive market with the complete and continual perishability of its product.

Facing the differing price sensitivities of travelers and the lost revenue potential of unused seats on any given flight, airlines have decided to concentrate on demand stimulating and revenue maximizing pricing schemes in order to cover cost of operation rather than directly relating each passenger's fare to the cost of production. Since a seat on a given flight is essentially a homogeneous product, it is difficult from a cost standpoint to justify the vast differential of fares paid among passengers on any one flight. If the airline has done its yield management right, all persons will have paid just as much as the flight was worth to them and nothing less. Since the CAB is no longer in the business of restricting prices or market access, air carriers must cover cost and fend off competition through the myriad of fare offerings, advance purchase requirements, and cancellation fees. In this manner, the airlines attempt to cover the cost of supplying service and to extract a profit.

The fast-growing Pacific Rim market, with its fierce competition, is a likely arena for the type of fare wars seen in the Atlantic market in the early 80' s. Because of the diverse nature of airlines operating in the Pacific Rim, there is a wide range of expectation as far as profit levels. State-owned airlines, on the one hand, may seek only to break even. Other carriers want to expand into new markets to enhance national prestige. Still others have the ability to accept lower profitability on international routes since their domestic market is highly profitable.

Under the current system of bilaterals, Asian-Pacific carriers have so far been able to control the passenger market, with 59% of market share, up dramatically from 1960 when U.S. airlines controlled 70% of this market.[6] With higher than average employee productivity[7] and superior service,[7] Asian carriers should be able to effectively compete against those with larger operations. A major fear of Pacific Rim governments is that under international deregulation, air carriers with a bigger home market would have a competitive advantage over carriers with a smaller base. If, however, airlines were covered by the GATT the actual cross-subsidization of international routes would be inhibited be the dumping provisions.

Opponents of international deregulation fear that airlines with profitable domestic operations would have the ability to subsidize their less profitable international routes permanently, or at least until they were able to establish a presence in that international market. The emergence of hub and spoke system in the U.S. under which many airlines have established quasi-monopolies in regions surrounding principal traffic hubs may, in fact, increase the likelihood of such behavior since, under this system, profit levels have increased.

With official fares regulated by the existing bilateral agreements, pricing flexibility is somewhat limited. Airlines competing in this market, therefore, have resorted to illegal discounting of fares, since there is no effective enforcement mechanism to prevent such practices. This practice of "buying traffic" can clearly be seen when comparing commission rates paid for domestic and international travel. For domestic flights, U.S. airlines paid an average of 9.2% of their passenger revenues in commissions in the first half of 1987, considerably less than commissions paid in international markets. For the same period, U.S. airlines operating the Pacific Rim market paid an average of 25.4% of their passenger revenues[8] for commissions to travel agents.

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[6] Valente, Judith. "Flying High: Airline Market Grows Rapidly in Pacific Basin Despite Complex Rules," Wall Street Journal, February 26, 1988, p. 1

[7] Treitel, Daniel H. and Dean T. Smith, "The Pacific: Competition Heats Up Over the Ocean," Airline Business, January 1986, p. 20.

[7] "Rating the World's Airlines," Institutional Investors, June 1985.

[8] Source: U.S. Department of Transportation, Form 41.

Since not all airline tickets are sold through travel agents, these numbers are even slightly understated. Such efforts to buy into the Pacific market may very well constitute concealed dumping.[9] By setting pricing levels at equal levels but varying the terms of sale in each market, airlines may be concealing discriminatory pricing practices. The concealment of the dumping may not be due to deliberate design but may be merely an incidental result of different marketing strategy in the Pacific market.10

The question of whether U.S. airlines are subsidizing Pacific Rim fares with earnings from their domestic market and concealing dumping through different commission levels has provided an interesting case study in the application of the principles used in fair value analysis to airline services. In determining whether U.S. airlines are engaged in discriminatory pricing practices in the Pacific Rim market, we compared unit revenues, yield[11] per revenue ton mile, in the U.S. with those in the Pacific market. Measures of traffic for both passenger and freight, expressed in ton miles are publically available. Revenues per ton mile for either cargo or passenger traffic are calculated by simply dividing the respective revenue earnings by the respective ton-mile component. Operating costs can be allocated on the same basis according to ton miles, and it is customary to exhibit costs over capacity (available ton miles) rather than traffic (revenue ton miles). However, since we are attempting to examine profitability on a per-unit basis, it was required to state both revenues and costs in relation to the same base unit. Thus, unit costs are based on revenue ton miles in our analysis.

Initially, we set out to determine if average passenger and cargo unit revenues yielded a profit when

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[9] For a fuller discussion of this phenomenon, see paper given by John P. Carter at the Transportation Research Forum Annual Conference in Seattle in November 1986 entitled "Commissions and Discounts, Overrides and Vouchers."

10 Discounting is widely practiced by Asian airlines and ticket brokers. Virtually ignoring published fares, discounts of 35 to 40 percent are commonly offered in the Pacific market.

[11] Yield measures the average revenue obtained per available ton milw (ATM) or revenue ton mile (RTM). It is obtained by dividing an airline's total revenue by its total ATM or RTM. Revenue ton miles are obtained by dividing total revenue by total passenger and cargo miles.

compared to passenger cargo unit operating expenses in both domestic and Pacific markets. Since operating expenses are essentially joint and common costs, not explicitly distributed to a particular service, we distributed costs amongst passenger and freight operations according to the respective revenue share of each operation. As shown on Tables 1 and 2 (attached), carriers that fly both the Pacific and Domestic U.S. markets were analyzed for the most recent time span for which data was available; the first nine months of 1987. All carriers examined on domestic operations except continental have profitable unit cost/unit revenue relationships. In the Pacific, all U.S. carriers, except for the new Pacific entrant American Airlines, have similarly favorable unit profitability.

The weighted average of all carriers unit profits are positive for both cargo and passenger operations in both the Pacific and domestic environments. Revenues and costs per ton mile are higher in domestic operations for both passenger and freight than in the Pacific. This result could be attributable to the unit cost distance phenomena which tends to lower unit costs as distance increases. Over longer hauls, there is more distance over which to spread fixed costs. Since the average stage length (distance between takeoff and landing) is 2943 miles in the Pacific and only 680 miles domestically, the fixed costs associated with flight operations in the Pacific are spread over nearly five times as much mileage.

In a topical analysis of prices and costs, the distance taper explanation suffices, however, in a GATT pricing investigation, such effect must be eliminated so that prices and costs are free from extraneous impacts. Adjustments to the revenues of the home market operation must be made so as to equate them with international operations. In this instance the adjustment must be made to domestic revenues by applying domestic cost determining parameters such as stage length and capacity, to the Pacific.

To accomplish this we first performed an ordinary least square regression on cross-sectional data from Pacific Operations. The regression specification is as follows:

$$CRTM = a + b(SL) + c(AC) + u$$

Where;

CRTM = Operating Cost per revenue ton mile
SL = Stage length in miles
AC = Average aircraft capacity

The overall explanatory power of the regression was strong as evidenced by a high R-square value.

Pacific Passenger	CRTM = 94.21 + .011(SL)	- .112(CAP)	
	t-stat	(3.648)	(-1.054)
	R2 = 89.8		

A surprising result is the positive sign of the stage length coefficient which suggests that the unit cost distance taper isn't affecting Pacific operations in the manner in which one would expect. Effectively every additional 100 miles of stage length is estimated to add 1.1 cents to the unit costs of passenger operations in the Pacific. The results may be attributable to the somewhat abnormal Pacific operations of Continental Airlines, whose island hopping Micronesian operations limits its stage length to less than half the distance of any of the other U.S. Pacific competitors. Also Continental's labor costs are extremely low, giving them the lowest unit cost operations despite their relatively short stage length. Thus Continental's shorter-haul, lower-cost operations are likely to be the force undermining the distance taper in the Pacific.

Estimated Domestic Passenger Expense
Operated in Pacific

$$CTRM = 94.521 + .011(SL) - .112(CP)$$
$$83.9 = 94.521 + .011(680.6) - .112(161.6)$$

When average domestic stage length and capacity are inserted in the Pacific regression (as above) an estimate of unit cost (83.9 cents) for domestic operations in the pacific is obtained. The difference between this estimate of domestic unit costs as applicable in the Pacific and the actual domestic unit cost (101.5 cents - 83.9 cents) is used to adjust domestic unit revenues in order to equate them to Pacific operations. This procedure is shown on Table 3.

As can be seen from Table 3, revenues have also been adjusted to account for commission expense in each market. After these adjustments to domestic revenue have been made the price-to-price comparison of Pacific and domestic markets can be made. The unadjusted net domestic passenger price per RTM of 106.4 has been lowered by 9.79 cents (commission expense) and 17.6 cents (mileage and capacity adjustment) to yield a net price of domestic operations of 79.01 cents per RTM. After accounting for commissions expense, the Pacific market has an adjusted net price per passenger RTM of 77.36 cents. The 1.65 cent per RTM gap between domestic and Pacific operations is thus indicative of limited dumping by U.S. carriers in the Pacific market.

Ideally, fares used for such a comparison should be route- and company- specific, aggregate figures were used here for illustrative purposes only. Where company-specific figures have been used, they are intended to demonstrate the different experiences of established versus new entrant carriers in the market. Usually individual rather than average fares in each market are compared since, under most dumping laws, individual rather

than average prices must be at a fair levels. Use of averages prices, therefore, can substantially understate margins of dumping. Due to the temporary nature of the service being offered, however, use of average prices might be acceptable.

TABLE 1

PACIFIC REVENUE/COST ANALYSIS

Passenger Analysis

(in cents)

CARRIER	Pax Rev per Pax RTM 1/	Pax Cost per Pax RTM 2/
American	119.3	139.6
Continental	96.8	84.1
Delta	166.8	135.4
Northwest	100.3	89.7
United	108.3	103.0
Majors-PAC	103.7	98.3

Freight Analysis

(in cents)

CARRIER	Cargo Rev per Cargo RTM 1/	Cargo cost per Cargo RTM 2/
American	67.2	78.6
Continental	42.5	36.9
Delta	81.5	66.2
Northwest	41.4	37.0
United	74.7	71.0
Majors-PAC	50.7	39.6

1/ Source: U.S. Department of Transportation From 41.

2/ Cost Allocation based on revenue share.

TABLE 2

DOMESTIC REVENUE/COST ANALYSIS

Passenger Analysis

(in cents)

CARRIER	Pax Rev per Pax RTM 1/	Pax Cost per Pax RTM 2/
American	107.6	98.6
Continental	89.9	91.0
Delta	127.7	119.8
Northwest	113.2	109.7
United	97.5	94.0
Majors-PAC	106.4	101.5

Freight Analysis

(in cents)

CARRIER	Cargo Rev per Cargo RTM 1/	Cargo cost per Cargo RTM 2/
American	246.9	226.3
Continental	106.4	107.7
Delta	88.9	83.4
Northwest	57.7	56.0
United	92.4	89.1
Majors-PAC	108.0	103.0

1/ Source: U.S. Department of Transportation From 41.

2/ Cost Allocation based on revenue share.

TABLE 3

PRICE TO PRICE COMPARISON

(in Cents)

	Pacific	Domestic
Passenger Revenue Per RTM	103.7	106.4
Less Commission 1/	26.34	9.79
Adjustment for Mielage and Capacity	- - -	17.6
Net Price	77.36	79.01

1/ Commission expense = 25.4% Pacific, 9.2% Domestic.

NAVIGATION AND COMMUNICATIONS FOR ALL TRANSPORTATION MODES

Bill Law, Aviation Office
Joe Tsai, Transportation Technology and Energy Branch
Ontario Ministry of Transportation

INTRODUCTION

The Ministry of Transportation during the past few years has been promoting the use of radio aids to improve the safety and efficiency of all transportation modes.

The Ministry has modal offices for:

Aviation
Marine
Rail
Bus
Trucks
Municipal Transit

Although each of these offices has some radio navigation/communications activities underway, all have been influenced to some extent by the efforts of the Aviation Office.

I'm going to talk about the Aviation Office efforts in a minute, but first I want to mention the Canadian Radio Navigation Plan (CRNP) because it is also multi-modal and because of this it is going to have a major impact upon the future of all Canadian transportation modes.

Some of you may already be aware of the CRNP that is underway through the sponsorship of the Transportation Development Centre in Montreal.

The CRNP's primary aim is to propose a multi-modal navigation and communication system that will make the most efficient use of navigation/communication aids while at the same time recognizing the limited frequency spectrum available.

The plan of the CRNP is to prepare three studies, one each for air, marine, and ground surface. An advisory group, after analyzing all three studies, will propose the best benefit/cost navigation and communication system for Canada which will satisfy all transportation modes.

In the past, navigation aids have been designed for specific modal requirements. To give three examples:

- VOR's are strictly aviation navigation aids for the airways of the world.

- Omega is a long range navigation aid used both by airlines on overseas and polar flights, as well as by ships and submarines.

- Global Positioning System (GPS) which is a satellite navigation aid, will have many modal uses but even this navigation aid will have limitations on its use in mountainous and urban areas.

AVIATION OFFICE EFFORTS

Now let's look at the Aviation Office's efforts.

It's important to recognize that all transportation modes need navigation and communications at the surface of the earth. The needs of marine and ground vehicle users are obvious, but it may not be as apparent that the air mode also needs both communications and navigation from the ground up. It is a requirement for those small aircraft operators in the north of Canada who primarily operate unpressurized aircraft, and usually fly no higher than 2000 to 5000 feet.

These northern aircraft operators at present operate with an absence of, or a minimum of, navigation aids.

Because of this Ministry's concern with safety of operations for this particular group of aircraft operators, studies were funded, workshops were held, and the Canadian Airspace Review was attended in order to determine how best to address the concern for this particular operational requirement.

LORAN-C NAVIGATION AID

As a result of these efforts, it was found that only Loran-C could provide the operational requirement with a proven, existing, navigational system and most important, with relatively inexpensive receivers. Loran-C is a

land-based radio navigation system with master and slave transmitting stations.

It turns out that the advantages of Loran-C for the air mode have not gone unnoticed in the U.S. By the end of 1989 all of continental U.S. will be covered by Loran-C. You can see from Figure 1 that Canada will acquire free of charge, a good portion of coverage.

On this map you can also see the complete Loran-C coverage of the east and west coast and the Great Lakes. This was the Loran-C coverage provided, initially, only for marine users by the U.S. Coast Guard.

Because of the accuracy of Loran-C, it is to be used to provide approaches to about 6000 airports in the U.S. which otherwise would have no other means of obtaining an all-weather capability.

I have a very short video (about 3 minutes) which expands on the Loran-C airport approach program in the U.S.

The video mentioned that 40,000 aircraft in the U.S. were Loran-C equipped. This number is now more like 50,000 and growing at 1,000 per month. At this rate of growth it is apparent that by the time GPS navigation is approved for civil use, the smaller (or general aviation) aircraft fleet in the U.S. will be Loran-C equipped and should have no requirement for GPS receivers.

I must also mention, there is a very good probability that when GPS is approved for civil aircraft use near the year 2000, GPS will be "melded" with Loran-C to provide the aviation navigation system into the 21st century. Such a "meld" should provide a more accurate and reliable system than either navigation aid by itself.

It turns out that Loran-C can be the navigation answer not only to the air and marine modes but also to the ground surface mode; and I'll talk about this mode in more details in a few minutes.

PURPOSES OF RADIO AIDS

Now though, lets look at the two main purposes in using radio aids for navigation and communications.

First, it's to determine where you are and where you are going.

Second, and more important, it's to let other people know where you are. If you communicate your position to some remote control position, this is called "dependent surveillance". RADAR by comparison is "independent"

surveillance as it locates the vehicle (usually an aircraft) without any communication with the vehicle operator. Unfortunately most of northern Canada has no radar coverage.

It must be obvious that the paramount reason for using navigation and communication aids in both the air and marine mode is for the purpose of safety.

It may not be as apparent that the use of navigation and communications aids for the ground surface mode can also provide significant **safety** advantages.

Here are four examples:

- the monitoring of vehicles carrying hazardous material;

- recent rail accidents indicate that a more accurate knowledge of the location of each train certainly is required;

- off-road vehicle navigation and monitoring;

- the location of police, fire, and ambulance vehicles (I must mention that the cities of Detroit and Baltimore will each soon have about 1000 of these vehicles controlled from a command centre with the position of each vehicle continuously displayed on a map of the city.

Efficiency of operation is almost as important as safety and any means of saving travel time for any mode, saves money.

I can give you some specific examples for air mode:

- the concept of area navigation will eliminate the need for most of the present airways and where such airways continue they will be paralleled to reduce congestion and speed up operations. Studies indicates area navigation can save between 6% and 10% in direct operating costs. For any of you familiar with commercial aircraft operations, 1% in direct operating costs can mean the difference between a good profit or a sizable loss.

- the ability to fly parallel lines will be of significant benefit to aerial fire fighting, as well as aerial chemical and fertilizer spreading (to mention a few).

In the "dependent" surveillance mode, which as I just mentioned, is letting other people know where you are, the prospects are even more exciting from the potential savings to be achieved:

- the present radar could be eliminated with collision avoidance systems under the pilot's control rather a ground controller.

- search and rescue would be speeded up since aircraft position could be monitored at all times.

All these concepts save time and money as well, and for commercial aviation, both the traveller and shipper benefit.

Enough about the air mode and the benefits to it from the use of Loran-C!

GROUND SURFACE MODE

I would now like to talk about the ground surface mode and the trucking industry in particular.

One more mention of Loran-C though, for if we again look at the Loran-C coverage of Canada, Figure 1, you can see that within two years, you will be able to use the Trans Canada Highway from coast to coast using Loran-C all the way.

The ability to monitor from a control center the location of each vehicle in a fleet, has important implications for cost savings and safety of operations.

Studies on this concept, called Wide Area Vehicle Monitoring (WAVM), have been underway for some years at the Ministry.

TRUCKING INDUSTRY NEEDS

The use of just-in-time inventory system/concept by the shippers has turned a carrier's fleet on the highway or railway into a conveyer belt for the shippers and the manufacturers. For the just-in-time system to work properly, shippers have to track their freight movement regularly. This demand has prompted the carriers to computerize and to operate their fleet management and dispatch system in real time as much as possible.

Deregulation has also created a new breed of trucking companies which offer irregular route truckload service for intercity shipments. Under deregulation, the carriers, armed with the knowledge of where their trucks are likely to be, can perfectly match drivers and tractors and trailers and shippers to maximize the use of their equipment. This new wave of trucking operations has created a demand for the carriers to locate their trucks as required and to reach their drivers as needed.

If a trucking company has one or two tractor-trailers and operates in a small area, these types of operational problems may not be very serious. However, if a trucking company has hundreds or thousands of tractor-trailers and operate in a wide geographic area, the need to keep track of the trucks and coordinate overall fleet operation in real time becomes very urgent.

Furthermore, the introduction of the just-in-time transportation services by the industry also places a critical demand on the timing of goods delivery from the origin to the destination. Effective co-ordination for the just-in-time transportation service and other wide area trucking operations so that each truck and every driver is efficiently used to serve each customer's shipping demand will require the knowledge of the truck location and the ability to reach the driver at will in real time.

Unfortunately, these are the traditional problems that trucking companies face. These problems exist because the truck fleet operation covers a very wide geographical area and there is a lack of suitable vehicle positioning and communications technologies to serve the needs of the trucking industry.

WAVM CONCEPT

The Wide Area Vehicle Monitoring (WAVM) system is a combination of navigation and communications technologies. Utilizing the communications infrastructure provided by mobile satellites, and the vehicle positioning capability provided by either the navigation satellites - Global Positioning System, or the Loran-C land-based vehicle navigation system, the WAVM system will be capable of operating from coast to coast in North America. The system will provide real time truck location and identification information, and two-way message communication services between the equipped trucks and the trucking company's base station.

Many trucking companies consider the WAVM system an important missing link between their computerized fleet dispatch system and their trucks on the roadway. In

addition, other modern on-board electronic vehicle monitoring devices such as electronic trip recorder, speed control, weight control, etc., could be integrated with the WAVM system, and vehicle status information could be transmitted back to the truck fleet base station for management action.

Another possible extension of the WAVM system is to link with various traffic management systems in major corridor and urban centre areas to obtain important route traffic congestion information and to facilitate trucker's just-in-time transport control, dispatch and route control. Application of WAVM technology will bring about a major change and improvement in truck dispatching and management philosophies.

WAVM PROJECT

Recognizing the potential of the WAVM system technology and working in co-operation with trucking industry, and supplier industry, the Transportation Technology and Energy Branch of the Ontario Ministry of Transportation has organized a project group to facilitate the WAVM system applications in the truck fleet sector and to promote this new transportation market opportunity to the high technology industry.

The WAVM project group has evaluated various vehicle positioning and communications technologies for possible WAVM demonstration and has also defined the WAVM system operating requirements based on the participating trucking companies' needs and requirements. More recently, an interim WAVM demonstration scheme based on existing satellite channels has been adopted by the members of the project group.

Figure 2 shows the coverage area of the satellite-based interim WAVM system. In this system, the communications channels will be provided by the existing INMARSAT Marecs B (26 degree W) satellite. The vehicle positioning capability will be provided by the Loran-C receiver.

WAVM OPPORTUNITY

In addition to the potential applications in the trucking industry, WAVM systems may also be used by other land-based transportation sectors. Trucking is a big transportation business. The Canadian trucking industry is an $11 billion business, and the US trucking industry is a $200 billion business. More specifically, there are more than nine million commercial vehicles in the US and over half a million commercial vehicles in Canada. In addition,

the WAVM system technology can also be adapted and utilized by bus, rail, marine and air sectors.

To pursue WAVM-related high technology product market opportunities, the industry is encouraged to take the initiative to develop the WAVM equipment and system, based on the WAVM system operating requirements.

MINISTRY MODAL OFFICE EFFORTS

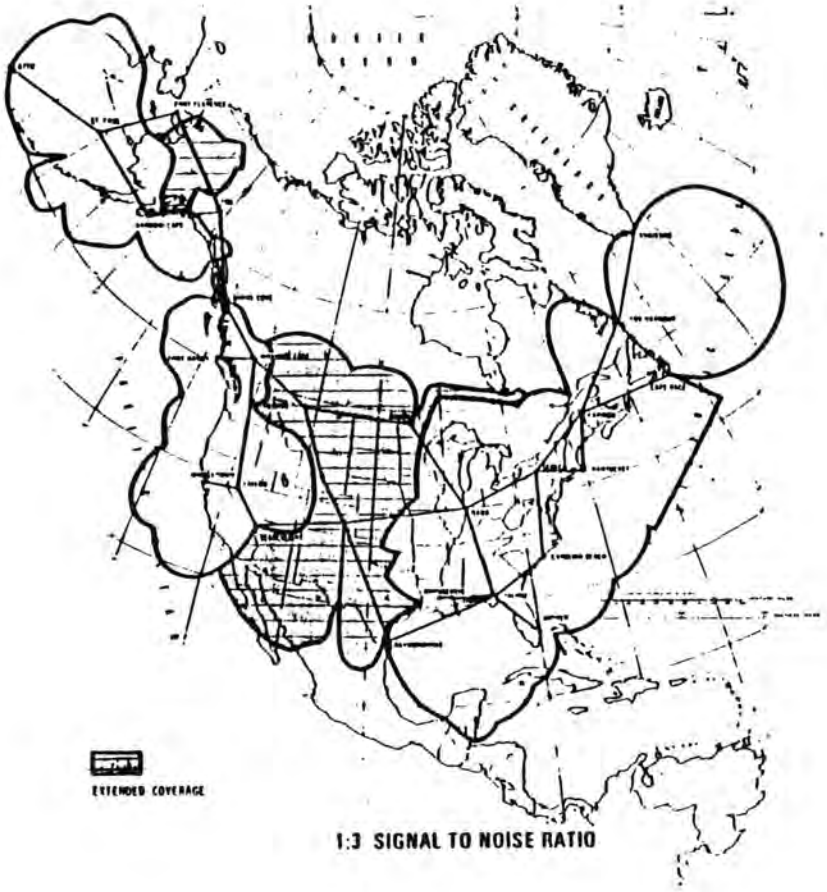
I mentioned that all the modal offices of the Ministry have some efforts underway to improve the safety and efficiency of their particular transportation mode. And without getting into any of the details of these studies, it is important to mention that all of these efforts revolve about a suitable means of vehicle position location from a remote control center.

I have also mentioned the Aviation Office's efforts to promote the use of Loran-C to provide the means of navigation for all transportation modes.

SUMMARY

In summary, I would again remind you of the importance of the Canadian Radio Navigation Plan as it will impact upon all transportation modes.

And finally, I would just re-emphasize that this Ministry is making significant efforts to improve the safety and efficiency of all transportation modes by promoting the use of specific navigation and communication aids.



LORAN-C COVERAGE

Fig 1

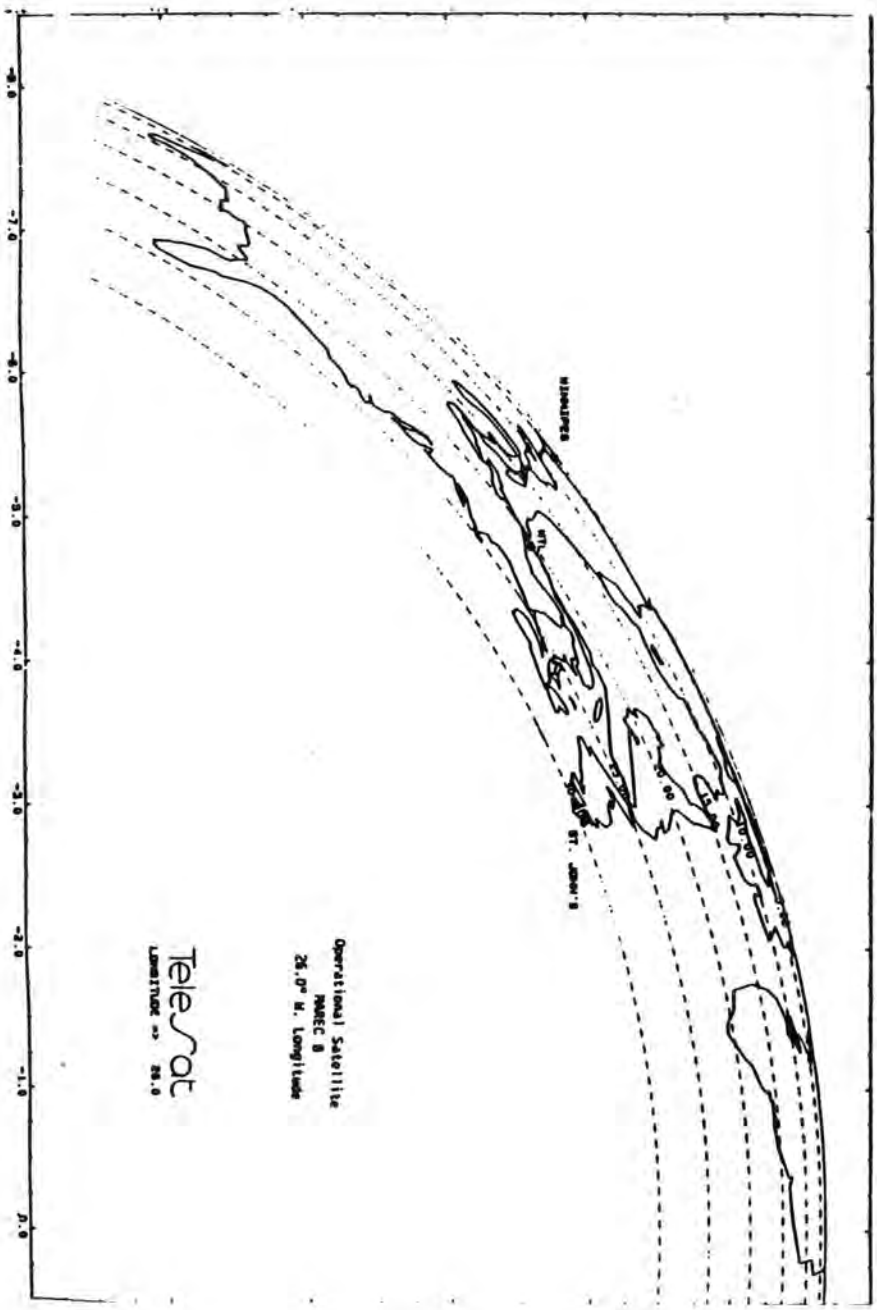

Operational Satellite
HARLEC B
28.0° W. Longitude
Telesat
LONGITUDE => 28.0

Fig 2

Système de prévisions des mouvements des navires

Résumé
L'analyse et la prédiction des mouvements de navires constitue un champs d'analyse qui a été peu abordé au Canada. L'objectif de ce rapport est de rendre compte des efforts qui ont été effectués par la Division des Statistiques et prévisions (Surface et marine) de Transports Canada pour développer et rendre opérationel un modèle qui relie les flux de marchandises aux mouvements de huit types de navires sur les voies navigables du pays.

Problématique

Le ministère fédéral des Transports exerce un rôle prépondérant dans le secteur maritime, non seulement en fonction des activités de la Garde Côtière et des ports qui sont sous son contrôle, soit les ports et havres disséminés à travers le pays, mais compte tenu aussi des sociétés de la Couronne qui relèvent du Ministre des Transports, soit la Voie Maritime, Ports Canada et les administrations régionales de pilotage. La formulation des politiques dans le transport maritime relève aussi du Ministère.

Pour seconder ces diverses fonctions, le Ministère s'est jusqu'à maintenant basé sur les prévisions des flux de marchandises qui sont reflétées dans la publication annuelle du ministère: Prévisions du volume des passagers et des marchandises. Ces prévisions avaient deux lacunes. D'une part, la ventillation géographique des prévisions n'était pas élevée, ce qui rendait difficile l'utilisation des prévisions à des fins opérationnelles où l'aire géographique doit être définie d'une façon plus précise. D'autre part, l'autre lacune concernait les mouvements de navires qui représentent une composante essentielle du trafic maritime au pays.

Nous avons entrepris au ministère de corriger ces lacunes. Dans une première étape[1], nous avons exploré la possibilité de relier à un niveau spatial relativement aggrégé les flux de marchandises aux mouvements de navires. C'était la première fois qu'au Canada une étude à l'échelle nationale s'attaquait à ce problème. Cet exposé vise à monter la suite qui a été donnée à ces travaux préliminaires à l'intérieur du ministère et au Centre de recherche de l'Université de Montréal[2] à la suite d'un contrat de services passé par Transport Canada. Dans un premier temps, nous allons exposer la méthodologie suivie et, dans un deuxième, présenter les résultats disponibles.

Nous allons conclure sur les phrases prévues de développement d'un système complet de prévisions des mouvements de navires.

Partie I - La structure du système de prévisions

L'élément clé du système de prévision demeure la prévision des flux origine-destination des marchandises. Compte tenu de peu d'homogénéité du trafic maritime par marchandises, l'analyse et la prévision des flux de transport maritime doivent s'effectuer à un niveau désaggrégé. Le système actuel de prévisions couvre 35 marchandises individuelles qui représentent quelque 88% du trafic marchandises aux ports Canadiens. Chaque marchandise est analysée en fonction des facteurs spécifiques d'offre et demande qui l'affectent et des flux de transports issus de l'interaction de ces facteurs. Diverses sources de variables exogènes sur les capacités de production, la demande, les exportations, etc., sont utilisées; à titre d'exemple, mentionnons Commodity Research Unit pour plusieurs minérais, Wharton Econometric Forecast and Associates pour les céréales et l'industrie de l'acier, Data Research Incorporated pour le pétrole et les produits pétroliers, Informetrica, et des contacts auprès de l'industrie canadienne. Le trafic conteneurisé qui représente quelque 3% du trafic maritime canadien est l'objet d'analyses spéciales, ce qui laisse moins de 9% du trafic dans une catégorie résiduelle qui est prédite à l'aide d'indicateurs économiques aggrégés, tel que des variables d'exportations/importations de produits finis vers les pays d'outre mer. La liste des marchandises analysées individuellement est produite en annexe.

Dans sa conception présente, le système des prévisions des flux de marchandises engloble les secteurs du trafic intérieur, transfrontalier (Grands-Lacs et reste des États-Unis) et océanique. Les nodes du trafic intérieur sont, soit des provinces (Terre-Neuve, Québec, Ontario, Colombie Britannique, Manitoba), soit des régions (provinces maritimes et Territoires du Nord-Ouest). L'avantage du choix de ces nodes intérieurs vient principalement de la plus grande disponibilité des données à l'échelle provinciale ou régionale sur l'offre et la demande des marchandises sur lesquelles se fondent l'analyse et la prévision de flux de marchandises.

Le choix d'une méthodologie appropriée s'est posé pour la conversion des flux de marchandises en mouvements de navires. Une approche classique d'optimisation, qui est utilisée dans la planification tactique du transport par camionnage ou par voies ferrées et qui sert de fondement aux prévisions des mouvements d'aéronefs du ministère des Transports, semble peu applicable au problème qui nous

concerne. Les mouvements de navires sont produits par des interventions si complexes entre une multitude élevée de transporteurs et d'expéditeurs pour l'acheminement de produits qui sont loins d'être homogènes qu'il est peu réaliste de vouloir reproduire les mouvements de navires à l'aide d'un modèle qui optimiserait le rendement global du système. Le recours à une approche descriptive à l'aide de séries chronologiques nous est apparu préférable, à partir de l'hypothèse que les mouvements des navires du passé reflètent intrinséquement une certaine optimisation du système. Il s'agit donc au niveau des prévisions du système de reproduire cette solution optimale en tenant compte des structures changeantes du trafic maritime, soit au niveau des marchandises transportées, soit au niveau des paires origine-destination. D'autres facteurs, tels les changements dans la taille des navires[3] sur certaines routes maritimes, peuvent être imposés sur la solution initiale produite par le modèle.

Avant d'aborder la méthodologie proprement dite de conversion des flux de marchandises en mouvements de navire, il est important de définir les concepts utilisés dans le système de prévisions des mouvements de navires.

Concepts

(1) Mouvements de navire: Dans le cadre du système, un mouvement de navire est défini comme un mouvement d'un port à un autre. Un voyage à plusieurs escales par le même navire comprend autant de mouvements qu'il y a d'étapes.

(2) Mouvement indirect vs mouvement direct: Un mouvement avec cargaison est considéré comme un mouvement direct quand les ports d'origine et de destination sont les mêmes pour les flux de marchandises et les mouvements de navires. A titre d'exemple, un mouvement de navire transportant des céréales entre Thunder Bay et Baie Comeau sera direct, si le navire ne fait pas escale dans un port de la Baie Georgienne en Ontario ou à un autre port au Québec. A l'inverse, si le navire en partance de Thunder Bay décharge des céréales d'abord au port de Midland puis à Montréal et finalement à Baie Comeau, un tel voyage va donc produire trois mouvements dont seulement un sera direct et les deux autres sont indirects. Dans notre système, ces mouvements indirects sont transformés en mouvements directs ayant comme origine le port intermédiaire d'arrivée. Quoi que les ports intermédiaires d'arrivée deviennent des ports d'origine dans le système de prévisions, les flux de marchandises continuent d'être exprimés en fonction des flux du port d'origine.

Deux points particuliers sont à noter quant aux mouvements de navires entre les ports canadiens et les ports d'outre-mer. D'une part, un grand nombre de mouvements de navires entre les ports de la Colombie Britannique et les pays d'outre mer sont impliqués dans les déplacements triangulaires avec les ports de la Côte-ouest américaine, ce qui donne un nombre très élevé de mouvements de navires entre les deux pays, qui est sans commune mesure avec le trafic de marchandises entre les deux pays. D'autre part, la portion intérieure des mouvements de navires avec les ports des pays étrangers est considérée comme un mouvement intérieur. Pour éviter le double compte des mouvements, on n'a tenu compte que des arrivées (via le Canada) et on a exclus les départs (via le Canada).

(3) Cargaison mixte: Plus d'une marchandise peut être transportée dans un même navire. Nous avons inféré une mesure abstraite, appelée, unité d'équivalence de cargaison complète (UEC) qui est exprimée comme le pourcentage d'une marchandise donnée dans la cargaison totale d'un navire. A titre d'exemple, si le total des marchandises chargées sur un même navire est de 100,000 tonnes, dont une partie (60,000 tonnes) est du blé et l'autre (40,000 tonnes) de l'orge, l'UEC sera de 0.6 pour le blé et de 0.4 pour l'orge.

(4) Mouvements avec cargaison ou sur lest: Si un navire transporte une marchandise, son déplacement en est un avec cargaison. Si le navire ne transporte pas de marchandises, il est réputé être sur lest. Compte tenu de cette qualification, la plupart des mouvements de bateaux-passagers, chalutiers et de traversiers sont définis comme étant sur lest.

L'élaboration du modèle de prévision

A partir de l'enquête de Statistiques Canada sur le cabotage et la navigation internationale, nous avons dérivé des matrice origine-destination de chacune des marchandises analysées pour les années 1983 à 1986. Ces mêmes flux furent ensuite ventillés selon le type de navires utilisé; notre base de données segmente les navires suivants: porte-conteneurs, navire-citernes, bateaux-passagers, chalutiers, traversiers, chalands et péniches, remorqueurs et autres navires de fret. Au moyen d'une application matricielle, les mouvements de navire pour chaque type de navires furent liés aux marchandises qu'il transportaient, non seulement en fonction des paires origine-destination, mais aussi en fonction des escales intermédiaires.

Finalement, nous avons dérivé une autre matrice de mouvements de navires sur lest.

Mouvements de navires avec cargaison. La prédiction des mouvements de navires avec cargaison est fondée sur les prévisions de flux origine-destination des marchandises comme principale variable indépendante et des coefficients calculés à partir des séries chronologiques. L'approche suit la séquence suivante:

(A) Répartition future du trafic par types du navires

Pour chaque marchandise et chaque paire d'origine destination, on pose que la part du trafic dévolue à chaque type de navire pour la période prédite sera déterminée par l'expérience passée. La répartition du trafic se fera en fonction d'une moyenne pondérée de la part de chaque type de navire au cours des quatre dernières années. Pour donner plus de poids aux données récentes, une règle de répartition géométrique des poids de chaque année a été établie. Cette règle apparait au tableau I, ci-contre.

Tableau I
Règle de répartition géométrique

Année	N=4	N=3	N=2
1	0.0724		
2	0.1396	0.1607	
3	0.2692	0.2956	0.3820
4	0.3188	0.5437	0.6180

La procédure de répartition du trafic par types de navires ne sera pas suivie pour les bateaux-passagers où le transport des marchandises fut moins d'un kilotonne au cours des deux dernières années. Pour la période de prévision, on présumera que le transport de fret par ce type de bateaux continuera d'être négligeable, i.e. égal à zéro. Les chalutiers ont transporté en moyenne quelque 48 kilotonnes de fret au cours des trois dernières années. Essentiellement, ces bateaux ont transporté des marchandises inclues dans la catégorie résiduelle qui comprend les produits du poisson. Compte tenu de la stabilité du trafic, nous avons supposé que le volume de marchandises transportés au cours de la période de prévision serait équivalent au volume de 1986, i.e. 49 kilotonnes et qu'il serait dans la seule catégorie résiduelle. En vertu de cette hypothèse, le nombre de mouvements de chalutiers avec cargaison sera donc égal au cours de la période de prévision au nombre de mouvements de chalutiers ayant transporté des marchandises résiduelles en 1986. On a suivi une approche

similaire pour les fret transporté par traversiers où le volume de trafic et les mouvements de navire avec cargaison sont au cours de présumés être égaux aux niveaux de 1986. Le faible volume de trafic transporté, moins de 200 kilotonnes en moyenne par année, et l'instabilité du nombre de mouvements de navire justifient cette hypothèse.

La règle de répartition future du trafic marchandises par les autres types de navire en fonction des tendances passées est fondée sur la relative stabilité de la part de chaque type de navires dans le trafic maritime au cours des années passées, comme en fait foi le tableau suivant.

Tableau II
Répartition du volume des marchandises transportées par types de navire, 1983 à 1986:

	1983	1984	1985	1986
			en %	
Navires de fret	75.5	77.4	76.0	76.3
Navires citernes	10.7	10.7	11.2	10.9
Porte-conteneurs	1.8	1.9	1.8	2.2
Chalands et péniches	12.0	10.0	9.5	9.1
Remorqueurs	(1)	(1)	1.6	1.5
Total (MMtonnes)	248.5	273.7	265.5	266.8

Source: Rubans magnétiques de transport maritime. (Statistiques Canada)
(1) Non disponible en 1983 et 1984, mais inclus avec les chalands et péniches.

L'autre facteur est la spécialisation des navires en fonction de certains types de trafic; produits pétroliers pour les navires citernes, les conteneurs par les porte-conteneurs et le transport des billes de bois en Colombie-Britannique par les remorqueurs, chalands et péniches.

(B) Détermination du chargement moyen futur pour chaque type de navires

Sur chaque paire d'origine-destination, nous allons poser que le volume de chaque marchandise individuelle transportée par chaque type de navires ne changera pas d'une façon significative du volume moyen observé au cours des années récentes. Cette hypothèse repose d'une part sur l'évolution passée de la flotte

intérieure qui ne montre pas de changements significatifs dans la jauge brute moyenne depuis 1981, selon le tableau ci-contre. Compte tenu de la situation du marché intérieur, il est peu probable que plusieurs nouveaux navires s'ajouteront à la flotte actuelle.

Tableau III
Jauge moyenne de la flotte marchande intérieure
1981 et 1985

	Vraquiers	Pétroliers	Cargaison générale	Total
	- tonneaux de JBR -			
1981	14603	6869	4155	11480
1985	16626	7695	4292	13289

Source: Dominion Marine Association

D'autre part, le Canada compte sur les flottes marchandes étrangères pour son commerce maritime avec le reste des États-Unis et le reste du monde. La flotte océanique mondiale de vracquiers demeure toujours affectée par un fort taux d'inutilisation de capacité qui va de 22% pour les navires-citernes à 32% pour le transport des marchandises sèches. Le renouvellement de la flotte se fera au cours des prochaines années autant par la mise au rancart de navires obsolescents que par l'entrée en service de nouveaux navires. Selon les données fournies par Drewry Shipping Consultants[4], la taille moyenne des navires-citernes pourrait diminuer de 5 000 tonneaux au cours des 5 prochaines années tandis que celle des autres vracquiers pourrait augmenter au maximum de moins de 6 000 tonneaux. Ces niveaux de changement ne seraient pas suffisants pour affecter de façon significative la taille des chargements de navires océaniques.

Le volume futur de cargaison unitaire par type de navires, pour chaque marchandise et chaque paire d'origine-destination fut estimé en compilant pour chaque année le chargement unitaire correspondant à chaque paire d'origine-destination et chaque marchandise. Les données de chaque année furent pondérées selon une règle de répartition géométrique pour donner plus de poids aux années plus récentes.

Le calcul des mouvements futurs de navire par paire d'origine-destination, par marchandise et par type de navires se présente sous la forme mathématique suivante:

$$V^{k}_{s,ij,91/96} = \sum_{1}^{4} \frac{(F^{k}_{s,ij,t})(Wgt)(F^{k^1}_{ij,91/96})}{(F^{k^1}_{ij,t})} \Bigg/ \sum_{1}^{4} \frac{(F^{k}_{s,ij,t})}{(V^{k}_{s,ij,t})}(Wgt)$$

où

- $F^{k}_{s,ij,t}$ est le trafic de la marchandise "k" transportée par un type de navires "s" au cours des quatre dernièrers années, sur chaque paire d'origine-destination "i" et "j".

- $F^{k^1}_{ij,t}$ est le trafic de la marchandise "k" au cours des quatre dernières années sur chaque paire d'origine-destination. $F^{k}_{ij,t}$ exclue le fret transporté par les traversiers, les bateaux-passagers et les chalutiers.

- $V^{k}_{s,ij,t}$ représente le nombre de mouvements de navires d'un type "s" entre l'origine "i" et la destination "j" pour transporter la marchandise "k".

- Wgt est le coefficient de pondération accordé à chaque année observée.

- $F^{k^1}_{ij,}$ 91/96 est la variable exogène du modèle de prédiction des navires. C'est le flus prédit du volume de la marchandise "k" sur chaque paire d'origine "i" et destination "j". F^{k}_{ij} exclue le niveau de prévision du volume des marchandises transportées par les traversiers et les chalutiers qui a été fixé à celui de 1986.

Il est à noter que:

$\sum \frac{(F^{k}_{s,ij,t})}{(V^{k}_{s,ij,t})}$ (Wgt) a été remplacée par $(F^{k}_{s,ij,}/V^{k}_{s,ij})$, 86 si cette dernière valeur, soit la cargaison unitaire moyenne de 1986, s'est avérée supérieure à la cargaison unitaire pondérée des quatre dernières années. En outre, ce n'est que depuis 1985 que les navires de type remorqueurs et chalands sont différenciés. Nous avons d'abord calculé sur base des quatre années la part du trafic transportée par les deux types de navire et reparti ensuite le trafic entre les deux types de navire en fonction des données des deux dernières années en choisissant le plus haut coefficient observé pour les chalands et péniches.

Mouvements des navires sur lest: La procédure retenue comporte trois phases. Dans la première on standardise les valeurs observées de mouvements de navires sur lest. En effet un système d'équilibre des mouvements de navire aux ports canadiens exige que le nombre d'arrivées soit égal au nombre de départs de navires à chaque port. Or si au niveau global les séries chronologiques ont tendance à s'équilibrer, au niveau de chaque région, des distortions ont tendance à s'introduire. On a entrepris de corriger ces distortions en utilisant une solution de programmation linéaire qui minimise le nombre de mouvements de navire sur chaque paire d'origine-destination à ajouter pour en arriver à une solution d'équilibre. Par définition on ne peut ajouter que des mouvements de navire sur lest. La solution d'équilibre est atteinte sur chaque région "i", quand

$$\sum_{j=1}^{N}(V^{C}_{s,ij}+V^{B*}_{s,ij})=\sum_{j=1}^{N}(V^{C}_{s,ji}+V^{B*}_{s,ji})$$

où

$V^{C}_{s,ij}$ et $V^{C}_{s,ji}$ sont le nombre total de mouvements de chaque type de navire "s" avec cargaison, sur chaque paire d'origine-destination

et

$V^{B*}_{s,ij}$ et $V^{B*}_{s,ji}$ sont le nombre total de mouvements de chaque type de navires "s" sur lest qui équilibre le nombre de départs et d'arrivées sur chaque paire d'origine-destination.

Il faut retenir de cette méthode de standardisation qu'elle ne s'applique pas aux éléments de la ligne diagonale i.e. aux mouvements de navires intra-régionaux et que l'équilibre des déplacements de navire entre le Canada d'une part et d'autre part le reste des États-Unis et le reste du monde se fait avec l'ensemble des ports de ces deux régions, compte tenu de la triangulation des mouvements de navire avec ce deux régions. En outre, des ajustements ont dû être imposés sur les données de mouvements de navires de type remorqueurs, chalands et péniches pour 1983 et 1984 et pour les déplacements de navires de fret et de traversiers aux ports de Terre-Neuve en 1983.

Tableau IV
Niveau d'ajustement apporté aux mouvements sur lest, 1983 à 1986

Année	Observés	Corrigés	Augmentation	% Augmentation
1983	39606	43785	4179	10.55
1984	35788	36530	742	2.07
1985	40679	41214	535	1.32
1986	42597	43045	552	1.05

Sources: Rubans magnétiques du transport maritime (Statistiques Canada) et Transports Canada.

Le tableau IV plus haut, indique que, sauf 1983, la standardisation des séries chronologiques amène peu de variations par rapport à celles-ci. En outre, le pourcentage d'ajustement baisse d'année en année.

Le tableau V plus bas, montre le niveau d'ajustement requis par types de navires en 1986. Il est le plus élevé pour les navires-containeurs (moins de 3%), les navires-citernes et les chalands et péniches (2%).

Tableau V
Mouvements de navires sur lest observés et standardisés et par types de navires, 1986

	Observés	Standardisés	Ratio
Porte-conteneurs	171	176	1.029
Navires-citernes	2 156	2 199	1.020
Navires de passagers	607	615	1.013
Traversiers	16 086	16 241	1.010
Navires de pêche	482	488	1.012
Chalands et péniches	317	3 234	1.020
Remorqueurs	5 982	6 032	1.008
Autres navires de fret	13 942	14 060	1.008
Total	42 597	43 045	1.011

Dans la deuxième étape, on calcule une première approximation des mouvements sur lest en fonction de la prédiction de mouvements de navires avec cargaison et de coefficients établis à partir des séries chronologiques de mouvements de navires sur lest standardisés. Ces coefficients sont essentiellement des moyennes historiques pondérées des ratios des mouvements sur lest dans une direction sur les mouvements avec cargaison dans l'autre direction. Pour les remorqueurs, l'approche a été légèrement modifiée pour tenir compte de leur rôle qui consiste à tirer des chalands et péniches.

Tableau VI
Arrivées et départs des mouvements de navires sur lest en 1986: standardisés et prédits

	Arrivées			Départs		
	Standard-iséés	Prédites	% D'écart	Standard-isés	Prédits	% D'écart
T-N	1405	1432	1.92	1305	1332	2.07
Mar	412	503	22.09	1856	1947	4.90
Qué	2768	2587	-6.54	3293	3112	-5.50
Ont	2284	2421	6.00	1952	2088	6.97
Pra	1	1	0.00	19	19	0.0
C-B & Terr	1689	1844	9.17	3088	3243	5.02
É-U-GL	933	1042	11.68	1384	1493	7.88
É-U-A & RDM	4757	4887	2.73	1353	1482	9.53
Total	14249	14715	3.27	14249	14715	3.27

Source: Rubans magnétiques de transport maritime (Statistique Canada) et Transports Canada.
Rem: Le test n'a pas été effectué sur les mouvements de chalutiers, les bateaux-passagers et les traversiers, puisque les mouvements de ces navires dans la période de prédiction sont par hypothèse égaux à ceux de 1986.

La prédiction de mouvements sur lest semble donner des résultats vraisemblables à court terme. Le nombre de périodes observées est peut-être trop court pour émettre l'hypothèse que les coefficients utilisés sont robustes à long terme, bien que la solution de programmation linéaire assure à tout le moins une certaine cohérence aux prédictions. A mesure que d'autres séries chronologiques s'ajoutent aux séries déjà utilisées, on pourra tester de façon plus sûre la stabilité des coefficients ou déterminer les facteurs de variation.

Partie II - Résultats

Faute d'espace, nous allons limiter la présentation[5] des résultats obtenus du système de prédiction des déplacements de navires.

Tonnage du trafic maritime

De 1986 à 1996, une croissance annuelle moyenne de 1.1% des flux de marchandise est prévue, à comparer à 2.4%

annuellement entre 1983 et 1986. Par contre le volume de trafic atteint en 1996 ne serait que de 4.6% supérieur au volume du trafic en 1981 et même inférieur de 0.9% à celui de 1979. En outre 60% de la croissance prévue jusqu'à 1996 viendrait d'une forte croissance attendue des flux maritimes des céréales, ce qui laisserait une croissance de 0.6% par année pour le trafic maritime des autres marchandises. Le tableau VII, ci-contre, présente des résultats sommaires des prévisions de flux de marchandise selon différents secteurs d'activité.

Tableau VII
Tonnage du trafic maritime; 1983,1986,1996

	1983	1986	1996
	en millions de tonnes		
Trafic intérieur	70.2	60.4	75.8
Trafic avec les G.-L. américains	30.5	35.4	38.2
Trafic avec le reste des É-U	20.1	32.9	33.5
Trafic avec le reste du monde	119.9	138.3	150.4
Total	248.7	267.1	297.9

Source: Rubans magnétiques du transport maritime (Statistiques Canada) et Transports Canada

Les mouvements de navires:

Depuis 1983, le nombre de mouvements de navire est relativement stable à 77-79 milles. Toutes les catégories de navires ont montré la même stabilité, excepté pour les mouvements de porte-conteneurs qui se sont accrus de 16% au cours de la période.

Notre analyse de la période de prévision montre une augmentation modeste de 0.6% en moyenne dans les mouvements de navires à l'intérieur des eaux canadiennes. Le tableau VIII, ci-contre résume les tendances des mouvements de navires pour l'ensemble du pays.

Tableau VIII
Mouvements de navires, 1983, 1986, 1996

	1983	1986	1996
Totaux	78918	78945	82240
Avec cargaison	35134	35900	38081
Sur lest	43785	43045	44159
Intérieurs	31756	29007	29870
Internationaux	47162	49938	52370
Navires de fret	33034	33012	35166
Navires-citernes	5455	4971	5138
Porte-conteneurs	1577	1834	2512
Remorqueurs et chalands	21920	20071	20369
Autres[1]	16932	19057	19055

[1] traversiers, chalutiers et bateaux de passagers.

Source: Rubans magnétiques du transport maritime (Statistiques Canada) et Transport Canada.

Le niveau d'activité de l'industrie maritime sur chaque région maritime du pays (Côte-est, le St-Laurent, les Grands Lacs et la Côte-ouest) se mesure non seulement par les mouvements de navires en provenance ou à destination de chaque région qui sont définis comme des mouvements locaux, mais aussi par les mouvements de transit dans chaque région. De 1983 à 1986, l'industrie maritime a généré un niveau d'activité à peu près stable. Au cours de la période de prévision, on peut s'attendre à une croissance modeste de 0.4% par an, ce qui équivaut à la continuation des tendances des dernières années. Une croissance plus forte de 0.9% par an est anticipée sur la Côte-ouest, mais beaucoup plus faible qu'au cours des trois dernières années (4.3% par an). Sur la Côte-est et dans les Grands lacs canadiens le niveau de l'activité de l'industrie maritime devrait être relativement stable. Une croissance légèrement supérieure à la moyenne canadienne pourrait être possible dans le St-Laurent, renversant les tendances de 1983 à 1985. Le tableau IX donne pour chaque région maritime du pays le nombre total de mouvements de navires locaux et de transit.

Dans la dernière étape, les valeurs à priori estimées à l'étape précédente sont normalisées pour assurer un équilibre entre les départs et les arrivées de navire à chaque région en appliquant la solution de la première étape. Cette dernière étape n'a pas été appliquée aux mouvements de navires intra-provinciaux. Compte tenu du niveau d'aggrégation, on ne peut assurer un équilibre mathématique des arrivées et départs des navires à l'intérieur d'une même région. On doit finalement noter que le modèle de prédiction des mouvements de navires sur lest s'est arrêté à la première étape pour les traversiers, les bateaux-passagers et les bateaux de pêche. Puisque les mouvements de ces navires avec cargaison sont par hypothèse égaux au cours de la période de prédiction à ceux de 1986, les mouvements de ces navires sur lest doivent donc être égaux à ceux de 1986.

Nous avons testé la vraisemblance de notre approche sur les données préliminaires standardisées de 1986, à partir des coefficients observés de 1983 à 1985. Un test de correlation effectué sur chaque paire d'origine-destination entre les données prédites de 1986 et les données standardisées de 1986 a montré un taux de correlation de 99.5%. Le tableau, à la page suivante, montre que le nombre total d'arrivées et de départs par région présente un écart maximal de moins de 10% et que globalement cet écart se situe à moins de 3.3%.

Tableau IX
Mouvements de navire locaux et en transit,
1983, 1986 et 1996

	1983	1986	1996
Côte-est	28191	26864	26950(1)
St-Laurent	15789	14237	15297(1)
Grands-Lacs	25622	23386	23545(1)
Côte-Ouest	25877	29321	32168(1)
Total(2)	79933	80004	83311(1)

(1) Comprend des estimés sommaires de mouvements de navires entre les Grands lacs américains et le reste du monde.

(2) Comprend les mouvements de navires dans les territoires du nord-ouest et a Churchill; le total n'est pas la somme de chaque région, car un mouvement local d'une région peut apparaître comme un mouvement en transit dans une autre région.

Conclusion

Le but visé du système de prévisions de mouvements de navires est de développer des indicateurs de l'activité du transport maritime à différents niveaux d'aggrégation selon les spécifications des usagers du ministère du Transport.

Les phrases subséquentes du développement du système concerneront une désaggrégation plus poussée de l'analyse des arrivées et départs des navires pour estimer de façon simultanés les mouvements avec cargaison et les mouvements de navires sur lest. Un autre aspect concernera une analyse plus poussée de la taille future des navires. Il s'agira surtout de déterminer quels types de marchandises sont susceptibles d'être transportés dans des navires à plus fort tonnage.

L'auteur tient à souligner la contribution de Messrs Ghislain Blanchard, Paul Kochhar, Garry Tulipan et Mario Ebacher au développement du système de prévisions de mouvements de navires.

Annexe

Renvois en bas de page

(1) Système de prévision des mouvements de navires (Rapport préliminaire), TP843F, Transports Canada, mars 1987

(2) Une méthodologie d'estimation des mouvements canadiens de navires sur lest, Sang Nguyen, Guy Picard, Dominique Paskievici, Centre des recherches sur les transports, juin 1987.

(3) Des analyses à ce sujet sont disponibles à partir de sources telles que Drewry's Bulk Shipping Trends on Marine Strategies International's Bulk Shipping Forecasts.

(4) Forecast Dry Bulk Carrier Profitability 1987-1991 et Forecast Tanker Profitability, 1987.

(5) Ship Movements Forecasting System (Phase II), TP843E, Transports Canada, janvier 1988.

Liste des marchandises analysées individuellement

(1) orge
(2) maïs
(3) avoine
(4) seigle
(5) blé
(6) graines de lin
(7) canola
(8) fêves de soya
(9) billes et billots
(10) bois à pâte et copeaux
(11) minerai de fer
(12) alumine et bauxite
(13) cuivre
(14) plomb
(15) nickel
(16) zinc
(17) titane
(18) charbon
(19) pétrole brut
(20) pierres et calcaires
(21) sable et gravier
(22) gypse
(23) sel
(24) roche phosphatée
(25) soufre
(26) bois d'oeuvre
(27) papier-journal
(28) pâte-à-bois
(29) potasse
(30) essence
(31) mazout
(32) autres produits pétroliers
(33) coke
(34) ciment
(35) produits de l'automobile
(36) conteneurs
(37) autres marchandises

LONG COMBINATION VEHICLES IN QUEBEC AND ONTARIO

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1. INTRODUCTION

This paper investigates the feasibility of allowing extra-long trucks -- "long-combination-vehicles" or "LCVs" -- to operate in Quebec and Ontario. [1] Three specific trucks are contemplated: the Rocky Mountain double, a double-trailer combination consisting of a 45- or 48-foot semitrailer and a 28-foot pup trailer; the Turnpike double, two 45- or two 48-foot semitrailers and/or trailers; and the Triple, three 28-foot and sometimes 27-foot semitrailers and/or trailers.

Currently these LCVs operate on major highways in Quebec at weights of up to 62.5 tonnes for approximately nine months of the year. The scenario envisaged here is the year-round operation of these LCVs from Riviere du Loup-to-Windsor along all four- (or more) lane divided highways within this corridor at the current Ontario truck size limit of 63.5 tonnes.

2. BACKGROUND

2.1 Weight and Dimension Regulations

Provincial regulations governing the size and weight of trucks are complex. [2] In Quebec and Ontario, any vehicle may operate under the standard regulations applying to most vehicles under most operating conditions. Important aspects of these regulations are:

maximum dimensions			maximum loads		
height	4.15	metres	- front axle	- Que	8.5 tonnes
width	2.6	"		- Ont	9.0 "
length			- single axles		10.0 "
- tractor	12.5	"	- tandem axles	- Que	20.0 "
- trailers - Que	14.65	"		- Ont	19.1 "
- Ont	12.5	"	- tri-axles		30.0 "
- semitrailer	14.65	"	- gross vehicle	- Que	57.5 "
- combinations	23.0	"	- weight ("GVW")	- Ont	63.5 "

There are also a large number of vehicles operating under special permits with dimensions and/or loads exceeding these limits. LCVs

exceed the above limits in two respects: they are longer than 23 metres (the longest turnpike double can exceed 34 metres); and they are heavier than Quebec's standard 57.5 tonne GVW limit.

2.2 Developments in Ontario

In 1983, the Uffen Commission [3] recommended some extension of the 21 metre length limit for combination trucks (to 23 m). However, it recommended against the use of LCVs.

The Commission's reasons for rejecting the use of LCVs were based on road-handling considerations: braking, rear-trailer amplification, acceleration and/or maintenance of speed on grades, splash and spray, wind blast, offtracking, and other on-road aspects of handling and/or performance. These are serious issues, but some of them can be overcome relatively easily (higher power-to-weight ratios, more experienced drivers, etc.). Others, such as braking systems or dolly designs, can be controlled to some extent. It should be noted that the Commission's reasons for rejecting LCVs was not based on any economic analysis.

2.3 Developments in the US

Eighteen states now allow LCVs to operate on some of their highways. This creates pressures on Canadian jurisdictions to do likewise as the use of LCVs is one means of keeping local transportation costs down and, therefore, of attracting new industry. In addition, as the use of LCVs becomes more and more common, there is less and less validity to the claim that LCVs ought to be banned because "not enough is known about them."

A second development in the United States is the 1985 study by the Federal Highway Administration (FHWA) investigating the feasibility of developing an LCV network of highways. [4] The FHWA concluded: "There is no compelling reason for designation of a federally mandated LCV network at this time. The States are currently providing opportunities for controlled use of LCVs." (p. S-8)

This recommendation, which casts doubt on the advisability of allowing LCVs, is not germane to a discussion of the issues in Quebec and Ontario. It depends on peculiar American problems: the federal/state division of responsibilities and the (possibly) very large truck weight changes required to introduce LCVs to parts of the US.

2.4 Developments in Quebec

Quebec has allowed LCVs to operate on four-lane divided highways under special permit since 1982. This experiment seems to have been a success, in that the joint task force created by the Department of Transportation and the Quebec Automobile Insurance Board ceased to monitor LCV operations in 1986. [5]

Under the experiment, LCVs were generally allowed to operate during a nine-month period, from March (or April) to December. Some restrictions were applied in November and December, depending on the weather and the road conditions. Other conditions imposed on the LCV

operators included a ban on operations during peak traffic hours in Montreal and Quebec City and a ban on any operations from Saturday at noon to midnight Sunday.

Four types of LCVs are permitted on four-lane, divided highways at weights up to 62.5 tonne: the Rocky Mountain Double, the turnpike double in a nine-axle A-train configuration, the turnpike double in a eight-axle C-train configuration, and the triple. With the exception of CP Trucks, which uses the triple, all carriers chose the nine-axle A-train turnpike double.

	1982	1983	1984	1985	1986
Trucking firms	7	18	24	42	50
Private carriers	0	1	2	6	14
For-hire carriers	7	17	22	36	36

	1982	1983	1984	1985
Trips	699	4,149	11,650	17,574
Weight (kgs)	14,112,114	87,497,898	235,238,984	376,532,568
Average weight	20,189	21,089	20,192	21,426
Distance (km)	298,941	1,491,867	3,479,314	5,083,468
Average distance	428	360	299	289

Table 1 LCV Operations in Quebec

Table 1 shows the increasing number of carriers using LCVs. All but two of the for-hire carriers are general freight truckers; one of the others hauls household goods and the other hauls motor vehicles. The private carriers are a more heterogeneous group: retailing firms, the food industry, telecommunication firms, grocery stores and paperboard and wood products firms. While the number of firms operating LCVs increased by a factor of seven, total LCV activity increased much more rapidly: total shipments increased 25 times and total weight increased by a factor of 26.7. Average weight per trip has remained relatively constant at about 21 tonnes. The average length of haul has continuously decreased, now averaging only 289 km. This suggests that trucking firms are now operating LCVs on distance as short as 150 km.

2.5 National Developments

The most significant national development has been the research program by RTAC and the CCMTA. Some of the results of the investigation into pavements and truck-axle loads is considered later. A second area of investigation was vehicle stability and control. Although there are problems with LCVs -- such as, for example, manoeuvering them on city streets -- the technical findings of the research are generally favorable towards the use of these configurations. [6]

3. CONFIGURATIONS

LCVs would operate under special permits allowing greater lengths at existing axle loads and GVW limits. The following tables show how LCVs compare with current trucks. Current configurations used to haul the less dense freight moving in vans are shown in Table 2 (the use of dromes is not, however, too common).

	tractor-semitrailers				doubles	
Configurations	3-S2	3-S2 with drome	3-S3	3-S3 with drome	3-S1-2	3-S1-3 3-S2-3
Axles	5	5	6	6	6	7,8
Trailers (ft)	48'	48'	48'	48'	28'+28'	28'+28'
Linear space	48'	66'	48'	66'	56'	56'
GVW (tne)	41-46	41-46	51-56.7	51-56.7	50-57	60-63.5
Cube (m3)	99.4	136.2	99.4	136.2	115.3	115.3
(ft3)	3508	4809	3508	4809	4072	4072
Payloads (tne)	26-31	25-30	35-40	34-39	34-41	40-46
Optimal density						
- kg/m3	263-315	184-222	354-406	251-289	300-362	368-403
- lbs/ft3	16-20	12-14	22-25	16-18	19-23	23-25

Table 2 Current Configurations

	Rocky Mtn Double		Turnpike Double		Triple
Configuration	3-S2-2	3-S2-2	3-S2-2	3-S2-2	3-S1-2-2
Axles	7	7	7	7	8
Trailers (ft)	45'+28'	48'+28'	2 X 45'	2 X 48'	3 X 28'
Linear space	73'	76'	90'	96'	84'
GVW (tne)	63.5	63.5	63.5	63.5	63.5
Cube (m3)	150.8	157.0	186.2	198.7	173.0
(ft3)	5324	5545	6575	7017	6109
Payloads (tne)	44.2	44.0	41.7	41.3	43.5
Optimal density					
- kg/m3	293	280	224	208	251
- lbs/ft3	18	17	14	13	16

Table 3 LCV Configurations

Configurations are indicated using the symbols "3-S2" (etc): the first number refers to the axles on the tractor, "S" indicates a semi-trailer, subsequent numbers indicate the axles on semitrailers and/or full trailers. The doubles shown are known as "A-trains" as these are typical of general freight operations. The two tractor-semitrailers shown in Table 2 with "dromes" are configurations with freight-carrying

boxes added to the tractors frame. Available cubes assume usable widths of 100 inches (2.54 m), usable heights of 106 inches (2.69 m) and usable trailers lengths of four inches less than the total trailer. "Optimal density" shows the point at which freight either cubes out or weighs out on each configuration.

Comparable data for LCVs is shown in Table 3. Notice that the largest cube available for most general freight operations in Ontario today is about 115 m^3 (4,000 ft^3). The use of LCVs would increase the cube available by about 31% (Rocky Mountain double) to 72% (turnpike double). Freight that would benefit the most with LCV operations would have a density of about 208 kg/m^3 (13 lbs/ft^3) or less.

4. FLOWS

Table 4 contains a summary of the main steps used to estimate freight flows [7]: the starting point is Statistics Canada's estimate of 151.9 million tonnes of freight moving by truck over Quebec and Ontario highways (line 1). Ontario road-side survey data suggests that Statistics Canada misses 25% of the domestic freight flows (line 2). The Ontario data also indicates that international freight accounts for roughly 30% of intraprovincial traffic (line 3). International flows in Quebec have been estimated, using Statistics Canada figures, at 6% of the Ontario figures (line 4). From the Ontario data, 75% of all truck trips occur in whole or in part on corridor highways (line 6). Using an assumed 10 tonnes per trip, annual trips on the corridor are estimated at 16.76 million (line 7), or 45,918 per day in both Quebec and Ontario (line 8).

1. StatsCan, 1985, total Que/Ont flow	151.9
2. Add estimate of non-surveyed domestic flow (25%)	38.0
3. Add estimate of international flows in Ont (30% of intra)	31.7
4. Add estimate of international flows in Que (6% of Ont)	1.9
	====
5. Total truck freight flow, Que/Ont	223.5
6. Truck freight flow on corridor (75%)	167.6
7. Annual truck trips (assume 10 tonne loads)	16,760,000
8. Daily truck trips	45,918

Table 4 Estimated Corridor Activity
(tonnes in millions, trips as shown)

To summarize, out of a total annual of 223.5 million truck tonnes in Quebec and Ontario, 167.6 million tonnes are estimated to move on the corridor for some part of their movement. This represents 16.76 million annual truck trips. These trips include all commercial trucks (small straight trucks up to nine-axle doubles) whether loaded or empty (note the low average load factor of 10 tonnes).

5. PRODUCTIVITY & COSTS

The costs of hauling freight has been computed (Table 5) assuming freight with a density of either 100 kilograms per cubic metre or 200 kilograms/cubic metre. The "base" linehaul costs shown are Trimac's 1986 estimates of operating costs [8] modified with data from several Canadian carriers with experience operating LCVs. To reflect the effect of load on fuel consumption, these base linehaul costs have been adjusted according to empirical measures of fuel consumption. [9]

	Tractor-semitr.	Double 28's	Rocky Mtn.	Turnpike double	Triple
Cube (m^3)	99.4	115.3	157.0	198.7	173.0
Payload (tne)					
- 100 kg/m^3	9.9	11.5	15.7	19.9	17.3
- 200 kg/m^3	19.9	23.1	31.4	39.7	34.6
Linehaul Cost ($/km)					
- base	0.804	0.857	0.963	1.011	0.981
- 100 kg/m^3	0.790	0.841	0.941	0.983	0.957
- 200 kg/m^3	0.818	0.873	0.985	1.039	1.005
$/cubic metre-km	0.008	0.007	0.006	0.005	0.006
$/tne-km					
- 100 kg/m^3	0.079	0.073	0.060	0.049	0.055
- 200 kg/m^3	0.041	0.038	0.031	0.026	0.029
$/unit of output					
- index (1)	100.0	91.8	75.8	62.8	70.0
(2)		100.0	82.5	68.4	76.2

Table 5 Truck Costs

As shown, LCVs cost more to operate per kilometre than current configurations -- 20% to 26% more than the standard five-axle tractor-semitrailer, and 12% to 18% more than the current double 28's. However, for low-density freight, the cost per unit of payload decreases with LCVs. Considering turnpike doubles, with almost 200 cubic metres of space, they haul freight at a cost 37% lower than the standard five-axle configuration and 32% lower than the current double 28's. As these are linehaul costs only, the inclusion of P & D, administration, and other costs would diminish these differences somewhat.

6. FREIGHT SHIFTS

There are 168 million tonnes of freight on 16.8 million truck trips moving on the corridor. In addition, there are 5 to 6 million rail tonnes moving in this corridor. [10] This section estimates the amount of traffic that might switch to LCVs.

6.1 Intramodal Shifts

The most likely freight to shift to LCVs is low density (less than 400 kg/m^3) moving in large volumes over long distances. This would include freight handled by the courier or parcel carriers, LTL carriers, and some TL carriers (commodities such as some food products, automobiles, and various other low-density manufactured goods).

The figures shown in Table 6 summarize the estimates for the annual trips and tonnages that might switch to LCVs. The first line shows the total trips (from Table 4), and the next two lines reduce this number by focusing on freight moving in some configurations (vans, etc) over some distances (over 200 km). The effect of these assumptions, developed from Ontario road-side surveys, is: out of the total of 45,918 daily truck trips on the corridor, 8,194 may be carrying suitable for LCVs. On line 4 these trips are converted to annual tonnes, using 10 tonnes per trip as an average for current activity. It is estimated (line 5) that as much as 25% of the 29.9 million tonnes of traffic moving in five and six-axle combination trucks with van and/or auto-hauling trailers on trips over 200 kilometres may switch to LCVs. This is in line with the percentages developed in the FHWA study for the larger general freight truckers and the larger shippers. [11]

Maximum Estimate	
1. Daily truck trips on corridor	45,918
2. Trips accounted for by vans and/or auto-carriers in tractor-semitrailer and/or train configurations with fewer than seven axles (38.5%)	19,194
3. Trips over 200 km (46.3%)	8,194
4. Annual tonnes (millions) (8,194 X 365 X 10)	29.9
5. Estimated maximum LCV potential (25%)	7.5
Minimum Estimate	
6. StatsCan, 1985, total intra-Quebec flows (million tonnes)	49.4
7. Add estimate of non-surveyed domestic flow	12.4
8. Total	61.8
9. 1985 LCV traffic (50,000 tonnes/month X 12)	0.6
10. LCV market share (line 9/line 8)	0.97%
11. Total Que/Ont flow	223.5
12. LCV annual potential (0.97% X 2)	4.4

Table 6 Estimated Intramodal Shift

The estimated minimum tonnes (lines 6 to 12) is based on the market share of LCVs in Quebec. Because freight characteristics in Ontario are different than in Quebec (a higher proportion of low-density manufactured goods), the 0.97% market share has been doubled to produce a minimum LCV market estimate of 4.4 million tonnes.

The Quebec experience indicates that the switch to LCVs will be rapid. In less than three years, all firms having permits from the Quebec Transport Commission used the LCVs daily. The shift will be

encouraged by two other factors. First, information about is now well known and many carriers involved on the corridor have experience with LCVs (in Quebec, Western Canada, or the US). Second, with deregulation, the pressures on the industry to cut costs and/or compete for market share will intensify and thereby speed the process of adjustment.

6.2 Intermodal Shifts

LCVs, by decreasing the relative price of truck to rail, may divert traffic -- particularly piggyback and container -- from the railways. For this study, CP and CN Rail computed their losses if LCVs were to be permitted on the corridor. To do so, they partially reproduced a methodology developed when answering a previous request by RTAC on the potential impact upon their activities if vehicle weights and dimensions were changed and standardized across Canada. [12] This methodology is a variant of the comparative cost approach. [13] The combined estimate is that 2.89 million tonnes of rail traffic would switch to LCVs with a revenue loss of $96 million.

This estimate may be high. First, it overstate the loss incurred because the analysis implicitly assumed that all shippers have identical preferences over the various attributes of transport services (speed, reliability, loss and damage and so on). This assumption is too strong and binding in the real world. [14] Second, the railway analysis assumes that, to meet LCV competition, rail rates could only be lowered to long run variable costs as defined under the CTC costing order. In practice the railways may have more pricing freedom than this (and, hence, retain more traffic).

For present purposes the rail shift is estimated at a maximum of 2.9 million tonnes (the railway's figure) and at a minimum 1.45 million tonnes (half the railway estimate).

6.3 Summary

The figures in Table 7 summarize the potential LCV market. As shown, there is an estimated 5.9 to 10.4 million tonnes of freight that may move on LCVs. This includes the high and low estimate for both intra- and intermodal shifts. Using the current experience in Quebec as a guide (LCVs average 20.7 tonnes per trip), these tonnages represent between 285,024 to 502,415 annual truck trips, or 781 to 1,376 trips on a daily basis.

	maximum	minimum
Annual truck traffic (million tonnes)	7.5	4.4
Annual rail traffic (million tonnes)	2.9	1.5
Total (million tonnes)	10.4	5.9
Annual truck trips (20.7 tns/trip)	502,415	285,024
Daily LCV Trips	1,376	781

Table 7 Estimated LCV Market

7. HIGHWAY COSTS

LCVs may have an impact on road costs. Bridge, geometry, capacity, and pavement costs are all affected by the type of trucks using the road. In part this is because the original design criteria has to take into account the characteristics of trucks and in part this is because the road may wear out at a different rate when different trucks operate over it. Allocating road costs among users (automobiles versus trucks, or one truck versus another) is both complex and contentious; no attempt is made to untangle all the issues here. Rather, by considering the technical relationships between configurations and bridges, road geometry, road capacity, and pavements, some general observations may be made about the impact of LCVs in comparison to the trucks they would replace.

As the proposed LCVs would comply with the existing gross-load, axle-load, and axle-spacing requirements, there would be no impact on bridges. There might, however, be a cost associated with roadway geometry (improvements to horizontal or vertical curves, intersections, etc.) The available evidence suggests that these geometric costs would only be incurred off the freeway (access ramps, arterial roads).

Highway capacity, and the need (cost) to add to capacity, depends on traffic. Given a desired service level, engineers use standard procedures to measure traffic and in doing so to convert the number of trucks in the traffic stream to "passenger car equivalents."

Even without precise numbers it is obvious that a fewer number of LCVs are required to carry the same amount of freight as conventional trucks; therefore, it seems safe to estimate that LCVs would actually reduce the capacity problem. But to put this on a more solid foundation, the figures in Table 8 show how the estimated LCVs compare with existing volumes of traffic.

	maximum	minimum
1. Total Annual Trips	16,760,000	16,760,000
2. Potential LCV traffic from existing Trucks (Table 6)(tne)	7,500,000	4,400,000
3. Potential LCV trips in conventional trucks (10 tne/trip)	750,000	440,000
4. LCV trips (Table 7)	502,415	285,024
5. Change in trips (line 3 - 4)	-247,585	-154,976
6. Percent Change (line 5/line 1)	-1.5%	-0.9%

Table 8 LCVs and Corridor Capacity

Total estimated truck trips on the corridor are shown on line 1. The freight on line 2, the "truck-shift" portion of the estimated LCV market, requires 440,000 to 750,000 conventional truck trips annually (10 tonnes/trip, including empty trips). However, if LCVs handled this freight plus the estimated 1.5 to 2.9 million tonnes of rail traffic with 20.7 tonnes/trip, it would only require 285,024 to 502,415 trips

per year. The reduction of 154,976 to 247,585 trips represents 0.9 to 1.5% of total truck traffic on the corridor highways.

There are rough edges to this analysis: the figures imply a uniform reduction in truck trips all along the corridor (unlikely); the analysis ignores temporal considerations (time of day, day of week, etc.); and, the implication is that these LCV trips have the same impact on traffic (hence capacity) as current configurations (also unlikely). Even admitting these rough edges, the analysis is sufficient to suggest that the direction of the expected impact is to reduce traffic and, hence, capacity requirements.

Pavement performance, pavement life, and the cost of pavement, are influenced by a range of factors: climate, quality of materials used, drainage, maintenance practices, and vehicle axle loads. It is the last item, axle loads, which receives most of the attention by those considering the impact of large trucks on the roads. An equivalency factor ("LEF") can be used to reduce axle loads to a common base and thereby permit different trucks to be measured in terms of their impact on pavements. Because there are various measures for these factors, two are used here in an attempt to see how sensitive the problem is to this issue of which equivalency factor to use. The first of these is the "fourth power law" developed by AASHO. The second LEF ("method #2") is based on the analysis of RTAC data by Hutchinson et al. [15]

Under either method of calculation, with freight in the range of 100 to 200 kg/m^3, all LCVs have a higher number of LEFs than the conventional configurations they would replace. Truck for truck, then, LCVs do not compare favorably with the trucks now hauling low-density freight. However, LEFs for an individual truck are meaningless without considering the payload. The figures in Table 9 show the number of equivalent axle loads per thousand tonnes of freight for various configurations.

	Low Density (100 kg/m^3)				Moderate Density (200kg/m^3)			
	Method 1		Method 2		Method 1		Method 2	
		5 tne front		5 tne front		5 tne front		5 tne front
48' semi	196.7	263.9	275.6	339.0	185.1	213.9	259.3	286.9
double 28'	127.3	227.5	232.5	326.4	161.6	187.4	250.9	275.7
Rky Mtn dble	122.3	189.9	218.7	281.4	188.4	188.4	264.2	264.2
Turnpike (7)	162.9	193.0	262.3	291.0	435.8	275.6	489.8	318.6
Turnpike (9)	117.3	151.7	188.6	221.3	282.2	155.2	349.2	224.3
Triple	128.0	166.7	234.7	270.8	169.6	169.6	257.3	257.3

Table 9 LEFs per 1,000 Tonnes

As shown, LCVs generally deliver the lightest freight (100 kg/m^3) with less impact on pavements than conventional configurations. With freight approaching 200 kg/m^3, the picture is not as clear. In particular, where LCVs have to operate with high front-axle loads (7 tonne or higher) some of these configurations perform poorly. But, given more

moderate front-axles (5 tonnes), three of the LCVs perform as well or better than current configurations. That is, all but the seven-axle turnpike double deliver 200 kg/m^3 freight with 155 to 188 LEFs per 1,000 tonnes (method #1) or 224 to 264 LEFs/1,000 tonnes (method #2), which is generally below the range of current trucks.

To summarize, there is no evidence to indicate that LCVs will change road costs significantly. Given that gross vehicle weights, axle loadings, and axle spacings will be held to the same limits as on conventional trucks, there is no measurable impact on bridges. Any geometric improvements required will occur off the highway and potentially could be charged back to the holder of a LCV permit. Highway capacity will actually improve (fewer trucks), but the change is so small that it probably could not be measured. In most situations, the use of LCVs can reduce or at least not increase pavement costs. The major exception to this is where some of the LCVs, particularly the 7-axle turnpike double, are used with front-axles of seven or more tonnes, hauling freight approaching or above 200 kg/m^3).

8. TRANSPORTATION COSTS

Table 10 shows the calculations of the total freight bill for traffic that might switch to LCVs. There are a number of variables: potential LCV traffic (from Table 7) is estimated to be between 5.9 ("minimum forecast") and 10.4 million tonnes ("maximum forecast"). The analysis has been done with two freight densities (100 to 200 kg/m^3) (column 1). As it is sensitive to the assumptions made about average shipping distances, three distances are shown (column 2). Average rail costs per tonne ($33.17) are computed from the information supplied by CN and CP Rail (column 3). As the average length of haul (or the distribution of hauling distances) for this rail traffic is not known, comparisons of the rail costs per tonne with the truck costs can be misleading (ie, the $33.17 in column 3 cannot be directly compared to the figures in columns 4 or 5). Current trucking costs are based on the figures computed in Table 5, namely $0.075 per tonne-kilometre for freight with a density of 100 kg/m^3 and $0.040 for freight with a density of 200 kg/m^3. To make these truck linehaul costs more comparable with rail costs (rates), the figures shown in Table 10 have been increased by 20% to account for administration costs (column 4). From Table 5, an average of the three LCVs shows a cost of $0.050 per tonne-kilometre for the least dense freight and $0.027 for the denser freight. In column 5, a 20% mark-up has been added to account for overheads. The final three columns show the cost of the total freight bill. Column 6 has been computed on the basis of the "truck-shift" traffic from Table 7 times the appropriate current truck cost per tonne plus the "rail-shift" traffic times $33.17 per tonne. Column 7 has been computed by simply multiplying the total potential LCV traffic times the relevant LCV cost per tonne. The final column shows the percentage change.

There are several qualifications to the analysis. First, it is a simple "before/after" comparison that assumes an instantaneous switch to LCVs; there is no attempt to discount any future stream of annual savings back to present values. Second, it ignores potential off-

setting costs: road-costs previously judged to be insignificant; or costs imposed on other rail shippers.

1	2	3	4	5	6	7	8
Freight	Ship.	Rail	Truck	LCV	Total Transport. Cost		
Density	Dist.	Cost	Cost	Cost	Current	LCV	change
kg/m^3	km	/tne	/tne	/tne	$ mill	$ mill	%
MAXIMUM FORECAST							
-100	400	33.17	36.00	24.00	366.2	249.6	-31.8
"	600	33.17	54.00	36.00	501.2	374.4	-25.3
"	800	33.17	72.00	48.00	636.2	499.2	-21.5
200	400	33.17	19.20	12.96	240.2	134.7	-43.9
"	600	33.17	28.80	19.44	312.2	202.1	-35.2
"	800	33.17	38.40	25.92	384.2	269.5	-29.8
MINIMUM FORECAST							
-100	400	33.17	36.00	24.00	208.2	141.6	-32.0
"	600	33.17	54.00	36.00	287.4	212.4	-26.1
"	800	33.17	72.00	48.00	366.6	283.2	-22.7
200	400	33.17	19.20	12.96	134.2	76.5	-43.0
"	600	33.17	28.80	19.44	176.5	114.6	-35.0
"	800	33.17	38.40	25.92	218.7	152.9	-30.1

Table 10 Freight Transportation Cost

Depending on the assumptions about shipping distances and freight densities (and to a lesser extent the mix of current and LCV trucks), there is clearly a significant reduction in freight transportation costs along the corridor. The figures shown in Table 10 suggest a savings of anywhere from $62 to $137 million.

9. ROAD USER TAXES

Quebec and Ontario now (1986) collect $3.2 billion in registration and fuel taxes. [16] If LCVs were allowed to operate, these taxes would decrease by less than one percent. Given a range of reasonable assumptions, the actual decreases have been estimated as follows:

	percent of total	millions of dollars
registration taxes	0.02 to 0.51	0.13 to 3.27
fuel taxes	0.06 to 0.24	1.55 to 6.20
		1.68 to 9.47

10. CONCLUSIONS

Recent US and Canadian studies have shown or suggested that there are productivity advantages available through the use of LCVs. This is not surprising; as in other modes of transportation, larger vehicles can haul freight at lower unit costs than smaller vehicles. Further evidence of the productivity advantages of LCVs is available from the

fact that 22 North American jurisdictions (including four Canadian) now allow their use.

The increase in cube available with LCVs, at the current axle and GVW limits would allow lower-density freight to move at a cost 24% to 37% lower than conventional five-axle tractor-semitrailers and 18% to 33% lower than the double 28-foot combinations now operating.

In terms of potential markets, there are 5.9 to 10.4 million annual tonnes of freight that might shift to LCVs, including an estimated 1.5 to 2.9 million tonnes of freight now moving on the railways. This is 3.5% to 6.2% of the total volumes of truck freight now moving over the corridor. This could be handled by between 781 to 1,376 LCV trips per day.

Allowing LCVs on the corridor would have a minimal impact on highway costs. Bridge, geometric, and capacity costs on the corridor would be largely unaffected; pavement costs could actually decrease although the impact of LCVs is probably too small to measure. There could be some highway costs associated with access ramps, access roads, and rest and/or staging areas. No estimate of these possible costs has been made.

The impact of LCVs on road-user taxes in Quebec and Ontario is too small to be significant ($2 to $9 million). In contrast to the very minimal impact on road costs and road-user taxes, the use of LCVs on the corridor would allow freight transportation costs to drop by $62 to $137 million, or in the range of 30% of the total current freight bill for the 5.9 to 10.4 million tonnes of freight under consideration.

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ACKNOWLEDGEMENTS

Funding for the research on which this paper is based was provided by Transport Canada. This paper reflects the views of the authors and not necessarily those of Transport Canada.

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IMPROVING RAILROAD PRODUCTIVITY: IMPLICATIONS OF U.S. EXPERIENCE FOR CANADIAN RAILROADS

INTRODUCTION

The recent experience of the U.S. rail industry is seen by some people in Canada as a blueprint for revitalizing the Canadian railways. In 1980, the Staggers Act gave the U.S. rail industry significantly greater freedom in marketing and in network rationalization. In the following years, the industry improved its financial performance and, by some measures, its productivity. During this period, the U.S. railroads' most visible and aggressive efforts were those aimed at downsizing both their physical plant and their labor force. The end result is usually portrayed as evidence of the great success of deregulation and a valuable improvement in productivity.

Before simply replicating the U.S. experience in Canada, however, it would be well to reflect upon some missed opportunities. Since rail deregulation has yet to open up rail facilities to non-union competition, the rail industry has not yet experienced the jolt of competition that has had so great an impact on trucking and air transportation. As a result, the U.S. railroads have made little headway in resolving fundamental labor issues related to work rules and pay scales relative to other industries. Consequently, the costs of providing rail service continue to be inflated far above what is technologically feasible.

The rail industry, whether in the U.S. or in Canada, has two choices. One option is to accept the cost structure and serve only the traffic most suited to rail. This is the approach that has been taken, for the most part, in the U.S. This choice leads inevitably to a greatly reduced role in the market, a smaller work force, and loss of revenue. The other approach is to resolve the impasse with the unions, push unit costs down to reasonable levels, and then compete strenuously for traffic and new transportation opportunities. This paper recommends that the Canadian railroads pursue this path, the path not taken in the U.S.

CHANGES IN PERFORMANCE OF THE U.S. RAIL INDUSTRY

First, it will be helpful to review the performance of the U.S. rail industry during the periods immediately preceding and following deregulation. Between 1978 and 1985, dramatic changes took place in the U.S. rail industry. These changes are well-known and need only be summarized here (1):

Mergers: the number of Class I railroads declined from 41 to 22, primarily as a result of mergers (a Class I railroad has annual revenues of $50 million in constant 1978 dollars)

Line abandonment: the number of route miles declined from 191 to about 171 thousand as more effective abandonment procedures were hammered out between the industry, the states, customers, and the ICC.

Railroad employment: overall Class I employment fell 34% from 491 to 324 thousand; train and engine service employment also fell 34%, from 141 to 93 thousand.

Labor costs: with the decline in employment, labor costs, including benefits, dropped from 51.6% to 46.9% of total revenue.

Regional railroads: in the 1980's, dozens of regional railroads were created as railroads, led by the Illinois Central Gulf, spun off major portions of their route structure to independent operators. In 1985, approximately 25 thousand route miles were operated by other than Class I railroads, up from approximately 15 thousand in 1978.

Intermodal growth: the number of trailers and trailer-sized containers loaded rose 5.4% annually from 3.18 to 4.61 million.

Terminal consolidation: this trend was most evident for intermodal facilities, with the total number of intermodal terminals declining 69% from 1,176 to 361 (in 1986). At the same time, the number of these terminals that were mechanized rose from 131 to 175.

Heavier axle loads: the 100-ton car replaced the 70-ton car as the standard for bulk traffic and the average car capacity rose from 67.1 tons in 1970 to 84.3 tons in 1985. Technological improvements in track components and in maintenance procedures eventually enabled railroads to handle these heavier loads without destroying their track structure or causing undue increases in maintenance costs.

Computer control systems: railroads made tremendous efforts in computerizing their control systems. Advances were especially noteworthy in equipment management and service control.

Marketing orientation: railroads experimented with a variety of forms of marketing organizations as they slowly transferred power from operations to the financial and marketing departments. Aggressive marketing efforts helped railroads to drop unprofitable lines of business and, in some cases, to develop new services.

Financial performance: from 1976 to 1978, net railway operating income averaged under $0.5 million for the Class I railroads; from 1983 to 1985, it averaged over $2 billion, in part but only in part reflecting the shift to depreciation accounting in 1983. Return on investment nearly tripled, reaching as high as 5.7% in 1984.

MEASURING RAILROAD PRODUCTIVITY

While it is clear that great changes took place in the U.S. rail industry, it is not clear that productivity improved to any great extent. For productivity to improve, it is not sufficient simply to reduce inputs. It is also necessary to reduce the ratio of output produced per unit of input.

Measuring productivity is a difficult task, especially in the service industries. Partial measures of productivity are sometimes used, such as gross ton-miles (GTM) per employee-hour, which grew at an annual rate of 4.7% from 1970 to 1985. This measure, however, gives the misleading impression that railroads were in the forefront of productivity improvement during a period when they were actually fighting for survival. In fact there are several good reasons for using more sophisticated measures. As an output measure, GTM lumps together widely divergent rail services, including unit coal trains, piggyback trailers, and boxcars originating on light density branch-lines. Economists prefer to measure railroad output as a weighted sum of ton-miles in various commodity groups, using the average revenue per ton-mile, the average expense per ton-mile, or the average employee hours per ton-mile as a weighting factor. Likewise, they prefer to use a more complete measure of railroad inputs than

employee hours, since capital costs, equipment rents, and fuel together account for more than half of all railroad expenses. Even as a labor measure, man-hours fails to distinguish among different categories of employees in terms of either the type of work or the pay scales.

A number of serious efforts to measure the productivity of the U.S. railroad industry have gone well beyond the simplistic GTM per employee hour (McCullough, 1983). Measurements of average labor productivity have been compiled on an annual basis by the U.S. Department of Labor's Bureau of Labor Statistics (BLS) since 1959. In a more detailed study of labor productivity, Banner and Brosnan (1983) divided labor into several categories and related the productivity of each category to an appropriate measure of railroad output. A more comprehensive measure of the combined productivity of labor and capital was suggested by Kendrick and adopted by the American Productivity Center (APC) in 1977. More complete estimates, taking into account intermediate material inputs as well as capital and labor were developed by Meyer and Morton (Task Force on Railroad Productivity, 1973) and Caves, Christensen and Swanson (1980).

Caves et al. summarized the various approaches toward measuring railroad productivity over the period 1951 to 1974 (Exhibit 1, Part A). In these approaches, various techniques were used to measure railroad output as a weighted combination of passenger-miles and one or more separate categories of ton-miles. As more inputs were included, measured rates of productivity growth declined. The slower rates of productivity growth were below the national averages for this period and were consistent with the rail industry's increasing financial difficulties.

From 1976 to 1981, when the GTM per employee hour grew at an annual rate of 4.8%, the more complete measures again showed less productivity growth (Exhibit 1, Part B). In the first two methodologies summarized in this exhibit, passenger operations were excluded and the output was a weighted combination of ton-miles in various commodity categories. As in the earlier period, adding capital as an input reduced the measured growth in productivity, this time from 4.0% to 2.9%. The other 2 methodologies used different approaches to measuring output to produce still lower estimates of productivity growth. Banner used car miles, carloads, or train miles as output measures for each of 4 categories of employee hours; his results suggest that improvements in ton-miles per labor hour resulted mainly from changes in traffic mix, not from the average annual improvement of only 1.5% in the productivity of individual categories of labor. In the APC study, output was a financial measure, namely value added, and no productivity growth at all was observed. This suggests that the market value of railroad output declined enough over the period to offset the slight gains in productivity as measured by the other approaches.

It is possible to relate productivity to commonly used measures of railroad activity and financial performance. This approach was demonstrated in an earlier study that investigated year-to-year changes in revenues and costs between 1973 and 1983 (Martland, 1984). Freight revenues for the Class I railroads were deflated by the BLS price index using 1978 as the base year, while freight service expenses were deflated by the Association of American Railroad's cost index.

Freight revenue was then related to physical activity as measured by various service units. In some cases, the ratio of service units to freight revenue changed markedly over the study period. Carloads originated and gross ton-miles increased, while train and yard switching-hours decreased substantially. These changes reflected the shift to bulk traffic, which was typically handled in unit trains at lower than average rates. The costs or savings associated with these changes were then estimated using unit costs per service unit based upon 1978 cost levels (2). From 1973 to 1978, rail

costs increased by $165 million as a result of the relative changes in service units. From 1978 to 1983, costs increased another $255 million. Basically, the added carload and gross ton-mile costs more than offset the savings in switching.

The next step of the analysis examined changes in factor productivity. For labor productivity, the approach was similar to that used by Banner and Brosnan, who emphasized the need to look at the productivity of distinct groups of rail employees. Absent any change in employee productivity, the number of employees in each each major category was assumed to vary with railroad activity represented by a particular service unit:

1. Maintenance of way employees with gross ton miles
2. Maintenance of equipment employees with car miles
3. Dispatchers, telegraphers, and road train and engine employees with train miles
4. Yard employees with yard switching hours
5. Executives, professional, clerical, and other transportation employees with carloads

The productivity of a group of employees was said to decline if the ratio of employees to service units declined. The benefits of the improved productivity were estimated using the average annual wages for that group of employees in 1978. In 1978, labor productivity was slightly worse than in 1973, adding $21 million to rail costs. By 1983, however, drastic cuts in rail employment led to substantial improvements in labor productivity, with savings estimated at $672 million relative to the base year of 1978. Note that Banner and Brosnan's analysis cited above extended only to 1981; the dramatic cutback in employment occurred occurred after that date.

Capital productivity is more difficult to measure. In general, however, it is clear that output fell much more rapidly than did rail equipment and facilities. To quantify the changes in capital productivity, three categories of capital were compared to an appropriate service unit. Freight cars were measured relative to carloads, locomotives relative to locomotive-miles, and miles of road operated relative to freight revenues, all of which declined dramatically over the study period. The cutbacks in freight cars, locomotives, and route miles did not keep pace with the cutbacks in rail revenue.

Next, the decline in capital productivity was related to operating costs by estimating the fixed costs associated with a single vehicle or mile of track. In 1978, the fixed costs of ownership plus the net rental payments (which reflect in part the use of non-railroad owned equipment) amounted to about $1,000 per car and $11,400 per locomotive. Vehicle maintenance expenses were not included, because these were assumed to vary with vehicle miles. Then, 20% of 1978 maintenance of way expenses, or $4,200 per route mile, were assumed to vary with route miles. With these admittedly crude estimates, the decline in capital productivity added roughly $300 million to costs from 1973 to 1978 and another $300 million by 1983.

In addition to labor and capital, railroads use a variety of materials and services. Significant improvements were obtained in two areas. First, fuel efficiency rose from 471 to 543 gross ton miles per gallon, for a savings of $182 million in 1983 at 1978 prices; the 15% increase in fuel efficiency was the same as that achieved by rail competitive trucks over the same period (Wolfe, 1987). Second, loss & damage dropped from over 1.5% of revenue to less than 0.5%, which was equivalent to adding more than 1% or nearly $160 million to net freight revenue by 1983, again in 1978 prices.

By combining all of these analyses, it was possible to relate the changes in factor productivity and prices to changes in overall railroad performance. Exhibit 2 ranks 14 major factors that were each estimated to affect industry costs by at least $100 million annually in 1983 as compared to 1973. More than $1 billion was saved because of a reduction in yard and train switching, while another $647 million was saved by an improvement in the productivity of maintenance forces. On the negative side, the increase in GTM per unit of output, quite likely caused by the shift to bulk traffic, in effect added $1.26 billion to operating expenses, while a decline in freight car utilization added $431 million. It is interesting to note that the third largest negative factor, at nearly $188 million, was the decline in productivity of train and engine service employees. Overall, the positive factors barely outweighed the negative factors, and the net productivity savings amounted to only $65 million over the entire period (Exhibits 2 and 3). The annual changes in profitability were therefore attributed to relative changes in rail rates and the unit costs of rail inputs.

THE CONTINUING PROBLEM OF LABOR COSTS

The previous two sections showed that overall railroad productivity did not improve much if at all in the years after deregulation despite drastic downsizing. The apparent benefits of network rationalization were offset by the loss of traffic. To understand what happened during this period, it is important to recognize that very little progress was made toward reducing labor costs and labor productivity, especially within the operating crafts. Between 1978 and 1985, the average annual wage rose 8% annually (71% overall) from $20,314 to $34,991. The annual wages of the highly paid train and engine service employees also rose 8% annually, from $24,025 to $41,139. By way of comparison, average wages for non-union drivers in truck load operations rose only 3.5% annually over the same period to an average level of $0.23 per mile (Wolfe, 1987), which would be only $23,000 for someone driving 100,000 miles in a year.

Wages were not the only problem, however. Railroad operations were still hampered to a very great extent by labor agreements that severely restricted operating flexibility and increased operating costs. The primary problems concerned the crew consist, the basis of pay, and restrictions on inter-divisional operations, because constraints in these areas directly affected the ability of railroads to offer competitive levels of freight service. The typical crew consist included an engineer, a conductor, and two brakemen, despite the fact that many trains could safely be operated with just two people (Martland, 1982). Agreements that allow operation with only one brakeman were achieved in both Canada and the U.S. during the late 1970's, but these agreements returned the majority of the alleged benefits to the members of the union; these agreements therefore provided little incentive to operate more trains (McCabe, 1987). Despite these agreements, the average crew consist was over 4.2 people as of 1981, since most trains not only had two brakemen, many still had a fireman (USRA, 1982).

The dual basis of pay, which dates back to the steam era, inflated crew costs in another manner. Steam engines needed to take on water every 100 or miles or so and they seldom ran more than 100 miles in a single shift. Labor agreements evolved whereby train crews received additional pay if they worked extra time or travelled extra miles. The dual basis of pay survived with only minor changes despite the shift to diesel locomotives and the advent of run-through freight trains that travel several hundred miles in less than 8 hours. Crews on these trains received several days pay for each shift, thereby capturing much of the economic benefits of running faster trains. Inter-divisional constraints posed a different kind of a problem in that they required

new crews to be used in each crew district, even if each crew only worked a few hours. In metropolitan areas, especially in the northeast, such restrictions severely hampered the ability of railroads to offer new services.

The combined effect of these outmoded aspects of labor agreements was that much of the inherent advantage of rail technology relative to highway technology was frittered away in excess labor costs. While some progress had been made in allowing smaller crews and inter-divisional runs, the typical train was still much more costly to operate than required by the technology.

RESPONDING TO THE COMPETITIVE CHALLENGE

Provision of general freight service is an inherently complex matter for railroads. It is no surprise that railroads were in the forefront of organizational innovation 100 years ago when they learned how to move people and freight over vast networks that they themselves constructed and maintained. The rise of highway competition dramatically changed the strategic position of railroads. They found themselves offering a relatively slow and unreliable service; advances in truck and highway technology even allowed trucks to undercut rail prices. Furthermore, railroads discovered that their extensive bureaucracies were ill-suited for competition with small, flexible trucking companies, including thousands of owner operators.

Nevertheless, the rail industry did respond to truckload competition with serious attempts to provide better service. There were well-publicized efforts that sought to improve coordination within and between railroads, including the formation of the Task Force on Railroad Productivity (1973), the creation of cooperative labor/management programs such as the Houston Terminal Project (1982), and the many studies related to the creation of Conrail. Another example was the Freight Car Utilization Research/Demonstration Program (FCUP), a cooperative program sponsored by the Federal Railroad Administration and the Association of American Railroads. Between 1975 and 1981, the FCUP was instrumental in the development of better techniques for distributing empty cars (Task Force I-1, 1976; Task Force II-4, 1979), for managing railroad terminals (Martland et al., 1983) for coordinating marketing and operations (Task Force I-2), and for controlling rail service (Task Force I-6). The FCUP, which had more than 20 task forces involving many of the most thoughtful people in the industry, also acted as a clearinghouse for ideas. Most railroads did try to improve their service through advances in terminal operations, dispatching, freight car management, and pricing, and many of these efforts were supported by or documented by the FCUP.

Gaining better control over rail performance is but one way to respond to the competitive threat posed by truckload carriers. Another way is to retreat, to give up traffic to the motor carriers in order to concentrate on what railroads do best. By 1970, it was evident to most observers that much of the U.S. rail network was redundant, although it was far from clear how to go about restructuring the system. The early history of Conrail was dominated by the search for a "profitable core", i.e. by attempts to identify those rail lines that had sufficient traffic to justify continued operation. The spotlight on abandonments led to a bitter, protracted, and largely unproductive public debate on what lines should be retained in the rail network. Eventually, procedures were agreed upon that required protestors to contribute to the costs of continuing uneconomic operations over light density lines and the pace of line abandonment accelerated.

Focussing on high-volume shippers and bulk commodities was another form of retreating from competition. Railroads could tailor their schedules to the needs of customers shipping hundreds of cars daily, but had difficulty in dealing with a myriad of small companies shipping only a few cars each per week. For example, railroads developed special equipment to handle autoparts and automobiles and created special techniques for managing this equipment. For bulk commodities, railroads eventually overcame regulatory resistance and developed high-capacity cars and unit train service, which dramatically cut transportation costs and enabled railroads to compete more effectively with both water and highway carriers.

The box car was the main casualty during the retreat to the profitable core. Once the ubiquitous work horse or the industry, the box car required too much care and attention to compete with trucks. Between 1978 and 1985, the number of plain box cars in service dropped nearly 50% from 263,000 to 141,000, while equipped box cars fell 22% from 173,000 to 136,000. Abandoning light density lines and concentrating on large shippers was easier than revamping and controlling the complicated terminal and train operations associated with single-car movements.

A strong merger movement was a third strategy for improving railroad competitiveness. Mergers had two major advantages. First, they could overcome the Balkanization of the industry and create carriers that served much larger regions of the country. Coverage was believed to be important to enable a single railroad to compete more effectively with motor carriers that enjoyed nationwide operating rights. The larger the carrier, the fewer the problems with interchanging equipment, establishing rates, and coordinating operations. The second advantage was that the merged carrier would be able to consolidate redundant facilities. The problem with mergers was that a great deal of senior management's time and energy was diverted from strategic thinking to the preparation of merger applications and, later on, to the consolidation of companies that had distinct procedures, cultures, and computer systems. Mergers offered the opportunity for achieving economies in operation, but quite possibly at the expense of innovation in marketing and operations.

In summary, over the past 15 years, the U.S. rail industry simultaneously pursued three strategies for improving its competitive position. Individually and collectively, railroads made many attempts to improve service and reduce costs so as to compete more effectively. The strategy of rising to meet the competition, however, was generally over-shadowed by the other two strategies, namely down-sizing and merger. In fact, the demise of the box car could be viewed as a symbol of the rail industry's failure to meet the truck competition during the 1970's and the early 1980's. Railroads successfully merged into much larger systems, abandoned large portions of their track, consolidated their terminal facilities, and cut back their work force drastically. Nevertheless, to a very great extent, all of this down-sizing simply allowed the industry's costs to remain in line with its diminished traffic base. The industry shifted its focus toward large shippers and bulk traffic much more than it improved its competitiveness or its productivity. The lack of a breakthrough on labor costs certainly favored downsizing over aggressive competition.

LESSONS FOR CANADA

The recent experience of the U.S. rail industry might suggest that it is possible to make dramatic reductions in equipment, facilities, and personnel while improving financial performance. Indeed, the most common interpretation of this experience is that deregulation allowed the railroads the freedom to innovate and to concentrate on profitable lines of business, thereby becoming competitive and productive. The obvious extension to Canada would be to reduce transportation regulation and to encourage Canadian National and Canadian Pacific to downsize dramatically.

To a large extent this interpretation may be true, but it is not complete. It would be highly desirable to reconsider the first strategy, i.e. the strategy of truly improving the productivity of rail operations in order to compete more effectively for a broad range of traffic. Much of the downsizing of the U.S. rail industry represents a failure rather than a success, namely the failure to take full advantage of rail technology.

The most obvious failure is in the arena of labor relations. Labor, management, and government officials must share the blame for not resolving crew consist, basis of pay, and related issues despite nearly 40 years of negotiation and disputation since dieselization. It is clear that none of these groups has benefited from the impasse. Labor, certainly, has lost vast numbers of jobs as a result of management's emphasis on bulk traffic, large cars, and long trains. The railroads have essentially given up on labor-intensive activities, such as less-than-carload freight, single car service, and retail piggyback. Where possible, they buy machines or find subcontractors to do the work once done by railroad employees. They also encourage shippers and third parties to acquire and maintain equipment that was once built and maintained by railroad employees. When labor costs are high, it is easy for railroad management to retreat into the apparently safe niche of the bulk transporter.

Even intermodal transportation, despite its rapid growth and bright prospects, cannot be considered an unqualified success. Many critics worry about the profitability of the traffic and wonder if intermodal will survive. Others contend that the railroads will act only as intermodal wholesalers, leaving the intricate and potentially lucrative retail side of the business to third parties. Once again, the high costs of rail labor surely hurt financial performance and promote the use of third parties wherever possible.

In Canada, there may still be a chance to compete for more of the traffic that is moving. Even if downsizing is ultimately inevitable, it can be accomplished with more grace and less personal hardship if pursued at a reasonable pace. Is it really necessary to reduce employment much faster than normal attrition? Is it really sensible to let vast numbers of boxcars sit idle with only modest attempts to reduce car hire costs or lower prices? To avoid precipitous downsizing, it will be necessary to restructure labor agreements so that they encourage the use of railway personnel in providing transportation services. There certainly should be enough incentive for management and the unions to negotiate, and for the government to encourage, labor agreements that give the railroads a chance to retain traffic, to recapture traffic thought to be lost, to provide new transportation services, and to offer a future to railroad employees.

END NOTES

1. Except where otherwise noted, the information in this section is taken from *Railroad Facts*, published annually by the Association of American Railroads.

2. The service units and the associated unit costs are as follows: train hours ($57); train and yard switching hours ($100); road train miles ($5); locomotive miles ($1); loaded and empty ($0.60); gross ton miles ($2.50 per 1000 GTM); revenue carloads originated ($150); and gallons of fuel consumed ($0.38)

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Exhibit 1

Estimates of Railroad Productivity Growth

Methodology	Inputs	Annual Growth
A. 1951 - 1974		
BLS	Employee-hours	3.6%
Kendrick	Employee-hours and capital costs	2.8%
Meyer and Morton	Labor, capital and material	2.4%
Caves *et al.*	Employee-hours, capital costs, fuel and materials	1.7%
B. 1976 - 1981		
BLS	Employee-hours	4.0%
BLS Output, APC Input	Employee-hours plus capital	2.9%
Banner and Brosnan	Employee hours, in 4 separate categories	1.5%
APC	Employee-hours plus capital	0%

Exhibit 2

Major Input-Related Factors Influencing Railroad Productivity, 1973 - 1983

A. Positive Factors ($ million)

1.	Reduction in yard switching per dollar revenue	$891
2.	Productivity of maintenance of equipment employees	471
3.	Increase in GTM/gallon	230
4.	Decline in "Other Transportation" employees	224
5.	Reduction in loss & damage	209
6.	Productivity of maintenance of way employees	176
7.	Productivity of professionals	155
8.	Reduction in train switching hours per unit of revenue	138
	Total, All Positive Factors	$2,494

B. Negative Factors ($ million)

1.	Increase in GTM per unit of revenue	$1,260
2.	Freight car utilization	431
3.	Productivity of road train & engine employees	188
4.	Increase in road train miles per unit of revenue	119
5.	Decrease in revenue per route mile (i.e. excess route mileage)	127
6.	Productivity of executives, officials, and staff assistants	99
	Total, All Negative Factors	$2,224
	Net Savings, All Major Factors	$272
	Net Savings, All Factors	$65

Exhibit 3

Summary of Changes in Productivity of U.S. Class I Railroads, 1973-1983

	Annual Savings ($ million)		
Category	**1973-78**	**1978-1983**	**Total**
Service units per unit of revenue in 1978 constant dollars	($165)	($255)	($420)
Labor Productivity	(21)	672	651
Capital Productivity	(288)	(317)	(605)
Fuel Efficiency	48	182	230
Loss & Damage	50	159	209
Total	($376)	$441	$65

ASSESSING THE EFFECTS OF COMPETITION UPON CONCENTRATION IN THE CANADIAN TRUCKING INDUSTRY

Ian M. Campbell

ABSTRACT

Economic regulation has long been regarded by Canadian legislators as a necessary tool to ensure balanced regional economic development. The January 1, 1988 enactment of Bill C-19, the new **Motor Vehicle Transport Act,** represents a new beginning in the regulation of trucking operations in Canada. Parties which favour continued economic regulation argue that deregulation will spur "cut-throat" competition. This, the argument goes, will necessarily result in increased industry concentration through horizontal merger activity. Consumers will ultimately lose in the long run.

This paper explores the validity of the aforementioned argument. References are made to the history of merger activity in Canada and recent levels of trucking industry concentration. A review of newly enacted competitive practice legislation aids the development of modest conclusions concerning the likelihood and importance of future consolidations within the Canadian trucking industry.

INTRODUCTION

The development of an efficient transportation system is a key element in the economic growth of a nation. Canada's pattern of development certainly reflects this rule. With a low population density and very large expanse, Canada relies greatly on an efficient transportation network to ensure balanced regional development. Attention has recently been directed toward the increased role that trucking has played in meeting shipper and consumer requests for timely and responsive service. One need only review recent tonnage, ton-mile, employment, and fuel

consumption figures in the trucking industry as evidence of a dramatic shift in consumer preference. Truckers have captured a significant proportion of the rail freight market because they can offer consumers greater on-time service, smaller risk of cargo damage, and enhanced flexibility over such items as routes and frequency of service.

Cognizant of these recent developments in overland transportation, the federal government enacted new legislation on January 1, 1988 to ensure that the principles of an efficient transportation system continue to be observed during a period of change. Bill C-19, the new **Motor Vehicle Transport Act, 1987**, seeks to guarantee a trucking industry which is economical, fast, safe, reliable, and convenient -- ultimately responsive to the specific needs of end-users. This legislation correctly interprets the provision of transportation services as a derived demand; that is, the pattern of demand is "derived" from other sources of economic activity. One of the most important features of Bill C-19 is the new role government will assume.

In July of 1985, (then) Transport Minister Don Mazankowski introduced a White Paper in the House of Commons entitled "Freedom to Move: A Framework for Transportation Reform". This document outlined a specific set of proposals for economic regulatory reform in the transportation sector based upon three axioms:

1. Less regulation, and therefore less government interference, to encourage innovation and enterprise;

2. Greater reliance on competition and market forces in order to achieve lower unit costs, more competitive prices, and a wider range of services to shippers and the public; and

3. A regulatory process that would be open, accessible, and not excessively costly or time consuming.

The government's decision to divorce itself from the burden of regulation was a bold step in a heretofore highly regulated industry. In its present form, Bill C-19 incorporates a number of steps first agreed to by the federal/provincial Council of Transport Ministers on February 27, 1985. These included: shifting the burden of proof on entry from the applicant to the respondent; elimination of rate approval; creation of a list of commodities and services exempt from control; streamlining operating licences and licence categories; and reform of the licence application process.

THE NEED FOR REGULATION

The government's decision to relinquish regulatory control over extra-provincial trucking endeavours is indeed a bold step considering the prominent role regulation has played in the history of Canadian economic development. Canada has employed regulation in the business of transportation as a policy tool whose goal is balanced regional development. While economic regulation was essentially concerned with rates and entry criteria, controls had been extended in Canada to a number of areas such as health and safety, industrial relations and macro-economic policy such that the inter-relation of these competing objectives left the summary effect unclear. Regulatory policies used in transportation to achieve economic efficiency and/or a redistribution of income between regions often were countered by investment policies such as job creation and national unity. This "quagmire" of legislative direction caused the government to seriously rethink the true purpose of its involvement and question the need for interference in an otherwise smoothly functioning economy.

It would be useful to reflect upon the arguments for and against regulatory control before proceeding with a study of the trucking industry. This will help to put into perspective the claim that absence of regulation will necessarily lead to increased industry concentration and grave consequences for consumers in the long run.

Those in favour of economic regulation predicate their beliefs on the notion that excessive competition is ruinous in the long run. Indeed, these individuals believe that cost savings necessarily come at the expense of other policy objectives. By restricting entry and competitive practices, regulators aim to secure essential common services, continued investment, improved safety, economic stability, and exceptional standards of service. Regulators seek to ensure the safe operation of transport undertakings with a watchful eye to environmental concerns. It is felt that only regulation can guarantee a fair distribution of transport amenities, thereby avoiding undue privilege or harm to users. Regulation focuses on the achievement of established minimum standards. Remedial steps are undertaken if these goals are not realized. Regulators thus attempt to secure a sense of flow and certainty in key industries. By eliminating harmful competition, monopolistic tendencies, and compromises to safety and service, regulators attempt to arrive at a national transportation system which is cost efficient and service oriented. The ideal situation calls for the fewest trucks which can support quality and service.

Regulation of motor carriers in Canada traditionally

has been the responsibility of provincial and territorial governments. A section of the **British North America Act** of 1867 empowered the federal government to regulate extra-provincial truck transportation. The results of a 1954 New Brunswick challenge of the federal powers, known as the Winner Case, confirmed the government's pre-eminence. The federal government enacted the **Motor Vehicle Transport Act** of 1954 four months later - legislation which, surprisingly enough, delegated federal regulatory powers to the provincial level where they remain today. The regulations are administered by quasi-judicial provincial transport boards with authority from the Lieutenant-Governor in Council. Provincial powers over extra- and intra-provincial motor carrier operations are quite extensive, encompassing: approval of operating authority, commercial vehicle licensing, bonding, insurance, freight rates, commodity specification, and route designation. The degree to which authority is exercised ranges from nominal to extensive application.

Those in favour of deregulation share regulators' desire for an efficient and responsive transportation infrastructure but do not agree with the suggested means of attaining this end. The bone of contention here is the cost of compliance with government directives. Proponents of regulation often fail to realize the true costs involved in a regulated society. Ron Hirshhorn, in a paper for the Economic Council of Canada, noted this fact.

> "The cumulative evidence on the effects of trucking regulation in Canada is consistent with the general conclusion (suggested by theoretical and empirical work on a broad range of regulated industries), that regulatory restrictions imposed on a competitive industry lead to efficiency losses and higher costs for the economy. The additional costs arise out of the resources that governments must devote to administering the regulatory apparatus, and that firms must devote to participating in the regulatory process; they arise out of the effect of regulatory restrictions both in the immediate period and over time on the cost of producing a given level of quality of trucking output; and they arise out of the distorting impact of regulation on the allocation of economy's resources -- and, in particular, on the allocation of resources between for-hire and private trucking."[1]

Regulators argue that service to small communities will be drastically affected if truckers are given a free

hand in choosing routes to service. A system of visible and direct subsidies is often suggested as a means of stemming selection of solely profitable routes. Advocates of market-driven forces are quick to criticize regulators' claim of destructive competition should entry standards be relaxed. Regulators feel that there must be a system of rewards in place in order to induce carriers to invest in capital equipment. Open entry would necessarily place their investments in jeopardy during low points in the business cycle. Companies attempting to service their debts would quickly find themselves in receivership due to "cut-throat" competition. Detractors to this logic claim that a necessary pre-condition is absent which brings into question the validity of the whole argument. This pre-condition is a high proportion of fixed to total costs. Advocates of unrestricted competition argue that automotive equipment is mobile and easily resold. They note that truckers are also given the option to buy or lease their equipment. Investment in extensive terminal facilities is limited to a small section of the trucking industry; namely less-than-truckload (LTL) carriers. While these carriers certainly are subject to rigorous competition, one must also note the potential for economies of scale. Supporters of deregulation argue that the relatively short life-span of revenue-generating equipment and the importance that shippers attach to attentive service limit the possibility of drastic price wars and chronic excess capacity.

One can see that advocates of regulation and those of deregulation feel equally qualified to prescribe the proper solution for Canada's regulatory woes. Canada has embarked on a new regulatory path, much to the chagrin of carriers previously sheltered from competition. Attention will now be directed toward the presence of concentration in the Canadian trucking industry and future expectations about its impact on consumers. We wish to discern whether or not concentration is present or indeed likely to appear in Canada's new regulatory environment.

CONCENTRATION

The structure-conduct-performance (SCP) hypothesis, a central paradigm of industrial organization, is often cited by regulators in defence of entry controls. According to the SCP hypothesis, the structure of an industry (particularly its degree of concentration and conditions of entry) influences the conduct of firms in the industry with respect to price, sales, employment, advertising, and research and development decisions. The conduct of firms, in turn, influences performance -- and particularly profits earned in the industry. A major tenet of the hypothesis is a positive relationship between concentration and industry profits.[2] As a significant structural variable, concentration impacts upon conduct which consequently influences the

profit picture. It is believed that firms in more concentrated industries are more likely to engage in collusion (tacit or explicit), which results in joint profit maximization.

Bill C-19's impact on this causal relationship stems from its effect on industry structure. Industry structure details the size and distribution of firms, barriers and conditions of entry, product differentiation, operating costs, and the degree of government regulation. It is thought that drastic price wars, due to the entry of new carriers, will result in horizontal mergers which will concentrate market power in the hands of a few very large carriers. Consumers, having benefitted from price cuts in the short run, will be made to pay inflated prices in the long run as carriers declare bankruptcy. Consolidations will flourish, leaving shippers (and ultimately consumers) with little choice over service considerations and absolutely no choice over prices. The concentration/cost argument implicitly ignores potential economies of scale and synergies which improve the co-ordination of production activities and relieve financial burden.

TABLE 1: Concentration Ratio Indexes

Concentration Ratio (4-firm) (%)	Description of Level of Concentration
75 - 100	very high "tight" oligopoly
50 - 75	high "tight" oligopoly
25 - 50	moderate "loose" oligopoly
below 25	low atomistic

SOURCE: Christopher Green, Canadian Industrial Organization and Policy, page 45.

Table 1 outlines in simple terms the measurement of market power through a term called the concentration ratio. This widely used summary statistic details the share of an industry's output, value added, employment, or assets accounted for by a small number (e.g. 4, 8, 10) of the largest firms in the industry. Share of shipments or value added statistics are more favourable measures than assets or employment since the latter are responsive to interim

differences in capital and labour intensity. A high concentration ratio is indicative of effective market control.

TABLE 2: **Concentration in the Canadian For-Hire Trucking Industry Measured by Gross Operating Expenses; 1976, 1981.**

REPORTING UNITS	1976 ($)	1976 (%)	1981 ($)	1981 (%)
10 Largest	448,028,584	15.5	977,247,019	16.7
25 Largest	818,784,740	28.2	1,620,786,280	27.7
50 Largest	1,116,449,398	38.5	2,162,417,068	37.0
100 Largest	1,419,693,740	49.0	2,722,875,361	46.6
All Units	2,899,081,270	100.0	5,843,992,320	100.0

TABLE 3: **Concentration in the Canadian For-Hire Trucking Industry Measured by Gross Operating Expenses; 1984, 1985.**

REPORTING UNITS	1984 ($)	1984 (%)	1985 ($)	1985 (%)
10 Largest	1,223,921,655	18.1	1,289,065,824	16.4
25 Largest	1,959,729,608	28.9	2,084,416,489	26.6
50 Largest	2,601,496,252	38.4	2,728,865,995	34.8
100 Largest	3,264,438,086	48.2	3,484,614,174	44.4
All Units	6,775,742,949	100.0	7,844,708,200	100.0

SOURCE: Trucking in Canada, Statistics Canada, Cat. 53-222.

The preceding two tables reflect levels of concentration present in the Canadian trucking industry for the years 1976, 1981, 1984, and 1985 (as measured by gross operating expenses). The 1985 figures represent the most up-to-date survey figures available from Statistics Canada. It should be noted that Statistics Canada collapsed various survey Catalogues into an annual summary report entitled Trucking in Canada, with its first publication covering the year 1984. The 1976 and 1981 figures presented in Table 2 have been secured by special request and at the convenience of Statistics Canada.

The data contained in Tables 2 and 3 give interesting insight into the recent levels and importance of concentration in the Canadian trucking industry. Remarkably, the ten largest carriers account for less than one-fifth of the total market share. The number of carriers surveyed in 1984 totalled 5,221. This figure climbed to 6,270 in 1985; an increase of 20.1%. The market share of the ten largest firms actually decreased by 1.7 percentage points for this same period.

Statistics Canada employs gross operating expenses in its concentration survey due carrier reluctance to release revenue statistics. Operating expenses are a suitable substitute since they vary in a manner which closely parallels levels of business activity. Statistics Canada notes that there is a possibility of underestimation of the true level of concentration in its for-hire trucking figures. For-hire truckers tend to submit consolidated reports less frequently than private carriers which leads to possible underestimation in the for-hire statistics and overestimation in the private trucking industry figures. The for-hire survey statistics apply to firms engaged in the transportation of freight for compensation which earn at least $100,000 annually. Small shipment carriers, such as courier services and other specialized carriers, are excluded. The gross operating expenses summarized in Tables 2 and 3 include all expenses pertaining directly to the for-hire freight operation of the firm.

Taking into consideration the possibility of underestimation, the message is certainly clear. With reference to Table 1, it can be seen that the Canadian trucking industry is best described as "atomistic". Table 1 uses the top four firms in an industry to characterize its level of concentration. The fact that Tables 2 and 3 focus on the top ten firms should more than compensate for any supposed underestimations. It is interesting to note that in none of the four years could the top one hundred firms in the Canadian trucking industry muster anything more than a "moderate" level of concentration. Three points appear to support the validity of the concentration figures. First, the data has been dispersed over a nine year period

and thus represent a trend rather than a quick inventory. A second consideration is the dramatic increase in responses to Statistics Canada's survey. Gross operating expenses totalled $2,899,081,270 in 1976. These expenses grew to approximately $7.85B by 1985 - an increase of some 270%. This clearly indicates effective representation as more carriers have been brought into the fold. The third point to note is relative stability in the data. The figures fluctuated by less than three percentage points over the course of nine years. Very good estimates can be drawn when the data differ by such small percentages.

TABLE 4: **Concentration Ratios for Select Canadian Industries; 1980.**

Industry	4-Firm Ratio
Tobacco Products Manufacturers	99.6
Breweries	99.0
Motor Vehicle Manufacturers	93.7
Iron Mines	86.7
Iron and Steel Mills	77.9
Major Appliances	77.0
Petroleum Refining	61.7
Agricultural Implements	61.0
Toys and Games	48.6
Coffins and Caskets	41.5
Bakeries	33.5
Sand Pits	29.6
Hosiery Mills	29.2
Logging	21.4
Machine Shops	6.4
Women's Clothing Factories	6.4

SOURCE: William J. Baumol, Alan S. Blinder, and William M. Scarth, Economics: Principles and Policies, page 608.
*Also in Statistics Canada, Industrial Organization and Concentration in the Manufacturing, Mining and Logging Industries, Cat. 31-402.

Four-firm concentration ratios for representative Canadian industries for the year 1980 are presented above in Table 4. While the year does not correspond exactly with the specific years covered in the previous trucking industry tables, Table 4 acts as suitable reference for comparison of concentration ratios in key sectors of the economy -- and some perhaps not so "vital" sectors. One must keep in mind the fact that Tables 2 and 3 group the ten largest firms in the Canadian trucking industry. One can see that the ten largest trucking firms rank somewhere ahead of machine shops with respect to concentration in the

Canadian economy.

Table 5 reworks the data of Tables 2 and 3 to present trends over the years in concentration for the 10, 25, 50, and 100 largest firms:

TABLE 5: **Trends in Concentration in the Canadian For-Hire Trucking Industry, Select Years.**

Year	PERCENTAGE SHARE OF MARKET ACCOUNTED FOR BY THE FOLLOWING REPORTING UNITS			
	10 Largest	25 Largest	50 Largest	100 Largest
1976	15.5	28.2	38.5	49.0
(CHANGE)	> 1.2	>(0.5)	>(0.8)	>(2.4)
1981	16.7	27.7	37.7	46.6
(CHANGE)	> 1.4	> 1.2	> 0.7	> 1.6
1984	18.1	28.9	38.4	48.2
(CHANGE)	>(1.7)	>(2.3)	>(3.6)	>(3.8)
1985	16.4	26.6	34.8	44.4

NOTE: (CHANGE) is measured in absolute terms as plus or (minus).

While concentration increased by 0.9% for the ten largest firms in the Canadian trucking industry between 1976 and 1985, the concentration for every other category fell over the same period. The evidence of concentration in the Canadian trucking industry points to a very atomistic structure at best. This is not exceptionally encouraging news for those who believe that concentration is already high and likely to increase greatly in a deregulated transportation environment. The figures appear stable and rank well behind other sectors in terms of the need for close government scrutiny. An examination of legislation in place to deal with mergers in the Canadian trucking industry is in order. This will help to determine whether or not controls exist to deal with "buy-outs" in a highly competitive market -- mergers which, unchecked, might otherwise harm consumers in the long run.

COMPETITION POLICY

Thus far, focus has been placed solely on the present level of concentration in the Canadian trucking industry. Static analysis such as this is of limited importance if one fails to incorporate variables which can directly affect future levels of concentration. One such variable is the scope of competition policy.

Competition policy plays an important role in establishing a legal framework for business operations. The goals of competition policy appear easier to list than to secure, and such has been the case in Canada's history. Competition is not an end in itself but rather an effective stimulus for efficiency, productivity, and industrial growth. Utopians envisage an economy with extensive consumer choice over high-quality, low-priced goods and services. With rewards for innovation and initiative, resources would be allocated both efficiently and in an impartial manner.

The application of an effective competition policy to transportation services has been sadly lacking in Canada, and dates back to the turn of the last century. The **Combines Investigation Act** was studied by the Economic Council of Canada in a 1969 report and found to useless at best. Not once in the whole history of the Act has a conviction been registered in a contested merger case. In fact, only eight such cases have been brought forward for consideration.

Legislators identified two key reasons accounting for the Act's dismal track record. The first was its classification under criminal law procedures. Illegal merger activity was spelled out in section 33 of the Act (in conjunction with the definition of a merger in section 2). Proof was required beyond a reasonable doubt that competition was or was likely to be lessened "to the detriment or against the interest of the public". The criminal law burden of proof (beyond a reasonable doubt) proved too onerous and thus rendered the Act ineffective. It was ironic that business transactions usually lacking in moral reprehensibility were closely examined in an effort to uncover the "criminal element".

The second problem area was with respect to merger evaluations. Criminal prosecutors often times were ill-suited to scrutinize complex economic evidence and detail the probabilistic consequences for the public. Subjective evidence undermined Crown cases thus allowing many mergers to proceed unchecked.

As a means of correcting the inherent short-comings of the **Combines Investigation Act**, the federal government en-

acted the **Competition Act** in June of 1986. Fundamental changes were introduced to "add teeth" to Canada's control over business operations. The new legislation was to apply equally to selling and purchasing activities, although with a specific focus on the supply side of the market. The scope of this new Act is indeed exhaustive. Coverage includes: conduct of sellers, predatory pricing, refusal to deal, consignment selling, exclusive dealing, tied selling, delivered pricing, price discrimination, resale price maintenance, abuse of dominant position, conspiracy, and mergers.

A major change incorporated in the **Competition Act** was the transfer of venue, from the criminal court system to a new Competition Tribunal. The Tribunal set out to establish a new standard of proof of wrong-doing. Cases would be judged by a balance of probabilities rather than "proof beyond a reasonable doubt".

The Tribunal draws from the best features of the court system as well as civil inquiries. Defendants are assured that issues will be thoroughly assessed by knowledgeable decision-makers, in an impartial manner, and with suitable avenues of appeal. An important aspect of the Tribunal is its review of prospective mergers. No longer are mergers judged solely on the basis of market share or concentration. Static concentration ratios give little indication about the actual conduct of firms in the market. The structure-conduct-performance hypothesis alluded to earlier assumes that concentration is necessarily and inherently evil. The Competition Tribunal has been careful to avoid structural interpretation of the law. Section 65 of the Act entrusts the Tribunal with a number of factors to be considered when evaluating the lessening of competition:

> "In determining, for the purpose of section 64, whether or not a merger or proposed merger prevents or lessens, or is likely to prevent or lessen, competition substantially, the Tribunal may have regard to the following factors:
> (a) the extent to which foreign products or foreign competitors provide or are likely to provide effective competition ...;
> (b) whether the business ... has failed or is likely to fail;
> (c) the extent to which acceptable substitutes ... are or are likely to be available;
> (d) any barriers to entry into a market, including
> (i) tariff and non-tariff barriers to international trade,

(ii) interprovincial barriers to trade, and
(iii) regulatory control over entry, and any effect of the merger or proposed merger on such barriers;
(e) the extent to which effective competition remains ...;
(f) any likelihood that the merger ... would result in the removal of a vigorous and effective competitor;
(g) the nature and extent of change and innovation in a relevant market; and
(h) any other factor that is relevant to competition in a market that is or would be affected by the merger or proposed merger."[3]

The **Competition Act** implicitly recognizes the positive features which some mergers can deliver. The Canadian economy is small. Firms should not be prevented from obtaining economies of scale which improve their competitive position simply because they trigger a certain level of market concentration. Many factor are involved and deserve consideration. The Competition Tribunal certainly cannot be considered a mechanistic review board.

The restructuring and strengthening of Canada's competition policy has important implications for the Canadian trucking industry. While Bill C-19 is expected to usher in new levels of competition, the likelihood of growth in illegal business practices appears very slim. Data in Tables 2 and 3 demonstrate an atomistic level of concentration in the for-hire trucking industry. A growth in competition is certain. However, one must be careful not to fall prey to the "competition equals con-centration" myth. Canada now enjoys effective and enforceable competition legislation. The outdated **Combines Investigation Act** pales in comparison to the new **Competition Act**. The burden of proof has been eased, while new criteria to judge the merits of proposed mergers have been introduced. One can expect to see mergers approved only if they can be shown on balance to benefit the economy. Mergers are possible and indeed likely in the LTL market as companies realize new economies of scale. Large investments in terminal facilities necessitate such consolidation. Taking into account present levels of concentration in the Canadian trucking industry and the existence of enhanced supply-side legislation, it seems unlikely that levels of concentration are capable of rising above more than a moderate amount. "Soothsayers" who predict a drastic rise in concentration as a result of Bill C-19, all the while mindful of the public's best interests, are advised to remain optimistic lest their concern be interpretted as self-serving.

CONCLUSION

This paper examined recent levels of concentration in the Canadian trucking industry and concluded that the term "atomistic" best describes the present environment. A review of Canada's newly enacted **Competition Act** (as it relates to mergers) was included in order to assess the likelihood of heightened concentration in this key sector of the economy. Based upon the evidence of minimal industry concentration and vast improvements to the regulatory framework, it appears the enactment of Bill C-19 might lead to only "moderate" levels of concentration. Mergers will flourish if and only if they can be shown to be in the economy's best interest.

ENDNOTES

[1]Hirshhorn, Ron, "Trucking Regulation in Canada: A Review of the Issues", page 182.

[2]Clarkson, Kenneth W., and Roger LeRoy Miller, Industrial Organization: Theory, Evidence and Public Policy, page 5.

[3]Revised Statutes of Canada, 1986, c. 26, Competition Act, pp 67-68.

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ACKNOWLEDGEMENT

The author gratefully acknowledges the assistance of Joseph Dion in the preparation of this paper. Any errors or omissions remain the responsibility of the author.

THE COSTS AND POTENTIAL SAVINGS OF EMPTY TRUCK MOVEMENTS OCCURRING BETWEEN NORTHERN AND SOUTHERN ONTARIO

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1. INTRODUCTION

In August of 1987 the Ministry of Transportation, Ontario, interviewed more than 3200 truck drivers at its two Vehicle Inspection Stations located north of Toronto on Highway 400. These interviews revealed that 36% of the southbound trucks and 24% of the northbound trucks were empty. This paper will:

- Outline the survey methodology employed,
- Examine the characteristics of the empty movements that were recorded,
- Estimate the costs of empty movements between Northern and Southern Ontario, and
- Estimate the potential savings that could be achieved with a more efficient matching of loads to available equipment between Northern and Southern Ontario.

2. SURVEY METHODOLOGY

Interviews were administered by summer students who had received training in the various elements of the questionnaire. The interviews were conducted for a period of 48 hours at each inspection station and began at the southbound station at 10:00 a.m. August 19 and at the northbound station at 10:00 a.m. August 21. Commercial vehicles were routed through the weighing platform and the gross vehicle weight was recorded. However, specialized equipment such as tankers, float trailers, cement mixers, gravel trucks and automobile carriers were excluded from the survey.

Drivers of straight trucks and tractor trailers were asked questions concerning employment type, origin, destination, weight of freight, number of shipments, commodity type and cube utilized.

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

Observations were recorded on equipment configuration, trailer style, the number of axles and the time of interview. The questionnaire used is shown in Figure 1. Driver co-operation was excellent as more than 99% of the drivers participated in the survey.

In order to determine the total number of commercial vehicles passing the inspection stations, a separate classification study was undertaken during the survey period. A total vehicle count by hour was obtained for the various equipment types such as straight trucks, tractor trailers, and specialized equipment. Thirty-seven percent of the northbound straight truck and tractor trailer drivers passing the inspection were interviewed while 33% of the southbound drivers were interviewed.

Once the interviews were completed, each origin and destination was coded into Provincial Transportation Zones in order that the data could be analyzed by various transportation corridors. Then a series of edit checks were performed to verify the accuracy of the data contained in the questionnaire. These checks included:

- Verification that the recorded shipment weight was correct by comparing the recorded shipment weight plus the estimated vehicle weight(1) to the total weight obtained from the scale reading.

- A comparison of the number of axles to the vehicle configuration.

- A comparison of shipment weight, number of shipments, cube and freight type. All four factors had to be recorded as zero for a trip to be considered as an empty move.

- Verification that southbound loads had southern destinations and northbound loads had northern destinations.

Corrections were made to questionnaires when obvious errors were discovered. If an error could not be corrected, the questionnaire was discarded. Approximately 3% of the questionnaires fell into this category.

The information from the questionnaires was entered into a micro computer data base program. A 10% random sample of questionnaires was then verified to ensure keypunch accuracy.

FIGURE 1

1987 TRUCK DATA SURVEY QUESTIONNAIRE

1. OBSERVATIONS: (Specialized equipment, such as tankers, floats, cement mixers and gravel trucks are to be excluded from interviews)

Control # | Interviewer | Location | Time | MMDD

a) Direction of travel: 1) North 2) East 3) South 4) West

b) Weight from weigh scale slip

c) Configuration: 1) Tractor-semi 2) A-Train
3) B-Train 4) C-Train
5) Straight Truck 6) Truck & Trailer

d) Trailer Style 0) Straight Truck 1) Van 2) Flatbed
3) Stake & Rack 4) Container

e) Number of axles

f) Tractor Style: 1) Conventional 2) Cabover

g) Drome Box: 1) Yes 2) No

h) Reefer: 1) Yes 2) No

2. QUESTIONS:

a) Are you an owner operator? 1) Yes 2) No

b) Is your company: 1) for hire or 2) private

c) In terms of space occupied, how full is your trailer?
0) empty 1) 1/4 full 2) 1/2 full
3) 3/4 full 4) full 5) don't know
(enter 0 in questions e, f, g and h if trailer is empty)

In order to answer the last questions we may have to look at your freight documentation

d) How much does your freight weigh? [X] if lbs. [ ]

e) How many shipments are you carrying?

f) How many shipments are you carrying over 10,000 lbs?

g) How would you describe your freight?
1) General freight (truckload) 2) General freight (less-than-truckload) 3) Used Household Goods 4) Live Animals
5) Parcel Carriers/Couriers 6) Logs or Lumber
7) If other specify .....

h) What is the initial origin and final destination of the freight?

	Nearest City	Province/State
Shipper/ Origin		
Consignee/ Destination		

If less-than-truckload or empty: Initial origin and final destination of trailer.

Note: Four observations and 1 question concerning safety and energy issues are excluded.

3. CHARACTERISTICS OF EMPTY MOVEMENTS

Tables 1 through 4 illustrate the nature of empty moves that occurred between Southern and Northern Ontario. Southern Ontario is primarily the Toronto area but it also includes a few locations in the Southwestern, Southeastern and Niagara areas of the Province. Central Ontario includes the Owen Sound, Barrie and Huntsville areas. Northern Ontario includes the North Bay, Northwestern Quebec, Timmins, Sudbury and Sault Ste. Marie areas. Northwestern Ontario is primarily the Thunder Bay area while Western Canada includes all the western provinces and a few northwestern States.

From Table 1, it can be seen that there is a higher percentage of empty movements in the southbound direction compared to the northbound direction. It also shows that there are fewer empty moves the longer the distance travelled. Presumably carriers are not as concerned with shorthaul empty costs because highway operating costs are a much lower proportion of total costs for short trips than they are for longer trips.

In Table 2, it can be seen that straight trucks have the highest percentage of empty moves. This reflects the fact that straight trucks are used more for shorter trips. Flatbeds (including stake and rack trailers) have the next highest percentage of empty moves. Presumably it is more difficult to match loads for this type of equipment than it is for vans.

Private and for hire carriers, as shown in Table 3, handle about the same percentage of empty moves. Private carriers account for about 67% of the total moves and about 68% of the empty moves. It is significant to note that private carriers handle a greater proportion of the moves for shorter trips while the for hire carriers handle more of the longer trips.

In Table 4 it is shown that owner operators and company drivers handle about the same percentage of empty moves. Company drivers handled a lower precentage of empty moves on shorter trips while owner operators had a lower percentage for longer trips. Company drivers account for 78% of the loads and 77% of the empty moves. However, the longer the trip the greater the likelihood that owner operators are used. Owner operators handle about 51% of the Western Canada trips.

TABLE 1
NUMBER OF MOVEMENTS BY LENGTH OF HAUL

Southern Ont. To & From	Southbound Total Moves	Empty Moves	% Empty Moves	Northbound Total Moves	Empty Moves	% Empty Moves
Southern Ont.	438	189	43%	188	71	38%
Central Ont.	646	248	38%	821	240	29%
Northern Ont.	325	105	32%	381	64	17%
N.W. Ont.	25	4	16%	27	0	0%
W. Canada	84	3	4%	172	2	1%
Total	1518	549	36%	1589	377	24%

TABLE 2
NUMBER OF MOVEMENTS BY EQUIPMENT TYPE

	Southbound Total Moves	Empty Moves	% Empty Moves	Northbound Total Moves	Empty Moves	% Empty Moves
Str. Truck	375	174	46%	378	130	34%
Tractor/Flat	326	122	37%	319	102	32%
Tractor/Van	777	246	32%	856	137	16%
Other	40	7	18%	36	8	22%
Total	1518	549	36%	1589	377	24%

TABLE 3
NUMBER OF MOVEMENTS BY TYPE OF COMPANY CARRIAGE

Southern Ont. To & From	Private Total Moves	Empty Moves	% Empty Moves	For Hire Total Moves	Empty Moves	% Empty Moves
Southern Ont.	460	187	41%	166	73	44%
Central Ont.	1066	337	32%	401	151	38%
Northern Ont.	419	103	25%	287	66	23%
N.W. Ont.	19	2	11%	33	2	6%
W. Canada	118	1	1%	138	4	3%
Total	2082	630	30%	1025	296	29%

TABLE 4
NUMBER OF MOVEMENTS BY TYPE OF EMPLOYMENT

Southern Ont. To & From	Owner Operator Total Moves	Empty Moves	% Empty Moves	Company Driver Total Moves	Empty Moves	% Empty Moves
Southern Ont.	114	65	57%	512	195	38%
Central Ont.	236	97	41%	1231	391	32%
Northern Ont.	195	48	25%	511	121	24%
N.W. Ont.	19	0	0%	33	4	12%
W. Canada	130	3	2%	126	2	2%
Total	694	213	31%	2413	713	30%

4. THE COST OF EMPTY MOVEMENTS

From Table 5 it can be seen that empty moves are a significant factor in the transportation of goods between Northern and Southern Ontario. Over the routes surveyed but excluding movements within Southern Ontario and between Southern Ontario and Western Canada, it is estimated that empty moves resulted in over 43 million kms in 1987 and in more than $34 million in expenses. This represents about 24% of the total kms driven and about 23% of the total costs incurred.

4.1 Determination of Kms Driven

The number of empty kms driven, as shown in Table 5, was calculated by multiplying the number of empty moves originating and terminating in each Northern Ontario location by the point to point kms between that location and Toronto. Toronto was used as the Southern Ontario location even if the move originated or terminated in another area such as Southwestern Ontario, Southeastern Ontario or the Niagara Peninsula. This was done for ease of analysis and because the majority of these moves did in fact terminate or originate in the Toronto area.

Total kms driven as shown in Table 5 was calculated by multiplying the average kms shown for each area by the total number of moves that occurred between each area and Toronto. Average kms for an area is the weighted average of the point to point kms between each specific location in the area and Toronto where empty movements occurred.

4.2 Determination of Costs Incurred

Total transportation costs in Table 5 were determined by multiplying the total kms driven by the appropriate cost per km. Similarly, empty transportation costs were determined by multiplying empty kms driven by the appropriate cost per km.

In this analysis, costs were calculated separately for straight truck moves and for tractor trailer moves because the cost per km is significantly different for these two types of equipment. The equipment cost per km shown for straight trucks in Table 6 is based on a new truck with a van box mounted on a 7.3 m chassis, powered by a diesel engine and equipped with a 5 speed transmission

TABLE 5

EMPTY MOVEMENTS COMPARED TO TOTAL MOVEMENTS

Southern Ont. To & From	Aver. Kms	Kilometres Total Kms	Kilometres Empty Kms	Kilometres % Empty Kms	Costs Total Costs	Costs Empty Costs	Costs % Empty Costs
Central Ont.							
Barrie	94	116,029	39,429	34%	$87,974	$29,314	33%
Owen Sound	190	14,420	4,933	34	11,006	3,716	34
Huntsville	198	31,218	8,496	27	23,596	6,469	27
Northern Ont.							
North Bay	339	55,206	17,273	31	43,663	13,590	31
N.W. Quebec	409	26,176	8,180	31	21,598	6,817	32
Timmins	637	72,573	14,642	20	59,297	11,798	20
Sudbury	360	93,294	20,892	22	74,490	16,756	22
S.S.Marie	682	72,267	11,590	16	59,503	9,513	16
Northwestern Ont.							
Thunder Bay	1,375	71,500	5,500	8	58,858	4,584	8
Total Survey		552,683	130,935	24	439,985	102,557	23
Estimated Daily		740,677	175,473	24	589,646	137,443	23
Estimated Annual		185,169,250	43,868,250	24	147,411,500	34,360,750	23

and power steering. The equipment cost per km shown for a new tractor trailer unit is based on the costs for a tractor powered with the equivalent of a 315 diesel Cummins engine and equipped with a 9 speed transmission and 40,000 lb. rear axle. The trailer costs are based on a new 48' 102" tandem axle van trailer.

It was felt that the costs for these equipment types would provide the best average for the wide range of straight trucks and tractor trailer combinations that can be found. For example, although the costs for a tractor flatbed combination would be lower than those shown in Table 6, the costs of a tractor train combination would be higher.

TABLE 6
ONTARIO TRUCK OPERATING COSTS/KM

	Straight Trucks	Tractor Trailer
EQUIPMENT		
Variable	$.211	$.290
Fixed	$.124	$.298
LABOUR		
Wage	$.175	$.185
Benefits	$.058	$.061
Total Costs	$.568	$.834

The costs in Table 6 are based on a detailed costing model.(2) However, since truck costing is not the prime focus of the paper, the model and its major assumptions are not included here.

4.3 Determination of Annual Estimates

Daily and annual estimates for kms and costs are determined by the following formulas:

Daily Factor = Total straight trucks and tractor trailers observed ÷ number of interviews ÷ 2 days
Daily Estimate = Kms or costs as calculated from the survey x daily factor
Annual Estimate = Daily estimate x 250 days

In order not to over estimate the daily factor, it was only calculated on data from the northbound station. This was done because a higher percentage of interviews occurred at this location. It must be noted that the method used to estimate annual kms and costs does not provide

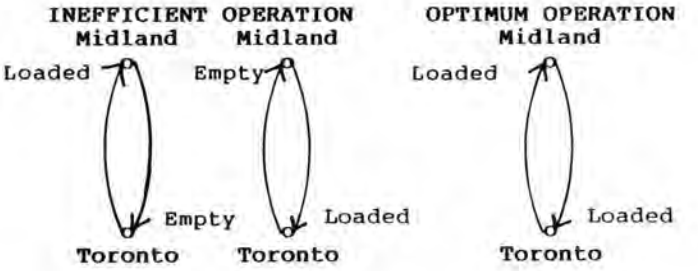
a very precise projection as it does not take into account seasonal variations. However, it does provide an order of magnitude and probably understates trucking activity since, by basing the calculation on 250 days, weekends and holidays are not taken into consideration.

5. POTENTIAL EMPTY TRIP SAVINGS

5.1 Methodology

In this analysis it is assumed that the potential exists to eliminate one trip if an empty movement occurs in both directions from one location to another. This is illustrated below in Figure 2 for movements between Toronto and Midland, Ont.

FIGURE 2



In an inefficient operation characterized by empty moves moving in both directions, two round trips are required. However, if loads are matched as shown in the optimum operation, only one round trip is required.

In determining potential empty moves that could be eliminated with a better matching of loads between locations, both equipment and carrier types were considered. Table 7 provides an example of empty movements that occurred between Toronto and Midland, Ont. and is used to illustrate the methodology that was used to calculate potential empty trip savings between each origin and destination pair.

It is important to note that each of the three equipment types, straight trucks, tractor van combinations and tractor flatbed combinations were matched with one another. It was assumed that the type of freight handled by each equipment type could not be handled by another type of

equipment. As a result potential savings are probably understated as some commodities could likely be handled by more than one trailer type.

TABLE 7
POTENTIAL EMPTY TRIP SAVINGS

Empty Moves Between Midland, Ont. and Toronto

	For Hire			Private		
	Truck	Van	Flat	Truck	Van	Flat
Empty Moves						
- Southbound	1	4		4	6	1
- Northbound		5		2		

Potential Empty Round Trips that could be Eliminated

With Market Entry Constraints:

- 4 empty vans by matching for-hire empty vans

Without Market Entry Constraints:

- 2 empty straight trucks by matching empty private straight trucks
- 1 empty van by matching the remaining empty for-hire van with a empty private van
- 2 empty straight trucks by matching the remaining empty straight trucks with empty straight trucks from a nearby location

In Table 7 for hire companies were responsible for 4 southbound empty vans and 5 northbound empty vans. With optimum matching of loads, 4 round trips could be eliminated. This type of savings will be referred to as savings that could be achieved "With Market Entry Constraints".

In addition, as shown in Table 7, private companies were responsible for 4 southbound empty straight truck movements and 2 northbound empty straight truck movements. If private carriers were allowed to match loads, a savings of 2 round trips could be achieved. Moreover, if private carriers were allowed to handle for hire loads, the remaining for hire northbound van could be matched with any one of the 6 southbound empty private vans. Finally, if private or for hire carriers were allowed to handle loads from nearby locations, the remaining 2 southbound private

empty straight truck moves could be matched with 2 northbound empty straight truck moves going to, for example, Penetanguishene. These three types of empty savings will be referred to as savings that could be achieved "Without Market Entry Constraints". It should be noted that 81% of the total survey moves that could be eliminated "Without Market Entry Constraints" result from the matching of loads between private carriers.

5.2 Empty Move Savings

About 54% of the empty moves that occur between Northern and Southern Ontario can be eliminated if loads are matched by location and equipment type. As shown below, there is more opportunity for savings on the shorter trips:

TABLE 8
EMPTY MOVE SAVINGS

Southern Ont. To & From	Total Empty Moves	Potential Empties Eliminated	Percentage Empties Eliminated
Central Ont.	488	292	60%
Northern Ont.	169	64	38%
N.W. Ont.	4	0	0%
Total	661	356	54%

5.3 Empty Km Savings

From Table 9 it can be seen there is the potential to eliminate approximately 18.5 million empty kilometres per year between Northern and Southern Ontario. This is about 10% of the total kilometres driven. It is important to note that 78% or about 14.5 million kms of the potential kms that could be eliminated cannot be achieved with present market entry constraints.

TABLE 9
EMPTY KM SAVINGS

South Ont. To & From	With Mkt Entry Constraints -000-	%	Without Mkt Entry Constraints -000-	%	Total -000-	%
Cen. Ont.	8.3	5.1	22.9	14.1	31.2	19.2
Nor. Ont.	4.0	1.2	20.3	6.3	24.3	7.5
N.W. Ont.	0	0	0	0	0	0
Total	12.3	2.2	43.2	7.8	55.5	10.0
Est. Dly.	16.5		57.8		74.3	
Est. Ann.	4113		14455		18568	

5.4 Empty Cost Savings

To determine the potential monetary savings that result with better matching of loads between locations, the following formula was used.

Potential Savings = ((round trip kms x # of round trips eliminated) less (additional P & D kms)) times (appropriate cost/km)

If loads are matched, the driver will incur additional kms when he travels to pick up or deliver the load. In Table 10 the cost of potential empty moves savings is calculated. Driving costs for travelling an additional 20 or 40 kms were deducted. If additional kms were required to match loads for an adjacent community, these kms were subtracted as well. The costs per km as shown in Table 6 were applied to the straight truck and tractor trailer moves that could be eliminated.

From Table 10 it can be seen that between $13.7 million and $12.8 million could be saved annually with better matching of loads between Northern and Southern Ontario. It is important to note that 63% of these potential savings are only possible if private carriers are allowed to match loads.

The potential impact on the costs of moving goods between Northern and Southern Ontario by better matching of loads is quite significant. From Table 11 it can be seen that the overall costs of transportation could be reduced by 8.7% to 9.3%. The impact of additional P & D kms is not as significant for the longer trips as compared to the shorter trips.

TABLE 11
POTENTIAL EMPTY COST SAVINGS AS A PERCENTAGE OF TOTAL COSTS

Southern Ontario To & From	With Mkt Entry Constraints	Without Mkt Entry Constraints	Total
	(LESS COSTS OF 20 P & D KMS)		
Central Ont.	4.8%	12.7%	17.5%
Northern Ont.	1.2%	6.3%	7.5%
N.W. Ont.	0.0%	0.0%	0.0%
Total	2.1%	7.2%	9.3%
	(LESS COSTS OF 40 P & D KMS)		
Central Ont.	4.3%	11.4%	15.7%
Northern Ont.	1.2%	6.1%	7.3%
N.W. Ont.	0.0%	0.0%	0.0%
Total	1.9%	6.8%	8.7%

TABLE 10

POTENTIAL EMPTY COST SAVINGS

Southern Ont. From & To	Savings if an additional 20 P & D kms are incurred: With Mkt Entry Constraints	Savings if an additional 20 P & D kms are incurred: Without Mkt Entry Constraints	Savings if an additional 20 P & D kms are incurred: Total	Savings if an additional 40 P & D kms are incurred: With Mkt Entry Constraints	Savings if an additional 40 P & D kms are incurred: Without Mkt Entry Constraints	Savings if an additional 40 P & D kms are incurred: Total
Central Ontario						
Barrie	$5,292	$10,273	$15,565	$4,663	$9,010	$13,673
Owen Sound	0	2,369	2,369	0	2,235	2,235
Huntsville	617	2,908	3,525	583	2,764	3,347
Northern Ontario						
North Bay	2,234	4,627	6,861	2,167	4,477	6,644
N.W. Quebec	0	1,330	1,330	0	1,297	1,297
Timmins	0	1,934	1,934	0	1,900	1,900
Sudbury	992	7,245	8,237	958	7,050	8,008
S.S. Marie	0	1,133	1,133	0	1,117	1,117
Northwestern Ontario						
Thunder Bay	0	0	0	0	0	0
Total Survey	9,135	31,819	40,954	8,371	29,850	38,221
Total Daily	12,241	42,643	54,884	11,219	40,003	51,222
Total Annual	3,060,250	10,660,750	13,721,000	2,804,750	10,000,750	12,805,500

There are several factors which will reduce the amount of potential savings that could be achieved. Some loads will move regardless of empty move costs because of service considerations. In some situations, a load will have to move immediately before a backhaul load is found. Timing and scheduling may prevent the matching of other loads. For example, drivers may not have sufficient time to complete an additional pick up or delivery and keep within allowed hours of work.

On the other hand, this analysis does not take into consideration the possibility of matching partially loaded trailers. In the northbound direction a further 17.7% of the movements are less than 50% full and in the southbound direction an additional 13.9% of the movements are less than 50% full. Thus, although the potential savings shown in this report represent an optimum elimination of empty movements, it would appear that the potential savings projected are quite realistic. In fact, projected savings could theoretically be exceeded if space on partially loaded trailers was utilized.

CONCLUSION

In this paper it has been shown that the percentage of empty moves that occur decreases with the length of haul. This is an important factor that should be considered in the development of truck costing models.

This paper demonstrates that with better matching of loads between Northern and Southern Ontario significant savings in transportation costs and trucking kms driven are achievable. There is an opportunity to reduce transportation costs by as much as 17.5% for movements between Southern Ontario and Central Ontario and by as much as 7.5% for movements between Southern Ontario and Northern Ontario. As many as 18.5 million annual truck kilometres could be eliminated. Not only would this reduce congestion on Highway 400 in the Toronto area but it has the potential to reduce highway maintenance costs as well.

The majority of these potential savings are possible only with:

1. substantial change in market entry constraints and

2. the establishment of an information system which would enable the effective matching of loads.

With respect to market entry constraints, this paper shows that 63% of the potential savings are achieved by the matching of private loads with private loads. Thus, much of these potential savings do not necessarily have any direct impact on existing for hire carrier activity.

Regarding better communications, one would expect that with the easing of market entry constraints there would be a significant growth in load brokers or other mechanisms to improve the matching of loads. In fact, this happened in the United States following the easing of their market entry constraints in 1981. It may also be useful to establish a centralized load matching centre in Northern Ontario that could be used by shippers, and carriers seeking to improve efficiency.

This paper deals only with the traffic flows between Northern and Southern Ontario. It would be instructive to perform a similar, detailed analysis in more heavily travelled transportation corridors.

REFERENCES

1. Equipment tare weights were based on a 1987 survey conducted by F. Nix of Clayton, Sparks and Associates.

2. Equipment costs were based on a modified version of Trimac's "Operating Costs of Trucks in Canada - 1986". Trimac Consulting Services provided the necessary information to make the modifications.

THE STRUCTURE OF THE QUEBEC TRUCKING INDUSTRY: AN EMPIRICAL ANALYSIS

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1. Introduction

The Canadian trucking industry has gradually adjusted to the new competitive environment which came about as a result of the Motor Carrier Act of 1980 enacted by the United States Congress. However, the benefits of American deregulation are only felt indirectly in Canada as long as provincial regulatory commissions do not modify their criteria based on public convenience and necessity. In 1985, the Canadian government published an informal policy-oriented discussion paper, entitled Freedom to Move, explaining its views on what should constitute an ideal environment for Canadian transportation. After various representations to provincial governments, trucking and shippers' associations, Bill C-19 became a law of the land in June 1987. Each provincial government will have to introduce a new transportation act to harmonize its legislation in keeping with the new federal law. Basically, the objectives of this paper are to quantify and evaluate the production structure of the regulated trucking industry in Québec, in order to anticipate the eventual behaviour of its members if existing regulations are completely abolished over the next few years. As a matter of fact, an excellent understanding of the structure of the underlying technology and the cost-generation process is a necessary step in the analysis of a policy issue such as deregulation.

In the following section, I shall briefly discuss the methodology used before proceeding to define the data and variable selection issues. Section III presents the main estimation results. In section IV, major econometric results are analyzed in the perspective of political economy considerations. The final section is given over to concluding remarks on the actual behaviour of trucking firms.

2. The Cost Function: Specification, Data and Variables

Following Friedlaender and Spady[1], let us consider a general long run cost function with the following form

$$C = (y, w, t) \qquad (1)$$

where C represents costs, y is output, w represents a vector of factor prices faced by the firm and t refers to a vector of depicting operating characteristics or technological conditions. This cost function is

approximated, for the econometric estimation, by a second order translogarithmic cost function. The latter, like parsimonious flexible forms, offers a second-degree approximation to the true cost function around the sample arithmetic mean of the independant variables. Moreover, the translog cost function permits the listing of a number of hypotheses concerning the separability, homogeneity, and jointness of the underlying production function.

The Quebec data used in this paper are derived from confidential tapes compiled by Statistics Canada from the Motor Carriers' Freight Survey (MCF) and the For-Hire Trucking Origin and Destination Survey (TOD) for the years 1982, 1983 and 1984. The MCF survey records mainly financial data collected from trucking firms and the TOD survey records information pertaining to the shipments carried by a subsample of carriers appearing on the MCF survey. The Quebec sample consists of 337 observations over three years. The main characteristics of the selected firms are that they are class I and II firms operating only as intraprovincial carriers and that at least 50% of their revenue is generated from the haulage of general freight.

Four factor prices, five technological variables or attributes and one output have been chosen. The various calculations are briefly sketched[2]. First of all, let us provide, details on the construction of the four factor prices. The price of fuel is defined as fuel expenditures and fuel taxes, divided by the total number of litres consumed. The price of labour is measured as costs of drivers and helpers, including social benefits, divided by the number of drivers and helpers. The implicit assumption is that the annual number of hours worked by employee is constant and invariant among firms. The factor price of capital is calculated as expenditures on capital services plus a 12-percent opportunity cost of capital divided by carrier property net; the elements of the numerator are depreciation and maintenance of capital items[3]. The materials input price consists of the expenditure on traffic and sales, administration, terminal operating costs plus expenditures on purchased transportation divided by the total amount of kilometres[4]. The components of the numerator are mainly composed of expenditure on labour and general supplies.

Five technological variables or attributes are used to grossly differentiate firms on the basis of the network over which they operate, the markets they face and the operating rights restrictions under which they operate. Average length of haul is measured as the total kilometres driven by a carrier, divided by the number of shipments. Thus, average length of haul should be larger in proportion to the spatial extent of the system operated by a firm. Average shipment size is defined as kilograms carried per shipment. This variable links a choice of inputs and input/output relationships to the nature of the demand faced by the firm. The capacity utilization is defined as the product of kilograms carried and kilometres driven, divided by the number of trucks used[5]. It tends to increase as a firm engages in more truckload activity or as a firm is able to balance its loads on return trips. In a nutshell, these first three operating characteristics attempt to reflect the composition of output in physical terms and serve as proxies for the firm's network. The fourth attribute, the percentage of freight in less-than-truckload lots (LTL), is defined as total LTL kilograms divided by total kilograms hauled by a carrier. This variable is used to

measure the distribution of traffic between LTL and TL components and, consequently, larger handling expenses at terminals. The last technological variable, the unit insurance cost, is computed as insurance costs per kilograms-kilometres; it serves as a proxy for the fragility and the high-value of the commodities carried by the firm.

Finally, output is measured in terms of aggregate kilograms-kilometres, whereas total operating costs are measured as the expenditure on each of the four specified factors.

As the point of approximation in estimating the cost function is the arithmetic mean, it is useful to know the mean of all the variables in the cost functions. These means and their standard error are given in Table I.

TABLE I

Means of Factor Prices, Technological Variables and Output for 1984

Variable		Unit	Mean	Standard error
Factor Prices (w)				
Fuel	w_1	$ per litre	0.456	0.042
Labour	w_2	$ per man-year	30,250	8,495
Capital	w_3	$ per unit of carrier property net	0.968	0.537
Materials	w_4	$ per kilometre	1.08	4.69
Technological Variables (t)				
Length of haul	t_1	kilometres	226.82	167.82
Average shipment size	t_2	kilograms	14,275	11,623
Capacity utilization	t_3	tonnes-kilometres (000) per vehicule	1,201.47	1,350.19
LTL	t_4	%	15.52	17.56
Insurance costs	t_5	$ per tonne-kilometre	0.0054	0.0123
Output	y	tonne-kilometre (000)	31,498	82,856
Total Cost	CT	$ (000)	3,428	8,410

The cost equation is estimated simultaneously with factor share equations for fuel, labour and capital. Additive disturbances, assumed to be normally distributed and uncorrelated across firms and years, are appended to the cost equation and factor shares. Linear homogeneity in prices and symmetry are enforced.

The system of equations is estimated using Zellner's Seemingly Unrelated Regression technique (ZSUR): the estimation process was iterated until parameter estimates converged. The resulting estimates are asymptotically equivalent to maximum likehood estimates, and they are invariant with respect to which factor share equation is dropped.

3. Empirical Results

The translog cost function, the associated input demand or share equations, and the proper parametric restrictions are presented in Appendix 1. Briefly, the estimated model, with homogeneity constraints imposed, involves 337 observations[7], nine independent variables (one output, three prices and five attributes), 55 coefficients and three factor share equations. As the homogeneity restrictions can be used to solve for coefficients relating to the one additional price, the table in the appendix contains results for all 10 variables, 65 coefficients, and four factor share equations. In general, the coefficients are statistically significant and the R-squares indicate an acceptable goodness of fit. Fits for the share equations, ranging from 31.8 percent for fuel to 54.1 percent for material, are weaker, but still quite significant. Our particular analytical comments will, in run, focus on the technological variable (t_j), the factor prices (w_i) and the coefficients of the interaction terms between attributes and factor prices ($w_i t_j$) and between factor prices and output ($w_i y$).

Before discussing the elasticity of costs, it may be useful to present the implications coming from this specification of the trucking technology[7]. First of all, since the coefficients on the interaction terms among factor prices and operating coefficients ($w_i t_j$) are generally significant, technology is consequently not separable in attributes: technological conditions affect factor shares and factor utilization. Moreover, the fact that the coefficients on the interaction terms among factor prices and output ($w_i y$) are generally significant, implies that production is nonhomothetic and nonseparable: factor shares and intensities do vary with levels of output[2]. Therefore, it is difficult to make global generalizations regarding the nature of technology and returns to scale in particular. The relevant discussions on the nature of truck technology only apply to the estimates of cost elasticities and elasticities of factor substitution and demand evaluated at the mean levels of the variables.

Table 2 presents the elasticities of cost with respect to output and attributes and their associated standard errors. The linear output term indicates that a hypothetical Quebec carrier, at mean factor prices, technological conditions and ouput levels would exhibit marked increasing returns to scale, (0.7538 with a standard error of 0.0963). However how would a typical Quebec firm bring about these results? A possible answer may be inferred from an analysis of the linear estimates of the technological variables. Three out of these five linear coefficients are statistically significant, although their respective value is of a small magnitude. Increases in the average shipment size (t_2), in capacity utilization (t_3) and in LTL in the multiproduct cost function will reduce production costs in nearly the same percentage. The first two technological variables are generally expected to attain that objective. However the negative sign of this last technological variable may seem, a priori, surprising because American studies always obtain a positive coefficient which is consequently related positively to an increase in production cost. A quick explanation may be found in the low mean of this variable, 15.52%, relative to generally 50% for American studies. In other words, the hypothetical Quebec trucking firm, operating at the mean of the independent variables, has not yet found the optimal TL-LTL combination which is cost-minimizing. On the other hand, the fact that the average

length of haul (t_1) is not statistically significant, shows that cost reductions to be expected from an extension of the firm network are low and unimportant. That conclusion is clearly associated with the geographical configuration and the location of Quebec cities. Finally, the insurance variable, which serves as a proxy for the fragility and value of the commodities carried by a firm, is not statistically different from zero. However, that its estimated coefficient is negative and that does not significantly reduce production costs is directly related to a former point namely that an increase in LTL traffic is also a statistically relevant variable to realize costs savings. In other words, production costs would be even lower because an increase in LTL in the overall distribution of traffic would induce the insurance cost to be distributed on more shipments.

TABLE 2

Elasticity of Cost with Respect to Output and Technological Variables at the Point of Approximation

Elasticity of cost with respect to	Value	Standard Error
Output (y)	0.7538	0.0963
Average Length of Haul (t_1)	0.0246	0.0463
Average shipment size (t_2)	-0.0934	0.0423
Capacity utilization (t_3)	-0.0866	0.0418
% LTL (t_4)	-0.0856	0.0344
Insurance (t_5)	-0.0479	0.0469

The elasticities of factor substitution and the own-price elasticity of each factor[8], with their standard error in parentheses, are given in Table 3 for firms operating at the sample mean. The own-price elasticity of each input is on the diagonal, whereas the elasticities of substitution are in the upper triangle of the table. In general, they are in accordance with prior expectations on their respective sign and order of magnitude. All factors are substitutes, although the degrees of substitution between fuel and labour, fuel and capital and fuel and materials appear to be low. Moreover, the elasticity of substitution of materials for labour is the only estimated value which is not statistically different from zero. Therefore, an increase in a given factor price induces a trucking firm to reduce the quantity of this factor and to replace it by another least costly factor, but in a quantity less than proportional to the initial decrease. On the other hand, the estimated own-price elasticity for each factor is negative and statistically inferior to unity.

TABLE 3

Elasticities of Substitution and Own-price Elasticity, Estimated at the Mean a

	Fuel	Labour	Capital	Materials
Fuel	-0.5226	0.6067	0.6286	0.6288
	(0.0302)	(0.1111)	(0.1637)	(0.1949)
Labour	-	-0.4458	0.8302	0.2850
		(0.0189)	(0.0424)	(0.3878)
Capital	-	-	-0.5694	0.8301
			(0.0266)	(0.0838)
Materials	-	-	-	-0.4428
				(0.1546)

a Standard errors in parentheses.

The own-price elasticities of labour and capital are comparable to those estimated by Friedlaender and Spady, Kim and Daughety[9]. However, the relatively high inelasticity of demand for fuel, higher than that reported by Friedlaender and Spady, is directly linked to two successive fuel price increases by the petroleum cartel of producers (OPEC) and the 50% increase in the fuel tax enacted by the Quebec Government in 1981. In other words, it reflects the long term behaviour of Quebec firms to overcome this series of fuel price increases. A matter of fact, trucking firms may have partially reduced their level of output or have proceeded to an increase in maintenance expenses or both, in order to enhance the efficiency of their trucks and tractors with respect to fuel consumption. The second possibility, raised by Kim[10], seems to be weaker than he would like because of the low value of substitution between fuel and capital.

Another step in the analysis is to consider the effect or impact of the technological variables on factor intensities. Some inferences may be obtained by decomposing the allocation mechanism which takes place on the total cost and then among factors' share of total costs when a variation in the cost share of a factor is changed by a variation in one of the attributes. The point elasticity of the demand for factor i with respect to technological condition j is given by

$$b_j + B_{ij}/a_i \qquad (2)$$

where b_j is the estimated coefficient of the attribute j, B_{ij} the coefficient of the interaction terms between operating characteristics and factor prices ($w_i t_j$) and a_i the estimated value of the factor shares[11]. The reasoning behind this computation implies a three-step procedure which describes the particularities of the technology as specified by the translog cost function. An increase in a given technological variable (t_j) induces an effect on the total cost, the b_j coefficient. As the production is not homothetic, the influence that a technological variable has on factor prices has to be taken into account, the B_{ij} coefficient. Finally, the impact of the interaction terms B_{ij} must be weighted by the respective factor share in the total cost, the a_i coefficient. The estimated values and standard errors are presented in Table 4. Thus, 1 percent increase in LTL, at the sample mean, lowers costs by 0.31 percent. The distribution of the savings among factors

utilization is translated in the following manner; fuel consumption drops by 0.33 percent, labour utilization by 0.25 percent, capital by 0.33 percent and materials by 0.36 percent. On the other hand, a 10 percent increase in the level of capacity utilization reduces costs by 5.8 percent and it brings about savings in all factors. Associated savings are respectively 5.1 percent in fuel, 7.9 percent in labour, 5.5 percent in capital and 3.8 percent in materials. Finally, as the average length of haul and the insurance variables are not statiscally different from zero, analytical inferences are therefore not well grounded. In short, variations in costs coming from technological variables are mainly associated with labour utilization and, at a lesser degree, with capital and fuel.

TABLE 4

Point Estimates of the Elasticity of Cost and factor demand with respect to Technological variables a

	Cost	Fuel	Labor	Capital	Materials
Average	-0.0583	-0.0236	-0.2664	-0.0175	0.1495
length of haul	(0.1153)	(0.1038)	(0.1164)	(0.1152)	(0.1178)
Average	-0.7526	-0.6187	-0.6268	-0.6418	-1.281
shipment size	(0.1288)	(0.1263)	(0.1020)	(0.1284)	(0.1380)
Capacity	-0.5788	-0.5160	-0.7948	-0.5471	-0.3777
utilization	(0.1279)	(0.1152)	(0.1298)	(0.1400)	(0.1293)
% LTL	-0.3123	-0.3262	-0.2495	-0.3283	-0.3652
	(0.0850)	(0.0843)	(0.0851)	(0.0847)	(0.1144)
Insurance	-0.0280	0.0423	-0.0640	0.0375	-0.1663
	(0.1358)	(0.1337)	(0.1363)	(0.1359)	(0.1764)
Output	0.7538	0.7256	0.8388	0.7747	0.6527
	(0.0963)	(0.0873)	(0.0962)	(0.0961)	(0.1004)

a Standard errors in parentheses.

4. Policy Considerations

Some of those econometric results will now serve to appreciate the behaviour of Quebec trucking firms when the new official competitive environment will be in place. As before, we will exclusively focus on factor prices and technological variables because they will have the most important influence on the determination of what the new structure of the industry will be like.

At the outset, it may be inferred, that the own-price and substitution elasticities, shown in Table 3, clearly indicate the adaptative behaviour of Quebec firms which operate in an "unofficial" competitive environment[12]. Therefore, their estimated values lead us to believe that few major changes, such as those which the American trucking industry has sustained in this decade, may eventually occur in the Quebec industry if the latter is gradually and officially deregulated. The deregulation of the American trucking industry has provoked not only strong decrease in labour demand, but also a decrease in wages. Moreover, another effect was an increase in the hiring of owners-operators, of unionized workers and the existence of a

two-tier scale wage, practised by some existing and new trucking firms. A second major effect of the American deregulation was a decrease in capital inputs by trucking firms. They reduced their excess capacity by eliminating certain factors which had been used in a suboptimal fashion by the ICC regulatory structure. However, some elements of this adjustment process were either clearly anticipated by some American researches[13] or analytically explained by empirical analyses using this same methodlogy[14].

The fuel own-price inelasticity is relatively high in that firms have not only rationalized some of their activities following various successive fuel price increases, but they have technically adjusted their production process to reduce their line-haul cost. Among these factors, it is worth mentioning new fuel-economy tractors, new radial tires, deflectors, the black box and so on. They have also increased their hiring of owners-operators. All of these particular money-saving techniques have been systematically adopted by Quebec firms, some even for a long time, in order to compete on an equal footing, with the various substitutes which make up the "illegal" trucking market, truck-leasing firms, brokers and freight forwarders.

The capital own-price elasticity, being in the same order of magnitude as estimated by Friedlaender and Spady, may foresee an excess capacity in the industry if more competitive forces are expected to enter from the outside or to emerge from existing entrepreneurs. However, since Freedom to Move, various mergers or take-overs are mainly taking place among firms operating on the same markets[15]. As a matter of fact, fixed costs drop when a merger takes place between competing firms operating jointly in a given geographic area, mainly as a result of the closing of terminals which also allows for labour cutbacks. Moreover, these mergers can also achieve greater network density, an essential element of efficiency. A greater diversity of shippers can also lead to a more intensive use of labour and terminals. However, until recently, the main reason for mergers was geographic expansion by the juxtaposition of complementary networks. It is now becoming more difficult to achieve greater operational flexibility by means of geographic network expansion because of the structural imbalance of the Quebec flows of goods. In short, economic forces are actually at work to reduce the relative overcapacity in the industry and therefore a more competitive environment will not produce or generate structural changes as severe as those in United States.

The labour own-price is also relatively high and thus reflects the underlying current adjustment process in the industry. As a matter of fact, the Quebec trucking industry is unofficially very competitive because of the relative openness of the province of Quebec (the small country hypothesis in international trade) as well as the existence of "leakages" in the application of regulations, together with the overall lax climate with respect to the setting of rates and tariffs[16]. Recent bankruptcies and mergers brought about by an eventual liberalization have also lowered the quantity demanded of all factors of production, especially labour.

As Quebec trucking firms exhibit strong economies of scale, any policy promoting competition will eventually reduce production costs. Those economies of scale may be realized, as shown in Table 2, by an increase, first of all, in the average size of shipment; secondly, by an

enhanced capacity utilization and thirdly, by an increase in LTL. This adjustment process initiated in the industry some years ago, will go on until each firm will obtain a minimum efficient scale of operation comptatible with the share of the targeted market. The long combination vehicule or LCV[17] is one of the means currently used. Another is a merger by firms operating on the same market to increase traffic density and to obtain a higher degree of network connectivity. These substantial cost avantages are indirectly related to the overall size of a firm and are directly associated with the firm's market share. Finally, by buying, for instance, two models of highway tractors, a firm is able to reduce its stocks in replacement parts and to allow its maintenance workers to increase their expertise and dexterity through successive operations involving one type of machinery. In the transportation literature, such a rationalization process is related to the principle of massed reserves and the principle of multiples[18].

These direct cost savings will mainly be translated into a decrease in demands for labour, capital and fuel as shown in Table 4. For instance, a 10 percent increase in capacity utilization of a given truck fleet will reduce fuel expenses by 5.2 percent, labour by 7.9 percent, capital by 5.4 percent and material by 3.8 percent. These estimates are generally lower than those estimated by Kim[19], except for capital.

5. Summary

The application of the translog cost function to the Quebec trucking industry helps us to understand why labour unions and trucking firms are opposed to the deregulation movement started by Freedom to Move. They knew very well that the industry would have to go through an adjustment process where they would be among the biggest losers. Benefits derived from provincial regulatory bodies, although highly inferior to those received by American labour and trucking firms will have to disappear because of the market forces. The various provincial pressure groups have therefore bought some time by insisting that each new Provincial transportation act contain a given timetable to implement the new federal philosophy.

In the Province of Quebec, the adjustment process has been at work, in some markets, for quite a long time. Two main facts are responsible for this adjustment, the first being the openness of the Quebec economy. In other words, the Quebec economy is not able to export the social costs of its protective policies, whatever they are, because it does not really have any influence on North American trucking rates and tariffs. The second, a logical consequence of the former, is the existence of "leakages" in the Quebec regulation which unofficially countervail the protectionist rules of the Quebec Transport Commission.

Footnotes and References

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4 The definition of this variable is from Kim M.. "The Structure of Technology of the Canadian Trucking Industry", Unpublished Ph.D. Dissertation, University of Toronto, 1982. As the Canadian database does not contain information which allows us to compute the purchased transportation as a factor price, the next best variable is therefore the price of materials.

5 This variable is different from that defined by American researchers because the Canadian database gives no information at all on the number of loads hauled by carriers.

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ACKNOWLEDGEMENTS

Funding for the research on which this paper is based was provided by Quebec Department of Transport. This paper reflects the views of the author and not necessarily those of Quebec Department of Transport.

APPENDIX I

The cost function in the text is approximated by a second-order Taylor-series expansion translog cost function. The expansion is naturally carried out around the mean for each variable.

$$\begin{aligned}\ln C(y, w, t) = {} & a_0 + \Sigma_i a_i(\ln w_i - \ln \bar{w}_i) + \Sigma_j b_j(\ln t_j - \ln \bar{t}_j) \\ & + c\,(\ln y - \ln \bar{y}) + 1/2 \sum_i \sum_l A_{il}(\ln w_i - \ln \bar{w}_i)(\ln w_l - \ln \bar{w}_l) \\ & + \sum_i \sum_j B_{ij}(\ln w_i - \ln \bar{w}_i)(\ln t_j - \ln \bar{t}_j) \\ & + \sum_i C_i (\ln w_i - \ln \bar{w}_i)(\ln y - \ln \bar{y}) \\ & + 1/2 \sum_j \sum_m D_{jm}(\ln t_j - \ln \bar{t}_j)(\ln t_m - \ln \bar{t}_m) \\ & + \sum_j E_j(\ln t_j - \ln \bar{t}_j)(\ln y - \ln \bar{y}) \\ & + 1/2\, F(\ln y - \ln \bar{y})^2 + \varepsilon_C \end{aligned} \tag{1.1}$$

The input demand (share) equations are obtained from Shephard's lemma as

$$D_i = w_i x_i / C = a_i + \sum_l A_{il}(\ln w_l - \ln \bar{w}_l) + \sum_j B_{ij}(\ln t_j - \ln \bar{t}_j) + C_i\,(\ln y - \ln \bar{y}) + \varepsilon_i \tag{1.2}$$
$$i = 1, 2, 3$$

Slutsky's symmetry conditions are imposed on the A_{il}, D_{jm} and F_{kh} parameters. Moreover, the adding-up property of the share equations and the fact that the cost function is linearly homogeneous in input prices imply the following linear restrictions,

$$\sum_i a_i = 1, \quad \sum_i A_{il} = 0 \quad l = 1, L \quad \sum_i B_{ij} = 0 \quad j = 1, j$$

$$\sum_i C_{ik} = 0 \quad k = 1, k$$

TABLE 1.1

Coefficient Estimates for The Translog Cost Function

Coefficient (a)	Variable (b)	Value	Standard error
a_0	constant	15.2771	0.0955
a_1	w_1 (fuel)	0.2086	0.0176
a_2	w_2 (labour)	0.2834	0.0135
a_3	w_3 (capital)	0.3209	0.0119
a_4	w_4 (materials)	0.1870	0.0155
b_1	t_1 (length of haul)	-0.0583	0.1153
b_2	t_2 (average shipment size)	-0.7526	0.1288
b_3	t_3 (utilization)	-0.5788	0.1279
b_4	t_4 (LTL)	-0.3123	0.0850
b_5	t_5 (insurance)	-0.0280	0.1358
c	y (output)	0.7538	0.0963
A_{11}	$1/2\ (w_1)^2$	0.0525	0.0061
A_{12}	$w_1\ w_2$	-0.0226	0.0095
A_{13}	$w_1\ w_3$	-0.0180	0.0052
A_{14}	$w_1\ w_4$	-0.0123	0.0035
A_{22}	$1/2\ (w_2)^2$	0.0726	0.0029
A_{23}	$w_2\ w_3$	-0.0139	0.0063
A_{24}	$w_2\ w_4$	-0.0364	0.0043
A_{33}	$1/2\ (w_3)^2$	0.0400	0.0019
A_{34}	$w_3\ w_4$	-0.0081	0.0035
A_{44}	$1/2\ (w_4)^2$	0.0568	0.0044
B_{11}	$w_1\ t_1$	0.0072	0.0055
B_{12}	$w_1\ t_2$	0.0279	0.0056
B_{13}	$w_1 t_3$	0.0132	0.0064
B_{14}	$w_1\ t_4$	-0.0029	0.0040
B_{15}	$w_1\ t_5$	0.0147	0.0060
B_{21}	$w_2\ t_1$	-0.0590	0.0070
B_{22}	$w_2\ t_2$	0.0357	0.0067
B_{23}	$w_2\ t_3$	-0.0611	0.0079
B_{24}	$w_2\ t_4$	0.0178	0.0049
B_{25}	$w_2\ t_5$	-0.0101	0.0073
B_{31}	$w_3\ t_1$	0.0130	0.0063
B_{32}	$w_3\ t_2$	0.0356	0.0059
B_{33}	$w_3\ t_3$	0.0102	0.0057
B_{34}	$w_3\ t_4$	0.0051	0.0044
B_{35}	$w_3\ t_5$	0.0211	0.0064
B_{41}	$w_4\ t_1$	0.0388	0.0082
B_{42}	$w_4\ t_2$	-0.0992	0.0078
B_{43}	$w_4\ t_3$	0.0377	0.0092
B_{44}	$w_4\ t_4$	0.0200	0.0084
B_{45}	$w_4\ t_5$	0.0257	0.0086
C_{1y}	$w_1 y$	0.0119	0.0023
C_{2y}	$w_2 y$	0.0241	0.0050
C_{3y}	$w_3 y$	0.0007	0.0044
C_{4y}	$w_4 y$	-0.0189	0.0057

TABLE I.1

Coefficient Estimates for The Translog Cost Function

Coefficient (a)	Variable (b)	Value	Standard error
D_{11}	$1/2(t_1)^2$	-0.0028	0.0762
D_{12}	$t_1\ t_2$	-0.1489	0.0531
D_{13}	$t_1\ t_3$	-0.1277	0.0693
D_{14}	$t_1\ t_4$	0.0024	0.0410
D_{15}	$t_1\ t_5$	-0.1630	0.0619
D_{22}	$1/2\ (t_2)^2$	-0.2645	0.0981
D_{23}	$t_2\ t_3$	-0.0264	0.0630
D_{24}	$t_2\ t_4$	-0.1508	0.0651
D_{25}	$t_2\ t_5$	-0.0869	0.0550
D_{33}	$1/2\ (t_3)^2$	0.1995	0.1042
D_{34}	$t_3\ t_4$	-0.0417	0.0478
D_{35}	$t_3\ t_5$	0.0401	0.0750
D_{44}	$1/2\ (t_4)^2$	-0.0738	0.0485
D_{45}	$t_4\ t_5$	-0.0508	0.0432
D_{55}	$1/2\ (t_5)^2$	-0.0448	0.0693
E_{1y}	$t_1\ y$	0.0246	0.0463
E_{2y}	$t_2\ y$	-0.0934	0.0423
E_{3y}	$t_3\ y$	-0.0866	0.0418
E_{4y}	$t_4\ y$	-0.0856	0.0344
E_{5y}	$t_5\ y$	-0.0479	0.0469
F_{yy}	$1/2(y)^2$	-0.0118	0.0426
		R^2	RMSE
Cost function		0.9077	0.3449
Labor share function		0.4171	0.6732
Fuel share function		0.3178	0.0597
Capital share function		0.4600	0.0651
material share function		0.5410	0.0870

(a) As defined
(b) We have omitted ln for convenience

A MICROCOMPUTER NETWORK MODEL FOR COAL ROUTING AND COSTING

by

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Abstract

The Coal Routing and Costing System (CRCS) is an interactive, user friendly microcomputer software package for predicting the routes of coal shipments through the national rail and waterway transportation network, and estimating the fully allocated and variable costs incurred by the carriers for providing this transportation. The system will analyze both single mode and intermodal rail and water routes, and will either generate the routes internally or develop costs for user-specified routings. The rail network represents the U.S. interregional Class I mainlines, and the water network includes the inland and intracoastal waterways, the Great Lakes-St. Lawrence Seaway system, and domestic coastwise shipping. Locations where transloading from one mode to another occurs are also included. The CRCS is menu driven, and extensive on-line help is available to assist the user in making menu choices and entering data. Utility fuel transportation planners and economists can use the CRCS to investigate transportation options for existing and potential future fuel supply sources, and for cost analyses supporting a variety of planning and management applications.

1.0 Introduction

Coal transportation costs, and changes and uncertainties in those costs, are extremely important elements of a utility's fuel supply planning. Transportation often accounts for more than 50% of the delivered cost of coal. Today, coal supply markets and transportation markets are both undergoing rapid change. Thus, informed decision-making about fuel supply requires the ability to recognize and analyze coal transportation options.

Examples abound of the need for high quality transportation analysis. Some of these are:

- Coal sourcing for new or conversion units;
- Determining inbound/outbound transportation costs for use in plant location decisions;
- Long-range generation planning and related fuel supply planning;
- Negotiation of transportation rates and services;
- Utility fuel cost component in rate setting actions;
- Estimating benefits to the utility of investing in the coal transportation system, such as by purchasing railcars;
- Estimating transportation costs related to alternative pollution control measures.

The Electric Power Research Institute (EPRI) has responded to these needs by developing an array of planning and analysis tools that can be used by utility planners and managers to perform the required transportation studies. One of these is a microcomputer software package called the Coal Routing and Costing System (CRCS).

2.0 Coal Routing and Costing System

The prior research on which the CRCS is based is presented by Bronzini (1980), CACI, Inc. (1982), and Bronzini and Sherman (1986). The CRCS enables utility analysts to develop preliminary, but accurate, estimates of carrier costs of transporting coal from mines to power plants by rail and waterway. The heart of the model is a computer representation of the U.S. national rail and water transportation network. The CRCS predicts the routes of coal shipments through this network, and estimates the variable and fully allocated costs incurred by the carriers to provide this transportation.

2.1 Transportation Network Data

Some summary statistics describing the national rail and waterway freight transportation network database are given in Table 1. The rail network is depicted in Figure 1. Network nodes represent individual elements such as rail junctions, marshalling yards, waterway locks, and ports. Links represent interregional linehaul segments such as single track or multiple track rail lines, rivers and canals, and coastal shipping lanes. The link data include information on the owning railroad and any railroad with trackage rights or, in the case of water links, the mode designation. Intermodal transfer links representing coal transloaders, river docks, and similar facilities which allow shipments to be transferred between modes for multimodal routing are also included. Local pickup and delivery transportation elements are not explicitly

Table 1. National Rail and Waterway Network Database

Mode	Miles	Links	Nodes
Rail	145,585	3,091	1,481
Waterway[a]	20,707	482	459
Domestic Deep Draft[b]	33,012	105	78
Total	199,304	3,678	2,018

[a]Includes Great Lakes and intracoastal shallow draft routes, as well as inland rivers.

[b]Includes Panama Canal and St. Lawrence Seaway routes.



Figure 1. Rail Network

defined as network links. Rather, the "terminal costs" for these services are included in the costing logic.

The operating characteristics of links and nodes are represented as functions relating the cost of traversing a link or node to the amount of traffic which uses it. These costs are intended to be fully allocated costs, including both variable costs and fixed costs, and hence may not be equivalent to the transportation rates paid by shippers. For example, in the case of rail transport the principal variable costs included are labor, fuel, railcar capital costs, locomotive capital costs, rolling stock maintenance, and a portion of track maintenance; fixed costs include the remainder of track maintenance, investment in fixed facilities, and overhead. Similar functions, called "time functions," relate transit time to shipment volume, and "energy functions" relate energy use to volume. Cost, time, and energy functions for intermodal transfers and for terminal areas are also used. Bronzini and Sherman (1986) describe the methods used to develop the rail functions.

Departing from the usual network modeling approach, the performance functions are all made commodity-specific by applying adjustment factors to the basic function values. Adjustment factors for the following three commodities are presently included in the CRCS:

UNIT-COAL	coal moving by unit train
CAR-COAL	coal moving in single car shipments
GENERIC	a general or "average" single car movement (the base functions apply to this commodity).

Rail cost functions which both include and exclude railcar costs are provided, to permit estimating carrier costs in situations where either the railroad owns the cars or the shipper owns them. In summary, the node and link data include four sets of cost functions (fully allocated cost and variable cost, each with or without railcar costs), time and energy functions, and factors to adjust time, fuel consumption, and cost for the characteristics of unit train or single car coal shipments.

2.2 Routing Method

The CRCS generates origin-destination routes that minimize a linear combination of two objectives: (1) the fully allocated cost incurred by the railroads; and (2) the number of railroads and modes utilized. The basic algorithm is the familiar Moore algorithm for finding the minimum cost path. At each stage of adding links to the path preference is given to links which continue the path on the same railroad or mode. This method has been found to reasonably approximate actual routing practice (Bronzini and Sherman, 1986). The user may restrict the route to be entirely on rail or water, and may designate the initial rail carrier to be used. The user may also input the exact route to be followed. This feature is useful

for fine tuning the model results, and for obtaining cost estimates for existing routings.

2.3 System Features

Some of the capabilities provided by the CRCS are indicated in Figure 2, which is the opening menu presented to the user. Options 2 and 3 allow the user to look at the content and structure of the network database. Options 1, 4, and 5 are used to enter the origins and destinations of the shipments to be routed, initiate the routing, and retrieve the results.

Figure 3 displays some key routing and costing parameters that are under user control. This menu can be invoked as part of the shipment specification process (option 1 on the main menu). Each of the five parameters listed has a default value that appears the first time that this screen is requested during a CRCS session. Parameters 1 and 2 in Figure 3 are at their default values. The user has changed the remaining three to be representative of the desired analysis conditions, namely a diesel fuel price of $US 0.70 per gallon, exclusion of railcar costs (presumably the shipper owns the railcars), and inflation of costs from the base year of the data (1984) to the year 1987. Parameters values set here remain in effect until changed by the user or until the CRCS is exited.

In summary, the CRCS is a menu driven system. The system displays a series of menus which offer a list of numbered choices. Frequently, the choice will lead to another menu with a new series of choices. Extensive on-line "help" messages are available to assist the user in responding correctly.

2.4 Hardware and Software

The CRCS will run on an IBM PC/XT/AT or fully compatible microcomputer, with 640K RAM, a math coprocessor, monochrome or color monitor, and a 20 megabyte hard disk. The software is written in PC Simscript 2.5, but the relevant executable code is distributed as part of the CRCS implementation package, so the user does not need Simscript software or expertise. The implementation package is designed to be installed in the PC-DOS or MS-DOS environment.

3.0 Typical Results

A coal shipment from the Powder River basin in Wyoming to a generating station near Baton Rouge, Louisiana, was investigated to illustrate the operation of the CRCS. The origin point is Jacobs Junction, Wyoming, and the routing parameters given in Figure 3 were chosen. The CRCS output for this example is displayed in Figure 4. The upper portion of the figure is a summary output screen, which is the minimum level of output that can be selected. As shown, this unit train rail movement covers 1,682 route miles one-way, and the fully allocated and variable costs to the rail carriers providing the service are estimated to be $US 21.36 per ton and $US 14.36,

```
03/08/1988          14:25:18          ACTIVE ROUTING MODE IS: RAIL

                    Main Routing Menu
                    -----------------

                    1. Specify shipment(s).

                    2. Display connection data between stations.

                    3. Display node name(s) by state.

                    4. Route the requested shipments.

                    5. Display the routing results.

                    6. Exit.

Enter your selection....
   PC SIMSCRIPT II.5        r2.20
```

Figure 2. CRCS Main Menu

```
03/08/1988          15:05:55          ACTIVE ROUTING MODE IS: RAIL

                CHANGE/DISPLAY PARAMETERS MENU
                ------------------------------

        1. The routing mode is        RAIL

        2. The commodity type is      UNIT-COAL

        3. The price of fuel is           $   .70

        4. The rail car cost is       NOT INCLUDED

        5. The shipper costs are adjusted from the base-year 1984 to 1987.
           The inflation factor applied to the base-year is   1.070


Parameter to be changed..  ?
   PC SIMSCRIPT II.5        r2.20
```

Figure 3. Routing and Costing Parameters

```
The shipping commodity is :  UNIT-COAL
FROM :        JACOBS JCT,WY
TO :          BATON ROUGE,LA
Results EXCLUDE Rail Car Costs.
Fuel Price is $  .700
Costs displayed are for the year 1987
The inflation factor applied to the base-year of 1984 is       1.0700
```

TOTAL SUMMARY STATISTICS

TOTAL $/TON	VARIABLE $/TON	HOURS	GAL/TON	MILES
21.36	14.36	52.2	3.297	1682.

```
Please, press the [ENTER] key to continue?
   PC SIMSCRIPT II.5        r2.20
```

```
    ROUTE TAKEN --

JACOBS JCT,WY -- (BN  ,CNW ) --  DONKEY CREEK,WY -- (BN  ,NONE) --
CRAWFORD,NE -- (BN  ,NONE) --  ALLIANCE,NE -- (BN  ,NONE) --
GRAND ISLAND,NE -- (BN  ,NONE) --  AURORA,NE -- (BN  ,NONE) --
SEWARD,NE -- (BN  ,NONE) --  LINCOLN,NE -- (BN  ,NONE) --
TABLE ROCK,NE -- (BN  ,NONE) --  FALLS CITY,NE -- (BN  ,NONE) --
NAPIER,MO -- (BN  ,NONE) --  ST JOSEPH,MO -- (BN  ,NONE) --
BEVERLY,MO -- (BN  ,RI  ) --  E LEVENWORTH,MO -- (BN  ,NONE) --
KANSAS CITY,MO -- (BN  ,NONE) --  FORT SCOTT,KS -- (BN  ,NONE) --
PITTSBURG,KS -- (BN  ,NONE) --  COLUMBUS,KS -- (MKT ,BN  ) --
JOPLIN,MO -- (KC  ,NONE) --  NEOSHO,MO -- (KC  ,NONE) --
SALLISAW,OK -- (KC  ,NONE) --  POTEAU,OK -- (KC  ,NONE) --
DE QUEEN,AR -- (KC  ,NONE) --  TEXARKANA,TX -- (KC  ,NONE) --
SHREVEPORT,LA -- (UP  ,SP  ) --  CUT OFF JCT,LA -- (UP  ,NONE) --
ALEXANDRIA,LA -- (UP  ,KC  ) --  LOBDELL,LA -- (UP  ,KC  ) --
BATON ROUGE,LA

Please, press the [ENTER] key to continue?
   PC SIMSCRIPT II.5        r2.20
```

Figure 4. Sample Results for a Coal Unit Train Movement

respectively. The lower portion of Figure 4 is the result of a request for an intermediate level of detail in the output, where the summary statistics and the route followed are displayed. The items in parentheses between each pair of nodes on the route indicate the carriers or modes available on that link. In this example, the route chosen by the CRCS follows the Burlington Northern railroad from Jacobs Junction to Joplin, Missouri, after which two bridge carriers are used to reach the destination. While this is a plausible route, it cannot be stated with certainty that this routing is the one that would occur in practice, since there are several alternate carriers and interchange points available. Any reasonable alternative routes will have costs similar to those of the selected route, however, so the CRCS output can be used for planning purposes.

To see the savings resulting from unit train service, the parameters were changed to CAR-COAL, and INCLUDE railcar costs, and the CRCS was directed to recalculate the costs. The fully allocated and variable costs for this situation were estimated to be $US 40.85 and $US 28.77 per ton, respectively.

Is there a viable rail-water route that is lower in cost? This was answered by returning to the parameter settings of Figure 3, but changing the routing mode designation to ALL. The results are given in Figure 5. The Burlington Northern moves the coal in unit trains to St. Louis, Missouri, where it is transloaded to barges and delivered by water to Baton Rouge. The fully allocated cost for this rail-water alternative is estimated to be $US 17.57, and the variable cost is $US 12.72. These estimated costs are less than those of the all rail routing.

4.0 CRCS Validation Studies

How accurate are the CRCS cost estimates? This issue was examined (Bronzini and Altouney, 1985) by using the system to estimate costs for a set of 14 coal unit train movements for which independent studies of carrier costs were available. No statistically significant differences were found between the CRCS estimates and the cost study estimates. These results held for both fully allocated cost and variable cost. The CRCS results have also been validated informally by a number of utility transportation analysts.

A second concern relates to the nature of the CRCS node and link performance functions. Recall that time, energy, and cost are all a function of the link (or node) traffic level. This requires that the network data include a volume estimate for each network element. How sensitive are the CRCS results to possible errors in these volume estimates? To answer this question, a set of 25 movements covering all areas of the network were specified, and rail link traffic volume estimates were systematically varied from 20 million net tons per year to 100 million tons or 95% of link capacity, whichever was reached first. Routes, costs, and so on,

```
The shipping commodity is :  UNIT-COAL
FROM :       JACOBS JCT,WY
TO :         BATON ROUGE,LA
Results EXCLUDE Rail Car Costs.
Fuel Price is $  .700
Costs displayed are for the year 1987
The inflation factor applied to the base-year of 1984 is      1.0700


                    TOTAL SUMMARY STATISTICS

    TOTAL       VARIABLE
    $/TON        $/TON        HOURS       GAL/TON       MILES
  ----------  ----------  ----------  ----------  ----------
     17.57       12.72        139.2       3.796       1950.


Please, press the [ENTER] key to continue?
   PC SIMSCRIPT II.5       r2.20



JACOBS JCT,WY -- (BN  ,CNW ) --  DONKEY CREEK,WY -- (BN  ,NONE) --
CRAWFORD,NE -- (BN  ,NONE) --  ALLIANCE,NE -- (BN  ,NONE) --
GRAND ISLAND,NE -- (BN  ,NONE) --  AURORA,NE -- (BN  ,NONE) --
SEWARD,NE -- (BN  ,NONE) --  LINCOLN,NE -- (BN  ,NONE) --
ASHLAND,NE -- (BN  ,NONE) --  LOUISVILLE,NE -- (BN  ,NONE) --
PLATTSMOUTH,NE -- (BN  ,NONE) --  PACIFIC JCT,IA -- (BN  ,NONE) --
RED OAK,IA -- (BN  ,NONE) --  AFTON JCT,IA -- (BN  ,NONE) --
CHARITON,IA -- (BN  ,NONE) --  MAXON,IA -- (BN  ,NWS ) --
CENTERVILLE,IA -- (BN  ,NONE) --  MEDILL,MO -- (BN  ,NONE) --
ALEXANDRIA,MO -- (BN  ,NONE) --  W QUINCY,MO -- (BN  ,NONE) --
MARK,MO -- (BN  ,NONE) --  HANNIBAL,MO -- (BN  ,NONE) --
LOUISANA,MO -- (BN  ,NONE) --  OLD MONROE,MO -- (BN  ,NWS ) --
W ALTON,MO -- (BN  ,NONE) --  ST LOUIS,MO -- (IFR ,FREE) --
ST LOUIS 1,MO(water) -- (WTR ,NONE) --  CORA,IL(water) -- (WTR ,NONE) --
LOWER MISS 10,TN(water) -- (WTR ,NONE) --  MEMPHIS,TN(water) -- (WTR ,NONE) --
LOWER MISS 8,AR(water) -- (WTR ,NONE) --  GREENVILLE,MS(water) -- (WTR ,NONE) --
LAKE PROVIDENCE,MS(water) -- (WTR ,NONE) --  VICKSBURG,MS(water) -- (WTR ,NONE)
LOWER MISS 3,LA(water) -- (WTR ,NONE) --  BATON ROUGE,LA(water) -- (IFR ,FREE) -
BATON ROUGE,LA


Please, press the [ENTER] key to continue?
   PC SIMSCRIPT II.5       r2.20
```

Figure 5. Sample for Rail-Water Routing

were generated for each movement at each system traffic level. As individual route segments were perceived to become congested due to the assumed increasing traffic loads, the CRCS tended to seek out alternate routes which weren't as heavily congested, as would be expected. The maximum sensitivity observed for any movement was a 30.6% increase in (fully allocated) cost from origin to destination for a 60% increase in the link volume estimates. Most route cost sensitivities were considerably lower. In other words, a one percent error in the estimated network traffic density will produce an error of less than one-half percent in the estimated costs in most cases.

5.0 Applications and Extensions

The CRCS has been applied successfully in all regions of the United States, both in case studies and in actual productive use involving more than ten utilities. These applications have covered nearly all of the areas listed at the beginning of this paper. The CRCS has been used to study the movement of commodities other than coal. For example, it has recently been used to make transportation cost estimates for sodium compounds, to aid in assessing their feasibility for use in flue gas desulfurization (Bronzini et al., 1986). The chief advantage cited in these applications has been the analyst's ability to obtain results quickly without providing very much data. In most cases, the user needs only to know the origin and destination of each shipment. The rest of the data needed for routing and costing are internal to the CRCS.

Work is currently underway to improve the system's user interface. A graphics package is being developed to permit on-screen displays of network structure and routes. A database editing and updating package is also being developed, to replicate and extend capabilities which were available in the mainframe predecessors of the CRCS. A CRCS User Group is being organized, and plans are being made to update the database.

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Acknowledgments

This research was performed for the Electric Power Research Institute (EPRI), under Contract Agreement RP 1219-3, by CACI, Inc. Dr. Edward Altouney served as the EPRI project manager. Dr. Michael Bronzini is currently the project principal investigator. Mr. Roger Aspinwall is the principal CACI analyst.

The Economic Potential of U.S. Routes for the Movement of Grain to Export Destinations

by Pamela Miller

Introduction

In recent years, there has been little interest, on the part of many in the grains industry, in exploring the potential for moving grain by routes other than Canada's current principal distribution channels. This attitude could be explained by the surplus capacity available on existing routes and the effect this lack of capacity utilization was having on the economics of grain movement. However, the recent strike and lockout at the terminal elevators in Thunder Bay and similar labour difficulties in Vancouver and Prince Rupert have stimulated interest in researching alternative routes for getting grain into export position to fulfill sales commitments. Grain producers, in particular, are interested in avoiding exploitation by other participants in the system at a time when returns from grain sales in international markets are low. Therefore, the availability of a low cost route for exporting Canadian grain is of vital importance to all Canadians. In this paper, an attempt will be made to put the economics of the various alternative routes available for export grain in the crop year 1984/85 into perspective.

The routes for movement of Prairie grain to export position examined in this paper include: movement by rail to Vancouver/Prince Rupert for transfer to ocean vessels, movement by rail to Thunder Bay for direct transfer to ocean vessel or for transfer to lake vessel and ultimate transfer to ocean vessel at ports on the lower St. Lawrence River, and movement by rail to Churchill for transfer to ocean vessel. U.S. alternatives explored in this paper include movement by rail to Minneapolis or St. Louis for transfer to barges on the Mississippi River and later transfer to ocean vessels at Louisiana ports, direct movement of grain by rail to Gulf of Mexico ports such as New Orleans or Houston/Galveston for transfer to ocean vessels, or movement by rail to Pacific Northwest ports such as Portland or Seattle.

Background

The sharp decline in U.S. grain exports during the period covered by this paper (pre 1985) resulted in a large amount of excess capacity in U.S. water routes and very low barge rates prevailed on the Mississippi River as a result. The bulk commodity barge industry in the U.S. is highly competitive and free of government rate

regulations, (i.e.) barge rates are free to fluctuate to reflect current market conditions. Barge rates for grain and other bulk commodities were quite low in 1984 and 1985 due to the large excess supply of covered hopper barges which arose from the overexpansion of capacity in the 1970's fostered by tax incentives.

Export demand did not increase at the rate projected while rail deregulation under the Staggers Rail Act of 1980 led to the transfer of traffic from the barge mode to the rail mode which further exacerbated the supply/demand imbalance. As a result, grain barge rates fluctuated around the lowest possible short run level (i.e.) the variable cost of operation. The decline in U.S. grain exports severely affected the Gulf and Pacific Northwest ports in terms of capacity utilization in 1984 and 1985. The Gulf and lower Mississippi ports recorded a 53% decline in total market share, with wheat market share declining from 20% to 17% while Houston/Galveston declined to 15.5% of total U.S. wheat exports. In addition, corn export centres located on the Pacific coast recorded a combined 40% decline in exports in 1985.[1]

The Mississippi River route offers some of the most modern and sophisticated elevator facilities in the U.S. with 10 elevators having a combined storage capacity of over 1 million metric tonnes. With much of this capacity lying idle, the Mississippi River appears to warrant examination as a possible low cost alternative to existing Canadian export routes.

The cost of moving Canadian grain to export by current routes has been progressively increasing over time and is becoming burdensome in a period of low grain prices. Under the Western Grain Transportation Act of 1983, the rail rates charged to producers and shippers will continue to increase in the future. In addition, the tariffs assessed at the primary, terminal and transfer elevators are also increasing. At the same time, the cost of moving grain through the St. Lawrence Seaway is moving upwards as lake vessel owners experience higher investment costs while experiencing a decline in the volume of backhaul cargo.

Method of Analysis

A number of studies were reviewed in order to determine the best type of model to adopt in the analysis. An attempt was made to overcome the shortcomings of the various studies reviewed when developing the model. An interregional single period, multi-modal linear programming transhipment-transportation model was used to analyze the the 1984/85 supply/demand situation and the transportation network for wheat, durum, barley and rapeseed. This model enabled movements of four grains originating from 98 points on the Prairies, moving via 10 possible shipment routes (5 in Canada, 5 in the U.S.) to 29 overseas export destinations to be analyzed

[1]"U.S. Gulf - Increasingly Dominant Market Share in Bulk Traffic", International Bulk Journal, August 1986, p. 9.

(See Figure 1).

The The 98 origin points for grain from the Prairies were selected based on the five year average grain and oilseed volume at that elevator point being at least 50,000 tonnes per year. These points were located on rail mainlines or secondary mainlines (no branchlines) and situated close to major federal or provincial highways, and spread reasonably evenly across all shipping blocks on the Prairies. This was necessary in order for a large volume of grain being available to load unit trains (26 or 52 100-tonne hopper cars) on short notice. It was also felt that if a major rationalization of the prairie grain handling system were to occur, these elevator points would remain in operation. In addition, if more grain cleaning were to be done on the Prairies, installation of cleaning equipment adequate to clean grain to export standards would be economic. This would eliminate the need for cleaning grain at the export ports. U.S. terminal elevators do not, in general, have adequate cleaning capability.

The supply of each grain available at each of the chosen points was determined by allocating the grain from each train run to a point chosen for our model (Canadian Grain Commission data). The grain from any nearby train run on which no chosen point existed was allocated to the nearest identified point in the model, the assumption being made that if these train runs were abandoned, the grain would be trucked to the next nearest remaining elevator point.

The location of the overseas importers of Canadian grain were determined from Canadian Grain Commission figures. The destination of Western Canadian grain exports were taken to be those countries absorbing more than 0.4% of total wheat exports, more than 0.5% of total durum exports and all those countries importing barley and rapeseed from Canada in 1984/85.

Four basic combinations of rates were used in the linear programming analysis. Each combination was subjected to modifications in the handling capacity of the ports of Vancouver/Prince Rupert and to the barge rates on the Mississippi River.

Four basic combinations of Canadian and U.S. rail rates were studied:

1. Producer share WGTA rail rates in Canada and U.S. rail rates as given by CN, CP and BN railroad information
2. Producer share WGTA rail rates in Canada and distance-based WGTA rates in the U.S.
3. Total WGTA rail rates in Canada and U.S. rail rates as derived from CN, CP, and BN railroad information
4. Total WGTA rail rates in Canada and distance-based U.S. rates at the total WGTA level. (Such a rate combination is deemed realistic under deregulation.)

In the case of U.S. rail rate determination, the method employing WGTA distance-based rates yields lower rates than the tariff-based



FIGURE 1
Alternative Routes for Movement of
Prairie Grain to Export Positions

rates. The WGTA based rates (in the U.S. as well as in Canada) were used in an attempt to approximate the confidential contract rates in the U.S., now possible following the passage of the Staggers Rail Act of 1980. Intense competition in contract railroad rate-making in recent years has resulted in some of the lowest grain rates in several years, in some cases one-third below the levels prevailing only a few years ago.[2] The low rates are the result of tremendous competition for the relatively small amount of business available due to low grain exports and competition from the barge industry during that period. U.S. grain exports have since increased dramatically with the result that the demand for rail and barge service from the grain producing areas to the export ports has caused an increase in both rail and barge rates in the past several months. As it was not possible to determine the contract rail rates, an approximation was necessary. In this case, it was felt that WGTA distance based rates would be reasonable estimate as they are known to cover railroad costs including a reasonable return to fixed costs.

Several scenarios were developed for each of the basic rate combinations. These included: the relaxation of the port capacity at Vancouver/Prince Rupert (10% increase in port capacity) and the modification of the barge rates on the Mississippi River from the base level of 126.5% of the benchmark tariff in 1985 to 100%, 150%, 170% and 200%. These barge rates were based on the average of 1985 monthly average spot barge rates as traded on the St. Louis Merchants Exchange. Barge rates may also be set through contracts between shippers or barge owners but these rates are not available and, in general, most barge rates aare based on the spot rates set on the Exchange call market. All barge rates on the Mississippi are quoted as a percentage of the Waterways Freight Bureau Freight Tariff 7, used as a benchmark since 1976, which was set at (100%) US $6.82 per tonne from Minneapolis to the Gulf. The various barge rate levels were chosen for the following reasons: 100% tariff is equivalent to the lowest rates charged at the height of the recession (considered to be at or below the variable cost of operation), 150% of tariff is considered to make some contribution to fixed costs, 170% of tariff is generally accepted as covering all variable and nearly all fixed costs of operations, while 200% is used to represent the rates charged in the 1970's when grain volumes were very high on the Mississippi).

Port capacities utilized in the model were based on the largest volume shipped through each port (Canadian and U.S.) used as representative of the possible capacity of the facilities.

Results of the Analysis

The various scenarios were analyzed for each of the four grains in this paper: wheat, durum wheat, barley and rapeseed. The analysis

[2]"Railroad Contract Rates Between Kansas City, Gulf in Sharp Drop,", Milling and Baking News, February 10, 1987, p. 22.

enabled the volume of each grain moved to various export positions, originating ports for grain going to each importing country, and the directional cutoff point for grain originating on the Prairies to be ascertained. The overall results of the analysis of each are presented here.

The results from Rate Combinations 1 and 2 were found to be identical, in terms of volume and direction of flow for all grains. This serves to indicate the degree to which the WGTA freight rates in Canada are shielding producers from the true costs of transporting grain. All grain under these two rate combinations moves by Canadian routes only, since the producer portion of the total WGTA rates is less than 30 percent. In addition, the results remain the same for all barge rate scenarios under each basic rate combination. In other words, barge rates on the Mississippi would have to fall very significantly, to well below variable cost of operation, before any Canadian grain would move via the Mississippi alternative with the present producer WGTA rates in effect. (See Table 1 for the detailed results for Rate Combinations 1 and 2.)

Under Rate Combination 3, at the benchmark barge rates (126.5% of tariff barge rates from Minneapolis), 588,000 tonnes of grain would move via the Mississippi River. This is equivalent to 78 one hundred tonne hopper car unit trainloads or twelve 50,000 tonne ocean vessels out of New Orleans. At 100% of tariff barge rates, this figure increases to 4 million tonnes through the Mississippi - a viable volume for continuous use of the Mississippi River for shipment of Canadian grain (see Table 2).

When Rate Combination 4 was analyzed, the results are even more dramatic. Even at barge rates at 200% of tariff, 1.2 million tonnes of grain would move through Mississippi and St. Louis to the Gulf while at 100% of tariff, 50% of the total volume of grain, 9.6 million tonnes, would move down the river. In addition, 1.14 to 1.17 million tonnes of grain would move via Portland under Rate Combination 4, this figure remaining basically constant under all barge rates. This demonstrates that the U.S. Pacific Northwest is also a viable alternative export route for Canadian grain under certain rate conditions. This is particularly true in the case of rapeseed due to the fact that Japan is by far the largest importer of Canadian rapeseed (see Table 3).

Several general conclusions can be drawn from the results of the analyses. The major conclusion is that no grain will move down the Mississippi River, or utilize any other U.S. alternative, as long as the current "pay-the-railways" version of the Western Grain Transportation Act is in effect. No matter how low U.S. rail contract rates fall, the rate charged for moving grain from the prairies to the U.S. border will result in the U.S. alternatives being uneconomical.

If the WGTA is changed to represent the "pay-the-producer" method of payment, where producers pay the full cost of moving their grain to

TABLE 1

Proportion of Total Grain Exported Through Specific Port Areas

Rate Combinations 1 and 2

	Basic Rate Combination	Barge Rate @100%	Barge Rate @150%	Barge Rate @170%	Barge Rate @200%
			percent		
Churchill	3.44	3.44	3.44	3.44	3.44
Thunder Bay	0	0	0	0	0
QuebecCity	22.07	22.07	22.07	22.07	22.07
Montreal	14.66	14.66	14.66	14.66	14.66
Vancouver	59.83	59.83	59.83	59.83	59.83
Portland	0	0	0	0	0
Minneapolis	0	0	0	0	0
St. Louis	0	0	0	0	0
Volumes Through Each Port Area					
			tonnes		
Minneapolis	0	0	0	0	0
Portland	0	0	0	0	0
Vancouver/ Prince Rupert	12,222,047	12,222,047	12,222,047	12,222,047	12,222,047
Thunder Bay	662,867	662,867	662,867	662,867	662,867
Churchill	735,000	735,000	735,000	735,000	735,000
Montreal	2,705,092	2,705,092	2,705,092	2,705,092	2,705,092
Quebec City	3,014,456	3,014,456	3,014,456	3,014,456	3,014,456

TABLE 2

Proportion of Total Grain Exported Through Specific Port Areas

Rate Combination 3

	Basic Rate Combination	Barge Rate @100%	Barge Rate @150%	Barge Rate @170%	Barge Rate @200%
			percent		
Churchill	3.80	3.80	3.80	3.80	3.80
Thunder Bay	3.43	4.30	21.37	22.10	22.47
QuebecCity	21.33	4.30	21.37	22.10	22.47
Montreal	13.99	13.99	13.99	13.99	13.99
Vancouver	54.51	53.78	56.20	56.20	56.23
Portland	0	0	0	0	0
Minneapolis	3.40	20.70	1.22	0.49	0.08
St. Louis	0	0	0	0	0
Volumes Through Each Port Area					
			tonnes		
Minneapolis	587,869	4,002,964	236,062	94,382	15,171
Portland	0	0	0	0	0
Vancouver/ Prince Rupert	10,541,864	11,064,340	10,868,148	10,868,148	10,875,205
Thunder Bay	662,867	662,867	662,867	662,867	662,867
Churchill	735,000	735,000	735,000	735,000	735,000
Montreal	2,705,092	2,705,092	2,705,092	2,705,092	2,705,092
Quebec City	4,106,770	832,066	4,132,293	4,273,973	4,346,127

TABLE 3

Proportion of Total Grain Exported Through Specific Port Areas

Rate Combination 4

	Basic Rate Combination	Barge Rate @100%	Barge Rate @150%	Barge Rate @170%	Barge Rate @200%
			percent		
Churchill	3.80	3.80	3.80	3.80	3.80
Thunder Bay	3.43	4.30	21.37	22.10	22.47
QuebecCity	0	0	0	0	0
Montreal	.82	.82	.82	.82	.82
Vancouver	44.42	44.42	44.42	44.42	44.42
Portland	5.89	5.89	5.89	5.89	5.89
Minneapolis	41.64	41.64	41.64	41.64	41.64
St. Louis	0	0	0	0	0
Volumes Through Each Port Area					
			tonnes		
Minneapolis	8,063,124	9,619,394	6,592,308	4,899,766	1,159,698
St. Louis	0	0	0	0	82,755
Portland	1,139,562	1,139,562	1,139,562	1,139,562	9,383,181
Vancouver/ Prince Rupert	8,590,421	7,182,639	8,888,844	9,197,175	9,383,181
Thunder Bay	662,867	662,867	662,867	662,867	662,867
Churchill	735,000	735,000	735,000	735,000	735,000
Montreal	158,488	0	1,320,881	2,705,092	2,705,092
Quebec City	0	0	0	0	3,444,742

export position, significant volumes of Canadian grain could be economically moved through the U.S. system. The problem then becomes how to determine U.S. rail rates. Using the alternative U.S. rail rates developed for this paper, obtaining published U.S. rail tariffs from the railroads and estimating U.S. rail rates based on the distance formula under the WGTA, varying amounts of grain would utilize the Mississippi and Portland alternatives. It must be pointed out, however, that use of these alternative routes would entail redefinition of "export" under the WGTA to include movements of grain to the U.S. for export through that country.

As the published U.S. rail tariff rates are relatively high, the volumes of grain moving down the Mississippi are not sufficiently large to utilize the U.S. system on an economic basis. However, if barge rates return to the early 1980's levels of 90 to 120% of tariff, economic volume movements of Canadian grain through the U.S. would be possible. However, it is unlikely that barge rates will fall to these low levels for any significant period of time as they are at or below the variable cost of operating the barges. It should be noted that current (1987/88) U.S. barge rates are approximately 180% of tariff. This is a result of the current record levels of U.S. grain exports under their export subsidy program. At these rates, the excess supply of barges has been essentially eliminated and the system is operating at nearly full capacity.

When U.S. rail rates are estimated on the basis of the WGTA distance formula, substantial volumes of Canadian grain would move via the U.S. system, using the Mississippi and also the Pacific Northwest ports. It is reasonable to expect the U.S. rail contract rates are similar, or even below, in some cases, these rate estimates as the WGTA rates are calculated so as to cover the variable cost of moving grain plus a 20% contribution to constant cost (broadly interpreted as normal profits). In areas of the U.S. where substantial intramodal and intermodal competition exists it has been suggested that rail contract rates have been closer to the variable cost of operation than the WGTA rates.

In looking at the utilization of the Canadian system, Churchill remains an economic port for Canadian grain exports only when rates are based strictly on distance. However, WGTA rates are designed to cover the total cost of moving grain for the whole Canadian system, regardless of the individual port considered. High line-related costs of operation are experienced on the Churchill route which in combination with the very limited season render this route economically unattractive when total shipment costs are included.

In all cases, the grain which moves down the Mississippi River does so at the expense of the St. Lawrence Seaway. This is unlikely to be politically acceptable in Canada. However, if iron ore and grain traffic again expands to test the capacity of the St. Lawrence Seaway, the use of the Mississippi River as an overflow route would delay or negate the need for extensive capital investment to upgrade

or expand the Seaway. Another conclusion which can be drawn from this paper is Thunder Bay direct overseas shipments (via "salties") are relatively economical. If more ocean-going vessels were available which could navigate the entire Seaway system, the total cost of moving grain through the Seaway would be reduced as one costly transfer operation would be avoided.

An interesting finding of this research is that the directional division line between east and west grain movements in Canada lies east of central Saskatchewan for all rate combinations. This demonstrates that Scott, Saskatchewan does not accurately represent the mid-point, in terms of transport cost, between Thunder Bay and west coast shipments when considering the transportation costs from point of origin to the destination country (See Figure 2). (Please note: Scott, SK is located near Unity, SK.) The directional cut-off point between Vancouver and Montreal/Quebec City shown in this figure for wheat, remains relatively constant for all variations of the barge rates. When U.S. rail rates are calculated using WGTA distance-based rates, the line moves slightly further west into central Saskatchewan but with significant modifications in that grain from southern Alberta moves to Portland, Oregan and grain from southern Saskatchewan moves to Minneapolis.

When durum wheat movements are considered, more grain from north central Saskatchewan moves to Churchill and grain from eastern Saskatchewan and Manitoba now moves via Thunder Bay direct. The cutoff point for durum between east and west shipments is the closest to the traditional division line near Scott, SK for any of the grains analyzed in this paper. Barley movements follow basically the same pattern as for wheat with even more barley from central Saskatchewan moving to Vancouver. In the case of rapseed, the directional division line moves into eastern Manitoba. Nearly all rapeseed moves via Vancouver as Japan is by far the largest importer of Canadian rapeseed. This has a profound effect on the directional cutoff point, therefore, the division line between east and west shipments of rapeseed remains constant for all modifications to rail and barge rates.

Conclusions

Overall, it has been demonstrated that the U.S. routes are economical alternatives (in terms of minimum cost routing) under certain rail rate conditions in Canada and the United States. The present rail rate hierarchy established under the Western Grain Transportation Act is therefore seen to render uneconomic movement of Canadian grain by U.S. routes from the standpoint of the user of the system. If users were to pay the full cost rate, routes through the U.S. would be rendered economic. Even under the Canada - U.S. bilateral "free trade" agreement, the current WGTA transportation subsidy has been maintained except for certain limited movements of products into the U.S. Pacific Northwest.

However, the degree of regulation built into the Canadian grain

FIGURE 2
WGTA Total Rates in Canada
U.S. Rates As Given by Railroads
Basic Rate Combination - Wheat



transportation system is likely to prevent movements of Canadian grain through the U.S. system. The institutional constraints in place in Canada take several forms and reflect the degree of regulation put in place, with producer support, to overcome perceived problems in the grain marketing system. The major constraints which may prevent the movement of Canadian grain via U.S. routes are as follows: certain aspects of the Canadian grain grading system, the location of cleaning facilities, segregation of Canadian grain enroute through the U.S., use of movements of Canadian grain in bond through the U.S., inspection of grain at export position and issuance of the Certificate Final by the Canadian Grain Commisssion inspectors, restrictions on use of Canadian Government hopper cars, the current definition of export in Canada, access to the U.S. system, pricing of grain for export, and political considerations concerning the use of the Canadian grain handling system. These institutional constraints could be removed if the economic advantages of alternative routes for grain transportation through the U.S. become evident.

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TRANSPORTATION RATES AND SEAWAY COMPETITIVENESS FOR MOVING CANADIAN GRAIN

by

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INTRODUCTION

Since the opening of the Seaway in 1959, Canadian grain traffic through the waterway increased steadily from about 4 million tonnes to the record level of 17.7 million tonnes in 1983, representing 35% of the total Seaway traffic on the Welland Canal. However, in the following years, the softening of the world grain trade market coupled with depressed ocean rates brought about a significant reduction in Canadian grain traffic via the Seaway. From 1985 to 1987, Canadian grain traffic through the Welland ranged between 11.7 and 13.8 million tonnes. Moreover, since the 1985 crop year, and for the first time in more than a decade, the Seaway's share of total Canadian grain exports dropped below that of the Pacific outlet. This situation coincided with the implementation of the Western Grain Transportation Act (WGTA). This Act has added a new factor in the shaping of the Canadian grain distribution pattern, and, if not adequately applied, could favour grain movements through the Western Canadian outlet, particularly in a period when ocean rates are depressed.

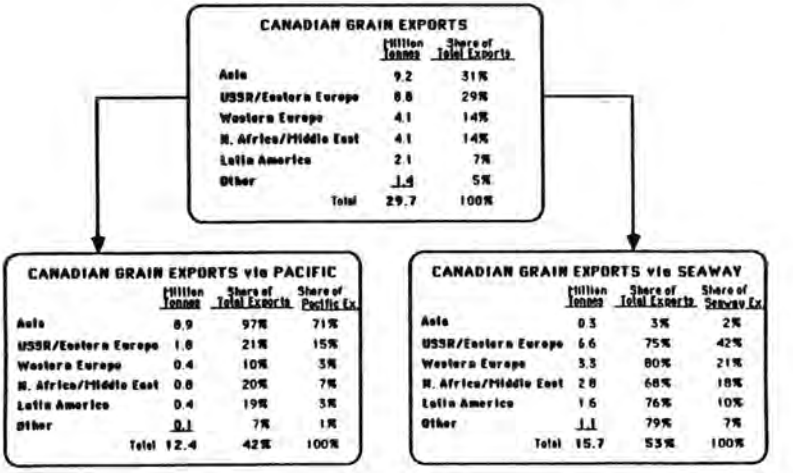
This paper analyzes the various components of transportation charges for moving Canadian grain from producing centers to overseas consuming markets through alternative routes and modes in order to assess the impact of these charges on the competitive position of the Seaway. The paper briefly describes the flow of Canadian grain through major alternative routes to overseas destinations and determines the share of the various Canadian outlets for shipping grain to these markets. The components of the domestic transportation costs for moving grain to the major Canadian outlets are reviewed and combined with ocean rates to various overseas destinations. The total transportation charges for moving Canadian grain from producing areas to overseas destinations through alternative routes/modes are then analyzed and finally, a conclusion relating the impact of these factors to the competitiveness of the Seaway is drawn.

CANADIAN GRAIN AND THE SEAWAY

Canadian grain is exported through several alternative outlets: the Pacific, Thunder Bay, St. Lawrence Ports, Atlantic Ports and the Churchill terminal. While all grain shipped to the Pacific is for export, grain moving eastward by water is for export and domestic use, both of which contribute to the Seaway traffic. Wheat is the most important component of the Canadian grain movements, accounting for 82%, followed by barley (12%) and corn (4%); the remaining is distributed among rye, oats, canola and flaxseed.

The competitive position of the Seaway for the movement of Canadian grain can be better assessed by examining the role the waterway plays in the Canadian grain export industry. Whereas the Seaway grain export market is relatively diversified, reflecting to a certain degree the composition of the overall Canadian grain export market, grain movements through the Pacific outlet depend heavily on the Asian market. In 1983-84, Canada exported a record level of almost 30 million tonnes of grain. The share of this amount between the Seaway and Pacific outlets is shown in Figure 1.

FIGURE 1
1983-84 CANADIAN GRAIN EXPORTS VIA THE SEAWAY AND PACIFIC OUTLETS

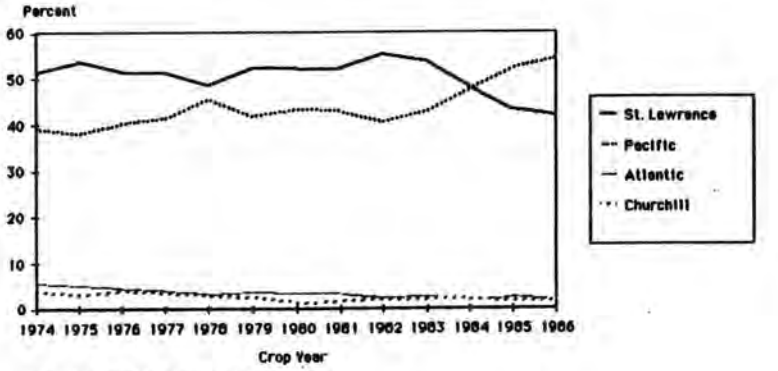


* The 1983/84 crop year was used since it represents the year before the Canadian grain export pattern changed.
Numbers may not add up due to rounding and the exclusion of the Atlantic and Churchill outlets.
Source: Economics Section, SLSA, 87.08.27.

Until 1983-84, the Seaway and the Pacific outlets were complementary rather than competitive. The amount of grain flowing through both routes depended, to a large degree, on the respective markets they served as well as on the available capacity of the Pacific outlet, i.e. the amount of Canadian grain exported via these two routes was more sensitive to the demand from major traditional markets, such as the U.S.S.R., Western Europe and China, than it was to domestic transportation rates.

Therefore, with increasing demand from the Soviet Union relative to the demand from China, the Seaway share of total Canadian grain exports was traditionally kept higher than that of the Western outlet, usually above 50% (see Graph 1). Fluctuations in this traffic were mainly the result of major changes in the world and domestic grain supply and demand situation.

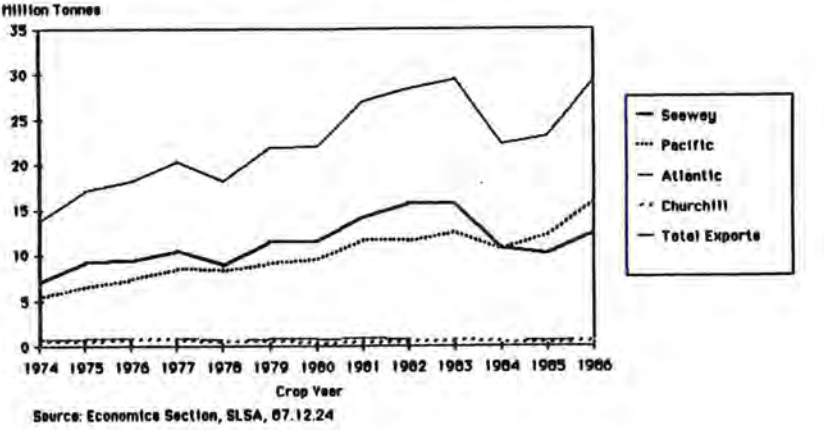
GRAPH 1
CANADIAN GRAIN EXPORTS BY OUTLET - SHARE



Source: Economics Section, SLSA, 87.12.24.

As an example, in 1985, the sharp decrease in demand for North American grain - a result of stiff competition in an over-supplied world grain market - drastically reduced Canadian and U.S. grain exports. In addition, serious supply problems in Canada, caused by two consecutive years of drought conditions, worsened the already weakened Canadian grain position. Consequently, Canadian grain exports through the Seaway dropped by about 5 million tonnes from the previous year.

GRAPH 2
CANADIAN GRAIN EXPORTS BY OUTLET



Source: Economics Section, SLSA, 87.12.24

Grain traffic through the Seaway has traditionally reflected fluctuations in Canadian grain exports more sharply than the Western outlet, i.e. when Canadian exports strengthened, the Seaway grain traffic increased relatively more than its Pacific alternative and vice-versa (see Graph 2). The sharp drop in this traffic was expected to be corrected once Canadian grain exports rebounded. This did not materialize; on the contrary, in 1985, for the first time in more than a decade, the Seaway's share[1] of total Canadian grain exports dropped below that of the Pacific outlet. Despite a noticeable rise in total Canadian grain exports in the following year, the Seaway share continued to drop while the Pacific share increased (see Graph 1). This change in pattern coincided with the implementation of the Western Grain Transportation Act (WGTA).

1/ The share of the total Canadian grain exports in a crop year for each outlet may differ from similar estimates for a calendar year.

TRANSPORTATION RATES FOR MOVING CANADIAN GRAIN

This paper covers transportation rates[1] for moving grain through two major alternative Canadian outlets[2]: the St. Lawrence Seaway, including trans-shipments through lower St. Lawrence ports and direct movements by ocean vessel from Thunder Bay, and the Pacific Seaboard.

The domestic grain transportation rates from Mid-Prairies to Seaboard for the two outlets are grouped under six major categories[3] as follows:

1. Interior Handling Costs (primarily elevator costs)
2. Rail Freight to Terminal
3. Terminal Storage
4. Thunder Bay Fobbing (Seaway route only)
5. Lake Transportation Costs (Seaway route only)
6. Seaboard Fobbing

Ocean rates were gathered for movements from the two alternative outlets to the selected destinations of Amsterdam/Rotterdam, Italy, the Black Sea, the Baltic Sea, Siberia, China and Japan.

The total transportation rate from Mid-Prairies to import destinations for each alternative route is the sum of the domestic transportation rate from Mid-Prairies to a specific Canadian outlet plus the ocean rate from this outlet to import destinations. All rates were converted to Canadian dollars per metric tonne.

1/ Transportation rates reflect the competitive forces in the transportation market which are dictated by the demand for and supply of transportation modes. Moreover, factors such as the availability of backhaul and the service and reliability of the transportation mode as well as the institutional links between the carrier and the shipper could also be reflected in the transportation rates.

2/ The Atlantic and Churchill outlets were not covered due to the unavailability of recent data.

3/ Based on the Canadian Grain Commission classifications.

From the analysis of the transportation rates matrix, the following may be deduced: (See Graphs 3a and 3b).

Domestic Transportation Charges for moving Canadian grain via the Seaway have historically been higher than those charges for moving grain via the Pacific. The rate gap between the two routes in 1974-75 was 5.88 $/tonne; by 1986-87, this gap had widened to 20.82 $/tonne, an increase of 14.94 $/tonne.

The higher charges of transporting grain through the Seaway are mainly due to the additional Thunder Bay Fobbing and Lake Transportation Charges which were 5.24 $/tonne and 17.55 $/tonne respectively in 1986-87.

The Interior Handling Costs, and Rail Freight to Terminal are similar for the two alternative routes. In 1986-87 they were 15.10 $/tonne and 6.27 $/tonne respectively.

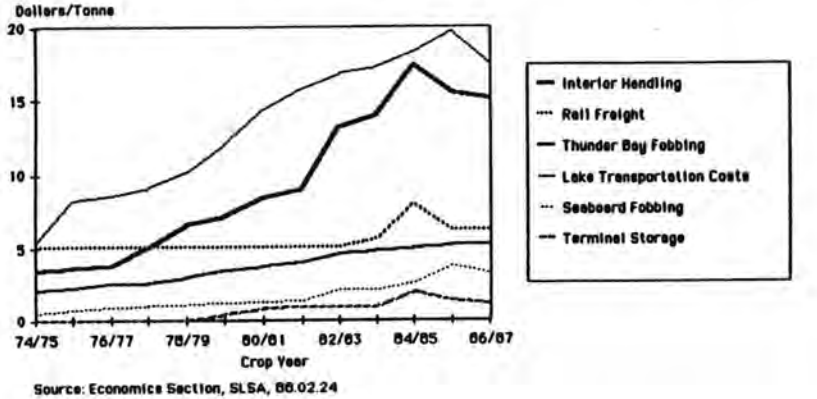
In contrast, Seaboard Fobbing Costs have historically been higher on the Pacific than on the Seaway route. On the Pacific, they increased from 1.99 $/tonne in 1974-75 to 5.23 $/tonne in 1986-87, whereas on the Seaway route they rose from 0.53 $/tonne to 3.26 $/tonne for the same period. The differential between the seaboard fobbing costs of the two routes has slightly increased from 1.46 $/tonne in 1974-75 to 1.97 $/tonne in 1986-87.

Meanwhile, Terminal Storage Costs for all the alternative outlets increased sharply from 0.46 $/tonne in 1979-80 to 1.10 $/tonne in 1986-87.

Rail Freight to Terminal Costs for both the Seaway and the Pacific were stable at 5.07 $/tonne until 1982-83. This cost, which represents charges for moving Western grain by rail to export positions, increased to 8.08 $/tonne in 1984-85 and then fell to 6.30/6.27 $/tonne in 1985-86/ 1986-87. These fluctuations resulted from the abandonment of the Crow rate and the implementation of a new rail pricing arrangement through the WGTA.

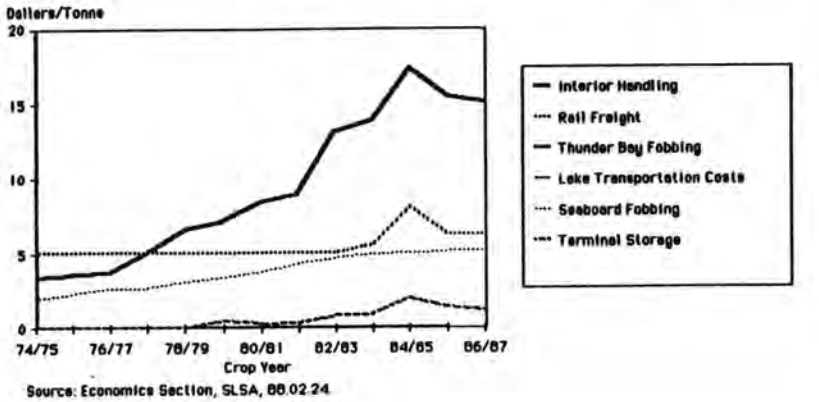
Ocean Rates from major Canadian grain export outlets to overseas destinations have generally decreased since 1981 to a level equivalent to the 1974-79 period, reflecting the depressed world freight market. (See Graphs 5a and 5b).

GRAPH 3a
GRAIN TRANSPORTATION RATES FROM MID-PRAIRIES TO SEABOARD
ST. LAWRENCE OUTLET



Source: Economics Section, SLSA, 88.02.24

GRAPH 3b
GRAIN TRANSPORTATION RATES FROM MID-PRAIRIES TO SEABOARD
PACIFIC OUTLET



Source: Economics Section, SLSA, 88.02.24

A detailed list of the costs involved in moving Canadian grain from Mid-Prairies to Amsterdam/Rotterdam for the period between 1984 and 1986 can be seen in Table 1. This table shows the magnitude of the various cost components relative to the total transportation rate.

TABLE 1
GRAIN TRANSPORTATION RATES FROM MID-PRAIRIES TO AMSTERDAM/ROTTERDAM VIA ST. LAWRENCE BY COMPONENT

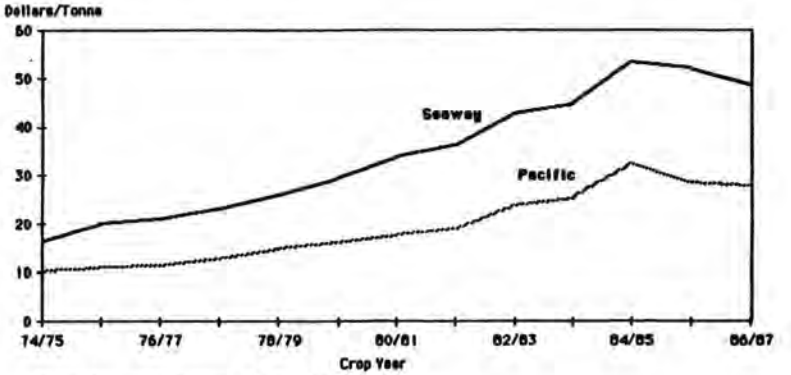
		1984/85			1985/86			1986/87 (Preliminary)		
		$ / tonne	% of Domestic Total	% of Total Rate	$ / tonne	% of Domestic Total	% of Total Rate	$ / tonne	% of Domestic Total	% of Total Rate
A	COUNTRY ELEVATOR									
1	Elevator Tariff & Removal of Dockage Fee	7.600 (1)	15.45	12.48	7.930 (1)	16.70	13.90	7.930 (1)	10.55	15.05
2	Carrying Charges	5.453	11.09	8.89	4.233	8.92	7.42	4.230	9.79	8.02
	Total	13.053	26.54	21.29	12.163	25.62	21.32	12.160	20.14	23.05
B	RAIL									
1	Rail Freight Charge	8.980 (2)	18.43	13.18	6.300 (2)	13.27	11.04	6.270 (2)	14.51	11.88
	Total	8.980	18.43	13.18	6.300	13.27	11.04	6.270	14.51	11.88
C	TERMINAL									
1	Canadian Grain Commission Fee	0.790	1.61	1.29	0.800	1.68	1.40	0.800	1.85	1.52
2	Terminal Inward & Outward Elevation	4.180	8.50	6.82	4.310	9.08	7.56	4.310	9.98	8.17
3	Terminal Storage	1.990	4.05	3.25	1.370	2.89	2.40	0.300	0.69	0.57
4	Drying	0.047	0.10	0.08	1.221	2.57	2.14	1.220	2.82	2.31
5	Lake Shippers Clearance Association Fee	0.045	0.09	0.07	0.070	0.15	0.12	0.070	0.16	0.13
6	Superintendence	0.015	0.03	0.02	0.015	0.03	0.03	0.015	0.03	0.03
7	Forwarding Brokerage	0.046	0.09	0.08	0.046	0.10	0.08	0.046	0.11	0.09
	Total	7.111	14.46	11.68	7.832	16.49	13.73	6.761	15.65	12.81
D	THUNDER BAY TO HISTORIC PORTREAL									
1.1	Lake Freight	15.010	30.52	24.48	10.690	22.51	18.74	12.020	27.82	22.78
1.2	Pilotage	0.100 (3)	0.20	0.16	0.110 (3)	0.23	0.19	0.120 (3)	0.28	0.23
1.3	Additional Lake Freight (Bunker Fuel)	NA (4)	NA	NA	4.270	8.99	7.49	NA (4)	NA	NA
2	Lake Freight Brokerage	0.100	0.20	0.16	0.100	0.21	0.18	0.100	0.23	0.19
3	Lakehead Harbour Commission Charges	0.067	0.14	0.11	0.067	0.14	0.12	0.072 (6)	0.17	0.14
4	Insurance on Lake Freight Cargo	0.700	1.42	1.14	0.720	1.53	1.29	0.442	1.02	0.84
5	St Lawrence Seaway Tolls	1.010	2.05	1.65	1.100	2.32	1.95	1.130	2.62	2.14
6	Inward Elevation into Montreal Transfer Elevator	2.400	4.88	3.91	2.470	5.20	4.35	2.470	5.72	4.68
	Total	19.387	39.42	31.62	19.535	41.14	34.25	16.354	37.85	30.99
E	PORTREAL									
1	Outward Elevation	1.260	2.56	2.06	1.340	2.82	2.35	1.340	3.10	2.54
2	Superintendence	0.015	0.03	0.02	0.015	0.03	0.03	0.015	0.03	0.03
3	Forwarding Brokerage	0.046	0.09	0.08	0.046	0.10	0.08	0.046	0.11	0.09
4	Wharfage	0.230	0.47	0.38	0.250	0.53	0.44	0.260	0.60	0.49
	Total	1.551	3.15	2.53	1.651	3.48	2.89	1.661	3.84	3.15
	TOTAL DOMESTIC TRANSPORTATION RATE	49.182 (5)		80.32	47.481 (5)		83.24	45.206 (5)		81.88
	OCEAN FREIGHT RATE	12.130		19.78	9.560		16.76	9.560 (7)		18.12
	TOTAL TRANSPORTATION RATE	61.312		100.00	57.041		100.00	52.766		100.00

NOTES
(1) The elevator tariff (A1) includes an administration fee.
(2) The rail freight charge was obtained from the CGC.
(3) Based on a vessel with a length of 222.5 m and a carrying capacity of 25,760 tonnes.
(4) Bunker fuel for this period is included in Lake Freight (D1.1).
(5) Transportation charges for moving Can.grain from mid-prairies to loading position in Montreal
(6) In 1987, the port of Thunder Bay changed its tariff structure. The cargo rate was lowered from $0.067/tonne to $0.049/tonne but a new harbour due of $0.0315/GRT was added.
(7) Based on 1985/86 rate since the 1986/87 rate is not yet available.

CAUTION: This table was prepared using a combination of published and unpublished information from various sources including the CWB, the CGC, and the Lakehead Harbour Commission. Thus, data may vary for similar items in other tables.
Economics Section, SLSA, 87 08 28

With respect to Seaway tolls, these charges continue to remain at about 2% of the total transportation rate for moving wheat from Mid-Prairies to Amsterdam/Rotterdam. The aggregate rate for domestic transportation charges through the Eastern and Western outlets continues to increase in favour of the latter (see Graph 4).

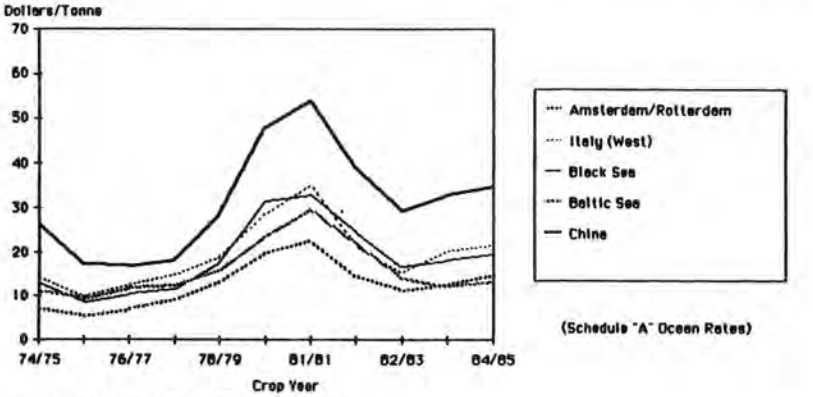
GRAPH 4
COMPARISON BETWEEN DOMESTIC TRANSPORTATION RATES FOR MOVING GRAIN FROM THE SEAWAY AND THE PACIFIC



Source: Economics Section, SLSA, 86.02.24.

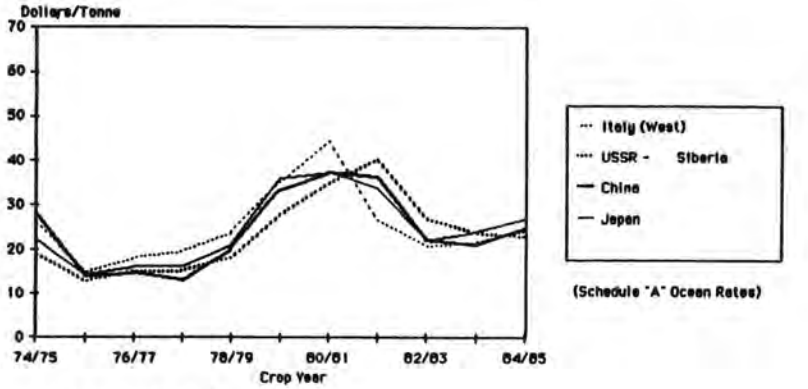
This is attributable to the greater significance of the rail freight rate in the cost components of the Pacific outlet which has decreased, particularly in 1985-86, relative to the increasing lake transportation and fobbing rate components of the Great Lakes/Seaway outlet.

GRAPH 5a
OCEAN FREIGHT RATES BY DESTINATION - ST. LAWRENCE OUTLET



Source: Economics Section, SLSA, 88.03.01.

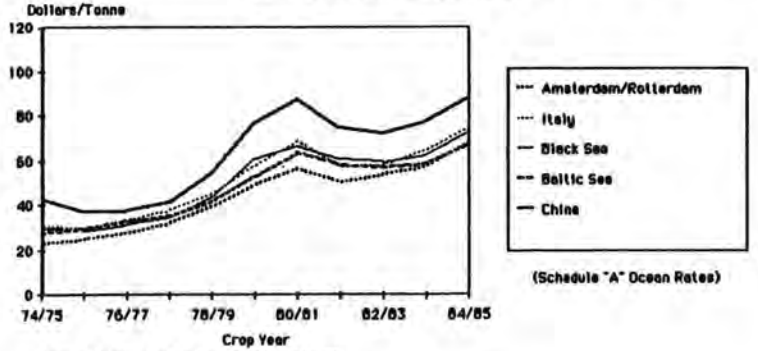
GRAPH 5b
OCEAN FREIGHT RATES BY DESTINATION - PACIFIC OUTLET



Source: Economics Section, SLSA, 88.03.01.

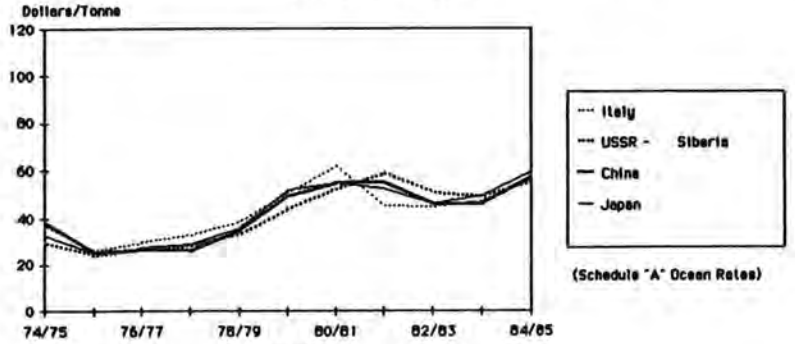
In addition, as a result of depressed world freight market conditions coupled with an oversupply of ocean vessels, ocean rates declined dramatically, their share of the total transportation cost for moving grain diminished, and consequently, domestic transportation costs increased in importance. Because the WGTA does not reflect the true rail transportation costs, rates via the Seaway to import destinations became less conducive to healthy traffic through the waterway (see Graphs 6a and 6b).

GRAPH 6a
GRAIN TRANSPORTATION RATES FROM MID-PRAIRIES TO OVERSEAS ST. LAWRENCE OUTLET



Source: Economics Section, SLSA, 88.02.26.

GRAPH 6b
GRAIN TRANSPORTATION RATES FROM MID-PRAIRIES TO OVERSEAS PACIFIC OUTLET



Source: Economics Section, SLSA, 88.02.26.

THE WGTA AND THE SEAWAY

The WGTA, which was passed in November 1983 to facilitate the transportation, shipping and handling of Western Canadian grain, established a standard rate on a tonne-mile basis for the movement of grain from country elevators to export positions. Accordingly, all expenditures such as fixed costs, mountain tunnels, roadbed upgrading, etc., were charged to the entire system. Therefore, a tonne of grain moving over any portion of the rail system contributes to improvements to any portion of the system. Grain shipped east, therefore, contributes to paying for the higher cost elements of the system in the Rockies for westbound shipments. If more grain moves west than east, westbound rates would not reflect or would under-represent the real cost - in effect, a subsidy to the shipper at the expense of the transportation system. This has distorted the true economics of the Canadian grain transportation system and diminished the competitive position of the Seaway vis-à-vis the Pacific outlet, particularly when world grain trade is soft and ocean rates are depressed.

Since the Railway Act and the WGTA restrict access to railway cost information, it is difficult to assess the impact of the WGTA tariffs on the movement of grain. However, from various studies[1] dealing with the transportation of Canadian grain via alternative routes we can deduce that transportation rates do not represent true transportation costs[2] and that the cost for moving grain by rail via the Western outlet is higher than the Eastern alternative if true transportation costs are considered.

For example, in an attempt to justify the Churchill alternative, Westburn Consultants undertook some research during the Crow debate to reflect the fact that it is "more expensive to go uphill than it is to go downhill", i.e. the Western route is more costly than the Eastern route. It was found "that if the average system cost for moving a tonne of grain out of the Prairies was 1, then

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1/ The Trade & Transportation Group & Wintemute, Randle & Kilimnik, Great Lakes/St. Lawrence Seaway System: Review of Grain Transportation Cost Structure, 1987 and Westburn Consultants, The Churchill Alternative, 1986.

2/ Transportation costs represent all of the resources employed and expenditures incurred by the modes to provide the transportation service on a selected route. This measure of costs would also represent the amount which the carrier must secure in the longer term in order to remain financially viable and to earn a commensurate return on investment.

it was 1.3 times more expensive to move grain to the west coast and 0.85 of the average cost to move it to Thunder Bay".[1] Westburn's results were based on earlier work by Snavely. Applying these ratios to the available rail rates we can deduce that the Seaway has an advantage of $12.85 per tonne in the true transportation rail cost for moving Canadian grain from Mid-Prairies to export positions (see Table 2).

TABLE 2
RAIL COSTS FOR MOVING GRAIN FROM MID-PRAIRIES TO TERMINAL

	(1) Hague, Saskatchewan (2) to VANCOUVER $/tonne	THUNDER BAY $/tonne	Reford, Saskatchewan (3) to VANCOUVER $/tonne	THUNDER BAY $/tonne	Scott, Saskatchewan (4) to VANCOUVER $/tonne	THUNDER BAY $/tonne
Rail Rate						
- Producer Share	$8.70	$7.80	$8.73	$8.75	$8.75	$8.86
- Government Share	$19.95	$17.90	$23.24	$23.24	$23.24	$23.61
Total	$28.65	$25.70	$31.97	$31.97	$31.97	$32.47
Volume-Related Costs (80% of Total) (5)	$22.92	$20.56	$25.58	$25.58	$25.58	$25.98
Adjustment Factor for East/West	1.30	0.85	1.30	0.85	1.30	0.85
Adjusted Volume-Related Costs	$29.80	$17.48	$33.25	$21.74	$33.25	$22.08
Line-Related Costs (20% of Total) (6)	$5.70	$5.15	$6.39	$6.39	$6.39	$6.49
Adjusted Rail Cost	$35.50	$22.63	$39.64	$28.13	$39.64	$28.57

NOTES:
(1) The published producers' rail rate of $8.70 from Hague, Saskatchewan to Vancouver was added to the government's share of $19.95 to get a total of $28.65. 80% of this figure - which represents volume-related costs - was then multiplied by the factor of 1.3 for the west coast; this was added to the remaining 20%, resulting in an adjusted total rail cost of $35.50 per tonne via the western outlet. A comparable figure for the Thunder Bay outlet, according to Westburn, was estimated to be $22.65, giving the Seaway route an advantage of $12.85 per tonne for moving Canadian grain from the Mid-Prairies.
(2) Hague, Saskatchewan was selected as the origin point by the consultant for the purposes of his comparison because it is located within the Churchill catch-basin.
(3) Reford, Saskatchewan is the traditional mid-Prairie point.
(4) Scott, Saskatchewan used to be the traditional mid-Prairie point. It was changed to Reford in 1984/85.
(5) Volume-related costs are costs related to the actual movement of traffic, and which, in the long term, vary directly in proportion to traffic volumes.
(6) Line-related costs represent the constant costs associated with the grain-related branch lines. These costs do not vary with the volume but do fluctuate from year to year because of variations in the miles of line which meet the required criteria and in the actual spending levels.
Source: The Churchill Alternative, Westburn Consultants, February, 1986; Canadian Transport Commission; Economics Section, SLSA 88.01.12.

As part of its rate-setting process, the WGTA requires the National Transportation Agency (NTA, formerly the CTC) to estimate annually the cost per tonne for moving grain and to multiply this by the Grain Transportation Agency's (GTA) grain export forecast for the next crop year in order to estimate the producers' and the government's share of rail costs. Since the GTA is also responsible for the administration and control of rail cars, a weakness in its grain export forecast could cause distortion within the system. For example, the GTA grain export forecast may maintain the traditional perception that the Asian market demand for grain will continue to grow relatively more than demand from other markets; if this assumption is not realized, it could affect not only

1/ Westburn Consultants, The Churchill Alternative, 1986, pg. 5.

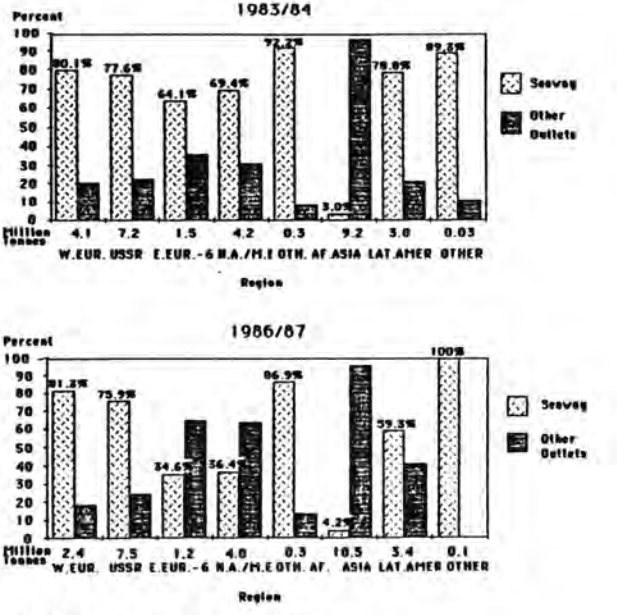
the rail rate but the efficient allocation of rail cars and the distribution of grain exports through alternative outlets. In this case, Canadian grain exports could be mis-directed towards the western outlet and, thus, Seaway Canadian grain traffic would be negatively affected.

FINDINGS

Prior to 1983-84, the Seaway and the Pacific were complementary outlets rather than competitive; the amount of grain flowing through both routes was more sensitive to the demand from their respective traditional markets and the available capacity of the Pacific outlet than it was to domestic transportation rates. The Seaway share of Canadian grain exports was usually higher than that of the Western outlet.

After 1983-84, the Seaway share of Canadian grain exports gradually declined below that of the Pacific outlet and the Seaway lost substantial shares in almost all traditional Seaway markets (see Graph 7); this dramatic change in grain flow distribution coincides with the implementation of the WGTA.

GRAPH 7
SEAWAY SHARE OF CANADIAN GRAIN EXPORTS
1983-84 VS 1986-87



Source Economics Section, SLSA, 88 01 07

Domestic transportation rates for moving Canadian grain via the Seaway have historically been higher than those for moving grain via the Pacific. The higher charges are due to the non-regulated components of the grain transportation rate, of which there are more for the Seaway route than there are for the Western alternative. In addition, the regulated components of the grain transportation rate are subsidized to a greater degree for grain moving west than they are for grain moving east.

In recent years, domestic transportation rates have taken on a greater role in dictating the direction of export grain movements since their proportionate share in the total transportation cost has increased as ocean rates have fallen - a result of softening world grain trade, depressed world seaborne trade, and an oversupply of ocean vessels. Thus, the Seaway route has appeared to become less competitive in terms of transportation rates.

CONCLUSION

Domestic transportation rates do not reflect true transportation costs for moving Canadian grain by rail to export outlets. The true cost for moving grain by rail via the Western route is estimated to be higher than the Eastern alternative. Rail rates derived from the WGTA should reflect this situation in order to prevent the biased distribution of grain exports against the Seaway, particularly during a period when ocean rates are depressed. If this situation is not corrected, further erosion of shares in traditional Seaway markets should be expected. In the long-term, this would negatively effect not only on the Seaway competitiveness, but also on the Canadian grain industry as a whole.

ACKNOWLEDGEMENTS

The Author gratefully acknowledges the valuable assistance and contribution provided by E. Riach.

METHODS TO RELIEVE AIRPORT CONGESTION

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ABSTRACT

This paper outlines the problem of airport congestion and delays and presents some approaches for the relief of airport capacity constraints. These include building new airports, expansion of airport facilities, provision of remote processing facilities, demand management through economic and regulatory measures, and application of new technology. The effectiveness of each approach in relieving congestion and the implementational difficulties involved are outlined and final conclusions are presented. The paper covers part of a research into capacity measurement and evaluation involving the entire airport system and its scope has been generally confined to the airport landside component.

The views expressed in this paper are those of the author and do not necessarily reflect those of Transport Canada.

INTRODUCTION

For many years after World War II, measures for relief of airport airside capacity constraints have customarily received the greatest attention. Now, with application of new and advanced technology to increase the traffic handling capability of airside facilities, adoption of more efficient air traffic control procedures and use of highly advanced aircraft control systems, coupled with the ever continuing growth in passenger traffic enplanements and deplanements through airport terminals, serious capacity limitations are found more and more on the landside than on the airside. At a great number of airports today, many subsystems of the air terminal building (ATB) and components of the ground transportation access system have reached and often surpassed their capacities thus giving rise to unacceptable levels of service marked by severe congestion and long delays. Lack of prompt remedial actions to increase the capacity could lead to an eventual breakdown of the airport terminal system.

In the United States, for example, 18 airports are already rated as seriously congested (experienced more than 20,000 hours of aircraft delay in 1986) and without aggressive remedial actions, the number could more than triple over the next decade[1]. In Canada, in addition to the many on-going capacity improvement initiatives at Pearson international airport in Toronto, which handled over 17 million passengers in 1987, work is currently underway to build a third terminal at that airport in order to relieve present and forecast landside capacity shortages, particularly at terminal 1. The airport's most severe capacity constraints are predominantly on the landside and pertain to the aircraft gates, several ATB

subsystems, and the road system and car parking facilities. Similar Problems, but of differing magnitudes, naturally exist at many other airports around the world.
As airport capacity has become a major concern of airport authorities, innovative approaches to improving capacity have been sought. In this era of economic restraint, constraints on capital expenditures and growing community resistance to developing new airports has made it necessary to give serious consideration to low-capital capacity expansion options and continued application of technological improvements.

The object of this paper is to describe some of the potential approaches for reducing airport congestion, including the option of building new airports.

AIRPORT COMPONENTS AND LANDSIDE-CAPACITY

An airport can be considered as consisting of five major functional components:
- Ground Access, including road system, curb and parking facilities
- Air terminal building complex
- Gates and terminal apron
- Taxiway and Runway systems
- Air traffic control system

The first three components are collectively referred to here as the "airport landside". The remaining two systems comprise therefore the "airside".

In broad terms, airport landside "capacity" refers to the airport's capability to process/accommodate the traffic (ground-access vehicles, passengers, visitors, cargo and aircraft) within a given time period at a specified level of service.

APPROACHES TO REDUCING AIRPORT CONGESTION

Increasing the capacity utilization of the airport (or any of its subsystems) means enabling it to handle a larger volume of traffic than its current throughput capability while maintaining an acceptable level of service. The alternatives that follow help achieve this goal and hence contribute to the reduction of airport congestion.

1. BUILDING NEW AIRPORTS

One approach to dealing with the need for additional airport capacity has been the development of new airport sites. While in the past this has been a feasible approach, particularly during the 1950's, and 60's, the constraints are now rather numerous: the enormous difficulties in finding and acquiring large tracts of land and developing them as airport sites, the ever-increasing opposition by local communities to airport development because of noise and increased highway congestion around the airport, and the

scarcity of funds needed to finance such capital intensive projects, and many other restrictions. These constraints may in certain cases, limit the viability of this approach as the practical solution to airport capacity problems. Very few, if any, new airports are presently contemplated in developed countries.

In Canada, for example, there are no plans at the present time for developing new airports, except for a third passenger terminal at Pearson international airport which is being funded by the private-sector rather than the government. No more than one or two major air-carrier airports are expected to be built in the United States within the next decade[2]. Similar statements can be made in respect of other developed countries.

2. PHYSICAL EXPANSION OF EXISTING AIRPORT FACILITIES

This has been the approach widely adopted by various airport authorities as a means of responding to the growth in airport traffic activity, at least in the short term. Increasing the capacity of the existing physical plant could take the form of extending existing piers or adding new ones in order to provide more gates, providing more apron space, physical alteration or enlargement of strained ATB subsystems to increase their passenger processing/accommodation capacities, provision of more car parking space (e.g. by building a parking garage), to name a few.

It should be noted that expansion of the capacity of an existing facility may not always entail its physical enlargement. Re-configuration (layout alteration) of existing space may be all that is needed. For example, adjacent holdrooms could be combined into one common area to allow accommodation of wide-bodied jets in areas previously designed to handle small aircraft, or simply to provide more space per occupant than previously permitted under a "separate holdroom-per-gate" layout.

In general, however, expansion of an airport may present several problems as it may entail purchase of high cost real estate and runs a high risk of triggering local opposition because of noise. Growing community resistance may make expansion more difficult in the future. In addition, expansion of airport facilities requires substantial capital expenditures which may not always be available because of other pressing priorities.

There is an important point to consider before adopting this alternative. capacity expansions through means of this type may in certain cases take the form of "quick fixes", designed to marginally increase the capacity of exisiting facilities in the short or medium term. It may in fact be cheaper and more effective in the long run to build a whole new facility (e.g. terminal) than continue to provide numerous piece-meal modifications to an existing air terminal(s). This has, for example, been realized in the case of Pearson airport, where a new third terminal was determined through extensive studies to be the most cost-effective solution to the airport's capacity problems.

3. PROVISION OF REMOTE PROCESSING FACILITIES

This approach helps reduce the demand on the traditional airport facilities by servicing part of it at alternate or complimentary locations farther away. It applies mainly to vehicle parking, passenger processing and aircraft gating.

Off-Airport Vehicle Parking: When capacity of airport car parking facilities is insufficient to meet demand and cannot be expanded efficiently within the airport boundary, additional parking facilities could be established at off-airport locations and connected to the terminal through a circulation system (e.g. shuttle bus). While offering an innovative solution to the problem of parking capacity limitation, this method has had mixed results. Drivers hesitate to use such facilities in the hope of finding close-in parking. If they cannot, they will return to the off-airport facility, and in the process they consume valuable roadway capacity, let alone the time they wasted[3].

Off-Airport Passenger Processing: This involves the performance of passenger ticketing and baggage checking functions at a remote terminal (e.g. in the peripheral parking lots) or at key locations within the city where passenger origins and destinations are concentrated (e.g. travel agencies, downtown hotels, etc.) and the delivery of passengers to the airport for completion of remaining enplaning activities (e.g. security checking, etc.) and direct boarding of the aircraft.

Again, while contributing to the reduction of passenger congestion in processing areas, the success of this type of operation in downtown locations depends on the concentration of predominantly business air-travellers in those areas to generate sufficient demand for the service. Other factors affecting the success of this method include the additional costs due to the duplication of services and accommodation facilities, and the security of baggage transfer from such locations to the terminal.

Remote Aircraft Gating: Lack of aircraft gates may require the use of transporters or mobile lounges to transport passengers to/from the terminal to a remote aircraft parking position within the apron. These specialized vehicles take the form of either customized ground-level busses or special transport vehicles equipped with hydraulic lift devices enabling their embarking/disembarking by the passenger at terminal building floor level and at aircraft door-sill level). This operation has been resorted to in situations where the available gates were not sufficient to accommodate all incoming aircraft, paticularly during peak periods. Dedicated full transporter operations exist at many airports such as Montreal (Mirabel) in Canada, Washington (Dulles) in the united states and many other airports across Europe and around the world.

Transporter operation is a cheaper and efficient alternative to building a gate. Experience also shows that there has been no appreciable difference in passenger acceptance . The main drawback

of using transporters is the high cost of their operation and maitenance. But such costs should be traded-off against the savings in terminal infrastructure investments and operating costs.

4. DEMAND MANAGEMENT THROUGH ECONOMIC MEASURES

Because of the above difficulties in building or expanding airports, there appears to be a growing sentiment that other solutions should be explored, and that proposals for airport expansion or development should not be entertained for implementation unless all other means of increasing capacity have been examined. One such means of reducing the congestion and delay without resorting to physical expansion is demand management, i.e. influencing the demand to make it fit within the limits of existing capacity. Although expansion may be inevitable at a certain airport, demand management solutions can be implemented in far less time than it takes to construct new facilities, with the effect of delaying the need for expansion and reducing the capital investment pressure at the airport concerned.

Traffic at airports is characterized by peaks and valleys created primarily by airline scheduling practices, but also due to the preference of passengers to travel at certain times of the day. It is a repetitive process that takes on seasonal, weekly, daily and hourly patterns[4]. One obvious way of increasing the traffic handling capacity of the airport is to avoid sharp peaks. At many Canadian airports, for example, the rate of passenger traffic flow during peak periods exceeds in some cases twice the daily average[5]. Similar fluctuations exist at airports in other countries. The wider these traffic fluctuations are, the worse becomes the level of service during peak periods, and consequently the more costly are the airport capacity additions needed to meet the peak demands at an acceptable level of service. Inevitably such expensive facilities and services will be underutilized during off-peak periods.

The concept of "demand management" involves the adoption of certain economic and/or regulatory measures aimed at accommodating the daily traffic demand within the existing capacity of the airport while maintaining an adequate level of service. This could entail shifting the excess traffic flow during peak periods to off-peak hours, thus making the diurnal distribution of demand more evenly spread across the day, and/or diverting a portion of the traffic activity at the busy airport to a neighbouring less-utilized airport(s). Two economic based instruments most commonly advocated for achieving this goal are discussed here.

4.1 PEAK PERIOD PRICING

This is an economic approach that uses the mechanisms of price as an instrument for modulating traffic demand and has been used successfully in urban transit services in some major metropolitan areas. It would typically take the form of "surcharges" (extra fees) on the use of the airport during busy hours, thus encouraging

aircraft operators to shift flights out of the most congested periods to other (less costly) times or sites. The result would, in theory, be a reduction in peak traffic volumes since this approach would operate selectively on those whose use of the airport is discretionary, and hence a more uniform level of demand throughout the day. The advocation of using economic measures stems in part from the commonly acknowledged observation that the present structure of airport use fee, especially at congested airports, is far from being economically efficient.

The extra revenues generated by imposing peak-hour surcharges could be used to finance needed expansions of airport facilities and could be justified on the grounds that the incremental cost of providing the "extra" facilities required to accommodate peak traffic (e.g. additional gates) ought to be paid for by those demanding and benefiting from these facilities and services.

Alternatively, the additional revenues could be returned to the air carriers in a way that induces them to shift traffic out of peak periods. They may then consider passing this inducement on to the passengers in the form of lower off-peak fares.

Although long-favoured by economists, peak period pricing schemes have had only limited use worldwide because their implementation is generally considered as troublesome. A major problem inherent with the concept of peak hour pricing is how to determine the true "marginal" cost which reflects the cost of the "additional" airport capacity needed to accommodate, say, a landing or a take-off during the peak period. This extra cost is to be added to the user's prorated share of the full cost (i.e. average cost) of providing the "normal" (or "base-line") facilities and services. There exists no accurate or generally accepted way to split the airport capacity into its "normal" and "peak-period" components thus rendering use of this approach rather controversial.

In order for the method to work, the base level of required capacity must be clearly established and agreed to by all parties before the amount of remaining capacity (against which peak period surcharges are made) could be quantified. Furthermore, there would likely be disagreements about the extent to which the "normal" capacity should be able to accommodate traffic volume increases. Any attempt to recover the costs of the peak hour component from peak period users would run the inevitable risk of triggering user complaints that the peak hour charges were unrealistic.

There are other drawbacks. In order for this option to be effective in shifting demand to slack periods, the peak hour charges would have to be set so high that they would likely be politically unacceptable. Further, certain carriers may, despite the higher peak hour fees, still continue to schedule flights during peak periods because the passenger market (hence revenue potential) is far greater during such times. Their use of the airport during certain peak times might also be necessitated by the scheduling process of their flights. In setting their fare structure, the carriers can, however, average the higher costs of peak-hour use

with the lower costs at other times and sites (i.e. internally cross-subsidizing their operations) and pass this along to all passengers as a general fare increase.

Another concern with the peak-hour pricing concept is that higher fees might be a burden to the small carriers (who often have to coordinate their schedules with those of larger airlines) or new entrants than for well-established airlines. By favouring those with the ability to pay, such a scheme of differential costing could be seen as discriminatory, anti-competitive and contradictory to a basic policy of free access to all users.

4.2 GATE/SLOT AUCTION:

Another economic measure that could be instituted to influence the level of demand during peak periods at a capacity-constrained airport is to sell to the highest bidder the right to use the airport (e.g. landing or take-off) at a certain time during the day (slot). In this way, the free market forces determine the cost, which is simply what users are willing to pay based on their perception of the value of the airport access at any given time. The use of this approach is justified on the grounds that if use of the airport is to be limited, then it should be treated as a scarce resource. Hence, the price of airport access should be determined by demand through a market-oriented mechanism. This method has been used at a number of high-density airports in the United States for domestic services (it would be incompatible with obligations under most international bilateral agreements).

While this approach circumvents one of the major difficulties inherent in the peak-period pricing method, namely the determination of the marginal costs (peak-hour charges), it presents similar problems. As with the preceding approach, one obvious concern is that well-financed airlines might "squeeze out" smaller incumbants and new carriers who would find it difficult to economically purchase entry into the "expensive" (but greater revenue-generator) peak hour slots. The approach could therefore be viewed as anti-competitive and detrimental to the commercial viability of the smaller and financially less-established carriers, which may in turn adversely affect the service they provide to the communities they serve.

There are also additional implementational difficulties associated with slot auctioning which pertains to the management of the auctioning process and the issues of slots ownership and right (and proceeds) of sale. At certain airports, such as those in the United States, a large portion of the slots may have to be awarded (grandfathered) to incumbant airlines in view of the substantial investments they have already made at the airport concerned, thus leaving out only a small fraction of the slots for auctioning. If not carefully implemented, this approach could be seen as unfair for it tends to maintain the economic interest of the incumbant airlines to the detriment of small incumbants and new entrants.

Incumbant carriers may have little or no incentive to support efforts to increase capacity since the additional capacity would benefit new entrant copetitors hence reduce the market value of incumbants' slots. It is important therefore in order for this mechanism to be effective in meeting its intended objectives that the auction proceeds are directed towards capacity improvement programs, that grandfathering of slots be kept at a minimum and that proper controls are established for the auctioning and trading of slots (e.g. "use-it-or-loose-it rule, etc.).

5. DEMAND MANAGEMENT THROUGH REGULATORY MEASURES

Market-based mechanisms such as peak-hour pricing may be difficult to implement and they are likely to encounter strong opposition from airport users. Another alternative approach is to adopt certain regulatory or administrative procedures aimed at limiting the volume or type of traffic (flights) that will be accommodated at an airport within the limits of some given capacity or acceptable level of delay. The method would therefore have the same general effect as that of managing the demand through application of economic measures in that the demand would be spread more evenly across the day and, if applicable, a portion of it would shift to other neighbouring airports. There are however some important differences between the two approaches.

The economic measures would likely influence both the aircraft movements and passenger volumes since use of the airport during peak periods will be at a premium. Regulatory procedures on the other hand would only spread or reduce aircraft movements and take pressure off the runway system. They are not likely to contribute significantly to relieving terminal or ground access congestion as they would not influence passenger preferences on travel time, and airlines would compensate for the reduction in flights at peak periods by operating larger aircraft to satisfy demand. Use of regulatory measures may therefore be appropriate if the critical capacity constraints are predominantly on the airside. A number of these regulatory procedures are described below. These may be applied individually or in combination.

5.1 TRAFFIC QUOTAS AND SLOT ALLOCATION

Under this approach ceilings are imposed on the number of aircraft landings and takeoffs and/or passenger volumes permissible within the limits of some specified capacity of the runway system, the aircraft gates and/or the air terminal building(s). Quotas may be imposed during certain times of the day (peak periods) or, in case of steady severe congestion, at all times. Because delay increases exponentially as demand approaches capacity, a small reduction in the volume of traffic could result in a relatively significant decrease in traffic delay. This makes the quota an attractive measure for dealing promptly (and inexpensively) with airport congestion.

Separate traffic quotas are usually set by airport authorities for the air carrier and general aviation traffic components. Through a scheduling committee comprised of the individual airlines which meets bi-annually, the pre-set air carrier traffic quota is allocated among the carriers in the form of "slots", and timetables which jointly satisfy the airport quota restrictions are prepared. (The term "slot" generally denotes the right to land or take off (not both) once during a specified hour, daily, for one winter or summer season.) The slots for general aviation operations are allocated on a first-come-first-served reservation basis. Slots may be traded among airlines (bought and sold), and the carriers have no future rights to currently held slots.

Unlike the economic measures described above which have had limited use, the quota/slot allocation approach has been used at a number of North American major airports and at many busy airports in Europe and the Far East. It proved to be an effective method to manage the peak period demands when instituted at a number of high-density U. S. airports following the 1981 air traffic controllers strike in that country, and has now evolved into a formal means of managing capacity-constrained airports.

In setting the quota system, the ceilings on the traffic demand flow rate could be prescribed for either or both the hourly aircraft movements and the hourly enplaning/deplaning passenger volume depending upon the type of capacity constraints prevailing at the airport concerned. The quotas may also be specified for time intervals shorter than one hour in order to "smooth out" the daily traffic demand profile. An example of a quota system at an existing airport is shown in Exhibit 1.

Airport quotas may be simply stated or, as in the case of the example shown the Exhibit, stipulated after rigorous evaluations to determine whether they are satisfied by a given set of airline schedules. In the latter case, extensive computations are performed based on carriers' supplied information on all of their planned arriving and departing flights which in the case of this example, would include scheduled arrival and departure times, aircraft type, gate occupancy time, estimated average number of enplaning or deplaning passengers, and average terminal occupancy times by enplaning or deplaning passengers.

Though slot allocation appears to be effective in controlling peak traffic, it has a number of drawbacks. It is unpopular with the aircraft operators because it restricts access to the airport at the "most desired times". This is viewed by those users as counter-productive in terms of economic efficiency and in violation of the basic principle of full access to the airport by all users. Another drawback, which is always inherent in such allocation approaches, is that the distribution of slots cannot practically ensure that slots will be allocated to those who value them the highest. Carriers with slots which might be of only marginal value to them would have no incentive to give them up to others who would value them highly unless by doing so they get slots they seek at other times or airports, which may not be possible. Deregulation

has made the allocation of slots a more difficult process because of the need to constantly accommodate new entrants and the complexities of the frequent changes to incumbent air carriers' route structures and schedules.

A further concern with the imposition of quota/slot allocation measures is the possibility of violating bilateral agreements respecting foreign carriers' capacity and frequency rights.

TERMINAL RESTRICTIONS

The following maximums apply to the hourly rate of passenger traffic flow computed on a 15-minute moving window of one hour:

- DEPLANING: 1400 international passengers
  + 1000 domestic passengers
- ENPLANING: 1500 domestic & international passengers
  + 800 cross-border passengers
- ENPLANING & DEPLANING: 5000 passengers (all sectors)

AIRCRAFT GATE RESTRICTIONS

Available gates with loading bridges can only accommodate a maximum of 23 aircraft at any time, with the following restrictions on aircraft mix:

Aircraft Class	Maximum Number permissible
B747 size	8
DC-10/L10-11 size	12
DC-8 size	19
B727 size	23

No restrictions are imposed on the rate of take offs or landings.

EXHIBIT 1 AN EXAMPLE OF CAPACITY RESTRICTIONS AT AN AIRPORT

5.2 TRAFFIC FLOW CONTROL

Flow control is a computer-aided air traffic management procedure now in use in the United States (again, introduced after the 1981 air controllers strike) which does not explicitly restrict airport access for any one user, which is a major concern with the traffic quota/slot allocation approach. The technique aims at dynamically controlling the volume of traffic to and from an airport in response to overall regional or national demand. This is accomplished through computerized continual adjustments of the times of aircraft arrival at and departure from airports throughout the system in such a manner that delay occurs in less costly ways (usually on the ground at the departure airport or enroute rather than in a holding pattern at the destination airport).

Traffic flow management may also involve assigning different priorities to different types of commercial aircraft (e.g. heavy, medium, small) for specific periods of time during the day. such an approach though violates the principle of first-come-first-served increases the overall capacity utilization of the runway system.

Though viewed by the air carriers as a costly limitation on their freedom of access to airports, this technique is somewhat more acceptable than the preceding approach for it may be advantageous to a carrier (from an economic efficiency point of view) to absorb the cost of the delays imposed by this system than bear the cost of flight rescheduling. It should be noted that the benefits of traffic flow management are predominantly airside related and that it does not increase the intrinsic capacity of the system. Rrather, it is a means of maximizing the utilization of existing limited airspace and airport respurces.

5.3 RESTRICTIONS ON GENERAL AVIATION ACCESS

One method of maximizing the use of available airport capacity is to discourage its use by low-valued flights by imposing restrictions on the type of flights that will be accommodated. There are two primary benefits associated with options of this type. First, the need for capital improvements to accommodate traffic would be reduced. Second, the more homogeneous is the mix of aircraft handled by the runway in terms of size, speed, and operating characteristics, the more uniformly and accurately they are spaced on approach and departure, thereby resulting in optimal utilization of the airside capacity.

General aviation (flights largely made by private/business aircraft and 'other commercial' operators) are usually the target of such restrictions. General aviation airplanes are typically smaller than and not as well-equipped as air carrier aircraft, and hence segregating the two types of aircraft flows is conducive not only to higher safety but to also improved airside capacity utilization. It has also been argued that it would be a waste of valuable resources to permit a small general aviation airplane to delay a larger commercial aircraft at a busy hub airport.

While the pricing measures described above could be used to achieve this end, explicit access restrictions could be imposed on such types of flights during certain times (peak periods) or, in very extreme cases, full-day restriction may be instituted. These actions, namely differential fees and/or access restrictions, would result in shifting a portion of the traffic activity out of peak hours to less busy periods and/or to alternate sites (reliever airports) where they can be accommodated; thus leaving more airside capacity for air carrier operations.

An obvious concern with this approach is the expected strong opposition and resistance on the part of business and private aircraft operators to relocate their traffic activities. Another difficulty relates of course to the availability of convenient and adequately-equipped alternate sites to accommodate the diverted traffic.

5.4 RELOCATION OF COMMERCIAL OPERATIONS

This approach would rely on a policy decision by the appropriate authority to relocate certain sectors of the commercial traffic operation (e.g. international flights, charter operations, etc.) or certain airlines to other less-utilized neighbouring air-carrier airports, or even to another terminal at a multi-terminal airport.

Tenant airlines may be provided incentives, or forced through policy administrative actions, to relocate their operations before traffic growth makes congestion and delay intolerable at the busy airport. When the cost of delay begins to outweigh the benefits drawn from the larger market at a busy hub airport, some carriers, particularly those with a high proportion of interconnecting flights, may voluntarily relocate to a neighbouring less busy airport. By developing the new location as a new hub, a hubbing carrier could attract a much greater share of connecting passengers who might have otherwise transferred to other competing airlines at the original hub.

Relocation of traffic from one terminal to another at the same airport is usually prompted by terminal capacity constraints rather than airside limitations. Traffic relocation to another airport on the other hand, could be the result of capacity shortfalls on either or both the airside and landside, or a desire on the part of the airport authority to balance the utilization of the overall airport system.

While the concept of expanding the use of secondary airports near major hubs appears logical, the impediments to this approach are numerous. As with the option of restricting general aviation operations, the affected users of the airport would attempt to muster considerable opposition against any such policy. The airlines would understandably be reluctant to relocate some or all of their operations to a less busy airport for obvious reasons. Their move would mean their loss of the high-density (lucractive) market at the original location, hence a possible loss of revenue.

Also, splitting passengers between two airports not only inflicts upon the the carriers an economic penalty due to duplication of services, but it might also make scheduling of their flights more difficult and render the utilization of their aircraft fleet inefficient. There is also the capital cost required to ensure that the reliever airport will adequately handle the relocated traffic.

A further difficulty with this approach is the need to respect bilateral agreements involving foreign carriers' rights, or else run the risk of possible equivalent retaliations.

6. APPLICATION OF TECHNOLOGICAL INNOVATIONS

Demand management techniques could, in theory, reduce delay and are worthy of serious consideration from the standpoint of efficient use of existing resources and avoidance of large new capital investment. However these concepts are viewed as controversial, and there are analytic problems and policy issues to be resolved. Several years of experimentation might be needed to establish the most effective fee structure for controlling congestion and delay.

Similarly, since the economic value of using an airport is not fully considered in setting the other set of options of demand management, namely regulatory measures, incumbent carriers may not be displaced by others who would place a higher value on use of the airport. For this reason, emphasis has been placed on application of improved technology that will add to airport capacity (service rate) or permit more effective and economical use of the airport as a whole.

Technological applications are not confined here to sophisticated electronic and mechanical devices such as those now used for air navigation, surveillance, communications and flight control, but also include new and innovative operational concepts and procedures and advanced computer modelling and simulation techniques applicable to all components of the airport: runways, taxiways, terminal building, and ground access system.

Technological techniques applied to relieve airport congestion or increase airport capacity utilization fall into three broad categories:
a) improved devices and procedures for expediting the flow of air traffic into and out of the airport thus increasing the airside capacity utilization, b) techniques to facilitate the movement of aircraft from the runway(s) to the gate positions and back again as expeditiously as possible, and c) techniques that can be used to improve the efficiency of processing passengers through the terminal building and moving vehicles on the groundside network by shortening travel time, lowering travel cost, and lessening inconvenience. There are of course other applications of technology which are not directly related to relief of airport capacity constraints such as computerized reservation system, flight planning and scheduling and other airline operations.

In terms of landside capacity which is the focus of this paper, application of technology contributes to relieving congestion through the possible increase in the traffic handling capability and other operational benefits such as improved efficiency, accuracy and reliability. Adoption of technological solutions also leads to lower costs. The extent of these benefits depends of course upon the physical characteristics and operational conditions of the airport in question. Further, it should be noted that while introduction of technological improvements would increase the traffic handling capability of airport facilities, the contribution of technology to relieve airport congestion and delay cannot be considered as a substitute to long-term future capacity expansions.

USE OF COMPUTER MODELS -- AUTOMATION

As part of the application of technological innovations discussed above, development and use of computer models to assess prevailing levels of service, and evaluate possible options for alleviating congestion have been widely recognized. Use of computer models in airport planning, design and operations has already advanced the state of technical art in this area. As tools to aid in improving the efficiency of airport operations, innovative and cost-effective applications of computer models can be realized in many areas. Such models could be used to simulate the movement of aircraft on the airside and apron, the flow of pedestrians in the terminal building and movement of vehicles along the ground transportation system.

For example, improvement of the management of gates could be greatly enhanced through computerized (automated) gate assignment techniques. At many airports today, gate assignment is handled manually using wall-sized scheduling boards with magnetic pieces to represent flights occupying gates. When flight delays, mechanical break-downs or weather problems occur at a busy airport, it becomes a burdening physical and mental process on the part of the gate controllers to "juggle" these flights around in order to accommodate the current situation. Much of this human routine can be easily eliminated (together with the wall-assignment-board!) through automation. This involves the development of computer models (incorporating the knowledge and expertise of these controllers) that efficiently reassigns the gates given the current information and instantly displays the gate assignment board on the monitor's screen. The system could also continually update the Flight Information Display System (FIDS) monitors throughout the airport terminal. Not only is it more efficient, but such a system would free up the controllers to concentrate on the more difficult problems that may arise throughout the operating day. Such systems will become increasingly more valuable as the airport demand (aircraft movements) increase and capacity limitations are reached.

The recent emphasis on scheduling and slot allocations has forced the airport operators to be very precise in defining what "capacity" means in that context. Thus an additional role for automation has been in the area of providing daily or hourly (real-time) predictions or measurements of capacity, delay and noise.

There is also a continuing need to measure the airrival/departure capacity of an airport and to predict the change in capacity if the airport layout is altered or if the demand profile (number and type of aircraft) changes. The complexity of these two problems (measurement and prediction) requires the use of computer models to obtain quick-response solutions.

Similarly, a study of the dynamic flows through the various processors of an airport is a prerequisite for evaluating the operation and level of service offered by such components as well as planning and design of facilities. This task requires computer methods and data. The difficulties of predicting traffic demand and its characteristics with reasonable accuracy, on the other hand, adds further complexities to the process of managing and planning airport facilities. The deregulation of the air transportation industry has added further uncertainty to the demand side owing to the highly dynamic nature of the market and the supply response of the airline industry in terms of aircraft used, routes served, frequencies offered, and prices charged. The requirement to add flexibility to plans and designs results in further dependence on comuter methods for efficient testing of the many capacity improvement options and assumptions.

A prerequisite for the orderly-functioning of an airport is that each of its many subsystems (road network, parking facilities, enplaning and deplaning curbs, ticketing areas, circulation areas, concourses, security areas, hold rooms and gates, baggage makeup and claim areas, government inspections and customs areas, apron areas, taxiways, runways, air traffic control system) should balance with the rest. Congestion and delay in any of these subsystems affects the utilization of all subsystems farther along the chain. For example, increasing the gate capacity to handle more aircraft will strain the entire deplaning system. These "system" effects can only be properly investigated through computer models.

SUMMARY AND CONCLUSIONS

The paper presented a range of options for reducing airport congestion and delay. In summary, there are four ways to solve the problem of airport demand/capacity imbalance: build new airports, increase the intrinsic capacity of the existing system, control the demand, and maximize the utilization of existing capacity. All should be considered.

The first option may well be the only viable long-term solution if air traffic continues to grow at current or historical rates, while the other approaches represent short or medium term actions to mitigate the problem. The second option aims at direct augmentation of existing capacity through physical expansion of facilities within the confines of the existing airport complex. The third is the counter approach to solving the problem in that it places constraints on the demand itself to make it fit within the available capacity.

The last option deals with both the demand and supply simultaneously by attempting to maximize the use of existing capacity through adoption of more efficient operational pocedures and application of technology. In this regard, computer-assisted operations and capacity management procedures (automation) hold a considerable potential for solving the problem in the short term, and can be implemented with existing technology.

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CONGESTION AT INTERCONNECTED AIRPORTS

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In a series of earlier papers, the authors have maintained that increasing airport congestion is an inevitable outcome of air transport deregulation. They have also argued that peak load pricing, preferably implemented through a periodic auction of the available capacity, represents the long term solution to the problem. The present paper is an examination of the impact of congestion on a hub and spoke network of interconnected airports, and of the slot auction prices implicit in the system.

The model consists of a number of hub airports serving both outlying uncongested destinations, and each other. Traffic may be constrained by the capacity of the airport at one or both ends of a link. This model reflects the peaked pattern of passenger demand using several competing carriers and a number of different aircraft sizes.

In Section 1 the problem is described and in the following section the model is derived. Emphasis is placed on the heterogeneous nature of passenger demand and the interconnections within the network. The third section consists of an initial solution algorithm which provides a good estimate of the shadow price of airport capacity at each hub.

A second solution method is presented in Section 4 using the initial solution as a starting point. An integer solution is derived from a simulated auction procedure although its validity is not limited to actual auction situations. In Section 5 the implications of the solution for auction prices at each hub are considered. It is noted that slot prices depend on whether slots are auctioned individually or in blocks or "lots" and an approach to the problem of optimal lot size at each hub is indicated. The solution also permits a clear distinction between the policy of auctioning, or otherwise assigning, the right to a particular route, and the auctioning of the runway slots at each end.

In Section 6 a data set is introduced and the results of applying it to the model are described in Section 7. Section 8 provides some concluding observations and suggestions for further research. In particular it is noted that the present model permits considerable experimentation within the system, particularly with regard to the impact of changing conditions at one airport on the rest of the system. Moreover it also allows the

investigator to manipulate landing fees (congestion tolls) at each hub to shift travellers from peak to off-peak periods.

1. The Problem: Passenger demand for air travel is uneven in the sense that it varies over the course of the day. Specifically, it is more intense during the breakfast period and in the late afternoon. This tends to make central airports congested at these times and relatively under utilised during the rest of the day. The effect is especially marked at hub locations [2].

Much of the morning and evening demand is from business travellers flying at short notice and prepared to pay a substantial premium to do so. By contrast, what may be termed recreational demand is much less sensitive to the times of arrival and departure. Such passengers will often plan well-ahead to obtain reduced fares. Thus there is a considerable incentive for air carriers to schedule increased flights during the morning and afternoon peak periods.

With the removal of regulated barriers to entry, the congestion problem is exacerbated as more firms seek to attract business travellers. Since the cost of airport capacity is not born directly by the carriers this creates strong pressure to expand airport facilities to accommodate more and more peak traffic.

Thus the supply of airline passenger service may be regarded as a peak loading problem with the special characteristic that some capital equipment is used jointly by competing firms. In particular carriers compete for the limited number of runway slots available. It was argued in an earlier paper [3] that the appropriate solution to this problem is a system of peak period pricing implemented by periodic auctions of available capacity.

Elsewhere [4] the authors have focussed on the peak loading problem by considering a number of links into one central airport. In the present paper the system is extended to a small network of interlocking hub airports, each serving its own spokes as well as connecting to the other hubs. As before [4] the system embraces several firms operating aircraft of different sizes. Moreover each link or route serves two markets. The business segment is characterised as smaller numerically, but prepared to pay relatively high fares. Demand prices are significantly lower in the larger recreational market.

A working day is divided into four time periods. The early morning peak period is followed by a longer off-peak period through midday and the early afternoon. The second peak follows in the late afternoon and is succeeded by a short off-peak period in the evening. Congestion is created by a combination of departures and arrivals at a hub during a peak period.

It is assumed that business passengers prefer to

depart during the peak periods but that they will accept off-peak flights rather than cancel their trips. Thus, in the first instance, business demand is applied to the two peak intervals. The residual of unsatisfied business demand is added to the recreational demand in each market to constitute the demand in the longer off-peak period. For simplicity, the evening period is limited to arrivals only.

Each carrier faces a number of routes and two demand components for travel on each of these links. Well-established techniques, such as advanced booking, exist to enable firms to discriminate within each pair of markets. Thus there are four ticket prices for each route, corresponding to the business fares in the morning and evening peaks and the business and recreational fares for off-peak departures. Morning and afternoon peak fares may differ due to the varying impact of congestion at the destination airport.

This is a greater degree of discrimination than is generally practised. However optimal discrimination may be anticipated as competition increases, particularly if an airport congestion toll is introduced. Alternatively, if peak traffic is limited by airport size, and off-peak is not, then the optimal differential between peak and off-peak fares is an indication of an individual passenger's valuation of increased airport capacity.

Hence a carrier maximises its profit over all markets on all routes subject to the behaviour of the other carriers, the size of the aircraft in use, and the capacity of the hub airports in the relevant periods.

2. The Model: (a) THE NETWORK: The model consists of three hub airports each having four spokes of different lengths. These airports interlock with each other as shown in Figure 1. Routes are arranged such that the three inter-hub distances are different from each other.

Travel time is of significance in this model since flights may contribute to congestion on arrival as well as on departure. The relationship between departure and arrival periods for each spoke length is shown in Figure 2.

(b) COST: The traffic pattern under consideration consists of nine airports connected by eighteen routes. A route is uni-directional in the sense that an outbound flight to a particular destination and an inbound flight from the same place are considered to be seperate routes. Service is provided by some or all of m carriers or firms. The cost to firm k of operating a single flight from airport i to airport j leaving in period t is given by:

$$\text{cost of flight by firm k on route i-j} = c_{ijk} + d_{ij}(f_{ijk} + h_{ijk}\, g_{ijkt}) \quad (1)$$

FIGURE 1: Small Network with Interlocking Hubs

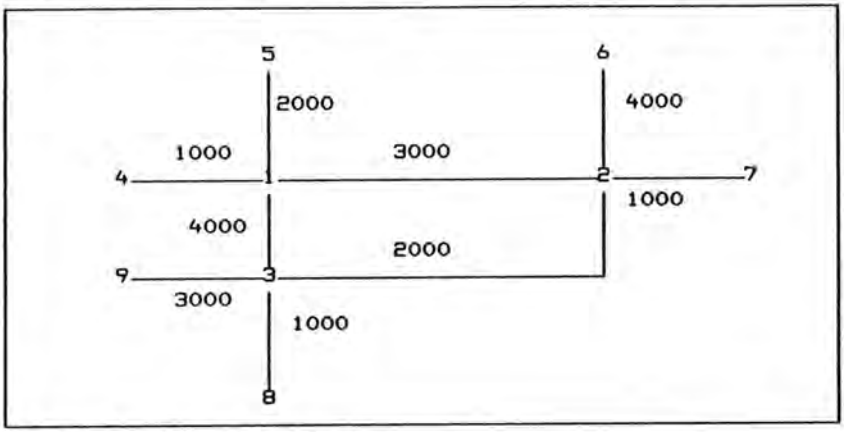


FIGURE 2: Trip Duration

Departing in Period #	Distance	Arriving in Period #
1	1000-3000 4000	2 3
2	1000 2000-3000 4000	2 3 4
3	1000-2000 >2000	4 not feasible

where d_{ij} is the length of route ij. Aircraft size is g_{ijkt} passengers and c, f and h are parameters of choice. Specifically, h is a cost per passenger per mile (or kilometre), f a cost per flight per mile, and c is a fixed cost per flight, including any fee for runway use.

There appears to be considerable support for the use of a function of d and g to represent cost. For example, in British Air Transport in the Seventies [6] it is noted that "size of aircraft and stage length are highly significant factors" influencing cost levels, whereas "stage density appears to be of minor importance in affecting unit cost" [9]. Moreover, as noted below, equation (1) provides a good fit to published cost data for several contemporary aircraft types.

(c) DEMAND: Each of the nine routes has two distinct markets, business and recreational, and two or three possible departure periods so that there are 92 basic passenger demand curves in principle. Adopting a linear form for analytic convenience:

demand from market s for seats on route i-j departing in period t: $q_{ijts} = a_{ijts} - b_{ijts} p_{ijts}$ (2)

where i,j = 1,...,9; t=1,2,3 and s=1,2 representing business (1) and recreation (2).

As noted above recreational demand is limited to the off-peak period t=2 and, in the first instance, business demand is applied to the peak periods only. Thus q is zero when s=2 and t=1 or 3 and when s=1 and t=2 which reduces the number of basic demand curves to 46. During the solution process, the unsatisfied business demand is added to a_{ijts}.

(d) CONTRIBUTION: Combining demand and cost, the net contribution of passengers of class s leaving in period t on route i-j to the profit of firm k is:

$$\pi_{ijkts} = p_{ijts} g_{ijkt} Q_{ijkts} - c_{ijk} Q_{ijkts} - d_{ij} (f_{ijk} + h_{ijk} g_{ijkt}) Q_{ijkts} \quad (3)$$

where g_{ijkt} may be interpreted either as the capacity of the aircraft or as the (average) loading factor for firm k on this route at this time of day. Q_{ijkts} is the number of flights (and portions of flights) allocated to class s passengers by firm k on route i-j at time t. The total number of class s passengers carried on flights on route i-j at time t is thus:

$$q_{ijts} = \Sigma_k g_{ijkt} Q_{ijkts} \quad (4)$$

Hence the fare for this market segment is given by equation (2) as:

$$p_{ijts} = (a_{ijts} - \Sigma_k g_{ijkt} Q_{ijkts})/b_{ijts} \quad (5)$$

Substituting equation (5) in the contribution function (3) and summing over all markets yields the total contribution for firm k, π_k.

(e) CONJECTURAL VARIATION: Each firm seeks to maximise its total contribution over all markets subject to the capacity of the airports in the relevant periods and the anticipated behaviour of the other firms. There seems to be little basis for expecting a significant amount of collusion between carriers using the same airport and, therefore, the model is solved under a 'Cournot assumption'. Specifically, each firm maximises its own contribution on the assumption that its rivals' schedules remain unchanged. Thus the Lagrangian function for the k^{th} firm's profit maximisation problem is:

$$V_k = \pi_k + \Sigma_{it} \tau_{it} (N_{it} - \Sigma_{jks} Q_{ijkts}) + \Sigma_{jT} \tau_{jT} (N_{jT} - \Sigma_{iks} Q_{ijkts}) \quad (6)$$

where T is the time period in which Q_{ijkts} arrives and N_{it} is the runway slot capacity of airport i at time t. τ_{it} is the shadow price of an extra runway slot at this airport during this period. The maximisation of V_k is carried out under the assumption that Q_{ijkts} is constant for all z not equal to k.

(f) AIRPORT CAPACITY: To focus on the interaction of airport capacity at the hubs, and for analytic tractability, the non-hub airports were assumed to be uncongested in all periods. Capacity limitations at the hubs were taken to be effective only in the two peak periods. Thus τ_{it} is non-zero only for i=1,2,3 and t=1 or 3.

3. Initial Solution: Under the assumptions in Section 2 the Kuhn-Tucker conditions for a solution may be shown to be:

$$V_{ijkts} = a_{ijts}\, g_{ijkt}\, b_{ijts}^{-1} - c_{ijk} - d_{ij}\, f_{ijk} - d_{ij}\, h_{ijk}\, g_{jkt} - g_{ijkt}\, b_{kj}^{-1} \Sigma_k\, g_{ijkt} Q_{ijkts} - g_{ijkt}^2\, b_{ijts}^{-1}\, Q_{ijkts} - \tau_{it} - \tau_{jT} \leq 0; \quad (7)$$

$$Q_{ijkts}\, V_{ijkts} = 0$$

$$L_{it} = N_{it} - \Sigma_{jks}\, Q_{ijkts} \geq 0 \; ; \quad \tau_{it}\, L_{it} = 0 \quad (8)$$

All Q and τ are, of course, non-negative.

Since the capacity constraints are assumed to be tight in the peak periods, $\tau > 0$ in conditions (8). However, in the remainder of the day some airport capacity is unused and $\tau = 0$ in (7) and (8). A priori it is less clear which Q will be zero, if any. Hence an iterative technique is required.

The algorithm used to solve conditions (7) and (8) is illustrated in Figure 3. Initially the system is solved assuming that all flight volumes are positive, and that the capacity constraints are slack. If the total number of flights exceeds the space available a solution is recomputed using a positive τ and L = 0.

Next each flight volume is checked to ensure that it is non-negative. Any negative values are constrained to be zero and the system is re-calculated. Optimality is confirmed by checking the values of the V in conditions (8).

Once an optimal solution is obtained the residual business demand is applied to the off-peak period and the system is resolved. However, changing off-peak departures has an impact on the use of peak capacity since some of these flights arrive at hubs during a peak period. Therefore the residual business demand will change and hence the solution must be recalculated. This process is

repeated until it converges and recalculation produces no change in demand. (Figure 4).

Thus what is termed the initial solution provides a set of flights by each carrier on each route for each of the two markets which maximises the contribution of each firm and is within the capacity of the airports. A positive shadow price τ_{it} indicates the value of an extra runway slot at hub i in time period t in the sense that it is the maximum extra contribution which would be earned by a carrier operating one more flight. Equivalently it is the maximum amount which a firm would be prepared to pay for one more runway slot.

4. The Auction Method: In general the initial solution will not assign whole numbers of flights to each route and to each carrier. This is to be expected since the solution is derived directly from a set of differential equations and conditions, (7) and (8).

FIGURE 3: Continuous Initial Solution

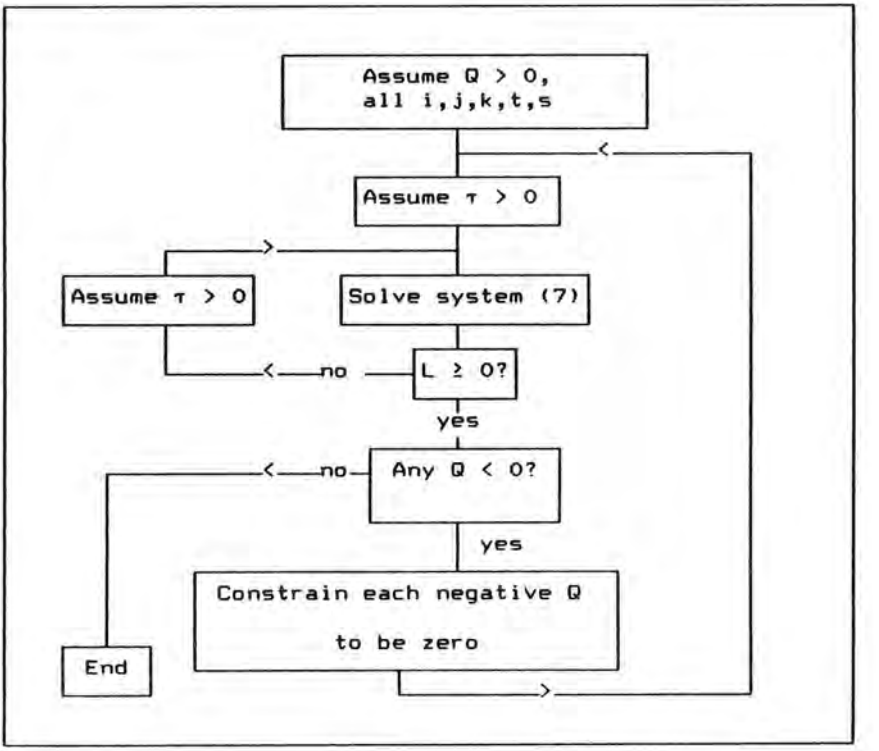
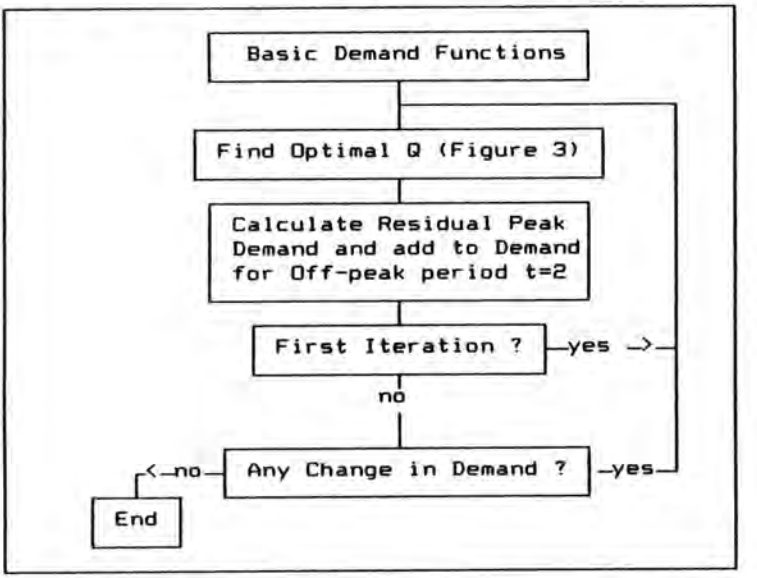


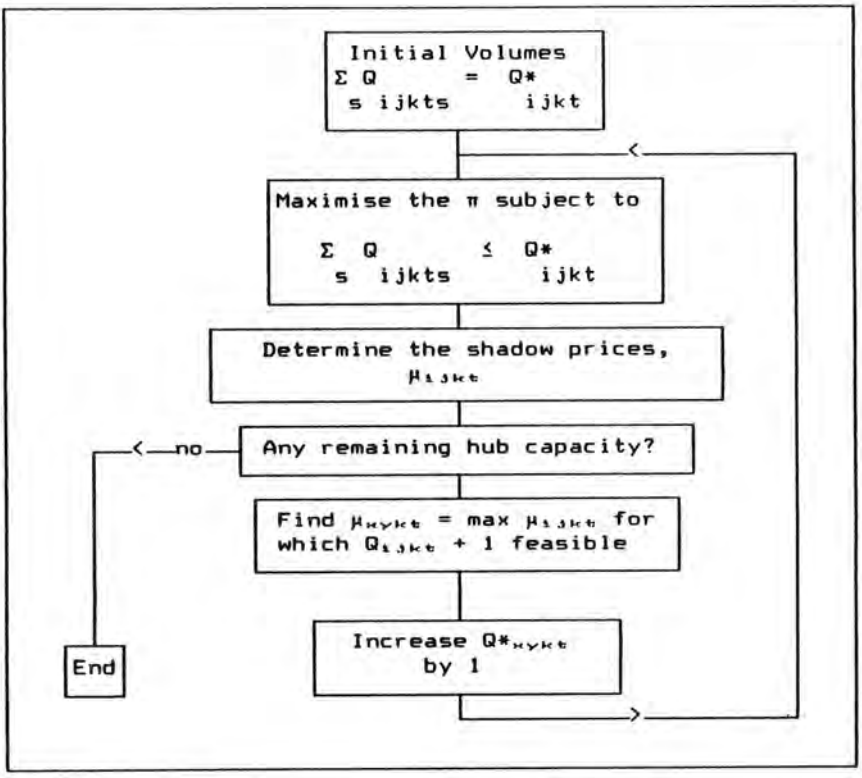
FIGURE 4: Residual Demand



Fractional flights are not only difficult to envisage in practice, they also make the model respond inappropriately to different sizes of aircraft (g_{ijkt}). If a fully loaded Boeing 747 is cheaper to operate per passenger mile than a smaller aircraft then the solution will indicate that carriers should accommodate lesser loads by flying "fractions of a 747". Thus the solution is likely to attribute a significant and disproportionate advantage to the operators of large aircraft. Therefore it is important to examine a method which will generate a set of optimum integer values for the Q.

To ensure a solution in terms of whole numbers of flights a new iterative scheme is required. Slots are distributed one at a time to the firm and route which can earn the most extra contribution from one more flight. In a sense the process may be regarded as an auction of each successive slot to the highest bidder, although no fee is necessarily collected. The procedure is illustrated in Figure 5.

FIGURE 5: Integer Solution



Let each firm currently operate a whole number of flights, Q^*_{ijkt} on each route i-j and within the capacities of the relevant airports, N_{it}, N_{jT}. Thus:

$$\Sigma_s Q_{ijkts} = Q^*_{ijkt}$$

$$\Sigma_{it} Q_{ijkts} \leq N_{it} \quad ; \quad \Sigma_{jT} Q_{ijkts} \leq N_{jT} \qquad (9)$$

We note that only the Q* need be integers since Q_{ijkt1} and Q_{ijkt2} represent the portions of the Q^*_{ijkt} flights which are drawn from the business and recreational markets respectively. Temporarily treating Q* as the maximum number of flights available, each of the equations in (9) becomes a "less-than or equal to" constraint. A new optimising solution will generate a set of route shadow prices, μ_{ijkts}, one for each firm in each time period on each of the routes. Each μ indicates the value to firm k

of being able to operate one more flight on route i-j leaving in period t.

The Kuhn-Tucker conditions for this problem do not permit a general analytic solution and so the μ must be found by using a numerical algorithm. If additional runway capacity is available then the next slot is "awarded" to the firm-route combination with the highest positive μ. If no capacity remains, or all shadow prices are zero, the solution is final.

The final values for the μ provide a second means of deriving the value of an extra unit of airport capacity at each hub. The hub shadow prices τ_{it} can be measured by the maximum shadow price μ for any route using hub i at period t.

It remains to provide a starting point for the solution routine in Figure 5. In principle the iteration procedure can start with all the Q* equal to zero. Every slot would be allocated individually. However, for a problem of any size, the computational time required is considerable. Each new μ solution requires a lengthy iterative procedure of its own which is repeated for each additional slot. A more computationally efficient approach is to use the initial continuous solution as a starting point. The non-integer volumes Q* are rounded down, freeing up a small number of slots which are allocated by means of the 'μ auction solution'. Starting from zero remains as an available method if the initial solution technique fails to converge.

5. Auction Prices: Using μ to measure the shadow price of an extra runway slot will produce a different answer from the τ-value obtained from a continuous solution. In practice the difference is not large, and the initial solution method provides a rapidly computed estimate of marginal slot value. However, the μ solution can yield additional useful information.

In a competitive bidding situation the final bid does not represent the maximum price which any carrier will pay, but the highest price which would be paid by an unsuccessful bidder. This result follows from the recognition that the successful firm will not bid against itself. It remains true for a variety of auction types including English, Dutch, sealed bid first price and sealed bid second price [8]. Since all the μ are calculated the price which would be paid at actual auction can be extracted automatically during the solution process.

Various different auction methods can be simulated by making small modifications to the algorithm. Thus, if the initial values of the Q* are set equal to zero, prices are generated which correspond to a slot-by-slot auction. If slots are auctioned in batches, then the solution method is readily modified to generate the corresponding prices and allocation.

6. Data: To examine the behaviour of the model data was selected to reflect, in a general way, a network system in the North American context. No identification with specific locations is intended at this stage.

(a) CARRIERS, ROUTES AND MARKETS: Computation focussed on four firms operating on some or all of the eighteen routes already described. Each of the routes differed in length from a medium haul 1000 miles, increasing in increments of 1000 miles to a substantial, possibly intercontinental flight of 4000 miles.

As noted above, demand for service on each route came from two markets, a relatively high-priced business market and the larger lower-priced recreational demand. To avoid generating results from peculiarities of demand, a "white noise" approach was adopted to the two types of market. Thus basic demand for seats on route i-j was given by:

$$\text{business demand: } q_{ijt1} = 1600 - (1250/d_{ij})\, p_{ijt1} \qquad (10)$$

$$\text{recreational demand: } q_{ijt2} = 5000 - (20000/d_{ij})\, p_{ijt2}$$

where d_{ij} is the length of route i-j as before. In a sense demand price is simply 'scaled up' as d_{ij} increases.

(b) AIRCRAFT SIZE: Throughout the analysis g was assumed to represent both the capacity of an aircraft and the number of fare-paying passengers actually aboard. This is for convenience only, and altering the loading factor to a constant less than 100% would simply shift the profit functions downwards.

In general, each firm might be expected to operate a mixed fleet of aircraft using different sizes on different routes. Aircraft capacity might also be varied between peak and off-peak services. Within the limits of the network examined, the present model offers some scope for investigating optimal fleet decisions.

However a distinction has yet to be drawn between each firm. To avoid too many interacting effects each carrier was identified with a particular size of aircraft. Firms were deemed to have a sufficient number of aircraft of the designated capacity to operate as many flights as they wished. Fleet size does not appear as a constraint.

For investigatory purposes four sizes of aircraft broadly appropriate to the route distances were selected. Thus the four firms operate fleets of 50, 100, 150 and 200 passenger aircraft.

(c) COST: The linear cost function (1) permits considerable flexibility in terms of cost variation between routes and firms. However, for the present analysis, the following simplified version was used:

$$\text{cost of flight by firm k on route i-j} = c + d_{ij}(f + hg_k) \qquad (11)$$

To obtain 'reasonable' values for f and h two steps were involved. Canadian Transport Commission data [5] provided operating costs per mile for eleven medium and large aircraft types. Representative passenger capacities for each of these types were obtained from Aviation Week and Space Technology [1]. Linear regression provided values for f and h as follows:

$$\text{cost of flight by firm k on route i-j} = d_{ij}(2.2031 + 0.0247g_k) \qquad (12)$$

Support for this straight line form is good with an R^2 of 0.97. However costs for small aircraft may be understated since none were included in the original estimation.

Parameter c was set equal to zero in the basic cost equation in (12) and remained available to introduce a landing/take-off fee as required.

7. Computational Results: A standard of comparison was set by assigning a capacity limit of 20 slots to each hub in the morning and afternoon peak periods (t=1 and t=3) and an unlimited number to the remaining off-peak periods. This limit was chosen with regard to the small number of spoke routes radiating from each hub. In effect it is intended to represent a "scale model" of a system with a larger number of spokes and commensurately higher hub capacities. With the data described in the previous section, the model generated plausible fares for both market segments.

The main focus of the experimentation was on the shadow prices of the runway slots at the three hubs. Three specific parametric changes were considered, passenger demand, hub size, and auction lot size. The results may be summarised as follows:

(a) DEMAND: The impact of demand shifts on slot price is illustrated in Figure 6 where the horizontal scale represents the proportion of the standard demand. The shadow price of an extra slot at hub 1 is shown on the vertical axis. As might be expected, recreational demand has least impact on the value of a runway slot. Typically, elasticity is about 0.4. Business demand has a significantly greater impact as shown, with an elasticity of approximately 1.1. Lastly the effect of a equi-proportionate shift in both demands gives a combined result with an elasticity of the order of 1.5.

(b) HUB CAPACITY: Figure 7 shows the effect of varying the peak capacity of hub 1 in both peak periods. As the capacity shrinks relative to the other two hubs, the shadow price of capacity at hub 1 rises rapidly. However it is interesting to note that this has very little impact on the shadow prices at the other two hubs except when all

FIGURE 6

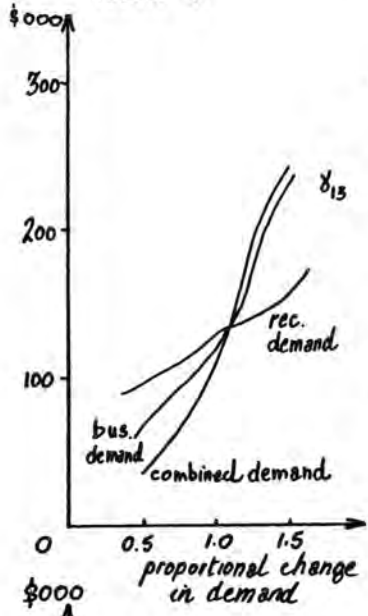


FIGURE 8

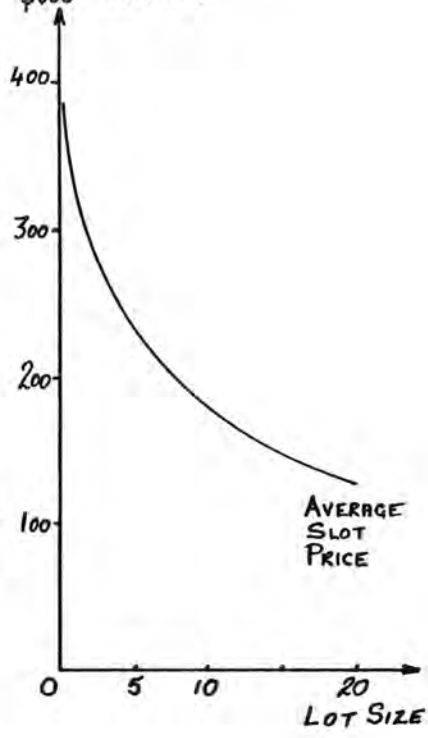
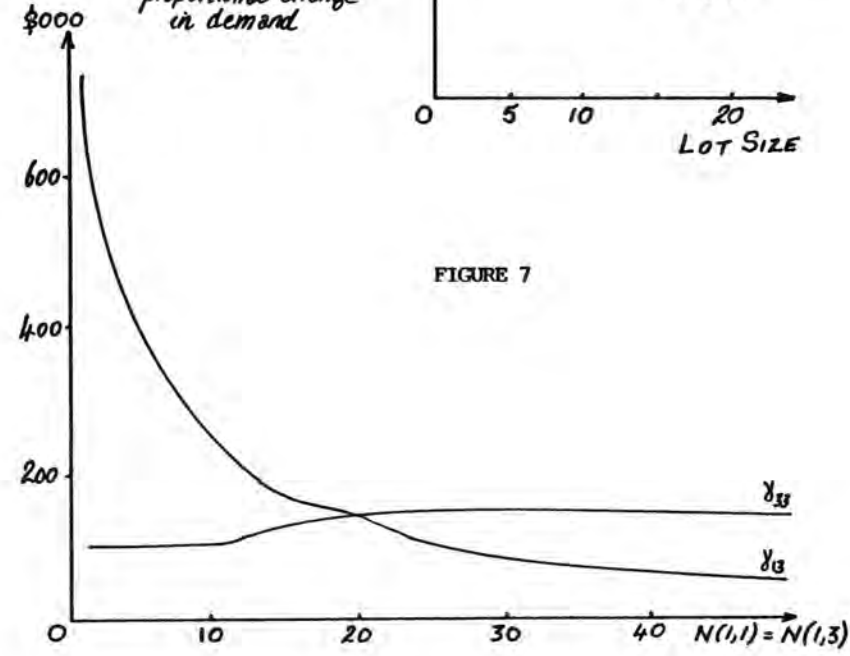


FIGURE 7



three hubs are of comparable size. Otherwise in a network of this size there is very little scope to adapt to a very small capacity or exploit a much larger one if it only occurs at one node.

If all three hubs have the same capacity then the interlocking flight from peak to peak between hub 1 and hub 3 causes capacity to be more highly valued at these two airports than at hub 2.

Although the capacity of each hub is the same in both peak periods, the shadow price of a slot will be higher for the afternoon period. This arises from the extra slot demand created by arriving flights in period 3. Thus τ_{i3} provides the measure of the shadow price of extra capacity at airport i.

(c) AUCTION LOT SIZE: The number of slots auctioned in a lot has a significant impact on the revenue derived from such an auction. Figure 8 illustrates the average revenue per slot when the 20 runway slots at hub 1 are auctioned in different lot sizes. Maximum "carrier surplus" is extracted by the airport when each slot is sold seperately to the highest bidder, that is lot size is 1.

However the cost of conducting an auction is likely to be a decreasing function of the lot size for both the bidders and the seller. Therefore the optimum lot size will be determined by the trade off between the average revenue curve in Figure 8 and the administrative and other costs associated with a small lot size.

8. Conclusion: The model presented in this paper is a development of that suggested by the authors in [4]. However in this case the analysis has been extended to a small network of interlocking hub airports. A solution algorithm has been derived which enables the system to be solved using specific parameter values. Some simplifications have been made in the cause of tractability, most notably in using linear demand and cost curves. Nevertheless the answers derived from plausible data suggest that the representation may not be entirely unreasonable.

Much could be done in terms of experimentation with the model as it stands. In particular the impact of different patterns of demand and different aircraft fleet structures are of obvious interest. Keeler [7] has also suggested that "interfirm cost variations are important enough that we gain by taking explicit account of them". This could be accommodated readily using the general cost function (1) rather than the simplified version used for the present results.

The form of the solution method also permits the derivation of auction prices and slot allocation within a variety of arrangements. Since the auction of individual slots is likely to be expensive and cumbersome, experimentation can be carried out to determine the

appropriate trade-off between lot size and administrative cost.

A complementary line of development is to use the model to examine the hubbing effects in more detail. In this paper demand was specific to each link. It would be interesting to incorporate a more sophisticated pattern of multi-stage demand in which inter-hub traffic is derived in part from the need to travel on spokes of different hubs.

The derivation and examination of shadow prices for slots at different hubs also lends itself to an analysis of a longer run optimisation problem in which the hub capacities themselves become the choice variables.

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The Microwave Landing System: a new approach to enhancing regularity and profitability in commuter airline operations

With the growth of the commuter airline industry, more and more carriers are looking at expansion of operations to locations which have not previously enjoyed regular airline service. Often, these communities have only small airports with, at best, a single radio beacon or similar non-precision approach facility with fairly high weather minima, i.e. low cloud or poor visiblity will prevent operations. Most commuter airline planners can cite a number of airports which they could serve quite profitably - if only they could obtain reliable access in bad weather. The potential traffic volume is there, but the likelihood of maintaining schedule is questionable. This in turn impacts on passenger confidence in the airline, or, perhaps equally important, in making connections with a major carrier at the regional hub airport.

In "feeding" a major carrier, the commuter operator is often caught in a Catch-22 situation. His big airline client operates large, new aircraft into airports equipped with the best navigation and landing aids, which assist in maintaining good schedule performance. To attract passengers connecting to and from the major carrier, the commuter operator will have made a substantial investment in new, short range aircraft, but he can never be certain of achieving the same level of schedule adherence at the smaller, and much less well-equipped, community airports in his local network. But diversions or delays in operating these new aircraft can incur high cost penalties, plus the dissatisfaction of his major airline client and the communities he is attempting to serve.

One of the major constraints to scheduled operations into small airports has been the difficulty of providing poor weather landing aids, such as the present day instrument landing system (ILS). This system requires space for its large antenna structure at the end of the runway, extensive surface "landscaping" to ensure the correct beam shape for its critical glidepath transmitter, and reasonably flat terrain for several miles along the aircraft approach path to the runway threshold. However, within these limitations, ILS has served aviation well for more than forty years, and over fifteen hundred airports around the world are equipped with the system.

But the increasing demands of air transport to operate into smaller, more "difficult airports", coupled with the need to operate to much lower weather minima - requiring very costly upgrades to the current "Category I" ILS, and not technically feasible in many locations - has led world aviation authorities to a new technology system of much wider capabilities than the traditional ILS.

The International Civil Aviation Organization (ICAO) has selected the microwave landing system (MLS) as the future replacement for today's ILS. A world-wide transition plan has been agreed, and most nations are now developing changeover programs which will see MLS installed by the end of 1997 at all airports serving international traffic, and at most domestic airports.

Because of its microwave guidance beams, MLS is inherently more accurate than today's ILS. As well, the small size of the MLS equipment, its ease of installation, and its insensitivity to siting and surrounding terrain means that a precision guidance capability is now available to airports where ILS is impractical because of real estate constraints or because of surrounding terrain.

The microwave system can also provide optimum precision approach paths for all classes of aviation, from steeply descending helicopters and STOL aircraft to the long, steady "straight-in" approaches of the large airline jets. As a result, MLS can now bring significant benefits to both the small airline and the local airport community.

One of the first demonstrations of these benefits was at Valdez, Alaska. In 1982, the City of Valdez installed an MLS to attract scheduled airline service to its mountain valley airport. The airport was already equipped with ILS but its approved 3,500 foot decision height (the height by which the pilot must be below cloud and in visual contact with the ground) offered little inducement to carriers in a part of the world noted for bad weather. Shortly after the installation of MLS, airline service began with deHavilland Dash-7's and, with an approved MLS decision height of 500 feet, high schedule reliability and profitability were achieved.

A similar situation arose more recently at Pemberton, in the Canadian Rocky Mountains. Located close to the major Whistler ski resort, the VFR, 4,000 foot runway at the Pemberton airport lies at 720' ASL on the floor of a curving mountain valley, whose peaks rise above 8,000 feet. Market analysis by Dash-7 operator Air BC, an Air Canada connector, indicated profitable traffic volumes could be generated by a scheduled service bringing winter sports enthusiasts from Vancouver, BC, and via interline U.S. carriers at Seattle Washington. Formerly, skiers were faced with a lengthy drive through the mountains to the ski resort, over roads which can sometimes be impassable due to heavy snow or rockfalls.

As ILS was completely impractical at Pemberton because of signal reflections and siting problems, MLS was investigated. The MLS configuration, which was adopted and is now installed, is unquestionably the most advanced application of MLS guidance in the world to date. (Figure 1)

The configuration employs co-located MLS Azimuth (lateral guidance) and Elevation (glideslope guidance) stations near the airport which bring the aircraft down a 7.7° glidepath along the valley to a descent decision height over a non-directional beacon (NDB) located two miles west of the field. A distance measuring equipment (DME) station at the Azimuth/Elevation site provides continuous distance-to-go information throughout the approach. Upon visual contact at decision height, the pilot carries out a curving final approach to the runway, oriented fifty degrees off the MLS centre line. If required, sufficient maneouvering area is available within the valley to allow the Dash-7 to perform a circling approach to the other end of the runway.

Should visual contact not be made at decision height, the pilot executes a missed approach procedure by climbing out along the centre line of a second MLS Azimuth transmitter located at the far end of the valley. This station transmits on the same frequency as the approach Azimuth and Elevation stations, but operates in the "Back Azimuth" mode. Thus, continuous guidance is available to the aircraft crew throughout the procedure without the need to select a different MLS frequency at a

high workload point. At six and one half miles DME, the pilot turns right and continues climbing to the departure NDB. IFR departure from Pemberton calls for a similar procedure, where the aircraft intercepts the missed approach MLS centre line after takeoff, and then follows the same departure route.

Extensive flight tests of the system have been conducted by Air BC and Transport Canada, and the procedures have proven to be extremely flyable, with very reliable guidance, no "bends" or other signal anomalies, and have received very favourable comments from pilots. Completion of technical and operational certification is expected later this year, in time for the 1988/1989 ski season. Initially, day Instrument Flight Rules (IFR) approval will be sought, with the eventual aim of year-round day and night IFR certification.

But mountains are not the only constraints to a precision approach installation. At some airports, particularly in coastal locations, there is sometimes simply no room beyond the runway to install a conventional ILS transmitter and building special support structures can be expensive. Here, the small size of the MLS units and their siting flexibility offer real advantages.

At a small airport in Eastern Canada, the "ideal" location for either an ILS or MLS installation turned out to be in a very large peat bog, with depths of 24 feet to the underlying bedrock. Local high power electricity transmission lines also added complications for an ILS installation.

MLS was selected, a small area of the bog was excavated to bedrock, and four simple concrete columns were erected to the surface. A frangible 15 foot tower was then built on the columns to bring the MLS Azimuth station up to runway level.

At the Toronto Island airport, a different problem arose, with an added, and somewhat unusual, consideration. Lying just off the Toronto city shoreline, the airport is Canada's third busiest, with up to 70 commuter airline movements per day - mainly de Havilland Twin Otters, Dash-7's and Dash 8's - and total annual movements, including private aircraft, of around 200,000 per year. The single main runway has an NDB non-precision approach, and in winter months airline diversions to Toronto/Pearson International are frequent, creating schedule interruptions and passenger dissatisfaction.

While both runways terminate close to the shoreline, it might have been possible to erect an ILS or MLS antenna in the water off the runway ends. This, however, is prevented by Canada's winter weather, where sub-zero air temperatures instantly freeze the spray produced by waves breaking in the ice-free patches of water around the shoreline. Ice buildups to thicknesses of as much as three feet on pilings and breakwaters have been reported.

As a result, Transport Canada plans to install MLS Azimuth transmitters offset to the sides of each runway threshold, with their approach centre lines intersecting the extended runway centre lines at the respective decision heights. This is an acceptable procedure with MLS for a precision approach, provided the intersection angle does not exceed three degrees i.e. a very minor alternation of aircraft heading on final. Both runways will have full MLS capability, with Azimuth and Elevation service on each approach, and a centrally located DME will be installed. A significant improvement in commuter airline schedule reliability - and profitability - is expected.

Micronav is discussing the application of MLS at "difficult" airports with a number of commuter airlines, and it seems likely that as the benefits offered by MLS become more widely known, increasing interest will be shown by the industry. The ability of MLS to provide precision approach service and improved landing limits at locations which were formerly VFR-only, or, at best, offered a non-precision approach, will have a major impact on commuter carrier operations. The potential access to new market areas brought about by MLS, coupled with improved schedule performance and the reduction of delays, suggests that the commuter airline industry could be a prime beneficiary of this new technology.

Speaker Background

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SHORT TERM SYSTEM PLANNING
A SPECIFIC EXAMPLE IN THE GRAIN INDUSTRY

by
Gordon Miles and Tami-Lee Reynolds

I. INTRODUCTION

Participants in the grain handling and transportation system have been involved in some form of forward planning for operational purposes since the grains and oilseeds industries developed. The need for forward planning is applicable to any industry, and like other industries, the grain transportation and handling system has encountered problems common to the planning process. However, problems unique to the industry have resulted in a specific role for the Grain Transportation Agency (GTA) in the planning process. The GTA acts as an independent co-ordinator dealing with players with varying and sometimes conflicting objectives.

This paper briefly presents the GTA's statutory role in forward planning, the general process, the results to date, the problems encountered, and possible resolutions for the problems.

II. LEGISLATED MANDATE OF THE GTA

The GTA was created with the passage of the Western Grain Transportation Act (WGTA) in November, 1983. The Agency superceded the Grain Transportation Authority which had been established in 1979. The WGTA contains provisions for the establishment of a GTA Administrator and sets out the powers of the Administrator.

Under Section 18 of the WGTA, the Agency has the following statutory responsibilities in the areas of forward planning and monitoring:

1. to establish grain transportation, shipping and handling performance objectives;[1]
2. to monitor the performance of system participants;

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[1] The GTA had been preparing tonnage targets and allocating railway grain cars prior to the WGTA.

3. to develop and administer notional awards and sanctions for system participants as deemed necessary; and
4. in performing the above functions, to consult with those parties as deemed appropriate.

In addition to its planning and monitoring functions, the GTA has specific authority for the allocation of railway grain cars on a weekly basis under the Canada Grain Act. The cars are allocated in conjunction with the Canadian Wheat Board (CWB), the Canadian Grain Commission (CGC), the railways and the private trade.

III. PROCEDURES

In order to fulfill the GTA's legislated planning and monitoring responsibilities, it was necessary to develop a consistent and effective process. This was done through consultations with a technical subcommittee of the Senior Grain Transportation Committee (SGTC). The SGTC has a responsibility under the WGTA to initiate or advise the Minister or Administrator on matters affecting grain transportation, shipping and handling. The Committee has representation from all levels of the grain industry including grain companies, the CWB, feed grain users, processors, (elected) grain producers, the railways, lake carriers, labour, special crops, the CGC and the GTA Administrator.

The three steps in the process are (1) target setting, (2) monitoring and (3) action with the intent of improving system performance. Target setting involves identifying the purpose of target, what is measured, how it is measured, the time frame, parties involved and any operating assumptions. Monitoring also requires identification of the purpose, measurement, and time frame, as well as identification of factors affecting performance. The actions taken as a result of monitoring performance include the implementation of operating changes, modification to procedures and either awards or penalties. The latter are in a notional form only at this time.

A. TARGET SETTING

1. Targets are developed by the GTA in consultation with the railways, the CWB and the private grain trade, and are published in the form of a "Three Month Plan".

2. Targets represent the rail movement to port position which is required to meet firm and anticipated sales, and inventory require-

ments. Actual and anticipated sales information is supplied by the CWB and private trade. Current stock information is provided by the GTA's Port Co-ordinators. All information is currently processed in the last week of every shipping month.

3. Targets are established for a three month period with a firm target in the first month and tentative projections (subject to change) for the following two months.

4. Monthly targets are based on complete shipping weeks (Monday to Sunday). A week is included in the target month if three or more week days fall within that month.

5. There is one overall system target which is gross tonnage unloaded of the six principal grains by port(s) i.e., Thunder Bay and West Coast.

6. The overall target is allocated between the two major railways (railway split) based on the location of CWB country grain stocks required for the CWB's sales needs, system capacity constraints and other factors such as country elevator space and quota requirements.

7. The tonnage target is converted into weekly rail car unload guidelines.

8. The weekly allocation of rail cars for country loading is determined bearing in mind the weekly rail car unload guidelines that have been established for each port in addition to operating conditions in the country, at the ports or encountered by the railways.

9. The GTA Co-ordinators at Thunder Bay and Vancouver provide the Agency and industry participants with daily and weekly information on unloads and port circumstances. This information is used in determining the weekly allocation.

B. PERFORMANCE MEASUREMENT

1. Data is sourced primarily from the CGC.

2. Final targets and actual performance are

summed for a quarter (three shipping months or 13 weeks).

3. An analysis of performance is carried out when the variance between the actual port performance and final cumulative target for a quarter is -5 per cent or greater.

4. The analysis is undertaken to identify why and where the system failed and to recommend ways to improve the system.

5. The analysis focuses on the major factors affecting performance.

6. System performance is analysed for all participants, if and where necessary. Participants are defined as producers, elevator companies, railways, government agencies and terminal companies.

7. The analysis is presented for comment first to the system participant(s) identified as responsible for a failure to meet a target, then it is circulated to the technical subcommittee for comment, and finally forwarded to the SGTC and the Minister of Transport.

C. ACTION

1. Incorporate changes in the planning and monitoring procedures.

2. Recommend study of operating problems or issues with the goal of implementing changes to improve system efficiency.

3. Apply notional awards and sanctions

   a) under current guidelines, notional penalties would be applied at an overall variance of -9 per cent or greater if a system participant(s) is found to be responsible for the shortfall;
   b) awards and sanctions for system participants are to be referred to a subcommittee of the SGTC;
   c) in respect to the railways, notional sanctions would be applied on a sliding scale; and,
   d) force majeure conditions are to be recognized, i.e., snow storms, strikes.

IV. MAJOR FINDINGS

Since the procedures were implemented in the second quarter of 1985/86, 27 monthly targets for seven quarters have been established. Performance at one or more ports has been below the established minimum percentage of target 11 times with nine reviews having been prepared. Performance was low enough to trigger notional awards in three cases; however, no actual sanctions (or awards) have been applied. Performance at a West Coast port(s) was the focus of seven reviews while Thunder Bay performance was examined in three reviews. Thunder Bay performance was not reviewed in two additional quarters because of exceptional circumstances, i.e. strikes.

Numerous factors have been identified in the course of the performance reviews as having affected performance at one or more of the ports. These factors are briefly summarized (in order from farm level to vessel loading) as follows:

1. availability of required country grain stocks;
2. heavy movement coinciding with limited railcar surge capacity;
3. sudden surges in sales;
4. operational factors such as line and bridge closures, computer problems, and blizzards;
5. congestion at terminals due to high stock levels, number of grades and condition of grain, and(or) level of screenings and by-products;
6. difference in timing between planned and realized terminal audits;
7. terminal mechanical problems;
8. union-imposed bans on overtime, strikes and work stoppages;
9. decisions by terminal managers based on operational and labour considerations to limit unloads to Monday to Friday; and
10. differences between anticipated and actual shipping requirements (loadings to vessel).

V. PROBLEMS/ISSUES SPECIFIC TO THE CURRENT PROCEDURE

One of the problems in the planning process relates to the purpose of the Three Month Plan. Questions have been raised as to whether the primary purpose of the tonnage targets is that of an indicator of movement required to meet sales, versus that of a guide for operational planning. Although there are advantages and disadvantages associated with either approach, the continued use of the tonnage targets as an indicator of required movement to the ports is recommended because it addresses sales requirements, indicates the level that the

system should be looking to achieve, and notes longer-term issues such as adequate surge capacity.

If the purpose of the Three Month Plan is to signal tonnage requirements in the near term then the timing of the Plan is crucial. Currently the nearby target is set after two weeks of the car allocation program has been implemented. Therefore the signal is only relevant for car allocations for the last two to three weeks of the nearby month. Participants are currently reviewing the process for the Three Month Plan to see if the timing of the Plan and car allocations can correspond.

A second timing consideration is the time required to react to surges in demand. The projections for movement in the following two months are tentative because sales projections are less certain two or three months in advance. The railways and terminals would like reliable projections to be set in advance to facilitate resource planning. For example, the railways indicate that five to six weeks notice is required if they are to acquire additional rail car and locomotive equipment, and place crews. In recognition of resource planning requirements, major changes to the projections are communicated to participants as soon as information is available.

Problems also arise when targets are not consistent with operational realities. Specifically:

1. a loss of confidence in the published targets by industry participants not directly involved in the planning process;
2. conflicting signals between the Three Month Plan targets and car allocations; and
3. triggering of a performance review even before the quarter is complete.

These problems could be minimized by having a warning system when sales demand does not correspond to operating circumstances. For example, the previous best performance for four consecutive weeks could be used as a guide for maximum system capacity.

An additional concern to the planning and monitoring process is that parties external to the current Three Month Plan negotiations can affect actual system performance. To address this fact, the Three Month Plan meeting should be expanded to include representation by key participants, i.e., country elevator and terminal associations (pending). This would further communication among participants, improve resource planning and allow direct comments on issues raised by other participants.

The combination of a warning system and expanding the number of direct participants could lead to the use of the Three Month Plan as a co-ordinating mechanism to identify actions required to meet a target. Participants would have to have the authority to commit their respective organization to undertake actions such as directional loading, weekend unloading or acquiring more cars. This co-ordination currently occurs at separate meetings held at the ports, at the Three Month Plan meetings and at the weekly car allocation meetings.

VI. OPERATING ISSUES ARISING FROM THE REVIEW PROCESS

Operating practises which might affect performance include weekend loading and unloading, directional loading, tentative block shipping plans, options for maximizing West Coast throughput, and changes in procedure for handling non-pooled grains to unlicensed terminals. These practices are currently being reviewed by a subcommittee of the SGTC. One other operating practice, car arrival and unload patterns at terminals, is being examined by the GTA in conjunction with system participants.

The review process has noted a problem of adequate surge car supply to meet fluctuating demand. The GTA, in co-operation with system participants, is in the process of analysing system capacity relative to current and future requirements to the year 1992. This particular issue is extremely complex as the capacity of the grain handling and transportation system is affected by decisions from the producer to vessel owner. This means that the efficient use of rail equipment can be affected by terminal elevator operating decisions, and vice versa.

A second issue relating to rail capacity is the question of how capacity improvements are to be achieved as well as who pays for the added capacity.[2] For example, a two day system-wide reduction in cycle times could increase optimum system capacity by 3.6 million tonnes per year. In comparison, the addition of 1,000 hopper cars would add approximately 1.1 million tonnes of annual rail capacity. The ownership costs of approximately 35 cents per tonne which are associated with these additional cars would ultimately be borne by the producer.

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[2] For more information, see Issues Relating to System Capacity, GTA draft discussion paper, January 18, 1988.

VII. SUMMARY

The involvement of the GTA in system forward planning began with its creation in 1979 and was expanded under the legislated authority of the WGTA. In conjunction with a subcommittee of the SGTC, the Agency has developed and applied procedures for establishing performance targets, monitoring performance and instituting actions as a result of monitoring performance.

The purpose and timing of the Three Month Plan and the roles of the participants involved in the process, as well as the method of achieving targets, have been re-examined since the procedures were implemented. Although the purpose of the targets remain unchanged, advancement of the target setting process is being reviewed so that it will correspond with car allocations. The number of participants in the process will be expanded to include other key participants. Some consideration may be given to an early warning mechanism and consolidation of co-ordinating actions at the Three Month Plan meeting. These changes should improve both communication and resource planning for all participants.

The process has also focused attention on operating issues that are broader in scope than the process itself. A review of operating practises is being undertaken by the SGTC and a study examining surge capacity requirements is being prepared by the GTA with industry input. Both issues have signficant financial implications for system participants.

VIII. CONCLUSION

Grain exports provided $4.6 billion or 46 per cent of Canada's net balance of trade in 1986. Railway transportation costs of $30 per tonne on 35 million tonnes are a billion dollar factor. In addition, 145,000 permit book holders and tens of thousands of others hold jobs that are directly or indirectly related to western Canadian agriculture. Solid forward planning and communications plays a major role in minimizing costs and maximizing returns to producers, elevator companies and grain dealers, and the railroads, with the benefits extending into other sectors besides agriculture. To quote an old adage: to fail to plan is to plan to fail.

A FRAMEWORK FOR MONITORING THE PERFORMANCE OF TRANSPORT SYSTEMS IN CANADA

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1. OBJECTIVES

The objectives of the paper are:

(i) to define and operationalize the concept of performance in a general framework that applies to a transportation system or subsystem, taking into account the viewpoints of all interest groups: operators, users, governments and society-at-large,

(ii) to discuss issues involved in the development of a Performance Monitoring System (PMS) that will provide a basis of assessing and interpreting changes in performance, and

(iii) to suggest as part of the monitoring system, methods for selecting the best set of indicators of performance that reflect the objectives of all interest groups.

2. INTRODUCTION

The services provided by the transportation sector are vital inputs into almost all other sectors of the economy as well as being important commodities of final consumption. Any changes in the performance of the transportation system is likely to have wide repercussions throughout the economy. An adequate, efficient and smoothly functioning transportation sector is therefore crucial for a healthy economy.

A Performance Monitoring System (PMS) is essentially a centralized information bank where performance data is coded, analyzed and distributed to interested parties. Such information can assist in better decision making by producers and consumers as

well as in the formulation of policy by the government. A PMS in place could anticipate inadequacies, bottlenecks and potential problems so that timely action may be taken before they become serious. It may also reveal causes of high performance in some areas that can be emulated by others to raise overall performance. Performance monitoring is particularly useful in the context of regulatory reform currently envisaged in the National Transportation Act of 1986. Only careful and systematic monitoring can provide us with the information necessary for an objective assessment of the benefits of the programme. An unbiased monitoring system could help foster cooperation among various groups and ensure that the reform will yield the maximum possible benefits.[2]

3. PREMISES OF THE STUDY

The development of PMS in this paper is based on the following basic premises:

(a) the performance of a system can be defined only in relation to the objectives of the system,

(b) since the ultimate goal of the system is to raise welfare in society, the analysis of performance should be conducted in the social welfare framework,

(c) transportation is a "system" with complex interrelationships and performance evaluation should reflect this fact, and

(d) any evaluation of the system should take account of the viewpoints of all the major "actors" in the system, namely, producers, consumers, government and society-at-large - as well as the multiplicity of objectives and indicators.

4. PERFORMANCE MONITORING[3]

Performance monitoring consists of periodically calculating a set of indicators of performance of the system - and possibly some "causal" indicators based on a heuristic specification of relationships - and the comparison of system performance with its own past performance or with other control groups. The results of a PMS may be used not only for evaluating the effectiveness of the system, but also as a guide to government policy formation and private decision-making.

5. METHODOLOGY OF PMS

A performance monitoring system may be viewed as a set of inter-related activities with feedbacks among them as illustrated in Diagram 1.

We can recognize five major steps in the development and implementation of a PMS:

1. Definition of Performance
2. Selection of Indicators
3. Collection and Organization of data
4. Analysis of performance
5. Action

We shall take these up in turn.

5.1 Definition of performance

The concept of performance has been used with different meaning in different disciplines and different contexts. Economists have generally viewed performance as efficiency in the allocation of resources and production of commodities.[4] In the context of project evaluation, performance is measured by the present value of net social benefits.

In this study, we define performance as the degree to which the objectives with respect to the system of various groups or "actors" in the system are satisfied. The greater the degree with which the objectives of participants is satisfied, the better the system. We shall represent this degree of satisfaction by means of a social welfare function[5],

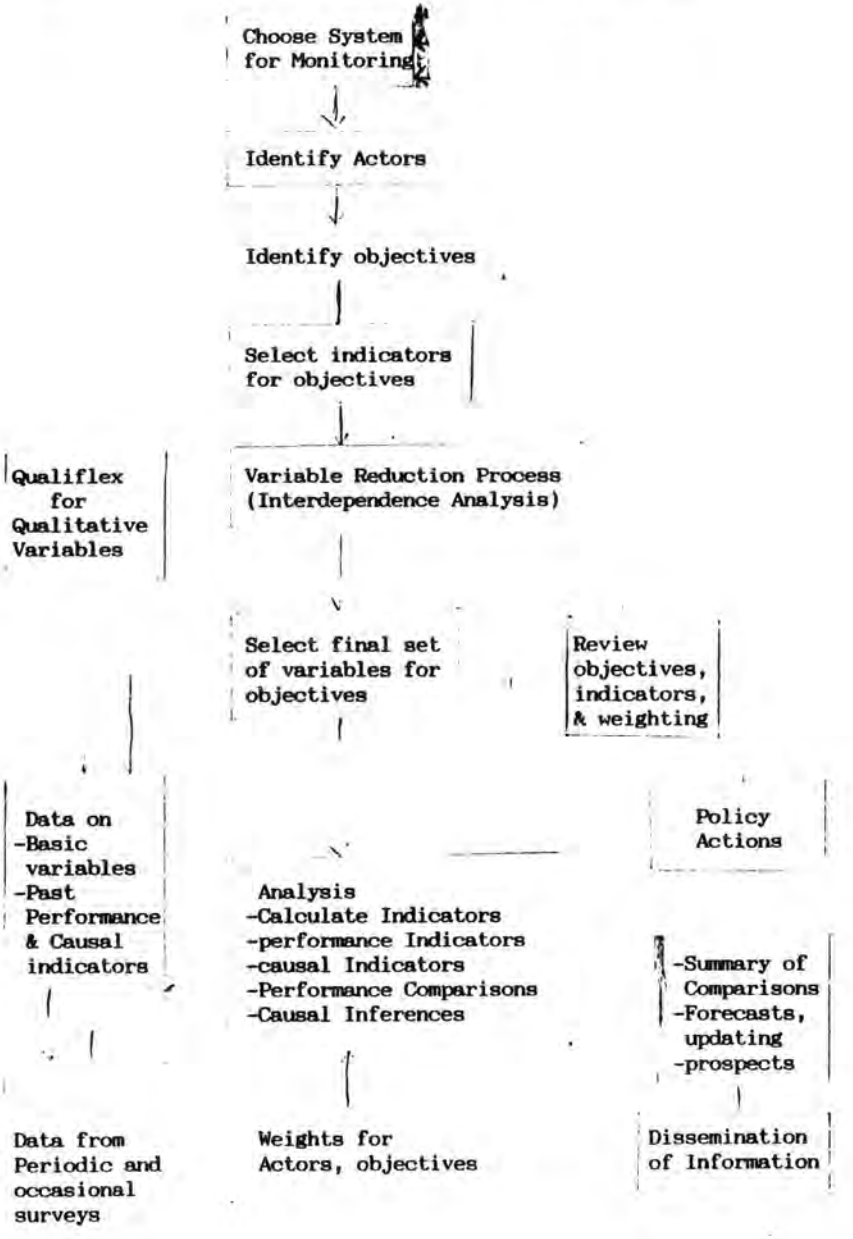
$$w = f(U_1, U_2, U_3, - - -, U_n, X)$$

where U_1, U_2, - -, U_n represent the utility or welfare levels of n individuals in society and X, the levles of collective utility that reflects costs and benefits beyond the utilities of individuals directly involved in transportation.

We recognize four major actors in the system[6].

(a) consumers, consisting of users of both passenger and freight transportation services,
(b) producers, consisting of all transportation firms that supply services,
(c) society-at-large, which includes everyone in society in their role as non-users who are indirectly affected by the transportation sector, and
(d) government, consisting of all levels of government.

DIAGRAM 1: PERFORMANCE MONITORING SYSTEM



We may then represent total welfare as determined by the welfare levels of these groups:

$$W = f(W_c, W_p, W_s, W_g) ,$$

where W_c, W_p, W_s, W_g represent the welfare levels of consumers, producers, society and government respectively. In turn, the welfare level of each group depends on the degree to which the group's objectives are satisfied. An improvement in the system occurs if there is an increase in total social welfare.

We have two options for assessing performance:

(i) We can specify indicators for objectives of each of the groups and monitor them individually, or
(ii) We can combine the indicators to provide us with overall measures of performance in terms of the level of social welfare.

In the former case, interpretation may become difficult if some indicators show improvement in welfare and others show decline. In the latter case we need Weights for objectives within a group as well as for groups, the weights indicating the relative importance of their contributions to total welfare. Therefore, to be able to assess the welfare effect of a change in the system we need to know:

(a) The objectives of various actors,
(b) changes in the values of the indicators of these objectives and,
(c) the form of the welfare function or at least the relative welfare weights for objectives and actors[7].

5.2 Subsystem, Actors, Objectives and Indicators Selection of sub(system)

For purposes of PMS, we should first select a (sub) system that has to be monitored. This means selection of the level of disaggregation desired, mode, region etc. We could choose the entire airline industry, urban transit in a given city or freight transportation of a given commodity in a given region. The choice depends on the purpose of monitoring and resources - physical and financial - that are available.

5.3 Identifying Ojectives

Once a (sub) system has been chosen, the next task is the identification of actors in the system and their objectives. We may need to consider more than the four major actors suggested in this paper. For example, labour that is included under "producers" may usefully be separated since their objectives are generally different and even in conflict.

Identifying objectives is not an easy task due to the complexity of the system, diversity of expectations from the system and the general lack of clear articulation by any of the groups. We may have to rely on indirect inference from past actions, statements and various documents. Alternatively, we could conduct periodic surveys of interest groups to ask them directly about objectives and their assessment of the system.

Whatever the method of identifying objectives, they should satisfy as far as possible, the important criterion of value independence which requires that for any two objectives, the marginal welfare of one does not depend on the level of the other. For example, for a shipper of freight, the value of imporved time-performance is independent of the level of safety. This property is not likely to be satisfied in practice, but another property, that of conditional monotonicity if satisfied, will make value independence more likely to hold. This property requires that more of any objective adds positive utility, irrespective of the levels of other objectives[8].

5.4 Selection of Indicators

Once the actors and their objectives have been identified, the next task is the selection of appropriate indicators to represent the objectives. This is not an easy task. It requires experience and judgement. We shall develop some criteria, however, that will assist in the selection. Periodic revision of the list of indicators is therefore desirable.

An important decision that needs to be made early is whether to include causal indicators in addition to performance indicators. A causal indicator is a variable that "causes" changes in performance indicators. Whether causal indicators should be monitored depends on the purpose of monitoring. When monitoring is used as a policy guide or when we wish to identify causes of changes in performance, we need to monitor both.

Indicators may be direct or indirect, subjective or objective. Direct indicators measure the objective

directly, whereas indirect indicators do not. For example profit rate is a direct measure of profitability, whereas sales is an indirect measure. Objective indicators have a quantitative measure naturally, whereas subjective indicators relate to expressions of perception, attitudes and opinions that are not easily quantified. Comfort and convenience of travel are examples. It is clearly desirable to have direct and objective indicators if at all possible.

5.5 Multiplicity of Indicators

While it is sometimes difficult to find suitable indicators for some objectives - especially qualitative ones - the more common problem is that of too many indicators. However, some of these indicators will be highly correlated with each other and some could be eliminated without significant loss of information. Our objective is then to obtain a small set of indicators that encompass the essential aspects of performance of the system.

5.6 Indicator Selection Criteria[9]

The first step in reducing the number of indicators is the imposition of criteria which ensure that the indicators possess desirable characteristics. Such criteria have been discussed in the literature on Social Indicators, particularly in the context of measuring the Quality of Life (QOL)[10]. In the context of monitoring transport systems, we suggest six major interrelated criteria: Measurability, Relevance, Representativeness, Cost-effectiveness, Interpretability, Timeliness. We describe the criteria briefly:

(i) Measurabilty

Measurabilty refers to the possibilty of obtaining a numerical value for the degree of objective achievement. The measure could be cardinal in which case a direct numerical measure is available, or ordinal, in which case the measure is subjective and only a scale or rank measure is available. For example, profit rate is a cardinal measure of profitability and a ranking on the scale of 1 to 5 for comfort of travel is an ordinal measure. It is sometimes possible to convert ordinal to cardinal measures by expressing the subjective variable (eg. comfort of travel) in terms of objective variables (eg. seat width, on-board service etc.)

(ii) Relevance

It is important to select both performance and causal indicators that are relevant for government policy and private decision-making. This choice is best made on the basis of a conceptual model of the system.

(iii) Representativeness

Representativeness or validity refers to the degree to which the indicator measures and reflects the given objective. The social indicator literature distinguishes four types of validity: face validity inferred by the way the indicator is designed and by its rationale; construct validity, inferred by the synchronization of its movement with those of related variables; predictive validity, measured by the ability of the indicator to anticipate system changes; and convergent validity, which refers to the extent to which the indicator moves with other indicators for the same objective.

We expect that an indicator that is representative will also be responsive to changes it is designed to measure. Also, the measurement error in the indicator should be as small as possible. A large error would reduce the degree of representativeness.

(iv) Cost-effectiveness

The cost involved in the collection, processing and analysis of data for the indicators should be as low as possible. This is facilitated when we have parsimony, that is, the objective is represented by as few indicators as possible. Cost of data may be reduced by devising indicators that utilize existing data as far as possible, minimizing the need for costly surveys and centralizing the data collection and processing activities. We should also try to choose indicators that are broader in scope, that is, indicators that are more versatile in terms of range of applicability as well as inter-group and inter-temporal comparability.

(v) Interpretability

The ease with which an indicator can be interpreted is an important consideration in monitoring. In view of the fact that the results

of monitoring will be used widely by diverse groups of people, simplicity of the meaning of the indicator and its presentation in non-technical language are necessary. It should be easy to interpret changes over time or differences among subsystems such as modes and regions.

(vi) Timeliness

Monitoring is basically of short to medium term relevance and as such timely availability of data on indicators is necessary. Unless information on any changes in performance or on causal variables are available with a short lag, the information is likely to run the risk of becoming irrelevant and obsolete.

The application of the criteria is not a straight-forward process. While there is correlation among the criteria, there are also likely to be conflicts among them. For example, using existing data to make an indicator cost-effective may make it less relevant or less representative, or choosing an indicator that is representative may make it less timely. It requires good judgement and experience to use the criteria for selecting appropriate indicators.

5.7 Variable Reduction

The application of indicator selection criteria will result in a set of indicators with desirable characteristics. If the number of indicators is of reasonable size, we could accept them as the final set of indicators. However, it is likely that we will still be left with "too many" indicators for some objectives. In this case, we could try to reduce the number further by using statistical methods. The strategy is to select a smaller set of indicators without sacrificing much of the information contained in the original set. For example, the efficiency objective may be represented by a number of indicators, say ten, such as partial input productivities, total productivity, various types of average costs, etc. We may decide to keep four variables. The question then is: how can we reduce the dimension from 10 to 4 with minimal loss of information?

A reduction is usually possible because of inter-correlations among the indicators. Two highly correlated variables may not contain much more information than either one alone. Choosing both is wasteful and may actually make inferences more difficult.

5.7.1 Methods of Variable Reduction

A number of methods are available in literature for this purpose. Among these, we choose Interdependence Analysis as the appropriate method for our purposes. We shall briefly mention two other methods first.

5.7.2 Dropping Variables (DV)

Dropping some variables on a judgemental basis is the obvious and perhaps the most commonly used method. Although when judgement is good this method may yield good indicators, the method is clearly arbitrary, and hard to evaluate.

5.7.3 Principal Component Analysis (PCA)

This method consists in choosing a smaller number of composite variables which are independent linear combinations of the original variables and account for a large proportion of variance among them.

Although the method is effective in reducing the dimension and in providing uncorrelated variables, the major problem with the method is in the interpretability of the new variables which are combinations of diverse variables. For example, for the efficiency objective, we may end up with a combination of physical productivity and financial variables. The meaning of such a combination is unclear and interpretations based on it subjective.

Factor Analysis is a variant of PCA and has the same problems.

5.7.4 Interdependence Analysis (IA)

An alternative to PCA that has been recently used has attractive features that makes it useful for our purpose. The method consists in selecting the "best" indicator set of a given size from a set of possible indicators, rather than form a composite as in the case of PCA. Consider the case where we have four indicators of which we have to select two "best" ones. Interdependence Analysis consists in choosing the two variables that have the maximum correspondence with the original data.

The appeal of this method is that it selects a set of indicators with maximum correspondence with the data without using artificial transformations. Also, the number of variables to be selected can be set by the user. Since indicators are used in their original form, interpretability is not jeopardised. Moreover, the computational burden of this method is low compared

to other methods. In view of these advantages, we suggest that Interdependence Analysis be used for variable reduction.

5.8 Overall Performance of the System

In the context of performance monitoring a natural question that arises is: Can we assess the performance of the system as a whole and determine whether the system has improved over the last period or whether the performance of one system is better than that of another?

This is a rather difficult question to answer, but we shall attempt to provide a partial answer in the framework we have developed.

As indicated above, we say that the system has improved if total social welfare has increased. Assuming value independence of objectives, the change in the welfare of an actor (eg. consumers) is the sum of the changes in the degree of achievement of objectives, weighted by the relative importance of objectives. These weights can be inferred from surveys or arbitrarily imposed by the analyst. The changes in objective achievement can be inferred from changes in the indicators. Together, they determine the changes in the welfares of actors.

The change in total welfare is the sum of changes in welfares of the groups, weighted by the relative importance of the groups. However, there is no single consistent set of weights since each group will generally attach different weights, with the maximum weight being given to own group. Unless we have an externally imposed concept of equity, there is no set of weights that would reflect the "social" point of view.

The view taken in this study is that we take the weights as parameters that can be set at arbitrary levels to enable the analyst and policy maker to understand the consequences of giving different weights to the viewpoints of different groups. For example, giving the weight of 1 to consumers and 0 to others would tell us whether the system has improved from the consumer point of view.

5.9 Application of the Qualiflex Method

As we indicated earlier, we may have indicators that are cardinal, ordinal or a combination of both. The Qualiflex method[10] is a multicriteria technique that allows us to make decisions on system performance change - improvement, deterioration or no change - when the indicators are of any type. The essence of the

method consists in converting ordinal to cardinal measures and then applying the welfare methodology of the last section.

6. COLLECTION AND ORGANIZATION OF DATA

The data component of the system consists of the collection and systematic organization of data on all basic variables considered relevant for measuring performance. For example, output and labour input are the basic variables that are used in calculating labour productivity, a measure of performance.

The data component is important since only good, reliable and accurate data can provide us with the ingredients for the calculation of performance measures that properly reflect what we are attempting to measure. On the other hand, even the best indicators of performance in a theoretical sense will not be of much use unless we have reliable data from which to calculate them.

There are often a whole range of data sources such as Statistics Canada, various departments in Transport Canada, other federal, provincial and local agencies, private agencies and associations, data from various surveys, data from consultants' reports etc. Many of these are often readily available but may not be consistent with each other since they are collected by different agencies for different purposes.

While additional data may sometimes be needed, the full use of existing data is necessary to make the PMS cost-effective and efficient. Often, there are large quantities of data collected by diverse agencies for different purposes. These are not always coordinated or even known to each other. It is therefore a useful exercise to make an inventory of all sources of data related to performance of the transport system, inspect them for use in the development of a PMS and place them under a central data bank from which the data can be retrieved as and when necessary. All data collection, organization and processing of data used in monitoring should be centralized.

7. ANALYSIS OF PERFORMANCE

Conceptually, this is the most important aspect of a PMS. It is at this stage that raw data is converted into information.

Performance measures and causal indicators are calculated at this stage and inferences drawn using statistical or econometric methods concerning changes in performance of the entire system as well as various subsystems of interest such as regions, modes, sectors

etc. For each of these, the change is assessed as an improvement or deterioration from the point of view of various actors.

Indicators are examined for any unexpected or unusual changes and their causes sought. Attempt is made to determine whether these changes anticipate possible future problems, for example shortages of capacity, cost increases etc.

Analysis of trends in various indicators should be done on an ongoing basis. Often, only minor adjustments to current estimates may be needed to update the analysis on the basis of new data.

7.1 Degree of Aggregation

Clearly, analysis may be done at various levels of horizontal and vertical aggregation. The highest level of aggregation is the total transport sector. At the second level we could distinguish modes and regions. At the third and higher levels of disaggregation, we could further divide these into region - mode combinations, passenger and freight classifications etc.

8. ACTION

Once the analysis is completed, actions to be taken by the monitoring agency include the following:

- disseminate relevant information to users, operators and the public.
- convey information to government decision makers for policy actions.
- revise objectives indicator set, actors and welfare weights

9. SUMMARY AND CONCLUSIONS

We have developed a general framework for the development and implementation of a Performance Monitoring System for Canadian transportation. As part of this, we have developed methods of selecting indicators and combining them to provide overall measures of performance taking account of the viewpoints of various actors in the system.

The recommended procedures for the PMS can be represented in the stylized fashion indicated below:

9.1 Summary of recommended procedure for PMS

1. Select a system for monitoring
2. Identify the actors in the system

3. Identify and select objectives of the actors
4. Select indicators for the objectives
5. Apply Indicator Selection Criteria and Interdependence Analysis to reduce the number of indicators
6. Calculate performance and causal indicators for the selected actors and objectives
7. Calculate overall performance measures using simulation and scenario exercises varying the weights for objectives and actors
8. Analyze the resulting measures of performance and causal indicators
9. Take policy actions if necessary and disseminate relevant information to the public.

FOOTNOTES

1. I wish to gratefully acknowledge the financial assistance provided by the Transport University Programme, Transport Canada, and the Centre for Transportation Studies, University of Manitoba.

2. Kruger (1986) suggests that it is the lack of such a monitoring system in the United States that has contributed to considerable confusion and controversy about the consequences of deregulation in that country.

3. The literature on Performance Monitoring is sparse. For an overview of PMS and a review of past work, see Wholey (1979), Waller et. al. (1976) and Poister (1983).

4. Dhruvarajan (1978) contains a discussion of productivity concepts with an application to the Canadian airline industry.

5. We assume that such a welfare function exists. See Winch (1971) for a discussion of the conditions under which this is true.

6. This division is made only for convenience. In any application, we may identify other groups or break them into smaller groups with similar intra-group objectives.

7. When we only have welfare weights, total welfare is taken as the weighted sum of objective achievement levels and groups. This is true if the contribution of an objective to welfare is

independent of the levels of others, which may be violated.

8. See Humphreys (1977) for a discussion of this issue.

9. Talley distinguishes two methodologies for selecting indicators, namely (a) specifying criteria that indicators should satisfy and (b) specifying operating objectives. He argues that method (b) is perferable. In our view, there need be no conflict between the two methodologies. We have argued that performance can be defined only relative to objectives and suggest that we select from among the indicators of these objectives on the basis of desirable criteria.

10. See for example, Carley (1981)

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LE REMANIEMENT DU SYSTEME STATISTIQUE ET LA RECHERCHE DU NOUVEAU MONDE DES TRANSPORTS

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RESUME

Les contraintes du système économique exercent une influence majeure sur l'organisation des services publics. Ainsi, sous l'effet des restrictions budgétaires gouvernementales et de la volonté de réduire le fardeau imposé à l'entreprise privée par les Gouvernements, nous assistons à l'émergence d'un nouveau monde des transports et à la réduction du système statistique. Ce nouveau monde des transports est marqué par une réorganisation de l'industrie consécutive à la réduction de la réglementation économique et des dépenses gouvernementales. Le système statistique tend, pour sa part, à limiter sa production aux données nécessaires à l'organisation du système de la comptabilité nationale.

Dans ce contexte, il importe de bien définir les besoins de données statistiques essentielles à la compréhension de la structure et de l'évolution du nouveau monde des transports et de trouver des solutions adéquates à leur financement. Les chercheurs en transport, préoccupés par la compréhension de ce nouveau monde, ont un rôle important à jouer dans la définition de ces besoins de données.

INTRODUCTION

Les restrictions budgétaires gouvernementales et la limitation du fardeau imposé à l'entreprise privée par les gouvernements impliquent une remise en cause des activités gouvernementales. Sous l'effet de ces forces, nous assistons à un remaniement du système statistique et à une restructuration de la réglementation et du financement des transports. Cette restructuration entraine l'émergence d'un nouveau monde des transports.

Le remaniement du système statistique, qui est lié à l'ensemble des données produites par Statistique Canada, ne tient pas suffisamment compte des besoins du transport. Aussi, ce texte abordera d'abord l'émergence du nouveau monde des transports et le remaniement du système statistique. Il considèrera par la suite son impact sur la recherche en transport. Il proposera finalement les éléments de

solution à apporter au système statistique des transports pour qu'il contribue davantage à la recherche de ce nouveau monde.

1. LE NOUVEAU MONDE DES TRANSPORTS

Le cadre opérationnel du transport au Canada est appelé à subir une mutation majeure, marquée par une libéralisation de la réglementation économique. C'est ce qu'indique l'énoncé des objectifs de la politique des transports que l'on retrouve à l'article 3 de la Loi nationale concernant les transports. Cette libéralisation signifie que la concurrence et les forces du marché doivent devenir les principaux facteurs en jeu dans la prestation des services de transport. Dans cette optique, les transporteurs doivent supporter leur juste part des coûts réels des installations et services publics mis à leur disposition. Les prix doivent être établis de telle sorte qu'ils n'entraînent pas un désavantage injuste entre les divers services rendus par un transporteur. Ils ne doivent devenir ni un obstacle abusif à la circulation des personnes et des marchandises, ni un empêchement excessif au développement des secteurs primaire ou secondaire et à l'exportation des marchandises. Cette libéralisation tend à restreindre la réglementation économique aux services et aux régions pour lesquels la quantité des transports ne permet pas une concurrence assez vive. Cette restriction s'applique notamment aux régions nordiques.

Par ailleurs, l'emphase est mise, au plan réglementaire, sur l'établissement des normes de sécurité les plus élevées pouvant s'appliquer en pratique tant au transport des personnes qu'au transport des marchandises. A ce titre, la réglementation doit faire en sorte que la concurrence plus vive recherchée par la libéralisation économique des transports n'entraîne pas pour autant un relâchement de la sécurité. Elle doit assurer que les passagers des transports publics puissent voyager sans risque indu d'accidents. De plus, au plan des marchandises, une attention particulière doit être portée à la sécurité du transport des marchandises dangereuses.

De même, en vue de favoriser le jeu de la concurrence et pour limiter les déboursés gouvernementaux, les subventions au transport seront normalement restreintes. Celles-ci ne s'appliqueraient plus qu'aux services reconnus d'intérêt public, ne pouvant fonctionner adéquatement sans cette assistance.

Ces nouvelles politiques ont déjà commencé à faire sentir leurs effets. Ainsi, dans le transport aérien, s'organise le regroupement des transporteurs régionaux autour des deux grands transporteurs nationaux. Ceci permet la mise en place de réseaux de transport intégrés offrant un service complémentaire à un coût raisonnable, couvrant à la fois les grands centres et les aéroports secondaires. Pour le transport ferroviaire des marchandises, une concurrence plus vive entre nos deux grands transporteurs est prévue par la loi. Celle-ci vise également à rendre ces entreprises plus concurrentielles vis-à-vis les transporteurs américains, en

permettant l'établissement de contrats confidentiels. Au plan du transport routier interurbain des personnes et des marchandises, la concurrence se fera également de plus en plus vive. Nous assistons déjà à un regroupement d'entreprises importantes et à un réajustement des services rendus par les plus petites entreprises. Pour le transport ferroviaire interurbain des personnes, les services rendus par Via Rail devront être de plus en plus efficaces et rentables. Ceci suppose le recours, en certain cas, à l'autobus pour mieux desservir la clientèle à un coût raisonnable. C'est la volonté du gouvernement du Canada de limiter la part des subventions qui y sont accordées.

Cette philosophie nouvelle se retrouve également au plan provincial. Elle s'applique tant aux entreprises pour lesquelles la juridiction est partagée avec le gouvernement du Canada, qu'aux autres services de transport. Ainsi, au Québec, le plan de transport urbain et suburbain de la région de Montréal tend à resituer l'ensemble des dépenses publiques de façon globale. Dans ce contexte, les subventions au transport en commun et les dépenses gouvernemenales de voirie doivent être analysées dans un même cadre de dépenses.

Ce nouveau cadre favorise non seulement la concurrence intramodale mais aussi la concurrence entre les modes de transport. Dans ce contexte, les services de messagerie qui utilisent les moyens de transport les plus efficaces en vue de la livraison rapide des marchandises, devraient connaitre une croissance remarquable. Comment le système statistique prendra-t-il en compte ces nouvelles entreprises et de façon plus générale le nouveau monde des transports? Réussira-t-il à le faire sans pour autant abandonner toute continuité dans ses séries de données?

2. LE REMANIEMENT DU SYSTEME STATISTIQUE

Des contraintes du même ordre que celles qui s'appliquent au système de transport existent également au plan du système statistique canadien. Elles tendent à limiter à l'essentiel l'intervention gouvernementale et notamment, celle de Statistique Canada, qui est l'agence centrale de la statistique.

2.1 Les restrictions budgétaires

Tout comme au plan des subventions en transport, la limitation de la capacité de payer des contribuables canadiens constitue un frein puissant à l'expansion du système de production statistique. Elle n'en garantit même pas le maintien à son niveau de service actuel. A titre d'exemple, lors du recensement de 1986, Statistique Canada a dû recourir à ses ressources internes pour absorber les dépenses spéciales occasionnées par ce recensement. Le gouvernement du Canada entend limiter de plus en plus ses dépenses réelles affectées à l'appareil statistique. Dans ces circonstances, seuls les secteurs, où les revenus provenant des clients du système le permettent, pourront-ils continuer à maintenir leur production. Le développement de nouvelles données ou même le maintien des données

existantes dans un secteur, grâce au financement externe, risque même de se faire au détriment d'autres secteurs.

2.2 La limitation du fardeau du répondant

Au fil des ans, le système statistique a donné place à une prolifération des enquêtes auprès des agents économiques et notamment des producteurs. Cette prolifération s'est effectuée de façon quelque peu anarchique, de sorte que les producteurs ont à répondre à de multiples questionnaires demandant des informations similaires selon des critères propres à chaque enquête. Parallèlement à cette prolifération d'enquête, nous avons assisté à une multiplication des informations demandées aux mêmes producteurs pour des fins administratives par les ministères et organismes publics. Cette demande de données à la fois redondantes et spécifiques devient un lourd fardeau pour ces répondants. Ceux-ci ont de plus en plus de difficulté à répondre adéquatement à ces cueillettes de données et se plaignent de plus en plus des coûts qu'elles leur imposent. Statistique Canada ne peut se permettre d'ignorer ce problème.

2.3 La réponse de Statistique Canada à ces contraintes

Pour répondre à ces contraintes, Statistique Canada entend centrer ses activités sur la production des données nécessaires au système de la comptabilité nationale. Tel qu'indiqué par monsieur Brian Nemes, directeur-adjoint de la Division des transport de Statistique Canada, dans sa présentation faite à la Conférence annuelle du Groupe de recherche sur les transports, tenue à Vancouver en mai 1986, ce système ne nécessite pas une information très détaillée sur chacun des agents économiques. Aussi, pour satisfaire à ce besoin, Statistique Canada prévoit limiter ses enquêtes complètes aux plus importants établissements. Il vise à couvrir par ces enquêtes environ 70 % des recettes brutes d'une division industrielle telle celle du transport au niveau national et 70 % des recettes brutes provinciales de l'ensemble des activités économiques. Pour évaluer l'activité des autres établissements de 250 000 $ et plus de recettes, Statistique Canada prévoit recourir aux données fiscales d'un échantillon de ces établissements. Il entend compléter cette information par un questionnaire adressé à un sous-ensemble de cet échantillon comportant des éléments de données d'enquêtes ne figurant pas sur les déclarations fiscales. Ceci signifie que, pour ce segment des établissements on risque fort de se retrouver avec deux ensembles de données qui ne soient pas parfaitement compatibles. De plus, les données fiscales individuelles ne pourront être disponibles aux usagers externes à Statistique Canada. C'est dire que les micro-données fournies à certaines provinces en vertu des ententes fédérales-provinciales seront touchées. C'est d'ailleurs ce qu'indique le compte rendu de la réunion du 26 mai 1987 du Comité fédéral-provincial de la statistique des transports. Ceci ne peut que réduire considérablement l'utilisation de ces données. Pour les établissements de moins 250 000 $ de recettes, les données obtenues ne présenteront qu'un intérêt limité en dehors des besoins de la

comptabilité nationale. Cette stratégie permet certes à Statistique Canada d'obtenir une information synthèse uniformisée qui répond adéquatement aux besoins de la comptabilité nationale, tant au plan provincial que national. De plus, elle limite ses propres dépenses et le fardeau des répondants.

2.4 Les enquêtes-entreprises et les besoins de données en transport des utilisateurs

Cette stratégie ne fait pas cependant l'affaire pour autant des organismes chargés de surveiller l'évolution de l'industrie des transports. Ainsi, pour les transports aérien et ferroviaire, l'information sera demandée aux transporteurs en fonction du cadre de la Loi nationale concernant les transports. Ceci permettra d'assurer un bon suivi annuel de ces industries, en conformité de ce qui est prévu aux articles 266 et 267 de la Loi. Dans ce contexte, même s'il y a volonté de réduire l'information sur les transporteurs, cette réduction s'effectuera en fonction des besoins de surveillance de ces modes et non pas d'abord en fonction du cadre de la comptabilité nationale. Il faut dire que pour ces modes, l'information est depuis longtemps demandée en vertu de lois de transport et non pas en vertu de la Loi sur la statistique.

Il n'en va pas nécessairement ainsi pour les autres secteurs de transport. En effet, il est de tradition pour Statistique Canada de demander aux transporteurs maritimes et routiers des informations statistiques dans le cadre de la Loi sur la statistique. Le projet de remaniement des enquêtes-entreprises devrait s'appliquer à ces établissements à partir de 1990. Sous sa forme actuelle, il constitue un net recul au plan de l'information demandée, surtout dans le cas du camionnage. L'information individuelle disponible aux organismes publics de transport sera encore plus mince. Le respect du caractère confidentiel des données fiscales la limite pour certaines provinces aux plus grands établissements. Ceci contraste avec la situation actuelle qui permet l'accès à une information individuelle pour l'ensemble des camionneurs pour compte d'autrui de 100 000 $ et plus; ce qui permet de suivre l'évolution des divers segments de l'industrie du camionnage. Il suffit en effet de regrouper les données individuelles en fonction des besoins spécifiques d'information. Cette information permet de plus à Statistique Canada d'établir son enquête sur l'origine et la destination des marchandises sur une base solide. Le cadre restreint d'information prévu, suite au remaniement des enquêtes-entreprises, ne fournira pas une base aussi solide à l'établissement de cette enquête. Parallèlement à l'enquête sur le camionnage pour compte d'autrui, Statistique Canada menait depuis quelques années une enquête sur les établissements de transport pour compte propre. Cette enquête ne semble pas cadrer très bien non plus dans le projet de remaniement.

2.5 Les autres projets de statistiques de transport en cours à Statistique Canada

Le système statistique des transports a évolué en fonction des besoins de transport des utilisateurs et tout particulièrement de ceux de Transport Canada qui finance plusieurs éléments de celui-ci. Ceci lui permet de continuer à se développer, même dans le contexte de remise en cause actuelle de la structure des enquêtes-entreprises. Trois nouveaux projets qui, dans le contexte actuel de libéralisation de l'industrie du transport et de plus forte concurrence entre les transporteurs et avec les transporteurs américains, présentent particulièrement de l'intérêt, sont actuellement en voie d'implantation par la Division des transports de Statistique Canada.

2.5.1 L'enquête sur le camionnage pour compte d'autrui - Projet international

La Division des transports de Statistique Canada est en voie d'implanter, pour l'année 1987, son projet d'enquête sur l'origine et la destination des marchandises transportées entre le Canada et les Etat-Unis par les transporteurs pour compte d'autrui canadiens qui tirent chaque année 100 000 $ ou plus des mouvements interurbains. Cet ajout à l'enquête origine et destination permettra de mieux connaitre ce que représente cette part du marché pour les transporteurs canadiens et son évolution. Les représentants de l'Association canadienne du camionnage sont d'accord avec cette enquête. Ils sont cependant préoccupés par la grande quantité de données qui sera publiée sur les transporteurs canadiens comparativement au peu de données disponibles sur les transporteurs américains.

2.5.2 L'enquête trimestrielle sur les entrepreneurs en transport routier

Cette enquête de la Division des transports de Statistique Canada, financée par l'Office national des transports et Transports Canada, va permettre de connaitre, trois à quatre mois après la période de référence, les principaux indicateurs de l'activité trimestrielle des transporteurs ayant des recettes de 250 000 $ et plus. Elle se fera à partir d'un échantillon de 400 établissements renouvelés de façon systématique. La première période qui doit être couverte par cette enquête est le premier trimestre de 1988.

2.5.3 Le système du transport maritime et du commerce

Ce projet est financé par Statistique Canada ainsi que par Transports Canada et d'autres ministères fédéraux de même que par l'industrie. Il va permettre de répondre aux besoins de statistiques plus exhaustives et actuelles sur le transport maritime international. Il va permettre en outre, en couplant les données du commerce extérieur aux données de transport et en les complétant

par d'autres documents administratifs, d'obtenir des précisions sur l'origine ou la destination des marchandises transbordées à un port. Il devrait commencer à être opérationnel en 1989.

2.6 Autres éléments du système canadien de statistiques de transport

La production du système canadien de statistiques de transport est très centralisée. Statistique Canada, tout comme pour l'ensemble des statistiques, en est nettement l'élément central. Il n'en existe pas moins des éléments de production extérieurs à Statistique Canada, tant au niveau du gouvernement du Canada que des gouvernements des provinces et territoires.

Ainsi, les statistiques sur la sécurité en transport se retrouvent, soit à Transport Canada, soit à l'Office national des transports, soit encore au Bureau canadien de la sécurité aérienne. Il existe également de telles statistiques au niveau de ministères ou organismes provinciaux ayant mandat de s'occuper de la sécurité routière.

Transport Canada et les autres ministères de transport possèdent de même des statistiques sur les opérations de transport qu'ils gèrent, au plan des infrastructures de transport qui relèvent de leur autorité. Les ministères possèdent également des données administratives sur les services qu'ils subventionnent, notamment les services de transport en commun.

3. LA RECHERCHE EN TRANSPORT

Le remaniement du système statistique canadien des transports a un impact sur la recherche. Ainsi, la mise en place de nouvelles enquêtes ou l'ajout de nouvelles informations aux enquêtes existantes permet de mieux cerner la réalité du transport. Par ailleurs, le remaniement des enquêtes-entreprises de Statistique Canada qui, au plan des transports maritime et routier, va s'appliquer à partir de 1990, va avoir un impact négatif sur la recherche en transport.

3.1 Les effets positifs sur la recherche en transport des nouvelles informations

La libéralisation de la réglementation et éventuellement la mise en marche de l'accord du libre échange vont avoir un impact sur les camionneurs canadiens. L'ajout du volet international (marchandises transportées entre le Canada et les Etats-Unis) à l'enquête origine et destination, va fournir un éclairage supplémentaire sur cet impact.

L'enquête trimestrielle va fournir une information conjoncturelle de base, en un délai assez court, sur les camionneurs pour compte d'autrui alors qu'actuellement nous ne disposons sur ceux-ci que de données annuelles, un an et demi environ après la période à laquelle ces données se réfèrent. En cette période de changement rapide du

cadre de l'industrie du transport, une telle enquête prend toute son importance pour suivre de plus près l'évolution de l'industrie du camionnage.

Pour sa part, le système du transport maritime et du commerce va informer les chercheurs sur les régions de première origine et de destination ultime des marchandises transbordées aux ports canadiens. Ceci est particulièrement important pour l'étude de ports importants faisant l'objet du transbordement de multiples marchandises en provenance ou à destination de points multiples tant au Canada qu'à l'étranger.

3.2 Les effets négatifs sur la recherche en transport du remaniement des enquêtes-entreprises

Le projet de remaniement des enquêtes-entreprises de Statistique Canada implique pour la recherche en transport un problème de continuité des séries statistiques. Si ce projet remplace tel que prévu les enquêtes-entreprises actuelles sur les transports maritime et routier, nous ne serons plus capables d'établir de lien entre les nouvelles données de ces industries et les données du système antérieur, sauf pour les plus grands établissements. Nous risquons fort de ne plus pouvoir faire la part des choses entre l'évolution de ces industries, suite à la libéralisation de la réglementation économique et les changements aux données reliés au cadre statistique.

Un élément positif du remaniement des enquêtes-entreprises pour la comptabilité nationale concerne la couverture de l'ensemble des moyens de transport à l'aide des données fiscales. Ces données n'apporteront guère plus de connaissance sur les moyens de transport moins bien couverts, fournissant tout au plus à Statistique Canada un chiffre global plus près de la réalité pour l'ensemble de l'industrie du transport. Cet avantage risque fort d'être très limité pour les chercheurs en transport.

Ce remaniement limite donc considérablement l'information disponible sans par ailleurs apporter un éclairage neuf sur le fonctionnement des transports. Il ne prend pas en compte l'émergence de nouvelles industries ou de nouveaux services de transport.

4. LES ELEMENTS DE SOLUTION

L'obtention d'un système statistique, adapté aux besoins de tous, demande la collaboration des intervenants intéressés à la compréhension de la réalité du transport. A ce propos, les ministères et organismes publics du gouvernement du Canada, notamment Transport Canada, ont déjà largement exprimé leurs besoins de données en transport et continuent à le faire. Transport Canada contribue de plus directement au financement des données produites par Statistique Canada pour ses besoins spécifiques.

Les gouvernements provinciaux et territoriaux ont, pour leur part, également l'occasion d'exprimer leurs besoins à Statistique Canada,

notamment par l'intermédiaire du Comité fédéral-provincial de la statistique des transports. A ce propos, une enquête a été faite auprès d'eux, en 1987, pour leur permettre d'exprimer plus expressement ces besoins. Selon cette enquête, ils désirent d'abord obtenir des données sur le trafic de passagers et de marchandises pour les différents modes de transport, et le transport intermodal, tant d'un point de vue modal que dans le cadre d'une approche multimodale. Les revenus et dépenses de transport soulèvent également un intérêt marqué. En plus de ces points, ils sont également intéressés à discuter plus à fond au Comité leurs besoins de données sur les sujets suivants pour différents modes de transport: le coût du transport, l'emploi, la sécurité et les subventions.

Il y va de l'intérêt de tous que les chercheurs en transport participent à cette définition des besoins de données. Leur rôle consiste souvent en effet à analyser les données disponibles, pour mieux comprendre le transport et proposer de nouvelles avenues à son fonctionnement. Cette participation est d'autant plus importante que, dans le contexte actuel, nous avons besoin d'un bon éclairage sur l'évolution du nouveau monde des transports, pour poursuivre son développement de façon cohérente et harmonieuse. De quelles données avons-nous besoin pour bien comprendre ce nouveau monde: données d'investissement et de stock de capital, données d'emploi, données de consommation intermédiaire, données sur les volumes de production, données sur le financement du système de transport, données sur les prix, données sur la sécurité du transport ou autres données? Ces données doivent-elles être les mêmes pour toutes les industries de transport? Est-il possible d'organiser les statistiques pour prendre en compte l'émergence de nouvelles industries? Voilà autant de questions sur lesquelles les chercheurs ont intérêt à faire valoir leur point de vue. Ne serait-il pas opportun d'organiser un mécanisme de collecte de ces besoins auprès des chercheurs?

Le premier élément de solution passe donc par une bonne identification des besoins de données statistiques de transport. A partir de là, il s'agit de bâtir un système statistique qui, partant de la situation actuelle, permettra de la transformer graduellement, pour répondre le mieux possible à ces besoins dans un contexte de ressources limitées. Ce deuxième élément de solution implique un partage approprié des enquêtes et de leur financement entre Statistique Canada, les autres membres du Comité fédéral-provincial de la statistique des transports et d'autres utilisateurs de statistiques de transport.

Pour certaines enquêtes, dont des enquêtes auprès des établissements qui exercent leurs activités dans plus d'une province, Statistique Canada est l'organisme de cueillette à privilégier. Ainsi, à mon point de vue, Statistique Canada est en bonne position pour organiser une enquête générale sur les camionneurs, tant les camionneurs pour compte propre que ceux pour compte d'autrui.

Pour d'autres données, les provinces, compte tenu de leurs besoins spécifiques d'information, peuvent devenir le lieu d'enquêtes particulières. Ainsi, l'Ontario réalise des enquêtes sur la circulation des camions sur les routes à partir, notamment, de son réseau de postes de pesée. Le Québec, pour sa part, mène depuis quelques années des enquêtes sur l'industrie du taxi à l'intérieur des agglomérations urbaines. Le Québec, comme d'autres provinces, possède également des données administratives importantes sur les transports en commun urbain et suburbain, le transport scolaire et le transport adapté, compte tenu des subventions importantes accordées pour ces transports. Il est possible que d'autres données soient collectées pour mieux couvrir ces secteurs d'activité, ainsi que celui des transporteurs interurbains par autobus.

Il importera donc de s'entendre sur le partage des enquêtes et de leurs coûts entre les producteurs et utilisateurs de données. Compte tenu du rôle de Transport Canada dans l'organisation des systèmes de transport au pays et du financement direct du gouvernement du Canada par l'ensemble des contribuables canadiens, il faut s'attendre à ce que le gouvernement du Canada continue à assumer une part importante de ces enquêtes et de leur financement. Les provinces et territoires, pour leur part, une fois leurs besoins bien identifiés, pourront prendre les mesures qui s'imposent pour compléter l'information dont ils ont besoin et que ne réussit pas à leur fournir d'emblée le système statistique. Ces éléments continueront à faire l'objet de discussions entre les membres du Comité fédéral-provincial de la statistique des transports. L'industrie pourra également se joindre aux gouvernements et participer au financement du système statistique des transports.

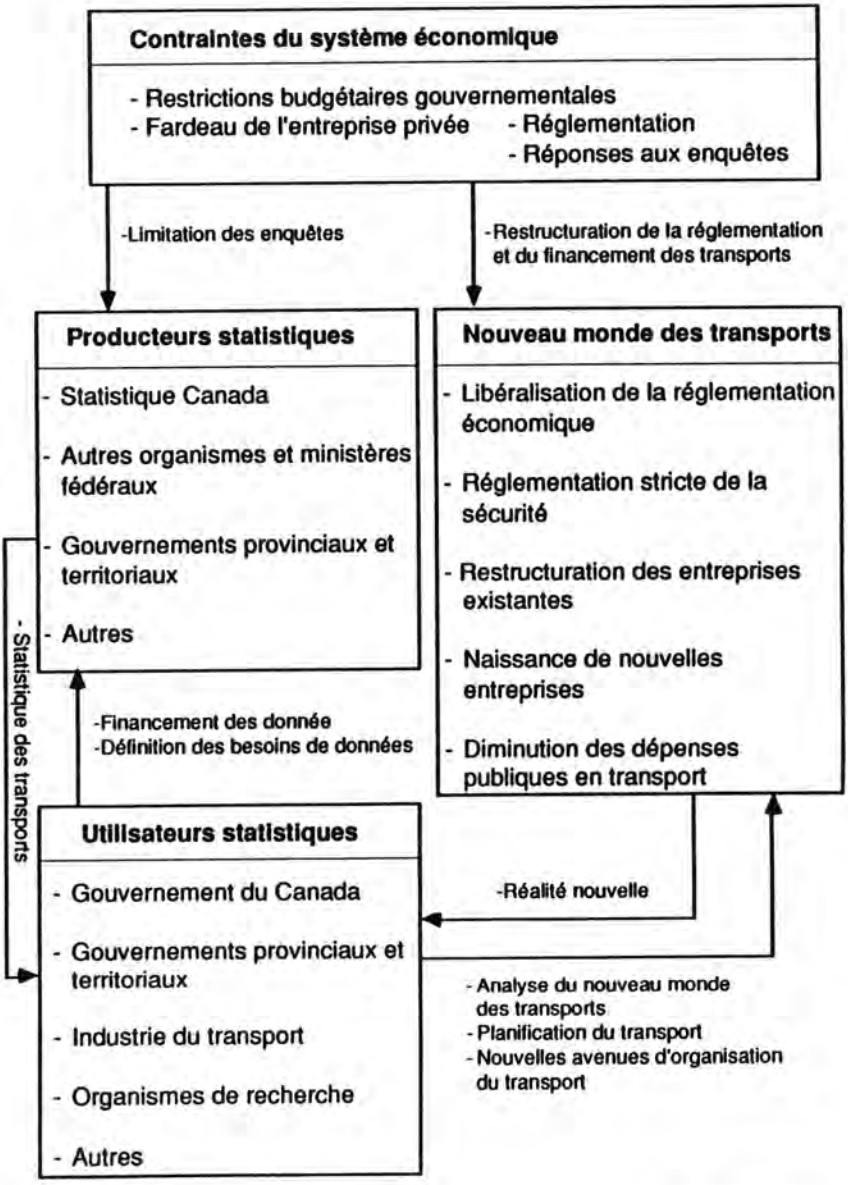
CONCLUSION

Comme nous venons de voir, les contraintes du système économique imposent des limites à l'organisation gouvernementale du transport et de l'information statistique sur le transport. Elles amènent la structuration d'un nouveau monde des transports, laissant une plus grande place à l'initiative de l'entreprise privée. Elles limitent également l'importance des enquêtes statistiques.

Dans ce contexte, les utilisateurs de statistique des transports se doivent de faire valoir leurs besoins de données et de trouver des solutions à leur financement. Les chercheurs en transport ont tout intérêt à exprimer leurs besoins spécifiques de données s'ils ne veulent pas se retrouver devant un système statistique qui limite trop leur compréhension de la structure et de l'évolution du nouveau monde des transports.

La figure ci-annexée schématise le cadre dans lequel s'effectuent la production et l'utilisation de la statistique des transports.

LE SYSTÈME STATISTIQUE CANADIEN DES TRANSPORTS ET LA RECHERCHE DU NOUVEAU MONDE DES TRANSPORTS



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MEASURING CANADA POST'S COSTS: Lessons from the U.S. Experience

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I. Introduction

In April 1987, Harvie Andre, the minister responsible for Canada Post established a study team to investigate whether a third party regulator should set postal rates. Regulation of Canada Post's rates was previously recommended by both the Marchment Committee on Canada Post and the Nielsen Task Force on Program Review. While development of regulation is not certain, it is likely that Canada Post would experience many of the same rate setting issues that the U.S. Postal Service faces before the Postal Rate Commission.

Currently Canada Post's Rates are set by Parliament with limited public review. Proposed rates are pre-gazetted or published in the Canada Gazette, and are then subject to a 60 day comment period. Comments, usually in the form of briefs from competitors and major customers and letters from individuals, are submitted to Canada Post and Parliament. Canada Post then submits a revised proposal to Governor and Council who have 60 days to approve or disapprove the proposal in its entirety.

The introduction of regulation would focus greater attention on how proposed rates are derived. As Canada Post, provides a wide range of services (letter mail, addressed and unaddressed ad mail, parcel delivery, priority post, etc.) and is characterized by a high degree of joint and common costs (the same letter carrier delivers letter mail and magazines) determining the appropriate revenue generated from each product is a complex problem. The problem is also likely to be quite contentious as many of Canada Post's products experience strong competition

[1] Authors' names appear in alphabetical order.

from unregulated firms. These firms could be expected to seek assurance that Canada Post would not under-attribute costs to those competitive products and to attempt to maximize the rates set on competitive products. Similarly, each of Canada Post's customers would seek to minimize the costs associated with the mail products that they use: they seek to minimize the rates that they pay.

Before any regulation is proposed, policy makers and other interested parties can gain some indication of the impact of regulation on the development of postal rates by reviewing the experience of the United States Postal Service under regulation. Canada Post and the U.S. Postal Service provide a comparable set of services. The actual processes of providing these services is also similar, letters are sorted by hand and mechanically, individual addresses are served by letter carriers by foot and in vehicles, and post offices both collect and sort mail and sell postal values. The similarity in both the services provided and how those services are provided increases the likelihood that the economics of providing these services are the same. The studies that examined cost causality in the United States should therefore provide guidance to those seeking to discover such causality for Canada Post.

A second reason that Canada Post's regulatory experience may be similar to the U.S. Postal Service is that Canada Post will likely face the same intervenors that the U.S. Postal Service faces in its rate cases: (1) competitors such as United Parcel Service and Federal Express; (2) publishers like Time, Newsweek and, the Magazine Publishers Association; (3) consumer advocates; and (4) major customers including parcel shippers and advertising mailers. Many of these organizations currently submit briefs criticizing Canada Post's rates during the existing public comment period. These intervenors would likely use the extensive knowledge about postal operations and postal rate-making that they have gained from preparing and reviewing testimony from over six U.S. postal rate cases in preparing analysis to contest Canada Post's rate making methodology.

The rest of our paper will focus on the methods used in the United States to determine the costs of providing postal services. Following a general discussion of costing methodology, an illustration of the type of analysis that is required will be presented. This illustration will focus on the analyses of the costs of purchased transportation that were presented in the most recent (1987) U.S. Postal Service rate case.

II. Postal Costing: An Overview

Costing for the U.S. Postal Service has been developed in order to meet two legislative requirements. First, postal rates and fees must:

> provide sufficient revenues so that the total estimated income and appropriations to the Postal Service will equal as nearly as practicable total estimated costs of the Postal Service

and second, each class of mail or type of mail service is expected to

> bear the direct and indirect postal costs attributable to that class or service.[2]

The first directive requires the Postal Service to make volume projections and estimate the total costs and revenues that may be expected with those volumes. Evaluation of the volume and cost projections determine the revenue requirement. The evaluation of various rate designs and levels and their impact on volumes, costs and revenue determine whether sufficient revenue would be generated to cover total costs.[3]

In following the second directive, the Postal Service has identified two types of costs that must be attributed to each type of service: volume variable costs and specific fixed costs. Volume variable costs are those costs that vary with incremental changes in mail volume. Within the context of a Postal rate case, discussions concerning the measurement of volume variable costs are framed in terms of measuring marginal costs. The methods employed to measure volume-variable costs will be discussed in detail below. Specific fixed costs are fixed or non volume-variable costs that are attributed to a single service. For example, the costs incurred by computer personnel at the Postal Service Money Order are classified as specific-fixed costs because as those personnel only work on money orders and no other postal product. In the recently concluded rate case, 61.6% of the Postal Service's thirty billion dollars in costs were volume variable, 0.5% were specific fixed, and the rest were considered institutional.

The measurement of volume variable costs is a complicated, multi-step process. Before, volume variable costs are calculated, costs from the general ledger are grouped by functional areas or cost components. The U.S.

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[2] 39 U.S.C. Sec. 3621

[3] 39 U.S.C. sec. 3622(b)(3). Cost coverage includes maintaining a contingency fund. The purpose of the contingency is to insure against errors in forecasting volumes, costs, and revenues and to protect the Postal Service against unforeseeable events.

Postal groups costs into sixty-five components including, for example, domestic air service, mail processing equipment depreciation, and window service labor costs. Some of these components costs are further disaggregated into more detailed groupings. The purchased highway transportation cost category is an example in which the general cost component is comprised of eight separate sub-components for which variable costs are calculated separately.

Total volume-variable costs for each of these cost components or sub-components are calculated by multiplying a "volume variability factor" times the total accrued costs for the cost component or sub-component. The Postal Rate Commission has defined volume variability as the percentage change in cost divided by the percentage change in volume.(i.e. if a 6% change in cost were caused by a 10% change in volume, volume variability would be 60%) Alternatively, volume variability can be defined as marginal cost divided by average cost.[4]

The Postal Service currently uses, and the Postal Rate Commission currently accepts, a number of methods for measuring volume variability. Some cost components are considered by definition either 100% volume variable, such as mail processing clerks, or 0% volume variable, such as the cost of employee awards. These determinations are made based upon examination of the inherent nature of the operations that affect cost incurrance.

Another method for measuring volume variability involves the derivation of the direct relationship between costs and volume. The measurement of the direct relationship is conducted primarily through engineering and econometric studies. An econometric approach was employed in the purchased transportation cost components and will be discussed in detail below. For some cost components, volume variability is pegged at the same level as a related cost component. For example, some supervisory costs are assigned volume variabilities equal to the volume variability of the cost component containing the supervised employee costs.

Once a volume variability factor for each cost component is determined, the factor is multiplied by the total costs for a cost component. This product is then distributed to the various postal products based upon a measurement of the proportion of total volume resulting from a specific product. For example, the volume variable purchased highway costs for service between bulk mail centers was distributed based upon the relative proportion

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[4] Therefore by definition, a measurement of volume variable costs must be a measurement of marginal costs as VOLUME VARIABLE COSTS * TOTAL COST = (MARGINAL COST / AVERAGE COST) * TOTAL COST = (MARGINAL COST / (TOTAL COST / VOLUME)) * TOTAL COST = MARGINAL COST / VOLUME

of pound miles associated with non-preferential mail classes (i.e. ret and 4th class).[5] Each cost component or sub-component employs an independent distribution method. Finally, the volume variable costs of a particular product is calculated by summing the volume variable costs for each cost component that were distributed to a particular product across all cost components.

The remainder of this paper will describe the efforts that were required to establish a new volume variability for purchased transportation cost components. The U.S. Postal Service has an extensive purchased transportation network, including air, highway, rail, and water transportation. This transportation of mail is obtained on a contract basis, and contracts are let through a competitive bidding process. Contracts are regularly bid and can be renegotiated by the Postal Service in the event of a change in the need for service.

In the rate case filed in May 1987 (Docket No. R87-1) analyses were presented for all modes except water. Our presentation of those analyses will be divided into two sections. The first section will detail the procedures that were required to ensure data reliability. Data reliability is critical in a rate case to ensure that data difficulties would not hinder the presentation of the econometric transportation analysis. The next section will outline the economic arguments presented during the rate case.

III. Postal Costing: Purchased Transportation

A. Data Preparation and Reliability

The importance of data reliability for postal rate making is clearly identified by the fact that the first witness that the U.S. Postal Service chose to present in Docket No. R87-1, was a data witness who described the statistical reliability of the USPS data collection efforts. Regardless of the merit of the arguments presented before the Postal Rate Commission, sloppy data collection and data handling procedures can undermine the acceptance of that argument.

For purchased transportation, data on costs and volumes was collected by the U.S. Postal Service for all modes analyzed. As part of the rate case this data was provided to the Postal Rate Commission and interested intervenors. Intervenor testimony used the data provided by the Postal Service.

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[5] For further examples of methodologies employed to develop distribution keys, see Library Reference E-31, Distribution of Domestic Purchased Transportation Costs, Docket No. R87-1

Computer records of transportation transactions are maintained for rail and air service, thereby allowing reasonably easy access to the required data. The existence of electronic records eliminated most problems associated with the collection of data for analysis. For all air analyses, data on the actual volume of mail transported was used, while for rail a proxy for mail volume was developed. Similar data for highway service was available only in hard copy contract records. Highway contract records for over 14,000 highway contracts were maintained in 26 Transportation Management Offices. The difficulty of collecting and entering the required data determined that only a sample of the data available could be analyzed. Separate samples were drawn for each type of highway service studied. The Commission's rules required, and intervenors demanded, an explanation of the sampling procedure in order to ensure that the sampling technique was statistically reliable and that proper sample sizes were chosen.[6] Intervenors also requested information on data collection procedures including, for example, copies of the instructions delivered to data collectors.

The reliability of the highway data was probed by intervenors through a number of avenues. United Parcel Service asked a series of questions concerning the classification of contracts, i.e. the procedures used to ensure that the highway samples were homogeneous. Other questions required explanation of why certain contracts were excluded from the analysis. Further questions required identification of the sources of the data entered from within the contract forms, explanations of calculations employed for all variables that required calculation, and listing of the criteria used for variables whose values were set based on decision rules.

In addition to answering concerns about the reliability of the data employed the Commission required that sufficient working papers be provided to permit a "reviewer to trace any number used but not derived in the associated testimony back to published documents or, if not obtained from published documents, to primary data sources."[7] This rule along with the rules on statistical studies[8] and

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[6] See 39 CFR Sec. 3001.31(k)(2)(i); Association of American Publishers - Recording Industry Association of America Interrogatory No. 2 to USPS Witness Michael D. Bradley, Transcript Vol. 12, Time Interrogatory No. 1 to USPS Witness Michael D. Bradley, Transcript Vol. 12, and United Parcel Service Interrogatory Nos. 11 and 51 to USPS Witness Michael D. Bradley, Transcript Vol. 12.

[7] 39 CFR Sec. 3001.64(g)(4)

[8] 39 CFR Sec, 3001.31(k)(2)

computer analyses[9] required that all computer programs employed be available to parties of record and that parties be prepared to provide both oral explanations in the form of technical conferences and written explanations in response to interrogatories.

As all of the Postal Service's highway analysis was performed on a personal computer using interactive software,[10] only output could be provided. Nearly all other analysis was conducted using SAS and programs were made available as part of working papers to testimony. Detailed explanations of these programs were required by both the Postal Service and intervenors as illustrated by the following interrogatory:

> Provide a detailed documentation of the SAS program listings in Workpaper 3. The documentation provided for each program should include the following information:
>
> (a) The objectives of the program and its relationship to other programs used to generate your results:
> (b) Identification of all input and output data files, including any files not contained in the Workpapers;
> (c) Designations of sources of all input data and explanations of any modifications to such data made for use in the program;
> (d) Definitions of all variables or sets of variables appearing in the program listing;
> (e) A description of the program logic and algorithms; and
> (f) An identification of all assumptions incorporated into the program design, and a description of the basis for each assumption.[11]

B. Econometric Analysis

As described previously, in the process of allocating costs to the various classes of mail, the Postal Rate Commission determines what is calls the "volume variability" of a particular type of cost. More generally known as a cost elasticity, volume variability measures the percentage increase in cost associated with a given

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[9] 39 CFR Sec. 3001.31(k)(3)

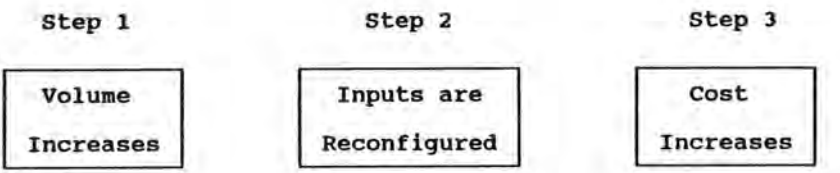
[10] Lotus Symphony and Quantitative Micro Systems's Micro-TSP

[11] United Parcel Service Interrogatory No. 30 to USPS Witness Michael D. Bradley, Transcript, Vol. 12.

percentage increase in mail volume. The goal then, of the purchased transportation analysis presented in the 1987 rate case was to determine the size of volume variability for each of the modes of transportation.[12] Two main analyses were presented: one by witnesses for the Postal Service and one by witnesses for the United Parcel Service (UPS). Several other intervenors provided critiques and extensions of the main analyses. The most significant of these were provided by witnesses for Dow Jones and the Magazine Publishers Association (MPA). This section of the paper will be organized as follows: the basic problem, how to measure volume variability, will be presented and two alternative approaches will be offered. A description of the Postal Service approach will follow with the UPS approach provided next. The Dow Jones and MPA critiques will be presented and an overview will conclude this section.

B.1. The Postal Service Approach

To measure volume variability, one simply must measure how quickly, in percentage terms, costs rise with volume. In economic terms, however, there are three steps to this process. First, volume rises and this causes a reaction among the suppliers of purchased transportation.[13] This reaction leads to step two in which the supplier reconfigures his inputs to most cheaply provide the new level of service. This increased use of inputs lead to a higher level of costs and the realization of higher costs is step 3. Schematically, the process looks like the following:



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[12] For a variety of reasons, some of them erroneous, the Postal Rate Commission previously assumed that purchased transportation costs were 100% volume variable.

[13] In purchased transportation, the Postal Service is the <u>demander</u> of transportation services and the individual contractors are the suppliers.

This three-step process permits two approaches in measuring volume variability. The first approach avoids modelling and estimating Step 2 and directly measures the increase in cost associated with an increase in volume. This approach can be termed the "direct approach." The second approach breaks the process down into its individual steps and models both how inputs respond to a change in output and how cost responds to the reconfiguration of inputs; this approach is termed the "indirect approach."[14] The advantage of the direct approach is that the intermediate response in inputs, which is difficult to measure accurately, does not have to be modelled. On the other hand, the advantage of the indirect approach is that it permits insight into why costs rise as quickly as they do.

Because the primary goal of the analysis in the rate case was to measure how much cost rose with volume and because of the extreme data collection and processing requirements of a rate case (explained above) the Postal Service analysis applied the direct approach. Specifically, data was collected on both costs and volumes (or proxies where required) and a cost function was estimated for each relevant mode of transportation. A cost function, which is obtained directly from the standard constrained optimization problem for the firm,[15] includes cost as the dependent variable and the level of volume as the independent variable. Input prices may also enter the cost function, but as the data set used was a cross-sectional data base, there was no variation in input prices and the input prices were subsumed into the intercept term.[16] The functional form specified was:

$$(1) \qquad \text{Cost} = A\,(\text{Volume})^{\beta}\, e^{\epsilon},$$

where A represents the non-volume costs and ϵ is a stochastic term. In logarithmic terms, this equation can be written as:

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[14] This dichotomy is quite familiar in economics. In the economics literature, the first approach is called the reduced form approach and the second is called the structural approach.

[15] See, for example, Henderson and Quandt, Microeconomic Theory: A Mathematical Approach.

[16] A supporting time-series analysis was also performed for purchased highway transportation. In that instance, input prices were also included.

(2) $\ln(\text{Cost}) = \alpha + \beta \ln(\text{Volume}) + \epsilon.$

where $\alpha = \ln A$. This form is linear in the estimated parameters and provides a direct estimate of the cost elasticity required; volume variability is just the estimated coefficient on the log of volume, β. This cost function was estimated for air, highway and rail purchased transportation and the results are provided below.

Purchased Air Transportation

The purchased air transportation network has two primary components the system network and the segment network.[17] The segment network consists of specified "windows" on individual origin-destination pairs. That is, the Postal Service specifies a time window for mail delivery between two cities and then accepts bids from any airline providing service between those cities. Segment routes are normally high-volume routes. System contracts involve a single line-haul rate for any shipment over the airline's entire network. The bidding airline must stand ready to transport mail anywhere its airplanes go at the system rate.

Because segment contracts are bid on individual windows but system contracts are bid for the airline's entire network, the unit of observation for the two types of purchased air transportation are different. For segment contracts, the individual window it the correct unit of observation whereas for system contracts, the appropriate unit of observation is the airline. The cost elasticity for segment contracts was found to be 72.6% and the cost elasticity for system contracts was found to be 77.83%.

Purchased Highway Transportation

Purchased highway transportation provided two additional difficulties: the provided service is not homogenous and actual measures of volume are not available. To remedy the first problem, data was collected for each of the four types of service provided and a cost function was estimated for each type of service. The four types of highway transportation provided can be roughly categorized as follows: transportation of local letter mail, transportation of inter-city letter mail, transportation of local bulk mail, and inter-city transportation of bulk

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[17] Recently, the Postal Service has added another component, the Evergreen network, for the speedy delivery of Priority and Express Mails. This network was not in place at the time the data sets were collected.

mail.[18] Because data on the actual volume of mail transported on the purchased highway network is not available, a proxy was used. The best proxy available for actual mail volume was cubic foot-miles of mail, a measure of capacity. The estimated volume variabilities for the four types of purchased highway transportation service were based on the use of this proxy and are given below.

Type of Service	Volume Variability
Intra-city letter mail	49.83%
Inter-city letter mail	57.88%
Intra-city bulk mail	82.84%
Inter-city bulk mail	88.27%

Purchased Rail Transportation

Purchased rail transportation is relatively homogenous, like air transportation but, like highway transportation, no data on actual volume were available. Consequently, the same proxy that was used for highway transportation, cubic foot-miles, was applied. When the cost function for rail transportation was estimated, volume variability was found to be 94.65%

B.2. The UPS Approach

UPS provided an analysis which differed from the Postal Service approach in two fundamental ways. First, for all modes of transportation, UPS included a measure of distance in the cost function, and for purchased highway transportation, UPS attempted to undertake the indirect approach of measuring volume variability.

The justification provided by UPS for including a measure of distance in the cost function is that cost has two primary determinants, volume and distance. However, the inclusion of this variable implies that for the single transportation contractor, distance is simply a constraint. This arises because for any additional quantity variable to be included in the cost function discussed above, its value must not vary over the period of optimization. If a firm's plant can not be changed, for example, the size of that

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[18] For Postal Service aficionados, the correct classifications are intra-SCF, inter-SCF, intra-BMC and inter-BMC, respectively. SCF stands for Sectional Center Facility and BMC stands for Bulk Mail Center.

plant would enter as a constraint variable in the cost function.

In purchased transportation, the distance constraint implies that the routing of mail cannot be changed -- that the distance on an individual contract is fixed. This is true, of course, in the short run and econometric estimates of this modified cost function will provide a measure of short-run volume variability. Economic theory argues that this short-run cost elasticity is larger than the long-run elasticities provided by the Postal Service. Not surprisingly, this is the result that UPS found.

The other modification provided by UPS was for purchased highway transportation only. By decomposing cubic foot-miles into its intermediate "inputs", mileage, trips, and capacity, UPS was able to measure how cost responded to increases in these inputs.[19] An estimated equation linking cost to these three inputs measures the link between the second and third steps of the three-step response to volume changes. As explained above, however, this is only part of the entire process. To measure volume variability, one must also measure how the inputs respond to the change in volume. Unfortunately, UPS did not measure this first linkage and only provided the unsupported assumption that all three inputs respond proportionately to a volume increase.

B.3. Other Intervenors

Two other intervenors provided substantial testimony in the rate case.[20] The first, Dow Jones, made two criticisms of the UPS approach, both on theoretical grounds. The first Dow Jones criticism deals with the addition of distance in the cost equation. Dow Jones points out that the UPS presentation is not consistent with economic theory. Specifically, if distance is not assumed to be a constraint, than the augmented cost function must be interpreted as a "hedonic" cost function in which cost is determined by the hedonic variables that describe the multiple outputs that are being produced. However, as Dow Jones highlights, UPS models the contractors as single-product firms, providing only mail transportation services as measured by cubic foot-miles. The cost function with both cubic foot-miles and distance included is therefore inconsistent with the nature of purchased transportation.

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[19] The actual inputs are things like labor, fuel and trucks. Presumably, the "inputs" listed above were chosen because the data were readily available.

[20] A third intervenor, American Association of Publishers - Recording Industry of Association of America, provided brief testimony criticizing UPS for its interpretation of its statistical results.

The second criticism that Dow Jones levels at UPS concerns the UPS attempt at measuring volume variability through the indirect approach. Dow Jones recognizes that the linkage between Steps 1 and 2 must be estimated as well as the linkage between Steps 2 and 3. As mentioned above, UPS simply presents an unsupported assumption about the first linkage and Dow Jones shows that other, perhaps more reasonable, assumptions about the reconfiguration of inputs yield dramatically different results for volume variability. Dow Jones then concludes that without measurement of the first linkage, estimates of the second linkage, by themselves, are not adequate for measuring volume variability.

The other intervenor, the Magazine Publishers Association (MPA), also recognizes that both links must be estimated. Moreover, MPA attempts to econometrically estimate the first link. When the MPA estimates of how inputs respond to an increase in output are combined with the UPS estimates of how cost responds to an increase in inputs, the combined measure of volume variability is virtually the same as that derived by the Postal Service using the direct approach.

IV. Conclusion

In this paper we have reviewed the econometric analyses and data collection procedures required to determine the nature of costs for the purchased transportation in a rate case setting. We looked at both the general issues in allocating costs and the specific concerns related to purchased transportation. We believe that a careful review of the U.S. process would be extremely advantageous to those considering establishing similar regulation for Canada Post.

THE POTENTIAL FOR IMPROVED PUBLIC TRANSIT SERVICE THROUGH COMPETITIVE CONTRACTING

PRIVATIZATION AND PUBLIC SERVICE

Governments around the world are challenged by growing public needs and the difficulty of obtaining additional public revenue. Some innovative responses to these challenges have been characterized as "privatization." Privatization is one of two principal thrusts of the world-wide "market liberalization trend" (Chart #1), the second being deregulation of monopolies and oligopolies.

Privatization is the use of competitive market approaches in the production of public services and projects. The purpose of privatization is public service --- to serve the users of public services better, while more efficiently using the funds provided by the taxpayers.

Privatization is in contrast to nationalization and exclusive government production of public goods and services. In many cases, the exclusive, non-competitive public production of services has resulted in higher costs and mediocre services. Through privatization, costs can be controlled or reduced, and services can be improved by incorporating the incentives of the competitive market. The philosophy underlying privatization is summarized by the following:

> "The essential function of government is deciding. Government may later, itself, do what it has decided should be done. But equally it may not. Its basic intention is simply to see that what should be done is in fact done." (Citizens League of the Twin Cities, 1983)

Privatization has demonstrated that public needs can be effectively met without abandoning the self regulating incentives of the competitive market. Improved cost effectiveness is accomplished under the full supervision of government, which ensures service quality and quantity.

Competitive contracting is the most commonly used privatization method used in the United States, and one of the areas of most successful application has been in public transit. This paper describes that experience and suggests the applicability of the approach to public transit service in Canada.

PUBLIC TRANSIT COST ESCALATION IN THE UNITED STATES

From 1970 to 1985, public transit operating costs per kilometer increased an inflation adjusted (real) 63.8 percent (3.34 percent annually). This cost escalation outstripped virtually every element of the Consumer Price (inflation) Index, including both medical care services and fuel.

As public transit subsidies increased from 1970, there was a loss of $0.68 for each subsidy dollar expended. Only $0.32 in value was obtained. Approximately $0.20 was used to reduce public transit fares in real terms, while $0.12 was used to increase service levels. Alternatively, $0.68 went to pay for cost escalation above the inflation rate (Chart #2) --- a transfer of wealth from the riders and taxpayers to the transit agencies themselves.

PUBLIC TRANSIT COST ESCALATION IN CANADA

There is a crucial difference between the public transit funding situations of Canada and the United States. In the United States, unlike Canada, there is a large national transit program that dictates subsidy conditions through its regulatory process, and thereby severely interfering with local control. And, public funding has been more easily available to U.S. transit systems, while Canadian systems have been under pressure to justify capital expenditures and capital improvements. For example:

> In the United States, bus replacement capital funding is readily available, while operating assistance is more limited. Public transit authorities in the United States routinely replace buses that are 12 years of age. These same buses are operated by private companies in the United States for more than 20 years. Similarly, in the more accountable Canadian funding environment, British Columbia Transit (BC Transit) has an average bus age of 17 years. BC Transit operates vehicles comparable to those operated by U.S. public transit authorities. The crucial difference is that BC Transit must petition Victoria for capital funds on a case by case basis, rather than routinely receiving a formula grant for capital purposes from Ottawa, as would be the case in the United States.

Undoubtedly the fact that Canadian transit authorities have been required to more carefully account for their expenditures has assisted those authorities in achieving cost performance that is superior to that of their U.S. counterparts. A critical factor contributing to this more favorable performance is that public transit policy is made not in Ottawa, but rather in Victoria, Edmonton, Regina, Toronto, etc. Nonetheless, Canadians have paid a price for non-competitive public operation of public transit.

Public transit costs per vehicle kilometer increased 27 percent (1.6 percent annually), after adjustment for inflation, from 1970 to 1985. It cost $350 million more, in real terms, to operate Canadian public transit systems in 1985 than it did in 1970. This is enough to pay all fares and operating expenses of B.C. Transit for more than three years. New information indicates that costs are now escalating even more rapidly. From 1982 to 1986, public transit costs in Ontario increased 15.2 percent (3.6 percent), adjusted for inflation (Ontario accounts for 42 percent of Canadian public transit operations).

If public transit costs continue to escalate as they did from 1970 to 1985, it can be expected that a 19 percent real cost increase will occur from 1987 to the year 2000. On an annual basis, nearly $500 million more will be required to operate present service levels after adjustment for inflation. The gross cost above inflation for the period is projected to approach $5 billion (figures based upon a linear regression analysis).

COST PERFORMANCE IN THE PRIVATE BUS INDUSTRY

The opportunities that were made available by the increased public funding for public transit need not have been lost. In contrast to the cost escalation of the public transit monopolies, private bus companies have controlled their costs.

-In the United States real costs per kilometer declined 8.3 percent from 1970 to 1985.

-In Canada, real costs per kilometer declined 5.6 percent from 1975 to 1985 (Chart #3).

-The private bus industry in Canada is strong (for example, the largest school bus company in the United States operates 14,000 buses, equal to one third of the U.S. daily public transit total and 3,000 more public transit buses than

are operated in Canada. This large company is Canadian owned). In Canada, varying percentages of school bus service are already competitively operated in each province and the two territories.

The more favorable cost performance of the private bus industry should not be characterized as reflecting the superiority of private provision over public provision per se. The difference can rather be attributed to competition versus monopoly (the non-competitive environment of public transit). Even public transit agencies can substantially improve their cost performance in a competitive environment, as will be shown below.

The controlled cost performance of the private bus industry is characteristic of competitive markets. Its contrast to public transit cost escalation has been a reason for the use of competitive contracting in public transit.

COMPETITIVE CONTRACTING

Competitive contracting allows full policy control of the service by public authorities. The public authority determines which routes are operated, where they are operated, how frequently they are operated, what fares are charged, and transfer arrangements. Most public transit authorities require that the vehicles be painted according to the public authority's specifications (liveries), so that all of its services, private and public, have an identical appearance to the customers. Vehicles may be provided by the contractors, or by the public agency under a nominal lease to the contractors.

The public authority seeks bids or proposals to operate a particular service, for a particular period of time. Private companies respond, and the contract is awarded to the lowest cost responsible and responsive producer This operator provides public transit service, subject to quality standards established by the public authorities. The private company has incentives to perform effectively: The contract may be cancelled for unsatisfactory performance; many contracts provide for penalties for unsatisfactory performance; and, the private company will be interested in being favorably considered when the contract is rebid at its expiration. This duty to regularly seek new bids (3 to 5 year intervals) is the key to maintaining the competitive

market, price competition, and controlling costs. It is not a "franchise-in-perpetuity" arrangement that creates new private monopolies (again reinforcing the concept that the problem is one of competition versus monopoly, rather than public versus private).

Thus, competitive contracting does not necessarily mean private operation, it could mean public operation where public costs are lower than private costs. In such a case, a public authority can be awarded a contract under the same terms and conditions that would have bound a successful private bidder (as has occured at London Regional Transport).

The contracted public transit service does not have to earn a profit on passenger fares. The public agency pays the successful bidder the agreed upon price for providing the service, including a profit. This price will be the lowest price for which the service can be responsibly obtained, and will be less than the price of non-competitive public provision (Chart #4), otherwise public provision continues.

The jobs of present public transit employees can be protected by restricting the competitive contracting conversion to the natural employee attrition rate.

Competitive Contracting in the United States

More than 65 percent of the paratransit (dial-a-ride or demand responsive service) service is competitively contracted in the United States, and competitive contracting of conventional services is increasing.

Results: Four recurring results have been obtained from competitive contracting of public transit service:

1. Lower costs: Competitive costs are lower than public costs by an average of 30 percent. Cost savings have ranged from 10 to 60 percent (Teal, Giuliano and Morlok, 1986; American Bus Association, 1987) For example:

-In Los Angeles, three large contracts have recently been awarded, with savings of from 37 to 50 percent.

-In Houston, private park and ride service is operated for 33 percent less than public costs.

-In Seattle, private express service is operated for 37 percent less than the previous public costs.

-In Chicago, privately provided service for the disabled is operated at cost savings of more than 50 percent.

-In Fort Wayne (Indiana), the most expensive work runs have been competitively contracted, generating savings with which previously cancelled services have been restore.

2. Improved cost control: Competitive costs rise less steeply than non-competitive costs. This has been demonstrated in a number of California contracts and in Houston. Competitive costs have generally risen at or below the inflation rate, as has been the experience in the private bus industry generally.

3. Improved public cost performance: Finally, a competitive environment improves public cost performance. This has been documented in a number of cases in the United States.

-Lower cost increases have occured in San Diego and Norfolk.

-The competitive environment has considerably improved labour settlements in San Diego, Los Angeles, San Antonio, Phoenix, and other cities as it has become clear that there are alternatives to non-competitive public service provision.

4. Improved service quality: More and more, there are reports of improved service quality under competitive contracting. This impact has been noted in Los Angeles and Seattle.

Each of the above impacts has also been experienced at London Regional Transport (UK), which now competitively contracts more than 15 percent of London bus service.

Competitive Contracting in San Diego: The benefits of competitive contracting have been demonstrated in San Diego. In 1979 a very costly labour settlement brought driver wages to over US$10 per hour, the highest in the United States at the time. This controversial settlement induced communities in the San Diego area to begin competitively contracting for public transit service. From 1979 to 1987, the percentage of service competitively contracted rose to 18 percent and real costs declined, without causing the layoff of a single public transit employee. San Diego has realized these benefits as a result of competitive contracting:

1. Competitive costs were lower. On the average, the costs of service competitively contracted were approximately 50 percent below those of the public transit agency. The actual cost savings are greater, because the competitive costs include depreciation, while public costs do not.

2. Public cost control was improved. Not only did competitive costs rise within the inflation rate, but the public transit authority greatly improved its cost performance. Before competitive contracting, costs at the public agency, San Diego Transit, had increased at a rate similar to that of other U.S. transit agencies. However, the competitive contracting changed all that. From 1979 to 1987, while real California public transit costs rose 30 percent, real costs at San Diego Transit decreased 12.7 percent. Overall, including both directly operated and competitively operated services, real costs declined 17.1 percent. The comparative improvement in cost performance has saved the San Diego area approximately US$100 million dollars compared to other large California transit agencies, which averaged more than a 30 percent real cost increase.

Chart #5 compares the cost performance of U.S. public transit, San Diego public transit and the U.S. private bus industry.

Competititive Contracting in Canada

Competitive contracting is already being used in Canadian urban transit in a limited manner, both for conventional public transit services and for demand responsive (dial-a-ride) services. Most of the transit systems in British Columbia, outside of Vancouver and Victoria, are competitively contracted. B.C. Transit, which manages these systems, established these arrangements well before any significant competitive contracting of public transit was underway either in the United States or the United Kingdom. The competitive environment has assisted B.C. Transit in containing operating cost increases, and improving service quality. Smaller transit systems are also competitively contracted in Ontario.

Unlike the United States, however, competitive contracting of conventional public transit services has not yet occured in the major urban areas, where public transit costs are the highest. Without such experience, it is difficult to estimate the potential for cost savings, however the following can be suggested:

-By using a private cost prediction model developed for the San Diego Metropolitan Transit Development Board, estimates of competitive costs for operation and maintenance of Canadian transit systems can be obtained. This analysis predicts that the average cost savings from competitive contracting of public transit service in Canadian transit systems with more than 75 buses would be approximately 20 percent. Among the most expensive systems, savings of 35 to 40 percent might be achieved.

-The cost escalation of the public transit systems in Canada compared to the cost control of the private bus industry in Canada would seem to indicate that any presently achievable costs savings would increase in the future.

-Mirroring the experience in the United States and in London (UK), it can be expected that the establishment of a competitive environment would yield the same "ripple" effect on public costs, reducing their rate of increase.

The actual savings will only be known through seeking competitive bids for service. This can be done without any risk to the public transit agency, because direct public provision of service can continue should private costs be higher than public costs. Experience in both the United States and the United Kingdom would seem to indicate that cost savings will be achieved.

THE POTENTIAL FOR PUBLIC SERVICE

Competitive contracting can make a positive contribution to public transit cost control in Canada, as it has already in the United States and at London Regional Transport. Through competitive contracting, a public service is provided by the most economical producer, subject to quality standards set by public authorities. Competitive contracting makes it possible for public transit authorities to effectively serve the riders with higher levels of service, while serving the taxpayers through the most efficient use of tax resources.

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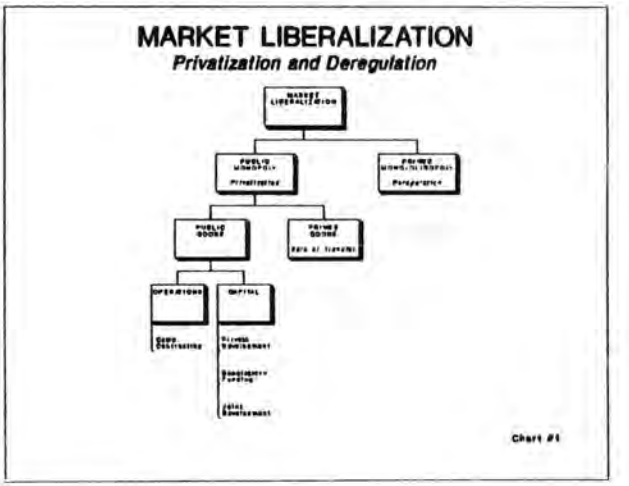
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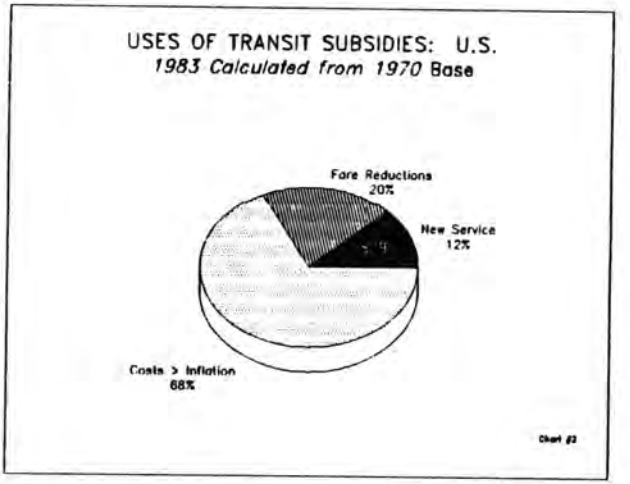
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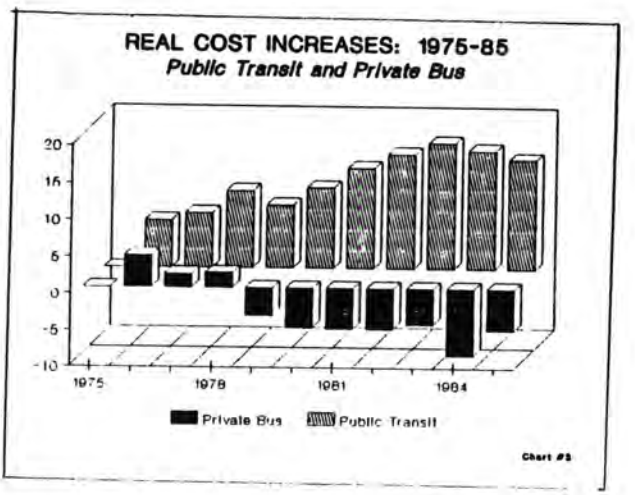
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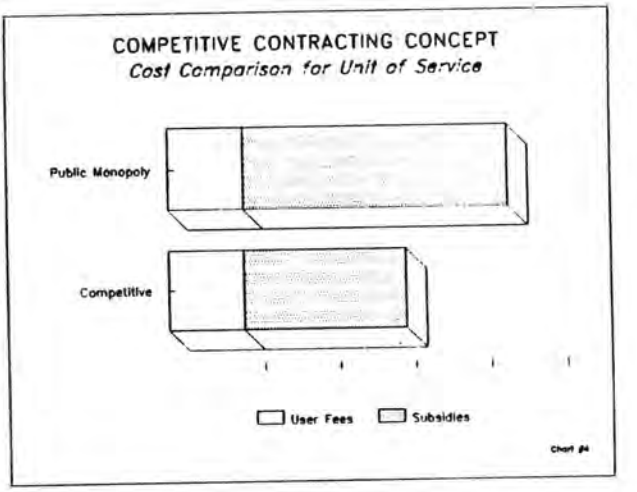
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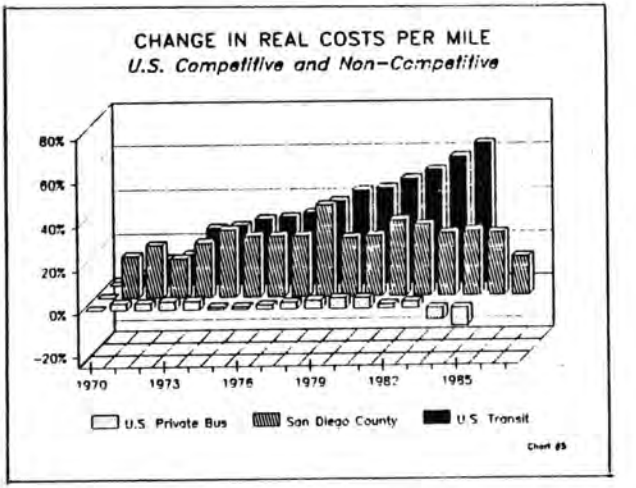
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USES OF TRANSIT SUBSIDIES: U.S.
1983 Calculated from 1970 Base
Fare Reductions
20%
New Service
12%
Costs > Inflation
68%


REAL COST INCREASES: 1975-85
Public Transit and Private Bus
20
15
10
5
0
-5
-10
1975
1978
1981
1984
Private Bus
Public Transit


COMPETITIVE CONTRACTING CONCEPT
Cost Comparison for Unit of Service
Public Monopoly
Competitive
User Fees
Subsidies


CHANGE IN REAL COSTS PER MILE
U.S. Competitive and Non-Competitive
80%
60%
40%
20%
0%
-20%
1970
1973
1976
1979
1982
1985
U.S. Private Bus
San Diego County
U.S. Transit

MARINE COST RECOVERY: AN INTERNATIONAL PERSPECTIVE

By
MARY R. BROOKS*

INTRODUCTION

Canadian Export Association President Frank Petrie has gone on record saying

> "because of geography, demography and climate, Canadian transportation costs are already among the highest in the world and increases would threaten Canada's existing transportation system and ability to compete in world markets."[1]

During the summer of 1987, Transport Canada issued its preliminary guidelines and policies on cost recovery in the air and marine modes for consideration by industry. The primary rationale for such a move came from the commitment of the current federal government to reduce the deficit rather than from any effort to equalize government support across the modes or meet the policy objective stated in section 3 of the new NTA that each mode bear its fair proportion of real costs. However, how such cost recovery activity will affect the international competitiveness of Canadian exporters and the extent of this can only be speculated upon until more detailed guidelines and policies are established over the coming months. (At this point in time, details on the implementation of such policies are much too sketchy and vague for any definitive conclusions to be drawn for the users of any transport mode.)

What can be evaluated at this stage in the process is the extent to which cost recovery takes place in other countries, both those we export to and those with which we compete. Should other countries subsidize, or provide at public expense, the services to transport operators that are now under discussion for cost recovery, the future competitiveness of Canadian exporters may be jeopardized in the global marketplace.

Of course, the provision of such services depends on the organizational structure in place for service provision now.

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1 Seaports and the Shipping World, November 1987, p. 59.

Is the organization(s) responsible for provision a government agency, an independent government-owned organization (like Canada's crown corporations), a regulated private corporation or is the service provided wholly by the private sector? Are any user fees assessed with partial cost recovery in mind or is the agency(s) required to be financially self-supporting?

METHODOLOGY

Identifying the services of interest to be aids to navigation, ice-breaking, vessel traffic management (VTM) systems, search and rescue (SAR), dredging and pilotage, a letter requesting information along the lines indicated above was sent to government officials responsible for shipping policy in each of the OECD countries with a coastline, as well as to the Directorate-General for Transport, EC Commission. Responses were received from Japan, Australia, New Zealand, Norway, Greece and West Germany. In addition, U.S. officials from various government departments and industry organizations were telephoned to ascertain the U.S. stance on cost recovery in their particular departments or area of interest. The following paper therefore reflects only a general overview of cost recovery policies in each of the responding countries, and should be taken as such. This superficial approach is only intended to provide a starting point for further examination of this complex issue.

COST RECOVERY ELSEWHERE

Japan

The Maritime Safety Agency of Japan (JMSA), a suborganization of the Ministry of Transport, has jurisdiction over aids to navigation, vessel traffic management systems, and search and rescue. At this time there is no discussion in Japan for cost recovery on these services. The only service for which costs are recovered is the control operations, in a case of spilled oil/noxious liquid substances, provided by a non-profit organization controlled by JMSA.

New Zealand

Like Canada, New Zealand is currently engaged in developing policies to reduce expenditures and transfer the costs of services to the users of those services. All services are currently provided by the Ministry of Transport or Harbour Boards. (Harbour Boards are autonomous bodies and, at the current time, are undergoing a change in administrative structure which should be complete by the end of 1988.)

Harbour Boards are responsible for aids to navigation, pilotage and dredging within ports and these costs are recovered from port dues. The full operational costs incurred by the federal government in providing navaids outside port boundaries are recovered through the imposition of light dues; this year the government is increasing these light dues in order to recover administrative costs as well.

Although no cost recovery takes place for SAR activities or radio safety services for shipping, these services are also being reorganized and their final form is not yet known, but cost recovery is being considered for the radio safety services.

Australia

Ports are responsible for aids to navigation, vessel traffic management and dredging within ports and these costs are recovered from port dues; most public sector ports are expected to "break even" if not pay a dividend to the state government. The only exception is development dredging which can be attributed to a single user; then the port authority may charge that user for the dredging either at the time the cost is incurred or as a part of lease costs.

The federal government provides navaids for trading vessels and these efforts may be supplemented by the state governments for fishing vessels and pleasure craft. The costs incurred by the federal government in providing these navaids are recovered through the imposition of light dues on commercial shipping, with some minor exceptions. Prior to 1973, the policy was to recover 80 percent of the costs of the navaid network from commercial shipping, and consider the balance to be attributable to fishing vessels, pleasure craft and the government's own vessels. Since 1973, full cost recovery has been the intention with a uniform charge levied based on the net tonnage of the vessel.

SAR activities are provided by the federal government and not operated on a cost recovery basis although, in some circumstances, state authorities may recoup the costs of medical evacuations.

Pilotage services are provided on a fee-for-service basis by a myriad of agencies — port authorities, state government Marine Departments or private companies under state government control, largely because ports fall under state rather than federal jurisdiction.

Federal Republic of Germany (FRG)

The government is responsible for the construction and maintenance of waterways and this covers aids to navigation, ice-breaking, dredging and vessel traffic management systems. Such services are free of charge with one exception -- a user fee is charged for passage through the Kiel Canal.

Pilotage is provided by private persons under government supervision; the operation of this enterprise is on a non-profit basis. Similarly, search and rescue is not provided at public expense; financed by voluntary contributions, Deutsche Gesellschaft zur Rettung Schiffbruchiger operates under an agreement between the government and the company.

United States

Aids to navigation, ice-breaking, vessel traffic management, and search and rescue services are provided by the U.S. Coast Guard (USCG) free of charge. There is no intention to recouperate the costs of these in the near future although there was an attempt, in 1987, to defray USCG costs through the imposition of $37. boat fee on the owners of recreational boats. (The Senate Commerce Committee had proposed that recreational boaters pay the annual "boat stamp" fee or be charged for any services requested but the provision failed to get Senate approval.)

Dredging is provided for U.S. ports by the U.S. Army Corps of Engineers. A new law signed in November 1986, PL99662, introduced a cost-sharing formula for port dredging in the U.S.. Other than the 12 federal ports which qualify for dredging by reasons of national defence, deep-draught ports now cost-share on dredging and maintenance under a scaled formula which takes into account the depth of the required dredging; the scale ensures that deeper draught projects bear a greater percentage of the costs. Ports exceeding a 45' draught must also cost-share on the incremental maintenance required as well as on initial construction. The cost-sharing formula has resulted in a scaling down of port projects, according to Mark Sickles of the American Association of Port Authorities. Under consideration is a harbour maintenance user fee of 0.04 percent assessed on the value of the cargo with the intention of recovering some of these costs.

Pilotage is provided by the private sector and conditions vary from state to state. Each state publishes its own tariffs and regulates access to pilot pools. The state may also regulate maximum wages paid to pilots. Both the state and the USCG can license pilots; the USCG certifies the American pilots working on Canada-U.S. routes.

Norway

The Norwegian government, through a general user fee assessed on all vessels moving in international trade, recovers 20 percent of the overall cost of navaids provision and maintenance. The other 80 percent is covered by the government. The exception is Decca and Loran C systems, where no cost recovery is undertaken. It is interesting to note that in the offshore oil sector there are a few private companies operating electronic systems on a competitive basis.

Full cost recovery is in place for pilotage, VTMS and dredging. Pilotage is recovered through a user fee assessed against ships in international trade, VTMS through a special "safety" fee, and dredging through port dues. (Dredging only takes place within port boundaries.)

There is no cost recovery for general ice-breaking services for major waterways; these costs are borne by the government. However

ports, which operate as economic entities, may assess a special user fee to recover their ice-breaking costs.

The government funds search and rescue activities, whether provided by the military or the private sector. If the equipment or personnel needed is not available in the military, commercial services will be used. Private sector operations may also be funded through voluntary contributions.

Greece

The provision and maintenance of navaids, VTMS, SAR and dredging are all provided at public expense while pilotage is a public-rendered service charged to the specific transport operator.

Canada

With the exception of pilotage, there is minimal cost recovery in Canada. Pilotage is provided by one of four pilotage authorities charged with financial self-sufficiency, although they do not always meet the goal.

There is about 10 percent cost recovery on ship safety costs - vessel inspections and certification, and seafarer examinations and certification. Navaids provided for private users are charged to that user but other than these nominal exceptions, most Coast Guard services are provided with funding from the public purse.

PLANNED COST RECOVERY IN CANADA

In philosophical terms, many of the cost recovery policies articulated in the guidelines released in the summer of 1987 are laudable:

* that users should not be expected to pay those costs which are attributable to public policy objectives;

* that users should be expected to pay charges which are reasonably attributable (although the term "reasonably" is not defined); and

* that, where possible, charges relating to facilities and services at a particular site should be site-specific.

Difficulties arise with the proposed guidelines. The one I wish to focus on is the delineation between site-specific and system-wide charges. It appears that the only site-specific charges being considered are those which take place at and within port boundaries. The only references (in the site-specific context) are to terminal facilities and services, yet regional differences do exist and should be accounted for. A two-tiered system is not always appropriate.

General Overview of Cost Recovery

Activity	Japan	Australia	New Zealand
Aids to Navigation	0	$$$	$$$
Ice-breaking	n.a.	n.r.	n.r.
Vessel Traffic Management Systems	0	n.a.	n.r.
Search and Rescue	0	0	0
Dredging and Maintenance	n.a.	SP	$$$
Pilotage	n.a.	SP	$$$

	U.S.	Germany (FRG)	Norway
Aids to Navigation	0	0	$
Ice-breaking	0	0	0
Vessel Traffic Management Systems	0	0	$$$
Search and Rescue	0	SP	0
Dredging and Maintenance	$	0	$$$
Pilotage	P/NP	P/NP	$$$

Notes:
- 0 = no cost recovery
- $ = partial cost recovery
- $$$ = full cost recovery
- n.a. = information not provided
- n.r. = not relevant
- P/NP = private or non-profit arrangement
- SP = see prose for detail

Geographical segmentation is not the only approach; seasonal differences exist in the case of ice-breaking. Imagine the consternation of a Canadian shipowner paying an ice-breaking charge while his Great Lakes vessel sits in winter layup. This is possible as ice-breaking on the St. Lawrence will now be divided up into that component attributable to flood control (non-transport related) with the remainder, with the possible exception of ice-breaking within a port's boundaries, considered as a way service, and therefore recovered through a system-wide charge. Cost recovery principles should promote equity and fairness and not result in greater distortion of the marketplace for shipping and port services.

CROSS-COUNTRY COMPARISON

How is cost recovery handled in other countries? What will this policy do to the competitiveness of Canada's ports and inland connections and, more importantly, to the competitiveness of Canadian exports?

For navigational aids and other activities within port boundaries, it appears that there are efforts afoot in other countries to recover these costs via port dues. The balance of this paper will look more at those activities outside of port boundaries, where specific users of the system are more difficult to define and beneficiaries encompass other users like fishing vessels and pleasure craft.

Navaids

For the other countries, navaids are either provided without charge or are subject to full cost recovery through light dues, or other forms of user fees. Perhaps if the government were to consider cost recovery in this area, it should examine the Australian and New Zealand experience closely. Alternately, a case for only partial cost recovery can be made on the grounds that Canada's fishing industry is a commercial beneficiary and therefore it is inequitable to recovery costs solely from commercial shipping activity.

Ice-Breaking

Where this is a relevant activity, cost recovery is not currently being followed, even in Norway where cost recovery principles are very much evident.

In Canada the seasonal nature of the service and the many beneficiaries will complicate any attempt to allocate charges. Why should foreign flag vessels visiting Canada in summer be required to pay a system-wide charge for ice-breaking? Likewise the Port of Halifax which sells its services on the international market touts one of its advantages to be an ice-free harbour; therefore is it reasonable to diminish this unique selling point with a charge for ice-breaking? Vessels could just as easily call at New York for 75 percent of the cargo now moving through Halifax. If there is to be

cost recovery on ice-breaking it needs to be carefully planned to ensure fairness in the application of charges.

Vessel Traffic Management

New Zealand does not have a vessel traffic management system like Canada given the low level of congestion in its waters, and so its case is not comparable to the Canadian situation. Neither is the case of Norway, which Norway does recover VTMS costs as its territorial sea is much smaller than Canada's. Japan, the U.S. and Australia provide a more comparable situation where the country is responsible for a large expanse of ocean; cost recovery is not being contemplated by them. In addition Coastguard believes that VTMS serves to protect the public interest, to reduce risk to life, the environment and public property without the disuption of traffic. Therefore, VTMS costs should be borne by the taxpayer.

Search and Rescue

It appears that there is a general consensus that this is an area where cost recovery is not undertaken. In Canada an examination of SAR activities would reveal that the majority of calls for assistance come from pleasure boaters who run out of fuel and need to be towed back into port. In such non-life threatening situations, tantamount to SAR abuse, charges should accrue to those who abuse the service at a level that will instill responsibility, act as a deterrent, and partially subsidize SAR activity which is life-threatening. Perhaps the American proposal of a boat fee was not all that far off the mark.

Pilotage

It is interesting to note that cost recovery is indeed seen as suitable for pilotage services. Perhaps it is because of the easy identifiability of the prime beneficiary. In other countries the provision of the service is quite decentralized; in many cases it is regulated or controlled by ports themselves with licensing and certification regulated at the state level.

It is time to review the current structure in Canada. The four pilotage jurisdictions charge rates not favorably viewed by the users, and the tariff increases have been fought frequently in recent years.

In order to maintain the competitiveness of Canadian international ports, perhaps those ports used heavily by international cargo interests should be looked at differently than those ports serving predominantly cabotage trades. For example, the ports of Halifax, Saint John, Montreal and Vancouver can easily lose business to U.S. ports. As these ports are now under the LPC system and required to be self-sustaining, they may have earned the right to offer their own pilotage services, with an umbrella organization responsible for pilot certification and licensing.

Dredging

Dredging is another area where the prime beneficiary is more readily identifiable and where partial or full cost recovery is undertaken in other countries. It is interesting to note that the U.S. experience in partial cost-sharing on dredging projects has reduced the scale of dredging requested. This is a self-limiting mechanism which ensures that users have a say in the size of project undertaken, and ensuring the best use of tax dollars. Perhaps a similar scheme in Canada would be quite workable as our basic port infrastructure is in place and dredging is largely a maintenance item. Remember the purpose of greater cost recovery is deficit reduction.

Marine Pollution Cost Recovery

Although this was not an item requested of those contacted, the respondents from Japan, New Zealand and Australia clearly considered it to be an appropriate area for cost recovery measures by including some commentary on it in their letters.

Australia's government imposes a levy on all vessels carrying more than 10 tonnes of pollutable oil in bulk; the levy funds the National Plan to Combat Oil Pollution. Like Japan, the actual costs of cleaning up a spill are recovered, where possible, directly from the polluter. The levy is used to fund the administration of the plan and any uncollected cleanup costs. New Zealand operates a similar system although the amount of the levy was not specified.

Japan's Maritime Disaster Prevention Center (MDPC), although controlled by the government through JMSA, is financed jointly by government and civil organizations. It receives guidance and assistance in its management from government, and spill enforcement takes place under the direction of the Maritime Safety Agency. The MDPC takes appropriate measures to control spills and expenses of the operation are borne by the shipowner responsible for the incident, except in cases of natural disaster. (Canada also attempts to recovet cleanup costs from the party responsible.)

CONCLUSIONS

I hope that in this paper I have provided food for thought. I did not intend a definitive study on cost recovery, merely an overview of what happens elsewhere, and some commentary on what directions might be taken in Canada in light of that. I hope that I have indicted some areas where cost recovery initiatives might be suitable but also where it is not, in the interests of trade maintenance and development as well as regional economic development through port spin-offs.

Japan and the U.S., our two major trading partners, do not engage in cost recovery on navaids, VTMS and SAR activities. We have to be careful that any charges levied will not impact on our

competitiveness particularly as we have a dependence on commodity exports which can bear very little increase in delivery prices. So far we have been successful in maintaining a competitive edge through the shrewd use of cheaper flag vessels and maintaining a trade-focused shipping policy that does not force Canadian exporters to use Canadian bottoms. But as competition becomes increasingly global in nature, Canadians have to ensure that our competitive edges are not eroded.

RTAC ROADWAY INFRASTRUCTURE STUDY

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RTAC ROADWAY INFRASTRUCTURE STUDY

INTRODUCTION

The First Canadian and International Good Roads Congress was convened, in Montreal on May 18, 1914. The 302 motoring enthusiasts in attendance heard grave misgivings about the state of the nation's roads. They were told $60 million was being spent on roads in Canada - "a very large sum" - and that roads didn't come cheap. They ranged, it was reported, from $5,000 to $8,000 a mile for a good macadam surface.

The Roads and Transportation Association of Canada,(RTAC), recently calculated that over $7 billion was being spent on roads in Canada - a very large sum. Even so, many transportation experts felt that this amount is inadequate to preserve the more than $200 billion (in 1987 dollars) that the three levels of government have invested in the Canadian road system.

The Technical Council of RTAC, in 1984, considered it a priority to determine the minimum annual expenditures needed to preserve the total roadway system in Canada and to compare this with what was being spent. In other words, a financial study was undertaken to determine whether Canada is spending enough to preserve its roadway system.

The concept of such a study was not unique. The Canadian Construction Association was conducting "The Road Information Program of Canada (1) and the Federation of Canadian Municipalities was conducting a municipal infrastructure study (2). The former assessed the problem from an administrators perspective while the latter dealt only with urban municipalities. Road funding and expenditures were not being looked at on a national basis.

Through the Canadian constitution, road transportation is the responsibility of the provinces and there is no government body to act as the national voice for the system. RTAC attempts to fill this void and the RTAC Board of Directors approved the study to be conducted on a national basis.

To carry out this study was not an easy task. Many of the provincial transportation departments and the larger municipalities have very sophisticated techniques to manage their road networks. However there are thousands of agencies in Canada that own and maintain road systems and most do not have detailed information on their system.

RTAC therefore decided to take a generic approach to the problem. Although every road is unique and may require different engineering, all roads have similar life cycles and many have similar expenditure needs.

THE LIFE OF A ROAD

Once constructed, a road soon starts to deteriorate and operating and maintenance efforts are required. Traffic control, snow plowing and cleaning are underway almost immediately, and pavement sealing and patching will likely be needed within three years. The most economical management of the road calls for a resurfacing before the deterioration is too far advanced. This resurfacing can be done two or three times before a complete reconstruction is required at about 45 years.

In other words, during the life of a typical road, it is annually maintained, resurfaced two or three times, then reconstructed. If a road lasts 45 years before it requires reconstruction, one could calculate the total needs of the road by adding:

the cost of 45 years of maintenance,
the cost of two or three resurfacings,
the cost of a reconstruction.

The annual needs of the road could then be identified by dividing the total needs by its life, in this case 45 years. This then became the approach used in the study.

INVENTORY

The first task was to determine how many kilometres of roads there are in Canada. While highway system length and expenditure statistics had been collected and published in the past by Statistics Canada, that agency ceased its activities in this regard with data from 1976 "...primarily because of the problems experienced in obtauning compatible and consistent data from the many jurisdictions involved." (3)

Hassan's work presented at the 1984 RTAC annual conference suffers from the same definitional inconsistencies as others, in attempting to put together a national picture of the highway transport system in this

country. In the conclusions he points out : "Major deficiencies, inconsistencies and lack of uniformity exist in road statistics in Canada. A major co-operative effort is required to first establish a national 'bank' of existing statistics and then to bring about uniformity." (4)

The inventory of roads and streets was collected in a format expressly designed for the application of this study. Roads having similar maintenance and resurfacing needs were lumped together, such as freeways, paved roads, gravel roads etc. As can be seen, these categories do not correspond to the traditional functional classifications developed in the RTAC Geometric Design Manual for Canadian Roads and Streets.

Roads were also classified by ownership: federal, provincial and territorial, and municipal. The municipal were futher subdivided into those with an urban cross-section (curbs and sewers), and those with a rural cross-section (ditches). This was due to the fact that urban streets are more costly to maintain than rural ones.

Table 1 summarizes the national level road inventory. The total length is almost 850,000 km, somewhat less than the conventionally reported figure of one million. This could be due to the fact that some jurisdictions often include unopened road allowances in their reporting.

For the purposes of the study, instead of using the actual length of the roads in the calculations, a 2-lane equivalent length was used instead. This made it simple to deal with roads having 3, 4, 6, or even 12 lanes on an equal basis.

UNIT COSTS

Once the national length, by road category had been established, the annual expenditure needs for each type was required. Costs per 2-lane kilometre for each of the activities described earlier: maintenance, resurfacing and reconstruction were determined by polling transportation experts across the country. These unit costs were determined for each province in Canada then weighted by the ratio of that provinces road length to the national road length.

It should be noted that these unit costs are for a typical kilometre in each road category. The categories used in the study are very broad and do not account for the wide variety of roadway types found in each category. For example, a typical provincial road in the northern most part of a province is probably much different from

Table 1 1985 road network length (km)

Roads under Federal Jurisdiction	
Freeway	77
Paved	1,853
Paved (urban)	360
Surface Treated	2,222
Gravel	9,248
Subtotal	13,760
Roads under Provincial / Territorial Jurisdiction	
Freeway	7,635
Paved	120,991
Surface Treated	27,763
Gravel	100,060
Earth	5,127
Subtotal	261,576
Roads under Municipal Jurisdiction	
Freeway	31
Paved (urban)	71,478
Paved (rural)	38,701
Surface Treated	34,614
Gravel	361,532
Earth	59,719
Subtotal	566,075
Total	841,411

one found in the southern part of the province. There are also major differences in municipal streets even within the same city.

Frequencies for resurfacing and reconstruction were determined in the same manner.

From this information it was possible to determine how much should be spent on a particular road type annually. Details are shown in Table 2. It should be noted that this amount represents what the transportation experts feel is the minimum amount needed to maintain the system.

Table - 2 Average annual cost per 2-lane km

Road Type	Maintenance	Resurfacing	Recon-struction	Total
Federal Roads				
Freeway	$11,000	$5,600	$9,400	$26,100
Paved	7,400	4,200	6,000	17,600
Surface Treated	5,300	1,800	4,100	11,200
Gravel	4,800	NA	NA	6,100
Provincial Roads				
Freeway	$11,100	$5,600	$9,400	$26,100
Paved	7,400	4,200	6,000	17,600
Surface Treated	5,300	1,800	4,100	11,200
Gravel	4,800	NA	1,300	6,100
Earth	3,200	NA	350	3,550
Municipal Roads				
Freeway	$21,500	$4,800	$11,500	$38,000
Paved(Urban)	6,000	3,200	10,000	19,200
Paved(Rural)	6,000	2,500	6,000	14,500
Surface Treated	3,700	500	2,500	6,700
Gravel	3,200	NA	1,100	4,300
Earth	600	NA	400	1,000

ROADWAY BRIDGES

A major component of our roadway investment is in bridges. There are over 57,000 bridges in Canada and the total replacement value exceeds $11 billion. Like the roadways they connect, bridges require annual maintenance, frequent restoration and ultimately complete reconstruction.

The procedure for the bridge component of the study was the same as that for the road component. Bridge experts from across the country were polled and asked for annual maintenance needs, restoration costs and reconstruction costs.

It was very difficult to tabulate the bridges into like categories and determine unit costs. The bridge engineers therefore simply reported average costs. They also each used their own definition for a bridge structure. Most jurisdictions define a structure as a function of its length and this varies from one jurisdiction to another.

ADMINISTRATION COSTS

In addition to the needs of the roadway network and the roadway bridges, another item was needed to finalize the minimum level of investment required and that was administration overhead. The definition of administration expenditures as prepared by RTAC's Highway Statistics Project committee (5) is as follows: "Administration expenditures are costs of service activities, which cannot be assigned on a consistent national basis to specific projects and hence to specific road type classifications".

Unlike the rest of the study which looked at needs rather than actual expenditures, it was impossible to define needs when it comes to administration. Each department has developed over time and has established its own unique structure. It was therefore decided that for the purposes of this study, administration needs would be equivalent to their actual expenditures.

Expenditures for providing administration services for the road and street infrastructure in Canada total approximately $672 million. To simplify the study, unit costs were increased by a percentage to account for administration. Federal and provincial needs were increased by 6%, and municipal needs by 10%.

TOTAL FINANCIAL NEEDS

The estimated average annual expenditures required to administer, maintain, operate, resurface and reconstruct the road system are shown in Table 3. The figures have been derived by multiplying the system length (adjusted to reflect 2-lane km) by the average annual needs (per 2-lane km) for each activity.

Table 3 - Minimum annual expenditure needs

Federal roads	Road needs	-	$ 124,267,000
	Structures needs	-	$ 60,400,000
	Total needs	-	$ 184,667,000
Provincial and territorial roads	Road needs	-	$ 3,420,530,000
	Structures needs	-	$ 264,500,000
	Total needs	-	$ 3,685,030,000
Municipal roads	Road needs	-	$ 3,965,323,000
	Structures needs	-	$ 262,200,000
	Total needs	-	$ 4,227,523,000
Total Canadian roads	Road needs	-	$ 7,510,120,000
	Structures needs	-	$ 587,100,000
	Total needs	-	$ 8,097,220,000

These estimates are based on an optimum, or least cost, approach to managing a road. If maintenance is not adequate, or resurfacing not carried out when needed, the road deteriorates more quickly and reconstruction is required sooner. Experience has shown that this is a more costly program and the annual expenditure needs will rise significantly from those shown.

HISTORICAL EXPENDITURES

In reviewing historical perspectives in highway expenditures, the study was immediately presented with the problems of lack of uniformity and consistency in statistics. The multiplicity of jurisdictions, differences in accounting and classification systems and complex intergovernmental transfer payments tend to render statistics somewhat confusing and largely inconsistent. In recognition of these inconsistencies every effort was made to ensure that data was double checked with the original source.

The historical expenditures for the Canadian road and street system are summarized in Table 4 for the period 1975 to 1985 inclusive. The figures represent the expenditures by the federal, provincial and municipal governments on maintaining the road and street network in their own jurisdiction. Grants and transfer payments have not been included. Neither have expenditures on airfields, ferry systems or communication systems which are often maintained by the same government department.

Table 4 - Canadian expenditures on roads and streets (x 000)

Year	Total $'s	1985 $'s	Total $'s	1985 $'s
	Including new construction		Excluding new construction	
75/76	$3,763,792	$8,108,390	$3,577,025	$7,690,690
76/77	$3,904,180	$8,026,631	$3,699,003	$7,576,326
77/78	$4,386,372	$8,335,986	$4,124,346	$7,807,213
78/79	$4,705,301	$8,285,977	$4,433,801	$7,782,124
79/80	$5,043,199	$8,205,537	$4,793,913	$7,781,127
80/81	$5,673,594	$8,123,301	$5,435,231	$7,759,155
81/82	$6,229,165	$7,505,853	$5,634,667	$6,801,461
82/83	$6,670,693	$7,626,531	$5,961,326	$6,816,832
83/84	$6,650,257	$7,247,551	$5,949,534	$6,475,694
84/85	$7,061,900	$7,187,500	$6,249,476	$6,367,682
85/86	Unavailable	Unavailable	Unavailable	Unavailable

The federal government expenditures were taken from the annual report of the interdepartmental highway committee (6) and verified by Transport Canada. The provincial and territorial government figures were compiled from each governments annual report then verified by a representative in that department. The municipal governments' figures were obtained from the Statistics Canada publication "Local Government Finance"(7).

To compare the expenditures over time and develop a trend, the expenditures have been converted into constant 1985 dollars. The calculation was carried out using a price deflator for government expenditures in highway construction and maintenance, calculated by Statistics Canada.

As can be seen from Table 4, national level expenditures on the Canadian road and street system peaked in 1977 at just over $8.2 billion but have been dropping ever since.

COMPARISON OF NEEDS WITH EXPENDITURES

The total Canadian roadway network needs were calculated to be $8.09 billion. This can be further broken down into:

Federal	$ 184,667,000
Provincial	$3,685,030,000
Municipal	$4,227,523,000

These figures represent how much each level of government needs to spend on its roadway network just to preserve the system. It does not take into account the increasing demands on the system and the need for new roads or the addition of additional lanes to relieve congestion.

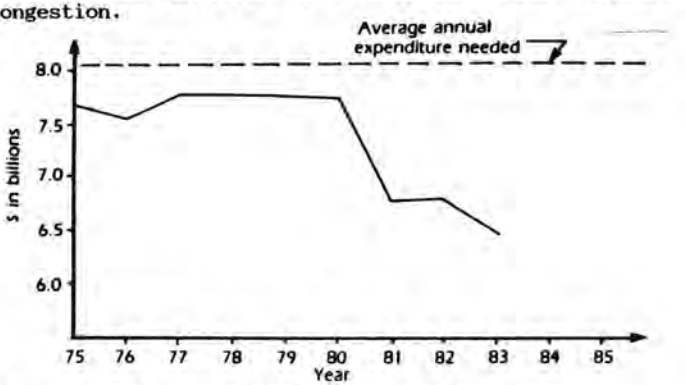


Figure 1 — Historical expenditures vs needs — total Canadian system preservation

The total Canadian roadway expenditures (exclusive of new construction) were found to be $6.49 billion, in 1985 dollars. This represents a shortfall of $1.6 billion or 25% of the calculated needs. As can be seen from Figure 1, the study also showed a downward trend in roadway expenditures.

CONCLUSIONS

The Roadway Information Study set out to assess the current levels of expenditure on the Canadian road and street systems and the levels required to maintain acceptable surface and service conditions. This was accomplished and a shortfall of $1.6 billion identified.

The study concluded:

1. There are very major shortfalls in the funds provided to preserve Canada's roadway system.

2. It must be made clear that these shortfalls cannot be corrected by a one time funding increase. These are shortfalls in annual budgets for maintenence and resurfacing purposes.

3. The implications of these shortfalls are serious. Inadequately preserved roads quickly deteriorate. Surface conditions become uncomfortable to drive and speeds reduce. The process is exponential, because rough surfaces cause significantly increased loading to the roadway structure, hastening deterioration. Ultimately, the road surface becomes impassable.

4. The impact is not only one of discomfort and inconvenience to the driver. Such a reduction of mobility has tremendous economic and social impacts.

5. Studies to develop optimum pavement management practices have clearly shown that delay in appropriate maintenence or resurfacing ultimately causes increased expenditures. At the extreme, frequent reconstruction is far more costly than implementing an appropriate maintenence program.

6. The technology is available to preserve our system, but adequate funding has not been provided to do so.

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THE BRITISH COLUMBIA RAILWAY AND ECONOMIC DEVELOPMENT IN BRITISH COLUMBIA

John M. Munro*

INTRODUCTION

The British Columbia Railway (BCR) and its predecessor, the Pacific Great Eastern Railway (1912-72) have been controversial government enterprises in British Columbia since the provincial government found itself the owner of a railway in 1918 after the builders of the BCR[2] found themselves unable to meet their debts, some of which had been guaranteed by the Province. The controversies over the railway have been various - including allegations of graft and undue political influence, mismanagement, and the proper developmental role of the railway.[3]

The purpose of this paper to attempt a new approach to interpretation of its role in B.C.'s development. Although the development of the Province's interior has traditionally been the major raison d'etre of the BCR and although the literature on the railway includes many detailed analyses of its operations and traffic and a few benefit-cost analyses of various segments of the railway[4], an ex post examination of the connections between the BCR and the growth of its Region (shown on the map) seems not to have been done.

The paper begins with a survey of the expansion of the BCR, concentrating on the economic objectives of each expansion. Then a simple model of the role of transport in regional economic development is presented. Empirical evidence on the nature of the growth process in the Region and the contribution of the railway is analyzed. An effort is made to relate the timing of railway expansion and other events with possible developmental consequences on the actual process of economic growth.

The working hypothesis in the paper is that the BCR was not a major catalyst in the development of the Region and that it is another example of transport being a necessary, but not a sufficient, condition for economic growth.[5] It is suggested that the key determinants of economic development in central and northern British

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2 The abbreviation BCR will be used to refer to both companies.

3 There are a variety of sources dealing with the history of the BCR. Among the most useful are Ramsey (1962), Royal Commission, volume 2 (1978), Ruppenthal and Keast (1979) and Select Standing Committee (1982).

4 For example, Heaver (1965) and Macdonald and Roggeveen (1974) both analyzed the BCR's Fort St. James extension.

5 Mythological aspects of the "transport is sufficient" view are discussed in Waters (1978).

Columbia were resource policies and supplies, world price levels, and industrial investment decisions.

The general time frame of the analysis is the post-war period, but particular attention is paid to the extensions north of Prince George. The forest industry is treated as the dominant and determining factor in the Region's economic development; in 1981 an estimated 25 percent of the Region's labour force was in the forest industry.[6] A concluding section of the paper summarizes the empirical results.

RAILWAY EXPANSION - THE EARLY YEARS

As first conceived in 1912, the BCR was to provide a connection between Prince George and Vancouver.[7] When the money ran out and construction ended in 1921, the railway ran from Squamish, 40 miles north of Vancouver to Quesnel, a village of 400 population located 75 miles south of Prince George.[8] The immediate commercial prospects for the railway were dismal - the area directly served was lightly settled and the requirement for water transport at the southern end and road transport at the northern[9] merely compounded the other disadvantages of the railway. A variety of proposals for rationalizing the BCR were considered[10] but the railway stayed as it was until 1949. So did the Cariboo-Central Interior region - between 1921

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6 This figure is for the Cariboo-Fort George Economic Region, not for the BCR Region as used in this paper. British Columbia, Ministry of Economic Development (1986), p. 330.

7 The reason for serious commercial interest in 1912, when construction began, was the arrival of the Grand Trunk Pacific Railway in Prince George and its desire to have a connection to Vancouver without using the Canadian Northern or Canadian Pacific. When the Canadian Northern and Grand Trunk Pacific ended up as fellow components of the Canadian National, these competitive considerations became irrelevant. See Roy (1980) for a discussion of this and other aspects of pre-1920 railway policy in British Columbia.

8 While there had been no construction at all between West Vancouver and Squamish, the grade between Quesnel and Prince George had been completed and a quantity of track laid. This was taken up and sold as scrap.

9 The development of transport facilities in B.C. before 1930 is surveyed in Harris (1983).

10 For example, a 1922 consultant appointed by the Minister of Railways proposed a number of draconian operating economies in an effort to remove the burden of the railway from the Province's taxpayers and place it on the shoulders of its shippers and passengers. See Sullivan (1922).

and 1941 its population increased at a slower rate than the whole province.

However, the dream of completing the PGE had never disappeared and when World War II ended a number of studies were completed concerning the potential which would be realized if the BCR could be completed to Prince George and perhaps, eventually to the Peace River country of northeastern B.C.[11] In 1949 construction was started on the connection to Prince George and by the end of 1952 the first trains were operating. In 1956 the difficult southern gap between Squamish and North Vancouver was filled and the railway originally visualized by the BCR's promoters was in place. This was not the end, however. By 1958 another 323 miles of line had been completed to connect Prince George with Dawson Creek and Fort St. John. With these extensions the BCR was carrying over four times the freight tonnage it had ten years earlier and the Region's population had almost doubled (see Appendix I). "RAILWAY TO THE NORTH"

These extensions had all been built to established centres of economic activity - while they often traversed areas which were barren of traffic potential, at least there was something at the far end. By the middle 1960's, the question was, where next? The areas to the west of the BCR were either served by Canadian National or were largely uninhabited. North of the BCR there was an equally tiny population but the building of the Alaska Highway and other development roads had been followed by some increase in population and economic activity and it was believed that this vast region - 40 percent or so of the province's area -had great natural resource potential.

With an eye on these opportunities, the provincial government decided to build the BCR into these areas. The first two extensions were relatively modest lines to serve the pulp mills at Mackenzie (1966) and the sawmills at Fort St. James (1968). In the late 1960's, construction was begun on the 250-mile extension from Fort St. John to Fort Nelson, a project whose immediate commercial justification was very weak and whose long term development potential was also questionable. This line was opened in 1971.

The major venture of this period was, however, the Northwest extensions of the railway. In the late 1960's the railway began construction of a line from Fort St. James to Dease Lake, a distance of 413 miles. The rationale for this extension was rather complicated. The provincial government wished to provide improved access to the substantial mineral resources of northwestern British Columbia and it wanted this to be provided by the BCR, not

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11 These are summarized in British Columbia, Department of Railways (1949).

the Canadian National.[12] As a more difficult, and substantial, construction project than the lightly-built Fort Nelson extension, building the Dease Lake extension extended well into the 1970's, well beyond the first target completion of 1974.

A long term political and financial objective of successive B.C. provincial had been to secure federal government assistance with the construction and/or operation of the BCR. After prolonged discussions with the federal government, whose specific interest in northern B.C. stemmed from their ownership of Canadian National Railways and the facilities at the port of Prince Rupert, the Northwest Rail and Port Agreement was signed in February, 1973.[13] It provided for federal assistance with the capital costs of the Dease Lake extension and a jointly-financed network of still more new railway lines in the North totalling almost 500 miles. Most of these were to be operated by the British Columbia Railway.[14]

None of the northwest projects turned out as planned and most of them were never built. In 1977 construction was finally suspended on the Dease Lake extension with track still 177 miles south of there and none of the joint projects proposed in the 1973 agreement were ever built, although some federal assistance was received for the Dease Lake extension. By this time the Fort Nelson extension was also proving to be a major source of concern; inadequate construction and light traffic combined to make its operating costs very high and its revenues very low and suggestions that it should be abandoned were heard. Moreover, the financial burdens of the large expansion programs of the previous ten years had pushed the railway into deep financial difficulty, a particular concern for the government at a a time of

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12 Interestingly, studies done in the 1980's on improved transportation to serve the coal and metal resources of northwestern B.C. have concluded that road access to the port of Stewart or, in some cases, railway connection to the CN line at or west of Hazleton is preferred over use of the BCR right-of-way to Dease Lake. B.C. Ministry of Transportation and Highways (1983).

13 The agreement was partly based on the recommendations of the Transport Canada study, Northwest Transportation Plan - 1972, but went beyond them in proposing construction of railways beyond Dease Lake.

14 Also included in the agreement was the construction of a jointly-funded connecting line from Clinton on the BCR to Ashcroft on the CP and CN. This project had been discussed for decades but it had previously been rejected for two reasons - steep grades and its effect in making the southern 325 miles of the BCR redundant.

general slowdown in the provinciale conomy and government revenues.

A NEW VISION - THE 1978 ROYAL COMMISSION

The government's response was to appoint a Royal Commission to investigate all aspects of the BCR's financing and operation and to consider its role in the economic development of the province. After 18 months exhaustive investigation, the Commission reached a series of conclusions concerning the BCR. The basic conclusion of the Commission was that "...the cost of the railway to the province is out of all proportion to any economic or social benefits conferred on the public... ." Its most drastic proposal was that the best interest of the province would be served by the transfer of the BCR to the CN. Otherwise, according to the Commission:[15]

1. There was no significant potential for future use of the BCR as a provincial development tool.
2. The problems of the BCR had in large part been due to the political nature of its direction which resulted in unbusinesslike and unrealistic management of its affairs.
3. The BCR's business function was limited to serving as a feeder line to the Canadian National at Prince George for mills located between Williams Lake and Mackenzie.[16]
4. Unless rvenues could be increased, all of the Dease Lake extension and the line from Chetwynd to Dawson Creek should be abandoned. The same solution might prove necessary for the southern portion of the mainline from Williams Lake to North Vancouver at some time in the future.
5. The BCR should be made a genuinely autonomous Crown corporation and its rates and service should be regulated by an independent commission.
6. Appropriate government assistance should be provided, including refinancing the debt ($700 million in 1978) and subsidizing the railway for uneconomic lines or services which the government required it to provide[17] and its shippers for any adjustment burdens associated with rationalization of the railway.

While these conclusions were not specifically adopted, it is reasonable to say that the point of view of the Royal Commission concerning the appropriate development role of the BCR and its financing and

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15 These are taken from Royal Commission (1978), volume I, Part II.

16 In 1981 about 55 percent of the BCR's carloads originated on this 20 percent of the railway. Select Standing Committee on Crown Corporations (1982), p. 3-7.

17 The government had already rejected an interim recommendation from the Commission that the Fort Nelson extension be abandoned.

operation has been reflected in subsequent government policy actions.

Before summarizing these actions, it is necessary to review the role of the BCR in the Northeast Coal Project. This highly controversial megaproject was designed to exploit the large coal resources south of Dawson Creek in northeastern B.C.[18] After lengthy, complex negotiations involving the provincial and federal governments, the mining companies, and Japanese coal customers, the decisions to proceed with this $2.9 billion project were taken in 1981. The BCR has had a very substantial role in the project. The construction of a $420 million branchline from the railway mainline 75 miles north of Prince George to the mine sites at Tumbler Ridge was the largest component, but the upgrading of the mainline portion of the BCR's haul to handle heavy coal unit trains cost a further $60 million. An additional $50 million was needed for BCR's share of the train equipment.

Although in outline the Northeast Coal project may seem like yet another developmental gamble for the BCR (and a clear rejection of the Royal Commission's point of view), in fact the financial and economic background was quite different from earlier ventures. The development to be served by the railway was to produce a guaranteed tonnage for an extended period of time at a price that was contractually set between the mines and the Japanese coal customers. This permitted the BCR to have a reasonable assurance that given levels of capital and operating cost could be covered from future operating revenues, a situation quite different from, say, the Dease Lake extension. (That this may not turn out to be the case is a further illustration of the problems of resource-dependent economies; the possible consequences for the BCR will be discussed in the last section of the paper.)

Other major events affecting the BCR since the Royal Commission are as follows. In 1978 the first non-political President of the BCR in over 35 years was appointed and the relationships between the government, the Board of Directors and BCR management began to be arranged on a more business-like basis.[19] While all the lines are still operated, service has been reduced beyond Fort St. James and freight rates increased. Also, in 1984 the government partially recapitalized the BCR. At this time its classification was changed from an "Economic Development Crown Corporation" to a "Commercial Crown Corporation."

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18 There are many sources of information concerning this Project. This section is based on British Columbia, Ministry of Industry and Small Business Development (1982).

19 See Select Standing Committee (1982), Chapter 2.

The BCR's history shows a series of visions of its developmental role. The "early pioneer" vision lasted from 1912 to 1916. This viewed the building of a railway almost anywhere was believed as a guarantee of economic success - the land was rich and the only barrier to development was inaccessability. The "retrenchment" view prevailed from 1917to 1940. Its stern message was that the drain of an unsuccessful Crown corporation on the taxpayers must be controlled. Then came the "expansion to the North" view from 1945 to 1977. This held that in order to be financially viable and developmentally influential, the BCR must first reach established centres of economic activity and then extend beyond them into areas with natural resource potential. Since 1979 the "commercial" view has been dominant. now, a provincial railway is a commercial venture and it must be profitable if it is to be economically successful.

A THEORY OF TRANSPORT AND DEVELOPMENT IN A RESOURCE-RICH REGION

Regions whose economy is based on generally immobile natural resources have an important difference from those with a broader economic base. Regions whose productive resources are mainly capital and labour can change the supplies of either through interregional flows. A region which uses large quantities of natural resources in production is left with immobile resource inputs and perhaps the capital and labour associated with them. Regions which are both resource-intensive and open (in the sense of producing for export markets) have another characteristic - they are more vulnerable to external shifts in market demand.

The model follows this approach; as well it emphasizes the role of transportation. This emphasis is appropriate for many resource industries because transport costs are a more important part of their prices. In the case of the wood products industry, the Canadian average for the ratio of domestic transport costs on raw materials and finished products to the delivered product price was 11.28 percent for domestic sales and 19.53 percent for export sales.[20]

The structure of the model is shown below.

(1) GDP = f(EXP)
(2) EXP = f(PRD COSTS$_i$, TRANSP PRICES, MKT PRICES$_i$)
(3) TRANSP PRICES = f(RAIL COSTS, TRUCK COSTS, POLICIES)
(4) RAIL COSTS = f(RAIL INVEST, r, WAGE, RAILEFF, GDP$_{reg}$)
(5) PRD COSTS$_i$ = f(OUTPUT$_i$, GDP$_{reg}$, r, WAGE, RMPRICE$_i$)
(6) RMPRICE$_i$ = f(HARVEST COST, TRANSP PRICES)

20 Skoulas (1981), Table A2. This is 1974 data. Ratios for the pulp and paper industry are about 9 percent for both domestic and export sales. Mining had higher ratios and most manufacturing industries lower ratios.

where:
GDP = gross domestic product
EXP = exports
PRD COSTS = production costs
TRANSP PRICES = price of transportation
MKT PRICES = delivered price of exports
RAIL COSTS = unit cost of railway trasnportation
TRUCK COSTS = unit cost of truck transportation
POLICIES = regulatory and carrier pricing policies
RAIL INVEST = total railway capital invested
RAILEFF = degree to which actual railway unit costs are at the lowest attainable level
r = cost of capital
WAGE = average wage level
RMPRICE = price of raw materials
HARVEST COST = unit cost of extracting resource commodities
and the subscript i refers to regional industries.

THE GROWTH OF THE BCR REGION

Is it possible to short-circuit the model and explain the Region's economic development directly from the extensions of the British Columbia Railway? That was, after all, the major public rationale offered for many of these projects. Appendix I provides data on the grwoth of the Region. We note that there has been substantial growth over this 34-year period. Population has increased four times and estimated regional GDP in nominal terms has risen from $104 million to $4.4 billion ($794 million in real terms). Both measures have grwon faster than the provincial average - the Region's share of B.C.'s population increased from 4.4 percent to 7.8 percent over this period. It is, however, difficult to make effective connections between the BCR's extensions and growth in the Region using either intuitive or statistical methods. Inspection of Appendix I in light of the extension timings discussed earlier reveals that the fastest growth rate in regional population occurred before any of the extensions north of Prince George could reasonably have been expected to have much impact. In the 1970's, when the impact of the various extensions might have been expected to be greatest, the rate of population increase was much lower than in the 1950's. Estimation an equation regressing revenue per ton and a dummy variable for pre- and post-1960 years also showed a weak result for the impact of the extensions.

(8) GDP = -166051.7 + 228236.7 REVPERTON + 224079.0 DUMMY
(-1.44) (6.14) (0.77)
$RBAR^2$ = .530; D-W = 1.07

So, while the BCR Region has shown substantial grwoth, we must delve more deeply into its possible causes.

TESTING THE MODEL

The use of this model in this paper will be heuristic rather than analytical. There are, however, several aspects of the relationships hypothesized in the model which can be examined, at least for the forest industry, which dominates the BCR Region.

1. The level of regional GDP depends on the level of regional exports.[21]
2. The level of exports depends on production costs, transport prices, and market prices.
3. Transport prices depend on railway and government policies as well as on railway costs.[22]
4. Rail costs depend on investment, the costs of capital, wage levels, traffic levels, and management efficiency.
5. Production costs are determined by the costs of inputs (including transport of raw materials) and are influenced by scale economies associated with output levels in each industry and in the region as a whole.[23]

First, we examine the relationships between GDP and exports. A test of the export base theory for the British Columbia economy shows that the relationship between the rate of growth of GDP and the rate of growth of exports is as follows:[24]

(7) DGDP = .0465 + .315 DEXPORTS
(5.43) (3.83)
$RBAR^2$ = .441; D-W = 1.77

A more comprehensive general equilibrium model developed by Percy (1986) shows a strong relationship between the value of output in the forest industry (most output is exported) and aggregate economic activity, there measured in terms of real incomes. So, while we do not have the data to test this particular hypothesis for the BCR Region alone, other evidence suggests that it is well-founded empirically.

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21 In practice, the nature of the connection between any single industry and the growth of the regional economy is quite complex. For a study of the pulp industry in the B.C. interior see Barr and Fairburn (1973). This study notes a failure of this industry to develop very many linkages with other regional industries in the manufacturing and service sectors.

22 "Transport prices" are an average across the modes - for this Region, rail and truck. The implication is that prices for each mode are influenced by the costs of both because the two modes are at least partial substitutes for each other.

23 This "feedback" feature places this model in the class of cumulative caustaion models of regional economic growth. See Armstrong and Taylor (1985), pp. 65-74.

24 The data is calculated from British Columbia Economic Accounts. T-values are shown in parentheses.

546 Testing the hypothesis of equation (2) concerning the determination of the level of exports is more difficult. The only available measure for BCR Region exports is the total timber harvest.[25] Use of this measure implies both the dominance of forest products in the Region's exports and the dominance of exports in the Region's forest products output. Both assumptions are reasonable. We do not have consistent information on production costs and the exploration of the factors which determine the level of exports (total forest harvest) will have to be based mainly on transport prices and market prices. Table 1 presents information concerning the trends in harvest, transport prices, and market prices over the 1952-82 period.

TABLE 1
TRENDS IN FOREST HARVEST, BC RAIL PRICES, AND MARKET PRICES, 1952-82
(1952 = 100)

	Harvest	BC Rail Prices	Forest Products Market Prices	GDP Deflator
1952	100	100	100	100
1957	131	113	103	108
1962	189	111	102	116
1967	256	95	118	136
1972	486	93	127	175
1977	795	139	286	301
1982	841	231	243	459

Sources: Harvest from B.C. Forest Service Annual Reports; B.C. Rail Prices are revenue per ton from Appendix I; Market Prices from Statistics Canada Historical Statistics 1952 and 1957 for Canada and wood and paper and allied industries implicit GDP deflator for B.C. for other years from British Columbia Economic Accounts; GDP deflator from same sources.

Table 1 shows an erratic pattern of change in all four measures. The most consistent pattern is the growth in harvest, at least from 1957 to 1977. The most inconsistent pattern is the trend in BCR prices, generally constant for the first twenty years and then increasing quite sharply, especially after 1977 when the rate of increase was gretaer than the increase in the general price level. Market prices for forest products were surprisingly stable until the 1970's. While the data used is far from ideal, the influence of higher market prices on harvest levels does not seem to have been very significant in the 1950's and 1960's. A rough conclusion from this data would be that factors other than transport prices and market prices stimulated the growth of the

25 The statistics are available for the Prince George and Cariboo Forest Districts, a reasonably good approximation of the BCR Region.

forest industry in the BCR Region in the 1952-72 period and that in the 1972-82 period the stimulative effect of higher market prices outweighed the negative effect of higher transport prices. The missing variable in all this is production costs - equation (5), which will not be tested in the paper offers several possible explanations for declines in production costs.[26] Another influence would be the policies of the provincial government in allocating and charging for the rights to harvest Crown timber.[27]

The third area of inquiry is the influence of company and government policy on railway prices. We have already seen that the BCR followed a steady freight rate policy through 1972 - an interesting counterpart to some of the freight rate freezes imposed on the federally regulated railways during this period and, indeed, to the Crow's Nest Pass grain rates. Although BCR rates are regulated under the provincial Railway Act (R.S.B.C. Chap. 354) there is no regulator except the Minister, since the mid-1970's the Minister of Transportation and Highways. While BCR rates are supposed to meet certain non-discrimination tests which are spelled out in section 217 of the Act, it is not clear how these are applied or what the process of regulation actually involves. It seems likely that decisions by the BCR concerning the level of its freight rates were for the pre-1979 period made on a political or developmental basis and that since that year they have been made on a commercial basis.[28]

It is also possible that various operating economies permitted the BCR to follow a low-price policy for this long period. Table 2 shows the changes in operating expenses per ton and per ton-mile between 1952 and 1986.

26 A useful analysis of some of these influences is in Nilsson (1985).
27 There were changes in these policies around the time the Region's six pulp mills were constructed.
28 It is important to note that most BCR traffic is interlined and that the railway does not have full control over its rate structure and only receives an average of about 35 percent of the prices paid by it shippers.

TABLE 2
BCR OPERATING EXPENSES, 1952-86
(1952=100)

	Per Ton	Per Ton-Mile	Haul
1952	100	100	100
1957	110	131	84
1962	82	68	121
1967	72	59	124
1972	78	73	106
1977	163	118	138
1982	210	153	138
1986	167	165	101

Sources: As for Appendix I.

The trends in costs per ton and per ton-mile are quite similar, another way of saying that BCR's average haul has not changed very much over this 34-year period. While the data on expenses must be regarded as somewhat unreliable and inconsistent because of BCR accounting practices and the treatment of government subsidies of various types, it is clear that the railway did lower its unit costs through the 1960's. These may have been due to new technologies or on economies of scale (tonnage tripled during the 1960's). This may explain the pricing policies of this period. It cannot, however, explain why freight rates were kept so low through most of the 1970's while costs were rising.

Data from later years suggests that commercial and financial considerations now guide the setting of BCR's freight rates. The National Transportation Act of 1987 should further encourage this approach. Although the NTA does not apply directly, it cannot help but have an impact as, indeed, the earlier Staggers Act rail deregulation in the United States did. As an originating carrier of long-haul traffic, the policy regimes of connecting jurisdictions are very important to the BCR.

CONCLUSIONS

An interesting recent event is the exclusion of the BCR from the government's current privatization program, although it would seem to have been an appropriate candidate. One possible explanation for its exclusion is that the railway is still receiving various government assistance ($15 million in 1986) and it might not have been attractive to purchasers for this reason. Another reason is the emerging financial difficulties of the Northeast coal project because of falling world coal prices - now about 30 percent below the levels specified in the contracts between the mines and their Japanese customers. The Japanese have insisted that the price must be reduced, the coal companies have stated that any reductions would force them to cease operations, and the dispute is now proceeeding to commercial arbitration. Meanwhile, the mines' auditors have required them to write

down their investment in the project to zero. For the BCR, the demise of this project would place it in as serious financial difficulty as the worst years in the 1970's. Perhaps the lesson of this is that transport companies are never insulated from the economic problems of their customers, whatever the label, "developmental" or "commercial", attached to them.

The BCR was given a developmental mission in its first days and this has controlled most of its decisions and operations over its 76-year history. Despite this, the actual process of economic development in the region it serves has been much more complex and it is not possible to single out a clear path by which the influence of the BCR has affected the pace of economic growth.

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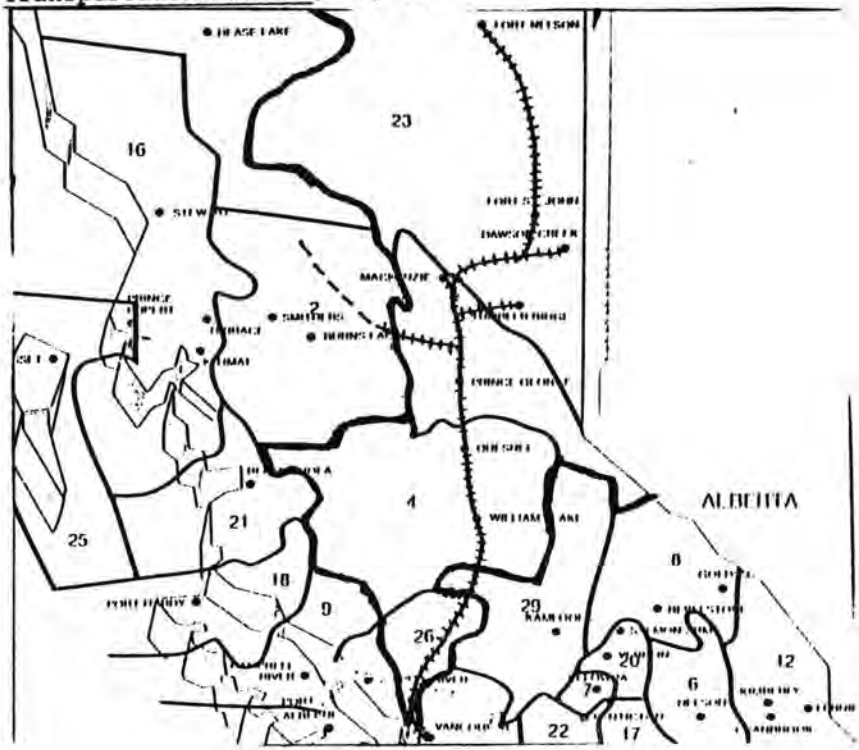
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APPENDIX I
STATISTICAL INFORMATION CONCERNING THE BCR AND THE REGION

	Tons Carried ('000)	Total Revenue ($mill)	Revenue Per Ton ($)	Regional Population*	Regional GDP ($mill)
1952	444	3.14	7.07	55,369	104
1953	623	4.15	6.66	60,197	118
1954	809	4.88	6.03	65,446	131
1955	1057	6.11	5.78	71,153	149
1956	1230	8.81	7.16	77,320	175
1957	1094	8.77	8.02	81,457	190
1958	1206	9.57	7.94	85,774	199
1959	1572	12.38	7.88	90,320	217
1960	1610	12.63	7.85	95,107	231
1961	1704	13.69	8.03	100,141	248
1962	1764	13.90	7.88	106,700	277
1963	2302	16.84	7.32	113,689	309
1964	2326	18.12	7.79	121,136	354
1965	2758	18.16	6.58	129,070	412
1966	2772	17.86	6.44	137,473	470
1967	3564	23.95	6.72	141,858	511
1968	4131	25.82	6.25	146,383	562
1969	4584	28.07	6.12	151,053	640
1970	4774	30.99	6.49	155,872	668
1971	5728	37.98	6.63	160.798	757
1972	6744	44.30	6.57	166,555	877
1973	8002	45.72	5.71	172,518	1100
1974	6292	42.04	6.68	178,694	1298
1975	6439	50.50	7.84	185,091	1449
1976	6801	55.09	8.10	191,843	1761
1977	8283	81.40	9.83	197,733	1999
1978	8842	92.67	10.48	203,803	2265
1979	8599	99.63	11.59	210,060	2671
1980	8664	119.33	13.77	216,509	3045
1981	8323	125.88	15.12	223,074	3512
1982	8024	131.00	16.33	223,788	3565
1983	9347	171.00	18.30	224,504	3759
1984	14672	222.00	15.13	225,222	3938
1985	17832	260.00	14.58	225,943	4142
1986	17854	279.00	15.63	226,579	4399

* The BCR Region includes the Cariboo, Fraser-Fort George, Peace River-Liard, and Squamish-Lillooet Regional Districts

Sources: Tons Carried - Statistics Canada, Railway Transport, Part IV (SC 52210) 1952-81 and BCR, Annual Reports, 1982-86; Total Revenue - Statistics Canada, Railway Transport Part II (SC 52208) 1952-81 and BCR, Annual Reports, 1982-86 (with adjustments); Regional Population - Census of Canada, with intercensal years estimated from exponential growth rates; Regional GDP - estimated from B.C. GDP according to region's share of B.C. population (B.C. GDP from Provincial Economic

Strategically positioning tomorrow's transportation systems

VISION, ENVIRONMENT & STRATEGIC DIRECTIONS

I. INTRODUCTION

The volatility of the present world-wide economic environment creates a high risk that decisions made today about transportation infrastructure requirements may not produce the transportation system that we need tomorrow. Given the long life of much of our transportation infrastructure and the high cost of putting it in place, we need to increase the certainty that we are indeed building for the future.

A major factor in Alberta at the present is the continuing legacy of the boom years, both in terms of an infrastructure which was expanded to meet growth needs and in terms of lingering remnants of high expectations. This creates the dilemma that strategic policies need to be developed by the department to deal with current financial constraints, but there is not yet agreement about whether Alberta is merely riding out the storm or is moving to a different level of economic activity for the foreseeable future. Strategic directions are needed which have a high probability of leading to annual transportation investment decisions which stand the test of time. In this way Alberta Transportation & Utilities will strategically position itself to deal with the future. As Michael Meyer says in "Strategic Planning in response to Environmental Change, "Public managers require the information that comes from strategic planning so that they can position their agency to meet the changing needs of the constituencies they serve and address the problems/opportunities of the agency's environment.[1]

This paper provides a conceptual framework for achieving strategic positioning, in Section II, and reviews the process being used at Alberta Transportation & Utilities within the context of that conceptual framework in Sections III and IV. Conclusions are presented in Section V.

If the terminology used in the conceptual framework feels foreign to practical transportation experts, it isn't to be wondered at. It isn't that long ago, after all, that visions were the territory of the psychic, the religious leader, the hallucinagenic generation. Today, however, we are told that visions are set by the astute CEO, guiding "excellent" companies and "Disney-ized" employees alike. Likewise scenarios used to take place on the stage, and strategies on the battlefields of war. Today scenarios are internally consistent, plausible hypotheses about the future, and strategies pilot an organization to its destiny through turbulent times. We live in interesting times, indeed, when the language of management is so lively.

Merriene Duncan

II. VISIONS, SCENARIOS, STRATEGIES: Strategic Positioning

The conceptual framework for strategic positioning includes the vision/mission, visioning/futuring/scenarios, and the determining of strategic directions. This is the front end of strategic management, taking an organization to the point of knowing what strategies it intends to pursue. The objective of this stage of the planning/management effort is to correctly position the organization, given the best knowledge of the organization and the future. For a transportation organization, the life of the infrastructure is up to 50 years. Changes come both slowly and in radical shifts. Therefore strategic positioning is vital in terms of ensuring that public monies are wisely spent. Being strategically positioned to manage a transportation system, then, results from developing strategies which deal with emerging trends.

Vision

In today's organizations, having a vision is widely viewed as a pre-requisite for success. Vision can be defined as a common purpose, a unifying force throughout the organization, which inspires and motivates workers and helps top managers organize their own thoughts and actions; or, as one executive put it, to know, to the bottom of his soul, what he is trying to accomplish.[2]

As Jef Mason has put it in "Developing Strategic Thinking, "In most successful enterprises the top management and many employees have a clear sense of what they stand for. ... "Motivation comes from clarity of purpose. Interdepartmental conflicts can be more constructively resolved by reference to superordinate goals. The vision of what can be achieved has to be broad enough for others to develop their own goals within it. ... Providing the clarity of a detailed vision while leaving room for individual goals and ideas from middle management is a priority task.[3]

Craig Hickman and Michael Silva, in The Workbook for Creating Excellence, recount the experience of one company: "At the meeting in Vermont ... Marshall wanted to turn everyone's attention to the company's future. ... he chose to involve his key people in the process ... thereby ensuring their full commitment. ... Of course, they didn't cement commitment to a common purpose during a few scant days in Vermont, but they did lay the foundation.
"Why do some executives ... work so hard to imbue their organizations with a commitment to a common purpose? Quite simply, such executives are aware of the crucial role commitment plays in building a strong corporate culture. Too many executives immerse themselves so deeply in the mechanics of their businesses that the details drown the fundamental principles that spur people to accomplish extraordinary feats. No fundamental principle should preoccupy executives more than developing commitment to a common mission. Such dedication results in "people power", the strongest force any organization can hope to harness.[4]

An organization without an articulated, communicated vision may nevertheless have a vision if it is a stable organization with a clearly understood product. In today's environment, it is probably not safe for an organization to assume that a vision exists if it is unstated.

The vision is often expressed through a mission statement. As Hickman and Silva state, "Once you have stated your company's vision, you will want to make sure everyone in the company understands it and is committed to it. Unless they understand it, people won't embrace it. Given the subtlety of a good mission statement, you must take steps to draw out its implications in detail. ... In a missionless environment, every employee usually interprets the company's purpose differently .... If you developed a mission statement years ago, you must regularly reaffirm it. Some people forget the statement, others veer off in new directions, and new people ... come on board. ... To be sure, not everyone in the organization will understand your purpose to the same degree, but everyone can grasp its essence."[5]

A mission statement is also important to a public sector agency. The public sector faces the same problems in defining its mission as the private sector: Too narrowly defined and there's too little scope; too widely defined and it gives no direction; incorrectly defined and it provides the wrong direction. In government, as in the private sector, it may be tempting to define a department's mission all inclusively. However a mission that differs considerable from the closely held mandate of the organization's managers and staff is difficult to subject to Hickman & Silva's process, above, without engendering more cynicism than pride. Getting a good mission statement should therefore be a prime task.

If the vision is to be maintained, in the words of Jef Mason, "Leadership by example is paramount. Experience of a few managers who planned brilliantly, and even one or two who communicated well, demonstrates that without direct intervention or modelling they could get a major strategy going but not carried through. Action speaks louder than words and through the lack of direct example other managers lost faith in the strategy. For the top manager all actions are symbolic. What she or he does will be analysed and interpreted and copied. ... The essentials of the corporate vision have to be maintained day in day out."[6] Successfully communicating the vision should greatly enhance managing strategically.

All great leaders have had a vision, albeit some visions have been a bit faulty on occasion, the most obviously, and publicly, faulty visions coming from military leaders such as Napoleon or Hitler. The vision of a private or public sector organization's leader, in comparison, would not only be widely communicated, but ideally would be well grounded in a solid grasp of the organization's capabilities vis-a-vis its potential future. The next section deals with establishing an information base for strategic positioning.

Scenarios

Good information creates a solid basis for developing a vision, as well as a plan, since a lack of reality tends--sooner or later--to end in failure. Information can be gathered and presented in different forms. Futuring or visioning (clearly related to, but not to be confused with, the vision or mission) are techniques used to look deeply into the future. For example, the Canadian Air Command conducted a major futuring exercise out to the year 2010, to facilitate the readiness of the Air Force to face the next century.[7] Through their extensive networking in gathering and validating their data, they generated widespread interest by other organizations similarly embarking on trying to see into the future.

While there is a great deal of uncertainty about anything that far off, through visioning, or futuring, there will be a number of emerging trends that point to certain conclusions about the world at some future point in time. Transportation infrastructure has lifespans of up to 50 years; thus any transportation agency would benefit from anticipating, today, the major shifts we need to prepare for. The objective of visioning or futuring is to be able to develop a "rear-view mirror" image of the future, so as to best position the organization for the short and long term. By working from the future backward, instead of the present forward, it is easier to avoid the traps caused by simply extrapolating trends.

Scenarios are a powerful way of organizing the information needed to chart a future course. Furthermore, scenarios are often preferred to forecasting, today, given the unreliability of forecasts. Scenarios seem to mean different things to different people, but basically are ways of encouraging the consideration of two or more alternative outcomes.

Lester Neidell summarizes the content and benefits of the type of scenarios being used at AT & U: "There is a focus on the wide range of possibilities that could affect the future. "Scenarios are one way to force ourselves and others to plunge into the unfamiliar and rapidly changing world of the future....They are one of the most effective tools in lessening the carry-over thinking that is likely ...."" As he outlines it, consideration should be given to specific political, socioeconomic and technological factors that ordinarily might not be considered; complex interactions of many elements, such as cultural, military and political, can be studied simultaneously; alternative outcomes of historical and present events can be scrutinized. "To summarize, a scenario is more than a set of forecasts.... The scenario occupies a position somewhere between a forecast collection with interrelationships that have not been examined and a mathematical model with internal consistency that can be rigourously examined. Scenarios clarify the **collective** impact of a set of forecasts by considering **some** of the interactions."[8]

Shell Oil proved rather dramatically that scenarios can assist a company to position itself for an impending change. They did this by gaining an appreciation of the underlying forces that were not yet highly visible, but which were developing enough strength to radically alter the future.[9] Using Shell's approach, ideally two or three scenarios are developed, showing that if one set of pre-conditions develop, the future portrayed by that scenario has a very high probability of occuring. This approach can be used by management to enable an organization to examine its assumptions about the future, by ascertaining to the best of its ability which set of pre-conditions are actually occuring.

Strategic Directions

If, comparatively prosaically, visioning and scenarios provide the information base about the future, and vision provides the heart and soul for an organization, strategic directions are the driving forces that lead to the delivery of an end product. Strategic directions differ from a strategic plan in that they point the way, i.e., set **directions**, rather than being prescriptive. The strategic directions should be selected for their ability to position the agency appropriately for the future.

Derivation of strategies varies from organization to organization. Strategic plans, strategic directions, strategic management, strategic thinking, strategic opportunism, crafted strategy, emergent strategies, strategic positioning[10]: the list goes on. Some of these strategic "whatevers" seems to defy the logic inherent in the word "strategy".

What is now perceived as a traditional approach to strategic planning calls for an organization to start from a mission which defines the business it is in, conduct environmental scanning, evaluate opportunities and threats, develop a set of strategic objectives, follow up with an implementation plan (including, but not limited to, resource allocation), and monitor success.

Strategic management is the organized application of strategic thinking on a day by day basis, which usually entails using a strategic plan for orientation but not being enslaved by it. To use an academic term, strategic management is a necessary, but not sufficient, condition for achieving strategic positioning. Strategic directions outline the details of strategic positioning. It is indeed a bit of hair-splitting to differentiate all the "strategics" since all are oriented toward setting and implementing strategies to ensure the long term survival and/or success of an organization.

Typically, after the first intensive effort at developing a strategic plan, the organization would then settle back into an annual cycle, which, if due care is not taken, tends to evolve into a bureaucratic ritual.[11] Several strategists, perhaps in a legitimate effort to keep the process dynamic, have developed the derivatives from strategic planning listed above. Daniel Isenberg, in "The tactics of strategic opportunism," goes perhaps too far away from having explicit strategies, but in the process provides some valuable insights. For starters, he suggests that, "Failing to think strategically has a price, of course, as the communications executive acknowledged: "Sometimes I feel like a rhinoceros who doesn't see well and whose power of concentration is terrible; he charges at something that's a long way off, then forgets where he's going and stops to eat the grass."[12] Strategic positioning ought to at least keep the rhinoceros--or the executive--pointed in the right direction.

One of the more interesting "non-planning" expositions is Henry Mintzberg's, "Crafting strategy", in which he touts emergent strategies. Emergent strategies are strategies that are not yet fully formulated, but are emerging--probably in small pieces--and will be recognized as explicit, or deliberate, strategies, at some time in the future when they are fully defined. This concept of emergent strategies fits the strategic directions/strategic positioning model. Compared with traditional strategic planning, strategic positioning is more dynamic since it rests on emergent strategies rather than on clearly defined strategies. Emergent strategies must be, by nature, more or less fuzzy until they are fully emerged. Furthermore, since they won't all be at the same level of development at the same time, it is unlikely that there would ever be a full-blown, totally defined, traditional strategic plan.

The lack of a concrete strategic plan, however, should not prevent a department from having a high level of confidence in the strategic

directions that represent emergent strategies that are fairly well developed. And the process of facilitating the continued development of strategic directions on an annual basis ensures that the organization continues to check its strategic positioning on a timely basis and that emergent strategies remain allied with emerging trends. Within this context of setting strategic directions, then, the strategist is a "pattern recognizer". As Mintzberg postulates, "So-called strategic planning must be recognized for what it is: a means, not to create strategy, but to program a strategy already created--to work out its implications formally.[13]

To keep strategies aligned with trends requires conscious effort. First, managers must recognize the need for change. To quote Mintzberg again, "To manage strategy, then, at least in the first instance, is not so much to promote change as to know **when** to do so." He goes on to point out, "The real challenge in crafting strategy lies in detecting the subtle discontinuities that may undermine a business in the future. And for that, there is no technique, no program, just a sharp mind in touch with the situation. Such discontinuities are unexpected and irregular, essentially unprecedented. They can be dealt with only by minds that are attuned to existing patterns yet able to perceive important breaks in them. Unfortunately, this form of strategic thinking tends to atrophy during the long periods of stability that most organizations experience. .... So the trick is to manage within a given strategic orientation most of the time yet be able to pick out the occasional discontinuity that really matters. " ... The ability to make that kind of switch in thinking is the essence of strategic management."[14]

Jef Mason makes a similar point. "In many organizations attention is drawn to the urgent and immediate. The longer-term implications of current action are often not considered. The focus on the immediate can become a habit and the skills of reflecting on the future and thinking in depth atrophy. It then becomes almost painful for a manager to be required to think in this way ..."[15]

Mintzberg's focus on knowing **when** to change dovetails nicely with John Whitney's "Turnaround management every day." Whitney observes that "...turnaround lessons aren't limited to troubled companies. Turnaround opportunities exist everywhere ...." He goes on to point out, "...thoughtful readers should reflect on what is actually going on in their own companies. Is the legacy of a stable past still driving the enterprise, or are the challenges of the turbulent present truly redirecting its actions?" In the face of the need for turnaround, he postulates that "I do not intend to minimize the importance of a carefully developed strategy that matches opportunities with the company's resources and reflects management's priorities. Rather, I want to draw a distinction between strategy and plans. ... What's vital is that the company's managers can sense when something isn't working, then have the guts and determination to change course, to find something that will work."[16]

A second major issue in staying strategically positioned is staying in touch with what the "customer" really wants. In dealing with the hands-on style of turnaround leadership required, Whitney advises turnaround managers to go directly to the source for information, especially to the customer.

"Obviously, the most useful information usually comes from the source. Sitting in a customer's office and hearing about three late shipments, five defective units, and invoices that don't match purchase orders has a sobering and salutary effect on senior managers. Information gained this way adds pungency to otherwise sterile staistical reports....The principle at work here can be usefully applied to all the constituencies on which a company's health depends."[17]

Jef Mason makes a similar point, "Organizations are sometimes misled by their assumptions and stereotypes about their environment. Numerous traditional U.K. industries from cotton to motorbikes have suffered from assumptions about what customers wanted...."[18]

Coca-Cola also learned the hard way about making assumptions about their customers, even after extensive research. Betsy Gelb and Gabriel Gelb, in "New Coke's Fizzle--Lessons for the Rest of Us," make several points that have application to transportation decisions as well as to consumer products. They suggest that for any company considering a change in what it offers to the public, "1) The possibility of consumer resistance to change must be recognized. 2) The likelihood of such resistance must be assessed, based on the kind of product involved, the kind of buyers involved, the use to which they actually put the product, and their degree of identification with it. ... 4) Once the degree and nature of resistance is determined, marketing plans can be designed to take the resistance into account. A change may best be explained, hidden, modified, delayed, abandoned, or only partially executed."[19] If this at first glance seems out of place here, consider the highly emotional attachment each resident and politician has to the road in front of his house. We also misjudge our "customers" to our detriment in today's participative society.

Alan Steiss, in his book Strategic Management and Organizational Decision Making, makes several similar points. In the first place, a changing world may make a prior "right" decision suddenly innapropriate. Another reason for a shift in objectives may be **better** information. If that information is subjected to a thorough analysis which considers a wide range of possible interpretations, the problems and their solutions may well lead to either slight or radical changes in the desired directions.[20] Appropriate information is thus the third major issue, i.e., the need for **enough** credible information **of the type the manager needs,** monitored, updated and fed into the decision process on a ongoing and timely basis.

Senior managers' information needs reflect the way they work. As Isenberg says, "Traditional theory suggests that management is a tightly structured, systematic, linear mental activity. Managers ... formulate goals with painstaking precision, then undertake carefully prescribed actions. In reality, however, ... managers never have enough information to make perfectly reasoned decisions. ...
"I learned that you can reach the point where you understand 75% or 80% fairly quickly; getting to 100% isn't worth the effort it takes. I've been involved in management long enough to know that there is no certainty.
"Effective management ... becomes an iterative process based on constant questioning, experimenting, reflecting, debugging, and retesting."[21] These managerial facts of life should be recognized in the design of a successful management information system.

Setting strategic directions, then, in the context of the above, requires that managers of an organization know its customers, know its environment, recognize discontinuities when they occur, and are comfortable working together within the framework of a vision to develop new strategies in an emergent fashion. Strategic planners provide a data base, promote strategic thinking, and codify the strategic directions. As can be seen, developing strategies in an emergent fashion entails appropriate effort from both managers and planners. To be most effective, it also involves a considerable number of managers. The requirement for this partnership is well documented by Steiss and others. It may sound like a tall order, but is indeed do-able when the commitment is there.

The conceptual framework developed in this section is used below to describe the process of developing strategic directions currently used at Alberta Transportation and Utilities and to chart our progress at strategically positioning our investment decision process.

III. ENVIRONMENTAL ASSESSMENT

As part of the annual strategic planning cycle, Alberta Transportation and Utilities has used environmental scanning information to develop a better appreciation of the external forces affecting this Department. We are currently using the scenario approach, and anticipate continuing to do so, since it seems to yield good results.

There was a preliminary round of planning sessions in late 1985 and early 1986, in support of a major strategic planning process used to develop a strategic plan for the Department's information systems; in this first round the approach was basically the Delphic approach, i.e., to assume that the collective wisdom of participants about the present and future was adequate for the planning process. While this approach works well on subjects about which the participants have a high level of expertise, when applied in this setting it left questions in the minds of the participants about the validity of the data it generated, hence our adoption of a more rigorous approach.

Under our current strategic planning process, the planning cycle begins in January for the fiscal year to commence 15 months later, e.g., in January 1987 planning commenced for the fiscal year 1988/89. This year is the second strategic planning cycle in which we have utilized a fairly rigorous analysis of environmental factors. The first document was titled "Challenges for 1988," and was basically a sectoral analysis of key industries in the province, plus relevant demographic and traffic data. This year's document is titled "Alberta Economic Outlook and Implications," and covers the period from 1989 through 1999, in an attempt to get that longer range perspective needed to move to strategic positioning.

We've come a long way since my paper on strategic management where I reviewed Pierre Wack's work with great interest.[22] By 1987 we had successfully adapted the scenario approach pioneered by Shell Oil and

detailed from Neidell in Section II, and it has proven useful both in organizing and presenting the data and in stimulating thinking about the impact of the environment on the Department.

As stated above, scenarios organize data into internally consistent, plausible projections of the future. Royal Dutch/ Shell, Shell Canada, and Alberta Transportation and Utilities using the Shell model, have used scenarios to set the boundaries of probability for, and to challenge current thinking about, the future. "The key to strategic planning is not to forecast a single future but to understand the range of uncertainty inherent in the future. The key to strategic planning is identifying and assessing risk. Scenarios provide a basis for assessing risk. They do this by providing coherent "mental maps of the future", making key assumptions explicit, forcing consideration of alternative futures, providing the context for developing and testing sensitivity of strategies, increasing awareness of broader business environment, and highlighting uncertainty and risk in decision making."[23]

Using this approach, Alberta Transportation and Utilities is identifying a high degree of uncertainty in the future for the province, albeit the forecast for 5-10 years out appeared less uncertain than the immediate future. As our experience in using scenarios grows, we may be able to select a most likely scenario, if we can decide with some degree of confidence between the alternatives. For the present, the major conclusion that we can draw is that the Department needs to remain flexible so that we retain the ability to move in the direction of either of the two scenarios. This, in itself, is a useful decision.

As presented in our current Outlooks document, the four economic forces driving the departmental budget were identified as 1) provincial government oil and gas revenue, 2) provincial deficit management, 3) growth prospects for the general economy (measured by provincial GDP), and 4) inflation. Six sectors of the economy together with general demographic trends were deemed to be the driving forces for programs and services demanded of the department. Taken together, these two sets of variables determine, respectively, our ability to supply transportation infrastructure and the likely demands on the system. In terms of the driving forces on the budgetary side, it is difficult to get good estimates for the time period under consideration, under today's conditions of uncertainty. The estimates for the driving forces on the program and services side are likely more reliable, in that more data is generally available and the trends seem a bit more clear on those variables.[24]

We adopted the scenarios, and adapted the labels, from Shell, since Shell's scenarios appeared to be realistic for Alberta, also. General predictions were made about the two sets of driving forces for each scenario, which we labelled Defensive and Cooperative. Defensive refers to a world in which countries and businesses become very protectionist; cooperative refers to a free trade environment and a general willingness to cooperate world-wide for the good of the majority. In addition, there appeared to be trends common to both scenarios; these were separated out to aid in understanding the range of probability.

Given the provincial dependence on oil and agriculture, both with highly

uncertain markets, and the fledgling nature of our tourism and forestry industries, the forecast for the immediate future ranged from slow, steady growth under the Cooperative scenario, to fairly shaky growth under the Market Defensive scenario, for the first few years, with the projections improving toward the end of the century. In straw votes taken after the information was presented and discussed in two consecutive meetings, both the Executive and the senior managers of the Department were fairly well split between the two scenarios, with very few choosing middle ground.

While we are successfully using the scenario approach in the Department, our data base is still being improved and that might well improve our ability to discern the direction of emerging trends, noted above. Environmental scanning areas which will benefit from further research, are included in the following list:
--Technological change vis-a-vis transportation infrastructure
--Oil & gas domination of energy vis-a-vis the Alberta economy
--Weights & dimensions of vehicles vis-a-vis roadway standards
--Major economic sectors, etc., vis-a-vis transportation requirements
--Changing demographics, especially age and rural/urban split
--Changes in government-wide and other provincial department's priorities requiring transportation support

Emerging trends or major shifts in these variable could lead to significant changes in the demands on the transportation system and/or on the ability of the province to finance needed transportation systems expenditures. A project is currently underway to evaluate these factors and utilize the data in constructing scenarios for next year's Outlooks presentation.

IV. SETTING STRATEGIC DIRECTIONS

Outline of process used

In setting strategic directions for the Department, a "roll down-roll up" process is used. Basically it is top-down objective setting, which cascades down to the branch level with divisions and branches setting objectives, then rolls back up to the corporate level for ratification. Ratified plans are then available for use in the budgeting process, and form the basis for the strategic directions document. Senior management and strategic management committee reviews and discussions, also, during this process, are aiding in improving communications and a sense of corporate culture.

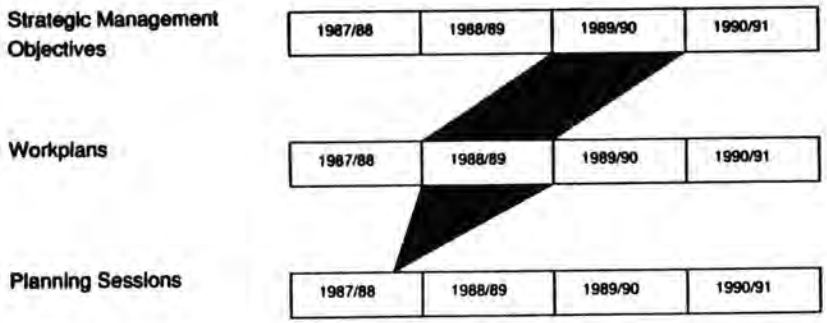
One document has been produced, Strategic Directions '87, and the next, Strategic Directions '88, is currently being drafted. The planning for Strategic Directions '89 began in January 1988. Strategic Directions '87 was based on the first set of planning sessions, those held for the strategic information system. The directions therein were abstracted from the material from the planning sessions, but molded into a cohesive framework by the Corporate Planning Services branch. This document has been well received at the political and administrative level.

Discussion

If set against the traditional strategic planning model, a deficiency in our process has been the difficulty of truly planning for the year commencing 15 months ahead, when riding the current turbulence. Thus while many of the corporate objectives identified for 1988 will have implementation phases in 1988, others will have been resolved in 1987. Likewise, this January's planning meetings tend to have a shorter time frame than the model calls for. Since we are again facing considerable uncertainty for the immediate future, this is understandable.

Perhaps this difficulty in truly projecting ourselves out in time is at the root of the appeal of Mintzberg's emergent strategy hypothesis. Another part of the appeal is its view of strategizing as a learning process; when you are on a learning curve for the strategic planning process itself, perhaps it is natural for strategies to be emergent rather than fully planned. Certainly it is true that while we are not following the traditional model faithfully, strategies are emerging.

In labelling these strategies emergent, it may currently be more nearly our process than our intent that produces that result. (However, understanding the power of using emergent strategies, it may become a deliberate approach). As outlined above, each year the Executive meets to set or reaffirm Corporate goals and objectives, which are then sent to the Division level to set supporting Division goals and objectives, which are then sent to the branches to set supporting Branch goals and objectives. In some, but at this stage not all, branches, workplans are developed to guide the implementation of objectives. Timing is such that all plans are to be ratified in time for the budget cycle, although since the provincial budget process has become an unstructured process, it has been difficult to tie the strategic planning process to the budget process. Another interesting dilemma in tying the implementation and planning cycles together is illustrated on the chart below. Workplans for the immediate year to come have to support the achievement of future objectives, which may sound



i.e., February 1988 planning sessions set objectives for 1989/90 which require workplans for 1988/89 to successfully achieve 1989/90 objectives

obvious. But when you are initially grappling with the process, and projecting objectives for 1989 while developing workplans for 1988, it takes a mental shift in approach to get there.

The above outlines the "roll down-roll up" process referred to earlier. By the time this process is complete, the department is heavily into the construction season, which lasts until just before the next planning cycle. Thus there is only a small part of each year that energies are directed to strategic planning, which may contribute considerably to the length of time it takes a new strategic direction to emerge. However, since the process involves a large number of managers and supervisors in the department, when it does emerge it likely has fairly widespread support within the department already. Our experience to date certainly seems to bear out a point raised by Michael Meyer, when he says that "The value of ... planning to managers ... lie(s) ... in their partipation in the process. ... strategic planning is as much an organizational philosophy as it is a planning process. Top management must place importance on the activities associated with strategic planning and on the results of the process. Organizational members must view strategic planning as an effort worth undertaking."[25]

Mintzberg's term "Umbrella strategy", which he describes as setting broad guidelines and leaving specifics to others lower down in the organization, may be appropriate, therefore, in its form, if not in its intent. "...it is...deliberately emergent in that the process is consciously managed to allow strategies to emerge en route."[26] The experience of Alberta Transportation & Utilities to date is that the opening of lines of communication which accompanies the roll down-roll up process is a major benefit. Our experience also suggests that Mintzberg's and Meyer's approaches, with involvement of managers in developing the emerging strategies, yield superior results.

Some emergent strategies at Alberta Transportation & Utilities relate to the organization itself, having to do with the structure of the department, human resource planning, communications, productivity improvements, and research and innovation. With regard to the transportation system, one emerging strategy is the need to shift from a developing system to a mature system. With slowing growth, and reduced budgets, priorities are shifting toward maintaining the existing system, which underwent significant growth in the 1970's and early 1980's.

A second emerging strategy should resolve questions as to appropriate standards under conditions of budget constraints. This is a difficult area, in part because the"squeaky wheel" syndrome can lead to a vocal minority being heeded rather than the silent majority. Additionally, there is the need to balance the needs of the current user against the needs of future users. Finally, there are priority issues involved in budget and programming decisions. Because of the contentious issues involved, this one may not emerge as a well-defined strategy before 1989 or 1990.

A third emerging strategy is emergent only in terms of focus. That strategy reflects the need to support new government-wide initiatives in the forestry and tourism industries. This strategy may have to run counter to the first emerging strategy, a situation which carries its own risks.

While these two emergent strategies don't appear, on the face of them, to be direly incompatible today, their downstream costs coupled with shortfalls in provincial revenues could ultimately make them incompatible financially.

A fourth emerging strategy is the revamping of our programs to reflect current needs. Like a lot of private sector organizations, transportation is very much a customer-driven business, and our programs and services must reflect current "customer" needs. This emergent strategy will have to relate closely to the standards strategy.

Most of the above mentioned emergent strategies are codified in the current objectives; some, however, are, in a "non-objective" stage (at least at the corporate level), i.e., talked about fairly widely throughout the department as issues, but not necessarily listed as objectives in the planning sessions.

V. CONCLUSIONS

How well is Alberta Transportation & Utilities doing at creating the appropriate strategic directions for managing the provincial transportation system? We keep hearing that we are "leaders" in the field. This is nice to hear, but not necessarily reassuring when we are aware of the extent to which we are still "mudddling through", trying to establish a "made in AT & U" form of strategic planning/management. A large number of government agencies, including other transportation departments throughout North America, are similarly embarked on adapting strategic planning for their organization. Can we really be at the forefront?

From an internal point of view, the process is at the fulcrum point of universal acceptance. A lot of good things are happening, but there are still sceptics. Still, the process did accurately identify departmental budget changes, which helped us avoid major layoffs. The process also paved the way for moving into new directions, with improved acceptance of the need for change. Also, through discussion of the Outlooks documents, acceptance of the need for the Department to respond to forces which result from factors external to the Department is more widespread.

If emergent strategies are to successfully position the department to deal with the impending future, what remains to be done? First, given improved environmental data, we will be able to more confidently assess current strategies and develop new ones. We also need to incorporate our stakeholders concerns into our planning data so that our plans fit the needs of the various publics at large. It is desirable also to continue extending the planning process throughout the department, to ensure that emergent strategies capture the best thinking of all department employees, and to ensure that all department employees assist in their implementation.

Where are there holes in our performance, in terms of the conceptual framework? Probably only in terms of **officially** having a vision. A mission statement exists, and a sense of strategic directions is growing. It may be

desirable for the department to also articulate and communicate a vision, as defined in section II. And having a vision is listed as a "hole" only in terms of the conceptual framework, in that it is not really part of departmental vocabulary or expectations at this stage. A vision, however, like our strategies, may well be in an emergent stage.

Is Alberta Transportation & Utilities now positioned strategically? As the emergent strategies are further developed, refined and adopted over time, success appears promising. If we move from a system expansion mode to a maintenance mode, retain or improve our "customer-driven" sensitivities, modify standards where appropriate while maintaining an excellent transportation system, develop new innovation and productivity initiatives in response to accelerating changes, create a lean, efficient organization to deliver our strategic objectives, and recognize the contribution of our staff at achieving all this, we should be strategically positioned to meet future transportation system needs.

Footnotes

I would like to give a special credit to departmental staff members Ken Holmes, for his front-end work in developing our understanding of scenarios, and Rick Cook for his development and application of scenarios for our Outlooks documents. Our progress in strategic planning has benefited considerably from their work.

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Haulers of Exempt Produce and Ornamentals From Florida: Revisited

by Richard Bellock, Nicholas Powers, and James MacDonald

I. INTRODUCTION

In the 1983 Proceedings of the Transportation Research Forum, Bellock and Fletcher (B&F) presented the results from a survey of truckers carrying exempt produce and ornamentals (P/O) from Florida. Of particular concern in their study was assessing the importance of owner-operators, significance of truck brokers making transportation arrangements, and if similar types of services were supplied and compensations collected across carrier types. B&F conducted their survey during the late fall of 1982 through the spring of 1983. Little time had elapsed since the regulatory reforms embodied in the Motor Carrier Act of 1980 and the railroads had just begun to compete seriously with truckers for Florida's produce.[1] Because of lagged adjustments in the industry, the effects of these developments may not have been fully identified by the B&F survey.

A similar survey was conducted three years later (1985/86) to update the work by B&F. In addition to the three primary concerns of the B&F paper, we examined the data for changes in both the inbound (to Florida) full/empty movement rates for vehicles leaving Florida with P/O and in overall profitability. Results from B&F are used as a baseline to assess developments and trends in the produce hauling industry. The effects of recent developments on the structure and performance of the motor carrier industry serving P/O are of interest to industry members and policy makers.

II. DATA

Data for the current study are primarily from a 1985/86 survey of truckers hauling P/O out of the Florida Peninsula. Interviews were also conducted with drivers of refrigerated trucks that were empty or had other cargos. The methodology used to conduct the survey parallels that used in the 1982/83 survey. The principal differences between the two surveys were that more questions were asked and more survey sites were used in 1985/86. In the earlier survey nearly all of the interviews were conducted at the Florida Agricultural Inspection Station on US I-95.[2] In the more recent survey, interviews were also conducted at the Inspection Stations along US I-75 and US I-10. These three stations account for more than 85 percent of the traffic out of the Florida Peninsula. Moreover, these three routes are the major corridors from Florida to all areas of the country (I-95

along the East Coast, I-75 northwest through Atlanta to the Lake States, and I-10 straight west). Finally, in the 1985/86 study interviews were also conducted with drivers of refrigerated vehicles that were not then hauling P/O.

In contrast to the 658 interviews conducted in 1982/83, 3,068 interviews were conducted in the more recent survey. Sixty-four percent of those interviewed in 1985/86 were carrying P/O, 28 percent had other cargos, and 8 percent were empty.

III. CARRIER TYPES AND SERVICE QUALITY

Concerns about a possibly declining role for owner-operators in produce haulage was one of the principal motivations for the B&F study. Some produce industry members thought that owner-operators, specializing in produce haulage, were being forced out of the industry by for-hire fleets seeking backhauls out of Florida. These for-hire fleets generally are assumed to have little experience with produce and, thus, to provide lower quality, less reliable service. The regulatory reform embodied in the Motor Carrier Act of 1980 was usually given as the primary cause for this development. However, prior to the B&F study, there were no credible estimates of the structure of this subsector of the trucking industry.[3]

B&F found that as of 1982/83 owner-operators were still the mainstream of the produce trucking sector. In that season they accounted for 53 percent of all trucks hauling produce from Florida, while for-hire fleets accounted for 28 percent, and private (i.e., own-account) carriers for 19 percent. As there are no comparable estimates for earlier years, it is not known if the owner-operator share had risen or fallen. However, in the ensuing three seasons owner-operators have essentially maintained their share, but the private carrier share has declined by almost a third in favor of for-hire fleets:

Shares of produce hauls by truck from Florida

Crop year	Owner-operator	For-hire fleet	Private carrier
1982/83	53	28	19
1983/84	55	27	18
1984/85	49	33	16
1985/86	50	37	13

Some or all of the apparent fall in private carriage may be an artifact of 'increased opportunities for private fleets to obtain authorities to haul on a for-hire basis and the method employed in the studies to identify carrier types. Drivers were asked which carrier type best described their firm. To the extent that private carriers have taken advantage of liberalized entry controls to improve fleet utilization, drivers are more likely to identify their primary function as for-hire rather than private carriage.

Method of load arrangement	Percent of all loads:		
	P/O	produce	ornamentals
Private carriage (carrier owns the load)	8	7	13
Direct contact between receiver and carrier or between shipper and carrier	27	24	52
Truck broker	62	66	34
Other, not specified	3	3	1

In contrast to the produce loads, most of the ornamental loads are arranged directly between the receiver and carrier or between the shipper and carrier. The smaller role for brokerage in ornamentals load arrangements is probably related, in part, to the relatively greater concentration of carriers hauling ornamentals and the associated lower cost of identifying and locating reliable ornamentals haulers. For example, of the 7,479 carriers hauling ornamentals from Florida in 1984, the top 15 carriers accounted for half of the shipments. All of these carriers have permanent offices in Florida which probably reduces search cost (Beilock, Rahmani, and Rosalsky). While there are no comparable data on the numbers and concentration of produce carriers, it is likely that there are more such carriers, they are much less concentrated, and identifying and contacting these carriers is more difficult and expensive than is the case for ornamentals haulers.[4]

The average truckload of P/O from Florida in 1985/86 had a linehaul distance of 1,134 miles, 2.6 pickups, 1.9 drops, and a freight rate of 1,621 U.S. dollars. One-third of the loads were mixed (i.e., multiple commodity). The load characteristics are surprisingly invariant across carrier types.

Load characteristic	Owner-operator	For-hire	Private
Average linehaul distance (miles)	1,136	1,155	1,069
Average number of pickups	2.6	2.4	2.7
Average number of drops	1.8	1.8	2.7
Average freight rate	$1,607	$1,650	$1,631
Percent mixed loads	35	30	33

Moreover, there is no evidence, either in the B&F or in this study, of differences in the freight rates received across carrier types for similar services.[5]

From the produce industry's standpoint, the impact on service quality from any changes in the makeup of the motor carrier fleet is a more pertinent question. Much of the P/O is highly perishable and many of the commodities require unique care to assure high quality at the final destination. As earlier stated, the basis of the concern regarding a relationship between carrier type and service quality is the contention that, unlike owner-operators and private carriers, for-hire fleets tend to specialize in regulated dry freight and processed food products. This relative lack of experience in hauling P/O by for-hire fleets may reduce the quality of transportation service and, thus, give an unfavorable impression of all truckers in the eyes of shipper/receivers. However, this concern is unfounded in the survey results. Indeed, refrigerated vehicles account for 90 percent of the capacity employed to haul Florida produce. Of those observed to haul produce, the average driver of a refrigerated vehicle reported that 69 percent of his/her loads were produce, and the average response for drivers of unrefrigerated vehicles was 41 percent. Less than 10 percent of the drivers of refrigerated vehicles observed hauling produce do so as an incidental part of their operations (7 percent of the owner-operators, 10 percent of the private carriers, and 7 percent of the for-hire fleet drivers reported that 10 percent or less of their loads were produce). Furthermore, 84 percent of the drivers of refrigerated vehicles not hauling produce when interviewed, indicated that produce was never carried, while 11 percent responded that produce accounted for at least 20 percent of their loads. Thus, 95 percent of the refrigerated vehicles observed leaving the state empty or with nonproduce loads never haul produce or produce accounts for over one-fifth of their loadings. The survey results of support the position that truckers hauling produce do so as a mainstream activity to their business rather than as an incidental, infrequent service.

High driver experience levels are also suggestive of competent transportation service. That is, a driver with more professional experience should be more knowledgeable about the proper care and handling of P/O, and, therefore, provide superior service. The average driver hauling P/O from the state has been doing so for 16.4 years. There is some variation across carrier types. Owner-operators average 17.2 years of professional experience, versus 15.9 years for for-hire fleet drivers, and 14.9 years for private carrier drivers. However, two-thirds of the drivers for each carrier type have at least 10 years of experience, and almost 90 percent of the fleet drivers have at least 5 years of experience. Therefore, drivers hauling P/O tend to have a high level of professional experience across all carrier types.

IV. LOAD ARRANGEMENTS AND CHARACTERISTICS

B&F reported that about 60 percent of all P/O loads from Florida were arranged by truck brokers. The data on loads from the 1982/83 survey were not disaggregated into produce and ornamentals. Results from the 1985/86 survey confirm the dominant position of truck brokers for produce, but reveal a much different pattern for ornamentals:

V. INBOUND OR RETURN LOADS

Carriers serving the Florida P/O industry can, at little additional cost, supply inbound transportation services when they return to the state (Baessman and Daughety and Jara-Diaz). In other words, loads inbound to Florida are complementary to the supply of transportation services for the outbound P/O carriage. If a carrier can pick-up a load inbound to the state, it can spread-out the fixed costs (i.e., insurance, vehicle registration fees, and capital depreciation) of the roundtrip. Therefore, rates should fall if truckers are competitive. Thus, the higher the share of loaded inbound traffic, the more the fixed costs can be spread-out and the lower the transport rates for P/O, ceteris paribus.

Full return rates for P/O haulers are high and have increased since the first survey. Across the entire crop year, 87 percent of the drivers reported entering Florida with a load compared with 69 percent of the drivers during 1982/83. While the full return rates for every carrier type improved, that for private haulers improved the most.

Crop year	Percent returning to Florida with loads		
	Owner-operator	For-hire	Private
1982/83	71	82	48
1985/86	87	89	83

The general increase in full return rates is related, in part, to improved coordination of the supply and demand for transportation services, relaxed regulatory controls, and overall economic growth. In addition, a part of the apparent gains may be a result of surveying along US I-10 and US I-75, as well as US I-95, during 1985/86. Indeed, the full return rate for US I-95 was the lowest of the three routes. For US I-95 the full return rate was 83 percent, versus 94 percent for each of the other routes. That some of the improvement may be due to eased entry controls is suggested by the following two findings:

1. Approximately two-thirds of the inbound loads by Florida's P/O haulers are subject to regulation.[6]

2. There were substantial rises in the percentages of owner-operators and private fleet drivers with ICC authorities. These two carrier types had the greatest increases in full return rates:

Carrier type	Percent with ICC Authority	
	1982/83	1985/86
Owner-operator	14	21
For-hire fleet	56	55
Private fleet	14	37

It should be recognized, however, that this evidence is only circumstantial in nature. Moreover, the rise in ICC authority ownership are probably too small to explain more than a small fraction of the improvements in full return rates. Nevertheless, these findings are consistent with the position that constraining regulatory controls can contribute to empty movements.

VI. TRAILER SIZES

The Surface Transportation Assistance Act of 1982 (STAA) became law shortly after the B&F study. With this legislative change the largest legal single trailer carriers could operate interstate from Florida increased from 45 feet long and 8 feet wide to 48 feet long and 8.5 feet wide. Much of the advantage from the larger sized trailer would be for nonproduce return loads because most produce types are too dense to fill a larger trailer without violating gross weight limits.[7]

The transition to larger sized equipment by P/O haulers has been fairly rapid. In 1985/86, the third season after STAA's passage, 35 percent of the trailers were over 45 feet in length and 13 percent were 8.5 feet wide. The average trailer lengths were virtually identical across carrier types (44.8, 45.1, and 44.5 feet, respectively, for owner-operators, for-hire fleets, and private fleets). However, for-hire fleets were more likely to possess 48 foot trailers and trailers that were 8.5 feet in width:

	Percent of trailers used for P/O	
	48 feet long	8.5 feet wide
Owner-operators	21	11
For-hire fleets	32	16
Private fleets	23	13

VII. PROFITABILITY

Industry members often contend that heightened competition since passage of the Motor Carrier Act of 1980, has kept freight rates from increasing with costs. This assertion is not supported by examining recent changes in the transportation rates and an index of the cost of transportation services. The average freight rate was $1,506 in 1982/83 compared with $1,606 in 1985/86 (for US I-95 only). The average index of transportation services for food marketing was 371.1 in 1982 compared with 393.9 in 1985 (USDA, Agricultural Outlook). In three years the average freight rate grew by under 7 percent while the index of transportation services for food marketing rose by about 6 percent. However, these averages mask differences between the two years in distances traveled and, more importantly, in the revenues and costs associated with return loads and the probability of securing such loads.

To more precisely assess recent changes in profitability, data from the U.S. Department of Agriculture's Fruit and Vegetable Truck Cost Report were used to compute costs. In this report, per mile costs are calculated for fleets and owner-operators hauling produce from California to the East Coast. These estimates include overhead and capital costs. The per mile cost estimates are probably lower than those for the carriers serving Florida because the trip distances upon which these costs are calculated are roughly 2-½ times that of those for the current study.[8] It seems likely though that costs for carriers serving Florida and those serving California would be highly correlated over time.

Average roundtrip revenues are calculated as the sum of the average P/O rate received and the product of the average inbound rate received and the proportion of full inbound returns.

	1982/83	1985/86
Average P/O freight rate	$1,506	$1.606
+	+	+
Average inbound freight rate times the full return rate	($710 * .69 - $490)	($962 * .83 - $798)
Average roundtrip revenues	$1,996	$2,404

Next, the average roundtrip revenues for each year are divided by the estimated average roundtrip mileages in each year.[9]

	1982/83	1985/86
Average per mile roundtrip revenues	$1,996/2420 - $.82	$2,404/2116 - $1.14

Finally, the average per mile roundtrip revenues are deflated by the U.S. Department of Agriculture's per mile cost estimate.[10]

	1982/83	1985/86
Real average per mile roundtrip revenues	$.82/$1.126 - $.73	$1.14/$1.13 - $1.01

This finding suggests substantial improvement in the profitability of hauling P/O from Florida between 1982/83 and 1985/86. The analysis though only reveals the direction of change. For example, it does not show if the average carrier made a profit in 1985/86 or merely a smaller loss per roundtrip in 1982/83.

Perhaps the most interesting aspect of this exercise is that only a quarter of the improvement in real average per mile roundtrip revenues was from higher rates received for P/O loads. The major reasons for improvement were higher rates received for inbound loads and for the greater probability of securing such loads.

VIII. SUMMARY AND CONCLUSIONS

The B&F study provided some basic information about the interstate trucking industry serving Florida P/O industry. This study has assessed changes over the three year period following their work.

B&F found that owner-operators accounted for just over half of all motor carriage of Florida's P/O. This finding was comforting to those in the industry who had feared owner-operators were rapidly disappearing. The current study reveals that the market share held by owner-operators has remained essentially unchanged since 1982/83. Moreover, it shows that P/O haulers are specialists, regardless of carrier type. On the basis of overall professional driver experience and the focus of operations on P/O, it does not appear that transportation service quality would be affected by shifts in the shares of P/O carriage held by the three carrier types.

This study also confirmed B&F's finding that about 60 percent of all P/O loads are arranged by truck brokers. A further disaggregation of the data, however, revealed that ornamental loads are half as likely as are produce loads to be brokered. This is believed to be due to cost advantages and the reliability of service provided by large, readily available carriers specializing in ornamentals carriage. A closer examination of the reasons for the differences in the importance of brokerage in these two never-regulated markets is a potentially fruitful area for additional research. It may offer indications of the eventual extent of brokerage in nonagricultural transportation markets following the relaxation of regulations.

The proportion of P/O vehicles entering Florida with a load increased markedly between 1982/83 and 1985/86. This finding is probably due to improved economic conditions, relaxed regulatory controls, or a combination of these factors. That at least some of the improvement is due to relaxed regulatory controls was suggested by the fact that the two carrier groups with improved full return rates also had markedly higher rates of ICC Authority ownership.

Controlling for average mileage and full return rates, between 1982/83 and 1985/86 real average per mile roundtrip revenues increased by nearly 40 percent. Three-quarters of the rise was due to higher freight rates for loads inbound to Florida and for a higher probability of securing such loads. It should be stressed that this result does not indicate that P/O carriers are now profitable, but that their operations are more profitable that in 1982/83.

The final result of note is that 35 percent of the combination trucks serving Florida's P/O industry have trailers larger than would

have been legal prior to early 1983, passage of STAA. This suggests that capital equipment replacement was rapid. This is consistent with the finding that these operations are becoming more profitable. Virtually all types of produce are high density cargos, and larger trailers are only advantageous for cargos of moderate or low density. Therefore, the rapid acquisition of larger trailers is also consistent with the finding that revenues from the inbound (nonproduce) segment of the roundtrip are becoming more significant.

FOOTNOTES

* The authors are associate professor of Food and Resource Economics at the University of Florida, economist at the U.S. Department of Agriculture, and associate professor at Rensaeller Polytechnic Institute. This work is part of a project funded by the Economic Research Service, U.S. Department of Agriculture.

1. Railroad's share of interstate produce traffic was less than one-percent at the end of the 1970's. In November 1982, CSX started the Orange Blossom Special, a dedicated trailer-on-railroad-flatcar train for perishable commodities serving primarily major U.S. cities along the Atlantic coast. During its' first crop year, the railroad accounted for about 3 percent of all Florida's interstate produce traffic. While this was a sixfold increase in share over the previous crop year, still rail competition to motor carries was small. By the 1985/86 season, rail's share had grown to over 6 percent. It is estimated that one load in seven to the Northeast went by rail in 1985/86 (Bellock, MacDonald, and Powers).

2. In the survey of 1982/83 a small number of interviews were conducted at the Florida Agricultural Inspection Station along US I-75.

3. For example, these concerns were articulated by participants at the 1982 meeting of the Florida Agricultural Transportation Task Force. At that meeting, carrier and grower groups, as well as State officials admitted to the paucity of data and information on the composition of the motor carrier segment serving Florida agriculture.

4. An idea of the total number of produce carriers operating in Florida is given by state registrations. Over 20,000 carriers registered to haul produce within or from Florida in 1979. Comparable numbers are unavailable for subsequent years because produce haulers are no longer required to register with the state.

5. In B&F and as part of the 1985/86 study, freight rates were estimated (via regression analysis) as a function of trip and load characteristics, routing, month, and carrier types. All

estimated parameters for the independent variables for carrier types were insignificantly different from zero at conventional levels (B&F and Beilock, MacDonald, and Powers).

6. The breakdown of inbound loads hauled by Florida's P/O carriers is as follows:

	Percent of inbound loads
Regulated:	
General commodities	26
Red meats	8
Processed foodstuffs	27
Paper products	5
Exempt:	
Produce	25
Ornamentals	1
Poultry and seafood	8

7. Anderson discusses the relationship between cargo densities and the benefits to carriers from larger trailer sizes.

8. Per mile transport costs generally fall with distance because fixed terminal costs such as, load search, pickups, and drops, are spread-out over more miles. This idea is developed further by Wilson (pp. 121 - 30).

9. Outbound distances were calculated using the over-the-road distances between the first pickups and the final destinations as reported in the Household Goods Carrier Mileage Guide. Roundtrip distances were calculated as two times the outbound distance.

10. The estimates used were the owner-operator per mile costs during March 1983 and March 1986.

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TRANSBORDER TRUCKING: INSTITUTIONAL BARRIERS TO CANADA-U.S. TRADE OF AGRICULTURAL GOODS

Barry E. Prentice & Marvin D. Hildebrand[1]

INTRODUCTION

Freight costs have an important influence on patterns of exchange and industrial location. The effect of freight costs varies, however, with the ratio of the finished product's delivered price to the total transportation bill. For industries, such as agriculture, where freight costs are a relatively high proportion of the finished product value, transportation can provide a significant level of protection for domestic producers, or stand as a major barrier to export market development. The focus of this study is the importance of transport cost barriers to the trade of agricultural and food products between Canada and the United States.

Agricultural trade between Canada and the United States differs significantly from the profile of each country's trade with the rest of the world. Whereas grain dominates both countries' agricultural trade with third countries, it is relatively unimportant between Canada and the United States. Instead, Canada-U.S. agricultural trade is comprised of mainly processed and/or highly perishable items, such as livestock and meats, horticultural crops and canned or frozen foods.

Differences in the makeup of Canada-U.S. agricultural trade have had a profound effect on the means of transport used. While rail and water are the major modes of transportation used for exporting agricultural products to the rest of the world, trans-border trucking has emerged as the most important facilitator of trade between Canada and the United States. With the exception of fish, which may be delivered to U.S. destinations directly from fishing vessels, more than 90 percent of Canadian agricultural exports to the U.S. are presently transported by truck. Consequently, a study of transport related barriers to Canada-U.S. trade of agricultural products is for all intents and purposes an analysis of barriers associated with trans-border trucking.

Studies of freight rates in Canada and the U.S. have found significant differences between trans-border freight rates and

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domestic freight rates for equivalent shipping distances in either Canada or the U.S. (Munro; Skorogchod and Bergevin). Such differences tend to be reinforced by the disparities in the regulatory environment and enforcement practices in the two countries. Although transport regulations, such as operating authority or weight and dimension regulation seldom prohibit trade, they may add significantly to the cost of traded goods. For the products of agriculture, which are relatively sensitive to freight costs, the effects of transport related barriers to trade are much greater.

The paper begins with a brief synopsis of the main transport regulations and additional costs or charges associated with trans-border trucking of agricultural products. Following this descriptive summary, the results of a survey are presented which analyze the costs and importance of these various measures from the perspectives of Canadian and U.S. carriers which are active in trans-border trade. In the final section, a comparison of freight rates is used to estimate the protection created by these institutional factors for a range of commodities which are traded between Canada and the U.S.

The regulatory environment governing trans-border trucking is complex, overlapping and administered by various levels of government. It consists of legislative, regulatory, policy and procedural considerations which often act as obstacles to truckers from other jurisdictions as much as fulfilling their intended roles (Clayton and Sem).

In order to supplement the limited literature pertaining to trucking regulations, the next section is devoted to explaining the various regulations and other transport related barriers to trade which affect Canada-U.S. trans-border trucking. For purposes of exposition, these transport related barriers are grouped into somewhat arbitrary classifications that include regulations pertaining to vehicles, regulations relating to drivers, costs and practices associated with border crossings, and taxes and fees which affect the costs of trans-border traffic.

Vehicle Related Regulations

In general safety regulations in Canada and the U.S. are consistent. Where inconsistencies do arise, an operator from a foreign jurisdiction whose vehicle does not conform to local safety regulations has only two options, aside from compliance. The province or state in question may be avoided by refusing the load or interlining with another carrier for the necessary portion of the trip. Alternatively, the operator may proceed through the province or state in ignorance or defiance of the law.

Weight and dimension regulations, which are enforced at the state/province level, exhibit considerable variation. The main areas of discrepancy are the permitted width of trailers, the

combined length of tractor and trailer, and the total gross vehicle weight. Also, but to a lesser extent, the permitted weights on specific axles is an area of inconsistency in regulation.

There are a number of different types of vehicle configurations in use across North American highways. Since the legally operable configurations vary among states and provinces, trucking firms tend to specialize in certain trailer types or configurations which are most suitable to their main routes. This tends to diminish rate competition between carriers in different geographic locations or countries with incompatible vehicle configuration legislation.

Vehicle licenses and insurance coverage are essential for operating on public highways. The total cost of truck licenses, and to some degree insurance, increases with the scope of operations. Licensing costs of operating in foreign jurisdictions are greatly reduced by reciprocal licensing agreements between provinces and states. For example, Manitoba currently has full and free reciprocity with 32 states. Thus, operators based in Manitoba with authority to operate in these reciprocal states are required to pay only a nominal ($10-$20) annual fee for license in each state. Alternatively, the cost of license for states without reciprocal licensing agreements may approach $1,000 per year.

Driver Related Regulations

U.S. Immigration regulations prohibit Canadian drivers from handling intra-U.S. shipments, while Canada has corresponding immigration rules that prohibit U.S. drivers from handling intra-Canadian shipments. Both countries also have customs regulations which place similar restrictions on equipment. As a result, carriers must either arrange trans-border movements in both directions or travel empty until crossing the border, at which time, a domestic shipment may be picked up. Clearly, the latter option carries a smaller economic penalty for U.S. carriers than for Canadian carriers. The major Canadian markets are located within 100 miles of the international border which limits the potential empty miles for U.S. carriers. In contrast, the distribution of U.S. cities could leave a Canadian carrier stranded one thousand miles from the border without a load.

Costs and Practices Associated with Border Crossings

Trucking firms appear to be subject to increasing taxes and border crossing fees. Since 1986, the U.S. customs department has levied a $5.00 (U.S) fee per truck for each crossing, which may alternatively be paid as a $100.00 (U.S) annual fee.

The hours of inspection must be taken into consideration by carriers when scheduling pickup and departure times for exports of live animals and poultry products. Trucks that arrive at the border after regular office hours must pay a "callout" fee to have their loads inspected by Agriculture Canada veterinarians.

Certain agricultural products are subject to inspection by the U.S. Department of Agriculture, either at the point of destination or at a USDA inspection office enroute. In the case of meat, the entire shipment is unloaded and inspectors examine a random sample of cartons (known as a skip-lot). At this point, a random computer selection determines whether inspectors examine every carton in the shipment (known as a full-lot), a process which requires approximately six hours.

A shipment may be refused if the product is not sealed or preserved properly, or fails to meet quality standards. The quality may be unsatisfactory if there is too much fat or bone, the product is damaged or bruised, foreign matter such as hair is present, or if there are bones in supposedly boneless meat.

Shipments which fail the inspection must be reloaded and returned to the plant of origin. Even shipments which pass inspection are subject to added costs, since the carriers are required to await lab results before proceeding on their trip and often are delayed up to a day in the process.

Taxes and Fees Influencing Truck Transport

The U.S. congress passed a bill in 1987 which requires Canadian truckers to pay an annual highway use tax. The tax, known as the Heavy Vehicle Use Tax, applies to Canadian trucks that travel more than 5,000 miles per year in the United States. The threshold increases to 7,500 miles for carriers of agricultural products. U.S. carriers currently pay US$550 per truck per year. Canadian carriers are assessed 75 percent of the Heavy Vehicle Use Tax, or $412.50 per truck per year.

Formal requirements imposed by the Interstate Commerce Commission (ICC) as well as individual states add considerably to the cost of motor carrier operations in the U.S. For example, Canadian carriers are required to maintain an address in each state for which they hold operating authority. Because of the limited number of U.S. terminals operated by Canadian carriers, this usually involves the services of professional associates in the various states who are referred to as resident agents. Although the duties performed by a resident agent may be minimal or non-existent from one year to the next, the expense of their association becomes a part of the carrier's transport costs.

Fuel tax bonds are also required by individual states, the successful posting of which may constitute a major effort on the part of the carrier. Preparation and submission of the necessary forms involves insurance companies, brokers, and a resident agent, in addition to the administrative effort by the applying firm. To the consternation of Canadian applicants the forms may be returned for petty corrections on a repeated basis, thereby adding to the basic bonding rates which range upwards from US$300. Other taxes and fees applicable to transborder carriers are fuel tax remittance, vehicle trip fees and property taxes.

CARRIER VIEWS

The extent and importance of transport related barriers to agricultural trade were investigated using survey techniques and direct personal interviews. Trucking firms in both Canada and the U.S. were surveyed in order to obtain a balanced perspective of transport related barriers. In addition, trucking firms on both sides of the border were interviewed to gather information on the costs imposed by the myriad of regulations and other requirements affecting trans-border shipping. The number of firms surveyed, the number of respondents, percent response, and the percentage of total traffic made up by trans-border shipments is summarized in Table 1.

TABLE 1: NUMBER OF RESPONDENTS, PERCENT RESPONSE AND PERCENT OF TOTAL TRAFFIC MADE UP BY TRANS-BORDER SHIPMENT, BY COUNTRY

Country	Number of Firms Surveyed	Number of Positive Responses	% Response	Respondents Average % Trans-Border Shipments
Canada	54	29	54	41.6
U.S.	175	64	37	18.7

Caveats

Before discussing the results of the survey, some limitations and qualifications should be made.

First, with minor exceptions, the survey includes only for-hire trucking firms that presently operate trans-border routes. This excludes several important groups, such as:

(1) Private trucking fleets, engaged in hauling a company's own product.
(2) Truckers who do not operate on trans-border routes because they lack the proper authorities. For example, U.S. carriers who wish to operate in Canada, but have either been deterred from applying for authorities, or had their requests denied.
(3) Truckers who have been discouraged by the regulatory and administrative burdens associated with trans-border trucking, and have ceased trans-border operations.

Second, the survey rate section of the report which examines freight rates, refers only to truckload shipments. Since agricultural products do not typically move in less than truck load (LTL) lots, the error in ignoring the LTL market is probably negligible. Nevertheless, the findings of this study may not be directly applicable to the LTL market, and should not be extended without further research.

Third, many of the carriers surveyed haul primarily exempt (or designated) agricultural commodities, which are not subject to the full range of regulatory forces applied to non-exempt commodities. Consequently, these results which are based on truckload shipments of agricultural commodities may under-estimate the transport-related barriers to trade of non-agricultural products.

Survey Results

Trucking firms were asked to rank the importance of various regulations, fees and other requirements imposed on trans-border traffic. These regulatory measures were divided into four categories, each of which contained three to five specific areas of regulation or fee assessment.

Within each of these categories, respondents were asked to rank the sub-categories in order of importance. The results are presented in Table 2 for Canadian respondents, and in Table 3 for U.S. respondents.

TABLE 2: IMPORTANCE OF REGULATIONS, FEES AND PRACTICES ON CANADA-U.S. TRANS-BORDER TRAFFIC: CANADIAN RESPONDENTS (1 = MOST IMPORTANT)

Category	Area	Average Ranking	Modal Ranking
Vehicle Related Regulations	Insurance Costs	1.8	1
	Licensing Requirements	2.2	2
	Weights and Dimensions	2.8	2
	Safety Standards	3.9	5
	Configurations Restrictions	4.0	4
Taxes, Fees and other Charges	Taxes and other charges	1.7	1
	Operating Authorities	1.9	1
	Vehicle Trip Fees	2.2	3
Border Crossing Regulations	Inspections at Customs	1.6	1
	Hours of Customs Operations	1.7	2
	Lack of Bonded Warehouses	2.6	3
Driver Related Regulations	Hours of Work	1.6	1
	Driver Licensing	1.9	2
	Residence Requirements	2.0	3

The ranking of the sub-areas within the four categories is nearly identical for the Canadian and U.S. respondents. For example, under vehicle related regulations, insurance costs are ranked most important in both countries, followed by licensing requirements, and so on. An interesting exception is the taxes and fees category, in which the first two sub-areas are reversed.

Despite the similarity of the Canadian and U.S. averages, the individual survey returns varied considerably. Each carrier is affected individually by the regulatory environment depending on the size of firm, geographic location, commodities hauled, etc. Regulations and practices which prove costly for certain carriers may be less important to others. This observation was reinforced by comments included in the survey returns, as well as by the comments made during the follow-up interviews. Nevertheless, the consistency of the average rankings do suggest the relative importance of these regulations in the industry.

TABLE 3: IMPORTANCE OF REGULATIONS AND OTHER COST FACTORS ON U.S.-CANADA TRANS-BORDER TRAFFIC: U.S. RESPONDENTS (1 = most important)

Category	Area	Average Ranking	Modal Ranking
Vehicle Related Regulations	Insurance Costs	1.79	1
	Licensing Requirements	2.25	2
	Weights and Dimensions	3.31	3
	Safety Standards	3.67	3
	Configuration Restrictions	3.96	5
Taxes, Fees and other Charges	Operating Authorities	1.77	1
	Taxes and Other Charges	1.96	1
	Vehicle Trip Fees	2.14	2
Border Crossing Regulations	Inspection at Customs	1.50	1
	Hours of Customs Operation	1.58	1
	Lack of Bonded Warehouses	2.88	3
Driver Related	Hours of Work	1.61	1
	Driver Licensing	2.07	2
	Residency Requirements	2.31	3

Overall Importance of Four Major Categories

Carriers were asked to rank the four major areas of regulation in order of importance. The results for both Canadian and U.S. respondents are presented in Table 4.

TABLE 4: IMPORTANCE OF THE FOUR MAJOR CATEGORIES OF REGULATION (1 = MOST IMPORTANT)

Category	--- average ranking --- Canadian Firms	U.S. Firms
Vehicle Related Regulations	1.85	2.56
Taxes, Fees & other charges	2.00	1.76
Border Crossing Regulations	2.73	2.13
Driver Related Regulations	3.40	3.43

For Canadian respondents, vehicle related regulations were ranked the most important, while this same area was ranked third by U.S. firms. This may be partially explained by the difference in weight, dimension, and configuration regulations in Canada vis-a-vis the U.S. On average, Canada has enjoyed somewhat more lenient regulations, particularly in Ontario. Although U.S. regulations have been relaxed in recent years, they are still more stringent in many jurisdictions than those in Canada.

Differences in insurance costs also help to explain the higher Canadian ranking. In general, the case of Canadian firms acquiring insurance protection for operation in the U.S. is a "small fish in the big pond" syndrome, which leads to costly insurance premiums. Conversely, the operation in Canada of U.S. firms was often viewed as a relatively minor addition to existing operations from an insurance protection point of view.

U.S. respondents ranked taxes and fees most important, which is partly a reflection of the cost and effort of acquiring operating authority in Canadian jurisdictions. Canadian firms, in ranking this area second, were most affected by the various user taxes assessed by U.S. jurisdictions. Of even greater importance, however, will be the extension of the Heavy Vehicle Use Tax to Canadian trucks operating in the U.S. At the time of our survey, the bill proposing this extension was under debate in the U.S. Congress, but has subsequently been passed.

Border crossing regulations were ranked second by U.S. respondents and third by Canadian respondents. Comments by U.S. firms indicated an indifference on the part of Canadian brokerage houses to after-hours clearance, as well as an inability to clear customs around the clock at various border points. In general, the process of crossing the border appears to include a significant inconvenience factor for many firms, but was not particularly tangible in terms of added expense in most cases.

Driver related regulations were ranked last by both Canadian and U.S. respondents. Again, this area constitutes an inconvenience factor for certain firms in such areas as maintaining log books and acquiring proper licenses for Canadian drivers operating in the United States.

QUANTIFICATION OF INSTITUTIONAL BARRIERS

The survey results suggest that institutional barriers affecting trans-border transport are of considerable importance for most carriers. The magnitude of their importance, however, is not amenable to direct estimation. Individually, most institutional barriers have only minor effects on carrier operating costs. Although most carriers indicated that in aggregate regulations affected their costs, they underscored the difficulty of determining the extent for their own operations. Many of the regulatory requirements for trans-border shipping are jointly carried out by the staff that handle domestic requirements.

Consequently few carriers can readily identify the actual costs incurred in operating trans-border.

The majority of carriers are affected by a unique combination of institutional barriers. This combination is determined by such factors as commodities hauled, geographical extent of operations, base jurisdiction, and types of equipment used. Thus, regulation and fees which are important to one carrier may be insignificant to others, and vice versa.

Certain institutional barriers are qualitative in nature, and from this perspective alone are nearly impossible to estimate accurately. For example, the effort expended to arrange loading and departure times to coincide with border crossing hours and customs inspections of agricultural products would be both difficult and impractical to measure. This type of inconvenience factor is not uncommon among carriers who deal with the various regulations and practices on a continual basis.

Institutional factors may be considered as "man-made" barriers to trade in contrast to the natural barrier to trade posed by actual transport costs (Conlon, Munro). Consequently, the aggregate effect of institutional barriers can be measured by separating transport costs into their natural and "man-made" elements.

The approach taken was to compare truckload rates for domestic and trans-border shipments, in Canada and the United States. To the extent that carriers accurately recover their costs on trans-border and domestic routes by the rates charged on those routes, the difference in these rates will approximate the difference in the costs of operating domestically versus trans-border; that is, the "man-made" barriers to trade.

Results of Using Rates to Approximate Institutional Barriers

Despite the potential weaknesses of using truckload rates as a first approximation to institutional barriers, excellent participation by survey respondents provided a solid base of data for analysis. Nearly 500 individual rates were compiled, approximately half from each of Canada and the U.S. In addition to the origin, destination and truckload rate, carriers were asked to indicate trailer type, and whether the route was a backhaul or fronthaul.

The rates for Canada and the U.S. are summarized in Tables 5 and 6, respectively. All rates were converted into Canadian dollars per mile, and are divided into four categories: domestic front haul, domestic backhaul, trans-border fronthaul, and trans-border backhaul. In each of these categories, average rates are provided for various trailer types, as well the overall average.

TABLE 5: CANADIAN BASED TRUCKLOAD RATES* (Canadian $ per mile)

Trailer Type	Domestic		Trans-Border	
	Fronthaul	Backhaul	Fronthaul	Backhaul
Dry Van	1.71	1.34	1.62	1.77
	(29)	(21)	(63)	(35)
Grain	2.31	.83	1.80	2.47
	(2)	(2)	(1)	(5)
Livestock	2.30	1.00	2.20	2.53
	(4)	(5)	(2)	(5)
Refrigerated	1.89	1.85	2.45	2.45
	(13)	(7)	(20)	(12)
Average	1.83	1.37	1.66	2.05
	(48)	(35)	(86)	(57)

*Number of observations in parentheses

The reader is cautioned that several of the cells in the Tables are not statistically reliable. The overall averages, however, are made up of at least 29 observations, and most are made up of more than 50 observations.

TABLE 6: UNITED STATES BASED TRUCKLOAD RATES* (Canadian $/mile)

Trailer Type	Domestic		Trans-Border	
	Fronthaul	Backhaul	Fronthaul	Backhaul
Dry Van	1.90	1.89	1.99	1.96
	(68)	(22)	(41)	(12)
Grain	2.35	1.31	2.21	1.36
	(10)	(3)	(11)	(5)
Refrigerated	1.72	1.64	2.16	1.59
	(22)	(31)	(16)	(12)
Livestock	2.40	-	2.41	-
	(10)		(4)	
Average	1.95	1.72	2.09	1.70
	(110)	(56)	(72)	(29)

*Number of observations in parentheses

(a) Canadian Rates. The average Canadian domestic rate from the data is $1.63 per mile while the average Canadian based trans-border rate is $1.82. This indicates an extra tariff on trans-border shipments of 19 cents per mile, or $190 per 1,000 miles.

Expressed on a per pound basis, and assuming a 42,000 lb. payload, the additional cost on a 1,000 mile trans-border shipment would be .45 cents per pound.

(b) U.S. Rates. The average U.S. domestic rate from the data is $1.81 per mile while the average trans-border rate is $1.97. This indicates an extra tariff on trans-border shipments of 16 cents per mile, or $160 per 1,000 miles. Expressed on a per-pound basis, the additional cost on a 1,000-mile trans-border shipment would be .38 cents per pound.

The above differences were tested using the t-test at 95 percent confidence level. In both cases, the differences were found to be significant.

Estimated Barriers versus Actual Barriers

The above estimates are first approximations to transport related barriers to trade in agricultural products between Canada and the United States. Discussions with trucking firms in both Canada and the U.S. provided evidence that estimates developed from rate data may be biased downward. This conjecture stems from two of the inherent weaknesses in using rates as a measure of institutional barriers and regulatory costs.

First, the practice by most firms to apportion overhead costs evenly among all routes, both domestic and trans-border, results in lower trans-border rates and higher domestic rates than if such costs were apportioned according to actual costs incurred. This reduces the spread between trans-border and domestic rates, and under estimates the actual institutional barriers to trade.

Second, the nature of competition in the market for trucking services may result in operation below a firm's total costs. This was found to be more common among small to medium sized firms, where fixed and overhead costs tend to be less clearly defined. When asked about relative costs for operating domestically or trans-border, the majority of firms indicated that their costs were higher on trans-border operations. Many of these firms added, however, that the competitive environment did not allow them to incorporate those extra costs into their rate structure. In other words, these carriers cross-subsidize their trans-border operations with domestic operations. Again, the effect is to reduce the spread between trans-border and domestic rates, and under estimate the magnitude of institutional barriers.

Relative Importance of Transport Costs to Agricultural Trade

Tariff and non-tariff barriers to trade exist on both sides of the Canada-U.S. border which limit the exchange of agricultural commodities. Menzie and Prentice catalogue the wide spectrum of barriers to trade in agricultural products between Canada and the United States. For some commodities, transport costs may have only a minor effect on the quantities of product exchanged because other

barriers to trade supercede the effects of small changes in price resulting from inflated transport costs. For example, quotas imposed by the United States on many cheese imports or Canadian quotas on poultry imports are restrictive to the degree that transport costs have no effect on the quantities imported. To the extent that transport related barriers are superceded by more powerful non-tariff barriers they can be considered insignificant in terms of affecting trade flows.

For those commodities that are relatively free from tariff or other non-tariff measures, transport costs may pose a significant barrier to trade. The actual barrier imposed by transport costs is dependent on several factors.

Length of Haul

The rates provided by survey respondents pertained to a specific origin-destination pair in all cases. To examine the effect of distance on rates, the various routes were divided into three mileage categories: less than 500, 500-1200, and greater than 1200. The average trans-border and domestic rates for each of these categories, as well as their differences are presented in Table 7.

TABLE 7: EFFECT OF DISTANCE ON TRUCKLOAD RATES* (Canadian $ per mile)

	Canadian Firms			U.S. Firms		
Mileage	Trans-border	Dom-estic	Differ-ence	Trans-border	Dom-estic	Differ-ence
<500	2.71 (19)	2.23 (11)	.48	2.21 (30)	1.94 (42)	.27
500-1200	1.86 (51)	1.81 (14)	.05	1.99 (30)	1.87 (39)	.12
>1200	1.61 (48)	1.41 (43)	.20	1.73 (30)	1.85 (56)	-.12

*Number of observations in parentheses.

Both countries show a considerably greater spread between trans-border and domestic routes which span less than 500 miles, as compared to routes over 500 miles. This indicates a greater importance of transport related barriers for commodities which typically move relatively short distances, and can be explained by considering rate structure in general.

A load moved between two points will incur the cost of loading, unloading and various administrative costs, which may be considered fixed and unrelated to the distance travelled. The remaining "line haul" costs of fuel, maintenance and driver's wages are directly related to the length of haul, and are thus variable.

Similarly, regulations, fees and practices which pertain to trans-border trucking can be classified as "fixed" or "variable" for a given load. For example, border crossing costs represent a fixed cost, while the chance of having to purchase a trip permit increases with the distance travelled, and is a variable cost.

In fact, the majority of regulatory costs are "fixed" for a given haul and thus are spread over the distance travelled. As a result, institutional barriers to trade are relatively higher for short hauls, although the absolute barrier continues to increase with distance.

Nominal Commodity Value

Transport costs tend to limit the economic trading radius of agricultural commodities. In general, sensitivity to transport costs is a function of the market price of the commodity. Table 8 provides volume and price data for various Canadian agricultural exports to the U.S., as well as the average transport cost for 500 mile domestic and trans-border hauls. The difference is the extra cost imposed by institutional barriers to transborder trucking and is expressed as the resulting percent increase in commodity value. This increase ranges from 0.5 percent for fresh or frozen beef to 4.1 percent for carrots.

TABLE 8: VOLUME, PRICE AND TRANSPORT COSTS* FOR VARIOUS CANADIAN EXPORTS TO THE UNITED STATES IN 1985 (Canadian $)

Commodity	1985 Tonnage	Export Value $/Truck Load	DOMESTIC Transport Costs as a Percent of Value	TRANS-BORDER Transport Costs as a Percent of Value	Percent Increase in Value due to Regulations
Fresh or Frozen Beef	85,149	44,520	2.5	3.0	.5
Fresh or Frozen Pork	164,006	42,420	2.6	3.2	.6
Fresh Apples	28,770	11,340	9.8	11.9	2.1
Fresh Carrots	61,567	5,880	18.9	23.0	4.1
Frozen Potato Products	27,188	13,020	8.6	10.4	1.8
Flaxseed	120,972	6,720	16.6	20.2	3.6

*Based on a 500 mile haul and 42,000 lb. payload. Per mile rates are listed in Table 8, and equal $1,115.00 for domestic shipments and $1,355 for trans-border shipments.

The results in Table 8 should be interpreted with caution, keeping several points in mind. First, the Canadian based freight rates for hauls of less than 500 miles from Table 7 exhibit the largest spread (48 cents per mile) between trans-border and domestic rates of any mileage category. This is considerably larger than that of the corresponding U.S. rates (.27 cents per mile) and the average spread for all Canadian rates (19 cents per mile). However, the trend towards lower rates of transportation barriers as length of haul increases is consistent.

SUMMARY AND CONCLUSIONS

This study was undertaken to examine the regulations, fees and practices which pertain to Canada-U.S. trans-border trucking, and their effect on trade of agricultural products. Survey techniques and direct personal interviews were used to determine the importance and extent of the various transport related barriers from the perspective of both Canadian and U.S. trucking firms. Carriers provided truckload rates for both trans-border and domestic routes, which were used to approximate the relative importance and magnitude of current institutional barriers. The analysis led to the following conclusions.

i) With the exception of lack of proper operating authority, no barrier is absolute in its ability to prevent a carrier from conducting trans-border operations. Although the barriers vary in importance, most may be hurdled by some combination of time and money.

ii) The aggregate effect of regulatory costs is significant. Using average truckload rates, they were estimated to add approximately 15 to 20 cents per mile to transport costs of trans-border shipments versus domestic shipments. This level of tariff is more important for low value commodities, and limits the geographical extent to which certain commodities are traded. Agricultural products are generally low in value in comparison to manufactured goods, and thus suffer the greatest penalty.

iii) It is not practical to suggest that regulatory costs could be entirely eliminated. An international boundary such as exists between Canada and the U.S. must monitor trans-border traffic, and in so doing constitutes a barrier to trade. It would be feasible, however, to eliminate many of the inequities and inconsistencies which exist, and thereby reduce the level of institutional barriers.

iv) This study does not address regulatory costs or institutional barriers between provinces and between states. Discussions with carriers revealed that although regulations have been standardized to some extent in recent years, domestic transport barriers remain a major consideration for most carriers.

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TRANSBORDER TRUCKING: EVALUATION OF CUSTOMS PROCEDURES

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Abstract

This paper describes customs procedures governing transborder trucking. The interest is how these procedures affect, or are affected by, two major changes in transportation and trade policy; trucking deregulation and free trade. In addition, certain issues about the performance of the system are raised.

1. INTRODUCTION

With trucking deregulation (1980 in the United States, underway in Canada) and the advent of free trade (pending), it is anticipated that transborder trucking will both grow (more trade) and become more competitive (less economic regulation). One factor affecting this transborder trucking market is the procedures used by Customs on both sides of the border.

There is little published information describing these procedures. Yet in both countries governments have conducted internal reviews and, in doing so, the question has arisen: what procedures do the other country use and how well do they work?

This paper is a preliminary attempt to describe these procedures and to determine if two major policy changes (deregulation and free trade) will affect these procedures, or, if the procedures are important to the functioning of these two transportation/trade policies.

2. BACKGROUND

Previous research indicates that customs procedures are important in understanding transportation flows between Canada and the United States. Clayton (1985) notes that U.S. procedures have a significant impact on productivity. "One trucking official indicated that southbound LTL payloads are often up to 25% less than what could be handled if other provisions could be made for U.S. Customs inspections." [1] The "problem" is that southbound movements of LTL freight have to be loaded in the truck in such a manner (aisle down the middle) so that U.S. officials can visually inspect the contents at the border.

Chow (1984) describes customs procedures as they apply to traffic between British Columbia and Washington.[2] Among the points raised are: (i) delays usually occur in the destination country where the importer is required to complete various forms and pay any applicable duties and taxes before the goods are released; (ii) for LTL shipments, Canadian procedures making use of inland sufferance warehouses have an advantage over "clearing-at-the border" procedures in that incorrect documentation and/or other problems do not hold up the whole truck (ie, only the "problem" shipment needs to be held back; for this reason, Chow notes that most northbound LTL freight does proceed through sufferance warehouses); (iii) carriers with facilities at sufferance warehouses have a strong advantage over carriers who use the public dock (lower costs, marketing advantages); and (iv) U.S. customs procedures "are easier to deal with" notwithstanding the onerous aisle-loading practices required to clear at the border and the possibly higher damage claims that these procedures cause.

Chow concludes his description: "Customs requirements are cited by shippers and carriers alike as a source of confusion and delay. Because there are so many ways in which delay may occur, an aura of complexity shrouds transborder movements, particularly for [shippers/receivers] who deal infrequently with such freight movement and those who are geographically far from the physical process." (p. 167)

Skorochod and Bergevin (1984) argue that international trucking rates (Ontario/U.S.) are much higher than domestic rates (Canadian or American).[3] While they imply there is little justification for carriers filing tariffs through the Niagara Frontier Tariff Bureau to charge rates of this level, they do admit one possible reason for the higher rates: "Perhaps there are legitimate reasons why the international rate structure is higher than domestic rate levels. Carriers often state that Canadian customs procedures delay the smooth and efficient flow of traffic." (p. 847) They continue by listing a number of other factors: union contracts requiring the use of multiple drivers, interlining practices, and an historical link between trucking rates and the rail rates for international shipments which were also set higher than domestic rates. (Although not mentioned, there is the additional problem of finding backhauls for some international trucking operations.)

Although there is not enough rate information presented in the Skorochod/Bergevin paper to provide a comprehensive measure of these differences, their Exhibit III with eleven rate comparisons (class 100 rates for a 2 000 lb. shipment) suggests that on average trucking rates over the Canada/U.S. border are 61% higher than comparable (ie, similar distances) rates for U.S. domestic traffic.

To summarize, while there has been little analysis of actual customs procedures, the following suggestions have been made: these procedures result in inefficient loads for southbound LTL carriers; they cause delays in the flow of goods on both sides of the border; Canada's use of inland sufferance warehouses has certain advantages for LTL freight over the U.S. clear-at-the-border procedures; U.S. procedures are easier to deal with than Canadian; and, customs

procedures may be one of the factors causing international trucking rates to be considerably higher than domestic rates.

3. TRANSPORTATION FLOWS

From available Canadian statistics, exports to and imports from the United States and the proportion of these flows accounted for by truck (for-hire and private) are as follows (millions of current Canadian dollars):[4]

	1984	1985	1986
exports - total	86,269	94,185	93,952
- by truck	47,103	51,468	55,532
- truck %	54.6%	54.7%	59.1%
imports - total	69,169	75,106	78,611
- by truck	49,456	55,635	59,337
- truck %	71.5%	74.1%	75.5%

In total (exports and imports) Canadian and American trucks moved goods valued at $114.8 billion in 1986 -- 66.6% of the total trade as measured by value of goods. As measured by transactions (somewhat comparable to a "shipment"), these trucks handled 6.8 million such transactions in 1986 or 80.3% of the total transborder transactions by all modes.

Transportation statistics on transborder activity are not as complete as trade statistics. From the available Statistics Canada data, the following shows truck activity in 1985.[5] Unlike the above figures, these apply only to Canadian-domiciled carriers.

For-Hire Carriers	
carriers operating internationally	1,177
international revenues	$1.1 billion
international trips (based on a sample of 124 carriers accounting for 75% of international revenues)	890 thousand
Private Carriers	
U.S. distance as % of total	2%
tonnage originating in the U.S. (metric)	4.4 million
tonnage destined to the U.S. (metric)	0.4 million
international trips	127 thousand

Overlooking the fact that transportation statistics are not as good as trade statistics and the fact that U.S. transportation statistics on transborder flows are difficult and/or impossible to obtain, the point is that the available data shows that transborder trucking is a large and important industry. From a trade perspective, trucking handles two-thirds of the flow of goods across the border; from a Canadian trucking perspective, transborder activities account for a significant portion of total activity (particularly for the for-hire carriers).

4. U.S. CUSTOMS PROCEDURES

There are several possibilities for a truck arriving at the U.S./Canada border: the trucker (or importer of record) may have the shipment cleared at the border and released into commerce; the shipment may be moved in bond to another location; or, the shipment may be returned to Canada.

Most shipments are cleared at the border either for "consumption" (ie, use in the United States) or for "temporary importation" (ie, for use and re-export). A customs broker usually prepares the entry showing the value of the shipment and the estimated amount of duties and fees, if any, that are payable to the U.S. Customs Service. The broker then submits the appropriate customs form and a cheque for any monies due U.S. Customs within ten working days of the release of the freight.

Alternatively, a shipment may be moved in bond to another location. This is accomplished under either the truck carrier's or a U.S. Custom Broker's bond guaranteeing delivery performance. These in bond movements usually occur when a shipper or consignee wants the freight moved to another port for clearance, to a warehouse, to a foreign trade zone, to a trade fair, or for re-export.

The last possibility -- having the truck and shipment returned to Canada -- occurs where there is some noncompliance with a particular law or requirement, or where the shipper or consignee does not have an agent at that port to affect clearance.

All shipments, whether released or bonded, are subject to examination. U.S. Customs requires that an aisle must be present down the centre of each LTL truck for this purpose; they may have a truck returned to Canada if such an aisle is not present. This can result in reduced load factors (although there are some who question whether or not all LTL trucks do leave this aisle). Also, unless load bars are used, there is an increased probability of damage from load-shifting.

Examinations can be made at the border or at a Central Examination Station. At either location, devanning may be required (the cost borne by the shipper and/or consignee). This devanning increases transit time and the risk of damaged freight. Some industry people claim that examinations are increasing in frequency.

Two of the procedures being used by U.S. Customs to facilitate rapid clearance are "line release" and the "ACCEPT program". The first, "line release", requires filing for approval to clear full truck loads at the primary line (ie, the first customs point at the border) instead of at the secondary inspection point (the truck dock at the border). The second, "ACCEPT program", allows for clearance normally without physical inspection. This is achieved by maintaining a data bank of information which establishes the sensitivity of certain cargoes from certain origins.

Most of the industry (carriers, importers, brokers) prefers to clear at the border as this is usually the least time-consuming manner of getting goods into the United States: most major border crossings are available for customs clearance 24 hours a day, seven days a week, whereas inland ports may have more limited hours.

U.S. Customs is also experimenting with electronic interfacing for transfer of documents prior to arrival of trucks at the border. This allows the inland cargo manifest and the customs invoice to be transmitted by fax or computer to the broker in the United States. The broker can then present the "exam package" (ie, the paper work) to U.S. Customs for review. If Customs wants to inspect any portion of the load, the documentation may be changed to reflect a movement in bond (ie, so that it can be inspected inland). Effectively a truck can clear customs "on the roll". These procedures are still in the test stage.

There are two relatively new requirements for commercial trucks entering the United States. Proof of liability insurance must be available for presentation at the border, and a tractor must pay a $5 fee each time the border is crossed. An annual permit ($100) may be purchased in lieu of this $5 fee.

5. CANADIAN CUSTOMS PROCEDURES [6]

An overview of the procedures used by Canada Customs with respect to in-coming freight carried by trucks is shown in Figure 1.

As shown, there are two options when the truck arrives at the border: the load can be cleared and released for consumption in Canada, or the trucker can file the paperwork necessary to allow the load to be forwarded to an inland sufferance warehouse. In either case, Customs will check for compliance with customs regulations and procedures as well as compliance with 60 other acts and/or regulations that relate to other government agencies (eg, agricultural regulations, health and welfare, sales tax on vehicles, etc).

If the option to clear customs at the border is chosen, a completed Canada Customs Invoice is presented. Customs may inspect the load to check for compliance with various rules and regulations such as proper piece count of items in the load, country of origin marking, etc. If the goods are intended for immediate consumption, a completed "B3" (a form containing the "accounting" data), as well as the amount owed for duty and fees must be turned into Canada Customs within five working days. This step is usually accomplished by a licensed customs broker.

If, instead, the load is destined for storage in a Customs Bonded Warehouses, it will be sealed for the movement. A "1/60th" form is given to Canada Customs at the border. These procedures allow importers to pay duties on goods as they are used or sold rather than at the actual time of importation. Importers have five years in which to complete the process. Loads can be withdrawn either in whole or in portions at any given time during the five year period.

Finally (still considering goods clearing at the border) certain shipments may be qualified to be duty and tax free. In this instance a form E29B is filed with Canada Customs.

1. Truck arrives at Customs office (border).

2. Report to Customs (carrier name or number, shipper, consignee, description of goods, quantity).

3. Initial assessment of report and check of shipment(s) for compliance with 60 other acts and/or regulations.

4. If carrier (shipper, consignee) wishes to have goods clear at border, a Canada Customs Invoice is presented and goods may be released (after payment of duties and taxes due).

5. If freight is to proceed inland to clear Customs at a Sufferance Warehouse, it may be moved by either a Post-Audit carrier or a Non-Audit carrier. These movements are accompanied by a Cargo Control Document ("A8A"). A Non-Audit carrier has to obtain a single-trip authority (after posting a bond) and must proceed directly to an Inland Sufferance Warehouse; the van is sealed by Canada Customs. A Post-Audit carrier operates under a standing general authority (and the posting of a bond) and may proceed to its own terminal for devanning before having the shipments moved to an Inland Sufferance Warehouse; Canada Customs does not use a seal on these vans.

6. Goods arriving at an Inland Sufferance Warehouse are held pending clearance.

7. Under the new "Customs Commercial System", the primary activity at the Inland Sufferance Warehouse is the collection, compilation, and checking of the accounting data required for the new "B3 accounting document" (or comparable information filed electronically).

8. Goods may be released in one of two ways. Under the standard procedures, an importer (or customs broker acting as an agent) presents Customs with the Cargo Control Document, the completed B3 (accounting data) and a Canada Customs Invoice. Under the RMD procedures, the importer or broker presents Customs with just the Cargo Control Document and the Canada Customs Invoice (or comparable invoice). The accounting data contained in the B3 is presented later (hard copy or electronically) to confirm release. Importers or brokers using RMD procedures have to post a bond and meet certain performance standards.

FIGURE 1 Overview of Canada Customs Procedures

Instead of clearing at the border, trucks may proceed in bond to have goods cleared at an inland sufferance warehouse. In this case, the driver files a cargo control document ("A8A") with Customs. While no data has been obtained, it is understood that the majority of goods entering Canada do move through these inland sufferance warehouses. There are three types: Class A, which are operated by railways, express, airline, and shipping companies and which are normal break-bulk and distribution terminals operated for the individual carrier's own use; Class B highway sufferance warehouses which receive inbound goods from motor carriers; and, Class C operated by consolidators and freight forwarders. The Class B warehouse is of most interest here.

As of 1985 there were approximately 241 Class B sufferance warehouses in Canada, each one operating under a licence issued by the Customs and Excise branch of the Department of Revenue. These warehouses were first established in 1951 in response to a growing inability to handle the inbound trucks at border points.

There are two points to understand about the licensing of these warehouses. From the government's perspective, licensing is a means of controlling aspects of the warehouse owner's business: standards on storage area, security requirements, proximity to a Customs office and major transportation routes, equipment and labour availability, and so on. From the operator's perspective, a licence is an assurance of a certain market as there is a policy on the part of the Department of only granting one licence for each Customs office area -- although some large centres, such as Toronto, have more than one Class B Sufferance Warehouse.

The warehouse owner provides free office space for customs officials and space where goods may be inspected. Currently Revenue Canada charges no fees for these inspection services but has considered the possibility of doing so (eg, a flat annual fee for each Class B warehouse or a fee tied to the volume of business). The warehouse operator earns its livelihood by charging fees to carriers and others (eg, customs brokers) and by renting out space.

There are two types of carriers that may move a truck from the border to an inland sufferance warehouses: "post-audit" and "non-audit" carriers. Bonded or "post-audit" carriers are registered with Canada Customs and have posted a bond to insure that the load will reach the inland sufferance warehouse for customs clearance, and that all duties and fees will be paid (the trucker is legally responsible for this while the goods are in its control). Customs bonded carriers may also transport shipments to their own terminals for activities such as de-stuffing and break-bulk before presenting the freight to Canada Customs for clearance. This movement to a carrier's terminal usually occurs with LTL freight where shippers or importers have specified various inland sufferance warehouses as the destination. The carrier may wish to have the linehaul movement broken apart at his own terminal for re-consolidation of various shipments to various sufferance warehouses.

If the shipment is being transported by a non-audit carrier, the carrier must post a "trip bond", good for five days, to insure that the shipment arrives at the inland sufferance warehouse and that all duties and taxes are paid. These bonds are issued by surety companies, and are usually sold through customs brokers.

When the shipment arrives at the inland sufferance warehouse for Customs clearance the procedure is the same as at the border: the warehouse is "the border" for such shipments.

The whole procedure for importing goods and having them cleared through Customs has recently gone through a major reorganization. Referred to as the "Customs Commercial System" these procedures include the following:

- Harmonized System ("HS"), a new international system for classifying goods.
- The "B3 documentation Requirements", which consists of the data that must be presented to Customs to establish the amount of duty and tax owing. The B3 (or comparable data submitted electronically) is submitted before and in some cases after goods are released.
- "RMD", or "Release on Minimum Documentation", which is described by Revenue Canada as a "privilege provided to importers and brokers to have goods cleared through Customs upon presentation of a cargo control document and unrated supporting documents." These RMD procedures have been implemented to speed up the customs clearance procedures.

6. ISSUES

This description of Canadian and American Customs procedures, although preliminary, raises a number of issues about the transborder transportation industry. Since in many cases these were raised in the context of interviews with people involved with the process, the attempt here is to list possible avenues for further research rather than to resolve anything.

Free Trade: People involved with the current system had a variety of views on the importance of free trade to the transborder transportation industry that can be summarized as follows. Free trade itself will not make the border or the customs procedures disappear. The process (cargo control, compliance with numerous other regulations, valuation of goods for the payment of taxes and/or fees, submission of various accounting data, release of shipments) will continue and, if anything, may even become more complex as the "country of origin" rules require more detailed information and/or investigation. The important point, then, is that under a free trade agreement goods will not flow across the continent in a completely unrestricted manner as they would within one of the two countries. There will continue to be an impediment to this flow of goods that contributes both to the cost and the time-dimension of freight flows.

Deregulation: Many people felt that while deregulation might increase the number of TL truckers crossing the border, this was probably not going to be a major phenomenon. It would not be comparable, say, to deregulating the dump truck industry within one state or province where the impact might be somewhat chaotic. The reasons used to substantiate these views can be summarized in the following three points. First, there already has been (on the U.S. side) a substantial increase in the number of TL truckers and some relaxation (on the Canadian side) of regulatory controls. In other words, the impact of deregulation will be diminished because some deregulation has already occurred. Second, many of the goods hauled by TL truckers have been unregulated for a long period of time (these are generally known as "exempt" or in some cases "designated" commodities, depending on the jurisdiction). Third, entry for new truckers in the transborder business will still be more constrained than in domestic markets as all of the previously-described customs procedures will have to be followed (usually under the control of a customs broker or a shipper/consignee), not to mention a host of other transborder issues (sales tax on vehicles, vehicle registration, weight and dimension regulations, driver-employment issues, insurance, etc.).

Deregulation may have more significance for the LTL market. If the experience in the United States is a guide, it can be expected that deregulation will lead to some consolidation (there are economies of scale in LTL trucking). These economies of scale in LTL trucking, coupled with some assumed economies of handling a transborder LTL operation (everything from the means of transmitting data to Customs, to the cost of the knowledge-base required, to the operation a special procedures at Inland Sufferance Warehouses), may result in a greater tendency towards industry concentration on transborder traffic lanes than in any of the domestic LTL markets. In other words, there may be a significant restructuring of the international LTL trucking industry over the next few years (mergers, buy-outs, bankruptcies, etc).

User-Pay: Under the Canadian system, the general taxpayer foots the bill for most of the work of Customs and Excise' work controlling the flow of in-coming goods. Some have suggested that there is an argument to be made for the importers of these goods paying for this system (the cost presumably being passed on to the consumer of imported goods). Although Revenue Canada has consider the issue of user pay, there are no known plans to do anything about it. In the United States, there is some effort made to make the shipping industry pay for the cost of the customs procedures. The fees that are levied are an attempt to shift the cost of Customs to the importing industry.

Transportation Costs: Over and above the public costs of the customs procedures (and the issue of user-pay), the existence of a border adds to the cost of transporting goods. These arise from factors such as: the reduced load factors on southbound LTL trucks; the costs associated with devanning trucks for examination; the extra routing and distances required in moving freight through inland sufferance warehouses in Canada; all the costs associated with "paper work"; waiting-time costs; etc. In describing their own practices,

one Canadian carrier noted that because of the location of the sufferance warehouses and the time of day when goods where released, it was impossible to integrate the city pickup and delivery operations of domestic and international freight. Obviously the cost of operating a second pickup and delivery fleet in the same urban area adds considerably to the total freight bill. (It is not known whether this carrier's experience is unique or fairly common.) The only hint of how much the border adds to transportation costs is the previously referenced paper which, if not precisely establishing a figure of 61%, at least suggests that the costs are significant.

Relative Performance: There do not appear to be any easily-accessible measures available upon which to judge the performance of the customs procedures in each country (cost per shipment, elapsed time, etc). The most notable difference between the two systems is Canada's use of inland sufferance warehouses versus the practice in the United States of clearing most goods at the border. That noted, the procedures on both sides of the border are somewhat similar, although there is a marked difference in the role of the customs brokers (U.S. Customs Brokers may have a shipment moved under their bond). Both Customs services are implementing and/or experimenting with procedures designed to facilitate the whole customs process.

Number of Inland Sufferance Warehouses: Some questions have been raised as to the number of sufferance warehouses (Class B) allowed under Revenue Canada's licencing policy. Users of the system have mixed views on this subject. On the one hand, some would like as many sufferance warehouses as possible to facilitate the easiest routing of freight (freight, documents, people). On the other hand, increasing the number of sufferance warehouse may raise the cost of the system (if there are currently some economies of scale in the process).

7 SUMMARY OBSERVATIONS

This paper has described the customs procedures in Canada and the United States to determine the impact of two major policy changes (free trade and deregulation). In addition, the existence of the customs procedures as a part of the process of transporting goods across the border is, independent of the policy changes, important in understanding how the transportation system works.

There is little evidence that the free trade agreement will have a major impact on the procedures themselves (duties, of course, will not be paid). All the "control/inspection/valuation/paper-flow" procedures, which result in time delays and extra costs, remain the same. Indeed, problems with country of origin authentication and marking may result in longer delays for some shipments. While the elimination of duties will have an impact on industrial activity in both countries, the impact will not be quite the same as it would be if the two countries were entering a customs union.

Deregulation may not affect transborder TL trucking as much as some anticipate: some of this market has already been partially deregulated and there are still restraints to entering the business

that do not exist in the domestic markets of either country. There may be a more noticeable impact with respect to LTL trucking: a trend towards consolidation, some changes in service (eg, reduce the amount of interlining). In fact, the existence of the border may act to intensify the trend toward consolidation within the North American LTL industry: the customs procedures are such that the economies of scale within this sector of the trucking industry are probably greater on international operations than on domestic ones.

Finally, there remain a number of issues concerning the performance of the customs procedures themselves: who pays for them, how they are organized, efforts to streamline them, relative efficiencies, and so on. There does not appear to have been any (public) evaluation of these procedures to this point in time and none of the preliminary descriptive material collected for this paper is detailed enough to make any final assessments.

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6 The description has been developed from: a) The Canadian Highway Sufferance Warehouse Association, Nov. 1985, "An Introduction to the Canadian Highway Sufferance Warehouse Association," Ottawa; b) "Canada Customs Cargo Control System" mimeographed paper from Revenue Canada, Customs and Excise, March 1987; c) Revenue Canada, Customs and Excise, Customs Commercial System: "General Information on the Customs Commercial System", Nov 1986; "Release of Commercial Shipments", Nov. 1986; "Classification in the Harmonized System", Nov., 1986; "B3 Documentation Requirements", Nov., 1986; "B 2 Documentation Requirements Package" Sept., 1987; and, "Customs Commercial System Information Update Package", Nov.,1987. In addition, Mr. Peter Baird, Mr. Rick Baird, and Ms. Carrie McElroy of Interport Sufferance Warehouse (Mississauga), Mr. Reg Swain of Abacus Customs Brokers Ltd. (Mississauga), and officials from Revenue Canada, Customs and Excise kindly assisted with the interpretation of some of this material.

SAFETY EXPERIENCE OF LARGE TRUCKS
AN ANALYSIS OF SAMPLE SIZE REQUIREMENTS

by

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AN ANALYSIS OF SAMPLE SIZE REQUIREMENTS

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ABSTRACT

Considerable debate has emerged in Canada in terms of the relative safety of different types of large trucks (i.e. double trailer units versus single trailer units; A-Train versus B-Train versus C-Train configurations etc.). This paper presents an analysis of the sample size required in order to have a reasonable expectation of detecting statistically significant differences in safety experience for varying levels of actual differences in accident rates. The results indicate that the sample size required to detect a 10-20% difference in (actual) accident rates is in the order of 1-2 x 10^9 vehicle kms of travel. Smaller samples could only be expected to detect larger actual differences. These results suggest that:

1) it is very important to include an appropriate statistical analysis as part of accident research analysis if differences in the order of 20% are of interest, and

2) the value of much of the research reported on the relative safety experience of various vehicle types may be limited and/or questionable because of limited sample sizes and/or the lack of appropriate statistical analysis.

INTRODUCTION

The debate in Canada related to the use of larger trucks has increased in recent months. The increased level of concern and debate is in part related to the release of recommendations resulting from research undertaken by the Roads and Transportation Association of Canada (RTAC). RTAC released the recommendation

from a multi-year, multi-million dollar research program in the spring of 1987. This research was directed at assessing the benefits and costs associated with permitting larger and heavier trucks to operate on Canadian highways. (*)

The RTAC research concluded, in essence, that the significant economic benefits associated with the operation of larger and heavier trucks outweighed the road and other associated costs and it was therefore deemed to be in the public interest to allow larger and heavier trucks to operate on Canadian public highways. The RTAC recommendations were first considered by the Council of Ministers Responsible for Transportation and Highway Safety in September of 1987 and, with minor modifications, were accepted in February 1988.

Major opposition to the RTAC recommendations to permit larger and heavier trucks on public roads came from the railways and highway users represented by the Canadian Automobile Association (CAA).

The opposition put forward by the railways was largely self-serving in recognition of the potentially significant increase in competition from trucks made possible by the permitted increases in truck size and weights. The opposition put forward by the CAA was based upon a concern for public safety. The general position put forward was that bigger trucks presented an increased hazard and inconvenience to the motoring public.

There is little question that safety is a major consideration relative to highway transport generally, and the use of larger and heavier vehicles in particular. Unfortunately much of the debate as well as much of what is published on this subject is highly emotional, and often lacks a substantive factual basis. The highly emotional nature of the debate can be attributed in large part to the significant personal vested interests possessed by the participants. The lack of objective factual information on the other hand is attributable to the complexity of the issue combined with the lack of detailed data and analysis. The situation is further complicated by the probabilistic nature of highway safety.

Accident experience of various types of vehicles are often compared but seldom are these comparisons undertaken in a manner consistent with sound

statistical methods. As a result, many of the comparisons are interesting but in a scientific sense are not particularly meaningful. Some are even misleading.

This paper identifies, illustrates and discusses one of the methodological difficulties encountered by researchers attempting to present an unbiased, objective assessment of the facts related to the safety experience of large trucks operating on public highways. In particular, this paper addresses the issue of sample size required to detect statistically significant differences in accident experience between different types of vehicles. The analysis presented would for example be applicable to determining how much data (in terms of vehicle kms of travel) would be required to detect statistically significant differences in accident experience between single versus double trailer units, or between A, B, and C-Train configurations.

ANALYSIS FRAMEWORK

In the context of the above, the issue of interest is whether there is a statistically significant difference between one vehicle type's accident experience relative to that of another vehicle type (i.e. single trailer unit versus double; A-Train configurations versus B-Train etc.). In statistical terms, such questions can be addressed by testing for statistically significant differences between means.

In this case it is easier to develop the details in the context of a specific situation and then generalize the methodology and conclusions. Therefore the following will be developed in the context of double trailer units versus singles. It will be obvious as to how the methodology could be extended to A versus B or A versus C or B versus C-Trains.

Let:

$\bar{X}_D$ = average number of accidents per 100 million kms of travel for doubles from the sample

$\bar{X}_S$ = average number of accidents per 100 million kms of travel for singles from the sample

Then, $(\bar{X}_D - \bar{X}_S)$ will be normally distributed

$$N\left(\mu_D - \mu_S ; \sqrt{\frac{S_D^2}{n_D} + \frac{S_S^2}{n_S}}\right)$$

Where

μ_D = average number of accidents per 100 million kms of travel for doubles from the population

μ_S = average number of accidents per 100 million kms of travel for singles from the population

S_D^2 = sample variance for the doubles
S_S^2 = sample variance for the singles
n_D = number of samples of $\bar{X}_D$
n_S = number of samples of $\bar{X}_S$

If the number of truck accidents per 100 million kms of travel is (approximately) Poisson distributed (5), then

S_D^2 approximately equals μ_D
S_S^2 approximately equals μ_S

Then if the accident rates for doubles is approximately equal to singles and both are in the order of 150 accidents per 100 million kms of travel (6), and $n_D = n_S$ (i.e. sample size for doubles and singles are equal), then

$(\bar{X}_D - \bar{X}_S)$ will be approximately normally distributed

$$N\left(\mu_D - \mu_S ; \sqrt{\frac{2S^2}{n}}\right)$$

If n = 10 (x100 million kms of travel for each doubles and singles (7) for a total of 2 x 10 x 100 million kms of travel in total, or 2 x 10^3 kms of travel), then

$(\bar{X}_D - \bar{X}_S)$ will be approximately distributed

$$N(\mu_D - \mu_S ; .455)$$

But S^2 is approximately equal to 150 or S = 12.25

therefore,

$(\bar{X}_D - \bar{X}_S)$ will be approximately distributed

$$N(\mu_D - \mu_S ; 5.51)$$

If 95% confidence interval is required before accepting an observed difference as real, then we would have to obtain an observed difference of sample means of 1.645 x 5.51 = 9.06. (*) A 10% difference in sample means would be approximately 15 (i.e. 10% x 150). The probability of capturing this 10% difference is:

$$Z = \frac{\text{observed difference}}{\text{standard error}}$$

$$Z = \frac{9.06 - 15}{5.51} = \frac{-5.94}{5.51} = -1.08$$

The area under the standard normal curve (F) for Z = -1.08 equals:

$$F\ (Z : -1.08) = 85\%$$

Therefore the probability of capturing a 10% difference in accident rate with a sample size of n = 10 (10 x 100 million kms for each doubles and singles or a total of 2 x 10^9 kms of total truck travel) would be 85%.

The above can be repeated for varying values of n and varying levels of actual differences to get the following:

Probability of Detecting A Difference

	Actual Difference	
n	10%	20%
1	22%	54%
5	62%	98%
10	85%	99%

From the above there is an 85% chance of finding a significant difference with a simple difference of means test if an actual difference of 10% exists when n = 10. If the actual difference is 20%, then there is a 99% chance of finding a significant difference if such exists. If n is reduced to 5 or 1, then the chances of detecting a 10% difference are reduced to 62% and 22% respectively. If the actual difference is 20% the

chances are larger, i.e. 98% and 54% respectively.

If we reduce the significance level required from 95% to 90%, and keep n = 10, we can increase the probability of observing a significant difference when the actual difference is 10% to about 93%. However we increase the probability of a Type I error from 5% to 10%. That is, there is a 10% instead of 5% chance that we will reject the hypothesis H_o that the accident rates for doubles is equal to that of singles in favour of the hypothesis H_1 that the accident rate for doubles is greater than singles, when in fact the accident rate for doubles is equal to that of singles. In a policy sense, this would lead to prohibiting doubles when there is no reason to prohibit them.

Conversely, this says that there is a 15% probability (100% -85%) of accepting the hypothesis H_o; that they are equal, and rejecting the hypothesis H_1 that accident rates for doubles is greater than that for singles when in fact doubles have an accident rate 10% greater than singles. (This is the probability of a Type II error.) This in a policy sense may result in permitting doubles when in fact they experience 10% more accidents.

If the primary objective is to protect public safety, the second error is obviously more serious than the first. In any event public policy makers would probably want to be reasonably sure (i.e. 95% or greater) that they didn't permit larger vehicles on the highway (i.e. doubles) if they experience substantially more accidents (i.e. 10-20% more than singles). In order to carry out an analysis that would provide the required information with the required level of confidence, it would appear as though "n", the sample size, would have to be in the order of 5-10 for a confidence level on a Type II error of >90% for real difference of 20%. This translates into a sample size of 5-10 x 100 million kms of travel for each doubles and singles, or between 1 - 2 x 10^9 vehicle kms in total (half for doubles and half for singles). If it is assumed that the average vehicle (singles or doubles) travelled 200,000 kms per year one would have to have a data base that included 5000 vehicle - years of data. This could be a fleet of 5000 vehicles for 1 year, 2500 vehicles for 2 years etc. Put another way, it would require 50 fleets of 100 vehicles each for one year, or 10 fleets of 100 vehicles for 5 years. In the context of Canada, there are probably 50 fleets that

operate 100 vehicles or more but the real practicality of undertaking such an experiment is limited when one reflects back upon the required assumptions. (See note 5) This in essence requires that all things must remain unchanged during the sampling. That is, vehicle types cannot shift, vehicles must operate on the same types of roads, driving skills must remain constant, and operations in the same traffic levels etc. The likelihood of meeting this requirement over 5000 vehicle - years of travel is remote at best. Any deviation from these assumptions would create "noise" in the sample which in turn would increase the sample size required to detect significant differences at any level of actual difference in accident experience.

CONCLUSION

The above results have important consequences in terms of research and analysis related to determining the relative safety of various vehicle types and/or configurations. That is, the sample size required to detect even 20% difference in accident rates in a "clean" sample is beyond the size that could be reasonably undertaken in Canada. This suggests that there is little if any chance of detecting these differences in a "dirty" or "noisy" sample (i.e. shifting composition of vehicle types, travelling in different amounts on various roads etc.) which is more representative of the real world data that is available.

Further, the above suggests that conclusions drawn from smaller samples (i.e. as per those sometimes reported) are at best questionable unless the difference in accident experience is large (i.e. >>20% difference).

Given that the practicality of undertaking such a study on a fleet specific basis is limited, one might consider undertaking such an experiment for a particular section of road. A busy section of road handles 100,000 vehicles/day of which 30% could be trucks, with half of these singles and half doubles. If one has a 10 km section of (uniform) roadway, one would have to collect data for 10 years, i.e.

$$100{,}000 \times 30\% \times 10 \text{ km} \times X \text{ days} = 1 \times 10^9 \text{ vehicle km}$$

$$X = \frac{1 \times 10^9}{100{,}000 \times .3 \times 10} = \frac{1 \times 10^9}{3 \times 10^5} = .33 \times 10^4 \text{ days}$$

$$= \frac{3300 \text{ days}}{365} = 9.04 \text{ years}$$

The above suggests that large sample sizes are required if differences in actual safety experience in the order of 20% are to be detected. This in turn suggests that it is fundamentally important to undertake appropriate statistical analysis when drawing conclusions about the relative safety experience of different vehicle types.

ENDNOTES

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4. Recommended Regulatory Principles for Interprovincial Heavy Vehicle Weights and Dimensions, RTAC Vehicle Weights and Dimension Study, Implementation Planning Subcommittee, September 1987

5. The number of accidents per unit of travel (i.e. per 100 million vehicle kms of travel) would be expected to be a Poisson distributed random variable if:

    1) The random variable is the number of times that an event occurs in a single trial which is defined as a basic unit of time, space, or quantity;

    2) The trials which are non-overlapping are

Independent of each other;

3) The average number of occurances of the random variable in a single trial remains constant from trial to trial.

In the context of the accident experience of large trucks, (1) and (2) above present no problem. However, (3) presents a major challenge because it essentially says that nothing (i.e. types of trucks, roads, drivers, etc.) can change during the sampling.

6. Data has been assembled on a fleet specific basis for a total of 600 million vehicle kms of truck travel in western Canada over 4 years. This data suggests that the average accident rate for over the road highway operations is in the order of 150 accidents per 100 million vehicle kms for both double and single trailer units.

7. One might be tempted to say that with $n = 10$, n is small in the context of large - sample tests and that the Student's t Distribution would be more appropriate for small n. Care must be used in the interpretation of n_D or n_S. In the context of our formulation n_D and n_S are the number of samples of $\bar{X}_D$ and $\bar{X}_S$ sampled from a very large population. In this way, $n = 10$ is not synonymous with a small sample (*). The point might be illustrated as follows. We might have defined $\bar{X}_D$, $\bar{X}_S$ etc. as the number of accidents in 10 million or 1 million vehicle kms of travel instead of the number per 100 million vehicle kms as we did. This would have had the effect of increasing n_D and n_S by a factor of 10 or 100. That is, for 2×10^9 kms of travel we would have had n_D and n_S equal to 100 or 1000. In turn $\bar{X}_D$ and $\bar{X}_S$ would have been reduced by a factor of 10 or 100 from 150 accidents per 100 million vehicle kms to 15 accidents per 10 million vehicle kms or 1.5 accidents per million vehicle kms. Clearly $n_D = n_S = 100$ or 1000 would have been large in the context of sample size and presumably the assumption that the difference of means was normally distributed would be appropriate. It is noted however that nothing has really changed in redefining n other than rescaling $\bar{X}_D - \bar{X}_S$, and S_D^2 and S_S^2. Their relative values, which are the important issue in the statistical test, remain unchanged. The requirement for n to be large

relates to the sample that $\bar{X}_D$ and $\bar{X}_S$ are drawn from and not n_D and n_S per se. Clearly in our case, $\bar{X}_D$ and $\bar{X}_S$ are drawn from very large samples and therefore it is appropriate to use the normal distribution for this statistical test.

* Mathematical Statistics with Applications, Third Edition, N. Mendenhall et al, PWS Publishers, 1986

8. The difference of means is normally distributed. The value for Z equals 1.645 for 95% under a one-tailed test. See any standard Statistics text for details.

SAFETY RECORDS OF TRUCKS USED FOR LONG HAUL HEAVY GOODS MOVEMENT

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1.0 INTRODUCTION

In Canada there is a growing interest and concern regarding effects of relaxing weight and dimension regulation of large trucks. Such relaxation might result in an increase in the number and proportion of heavier and larger trucks in the system and also result in larger sizes of cargoes being hauled over longer distances by such trucks. Some feel that this lends itself to more economical operation in the movement of goods by truck. Others feel that this would result in negative impacts on highway safety and therefore the physical restrictions should remain as they are. This too is disputed, as some parties believe the dangers of operating heavier and longer vehicles is largely imaginary, and based on intuitive feelings, rather than backed with solid statistical evidence.

In response to the safety debate, a literature review of heavy truck accident studies performed in various countries throughout the world was undertaken. This review concentrated on performance of heavy trucks in actual highway operation rather than on studies performed on test tracks or roadway test sections. The objective was to determine the quality and usefulness of existing information, and whether any useful conclusions regarding the safety performance of large trucks as a function of vehicle combination, length of haul, vehicle size and weight and tonnage hauled, could be made based on the existing information. There was no information available on the length of haul. Following is a summary of the more relevant information found during this literature review.

2.0 TRUCK SAFETY RECORDS BY GROSS VEHICLE WEIGHT (G.V.W.)

Gross vehicle weight is one of the primary vehicle characteristics of concern when one is addressing the issue of relaxing physical regulations on large trucks. Some fear that heavier trucks will increase road accident severity and risk of fatality, and may result in an increase in total accident rates. The literature review hoped to ascertain the effects of gross vehicle weight on the operation of large trucks with respect to safety.

Information on the safety record of heavy trucks by gross vehicle weight is limited. Three papers were found that presented accident data as a function of G.V.W., one from the United States by Valette et al. [ref. 1], another from Israel by Polus and Mahalel [ref. 2], and the third from the Federal Republic of Germany by Theis [ref. 3].

2.1 Valette et al. [ref. 1]

Exposure data for each truck type and accident data were obtained over certain road segments in a six state study from July 1976 to December 1977. The effects of G.V.W. on truck accident rates were investigated for straight, single trailer and double trailer trucks. The results are presented in Tables 1 and 2. They found a consistently increasing accident rate with increasing G.V.W. for the straight trucks. Accident rates decreased with increasing gross vehicle weights rapidly for both single and double trailer trucks. Accident severity as a function of G.V.W. was also investigated by Valette et al. by comparing relative occurrences of property damage only accidents and injury accidents. This is presented in Table 3. Over the range of G.V.W. investigated, occurrence of injury does not seem affected by G.V.W. for singles and the results for doubles are inconclusive.

This was a fairly detailed, carefully performed study. It was dedicated entirely to the collection and analysis of truck accident and exposure data first hand for the purpose of studying the effect of vehicle weight and dimension on safety. Both exposure data and accident data were collected independently without going to other sources for compiled data. This ensured that accident investigation and analysis was carried out in a consistent manner, relevant to the goals of the study. Data was statistically analyzed to ensure that comparisons were properly carried out.

2.2 Polus and Mahalel [ref. 2]

In investigating road accidents in Israel, Polus and Mahalel used two sources of data, the police accident file and the vehicle registration file. Similar to findings by Valette et al., Polus and Mahalel reported a declining accident rate with increases in gross vehicle weight for the range of vehicle weights considered (Figure 1), although the trend is only slightly evident. They also reported, however, that risk of fatality increases with increases in gross vehicle weight.

In their presentation, Polus and Mahalel do not mention the quality of their data or any statistical tests aimed at determining the significance of the final results obtained. It is also not specified whether the G.V.W. used was the authorized limit or the G.V.W. at the time of the accident. These concerns make final evaluation of the presented results difficult.

2.3 Theis [ref. 3]

Based on an on going study in the Federal Republic of Germany, Theis presented total accident occurrence by vehicle weight for single trailer and double trailer trucks. For comparison purposes, Theis presented information on vehicle registration rather than normalizing on the basis of vehicle-kilometers travelled. Vehicle registration data is only distinguished by G.V.W. and singles and doubles are not separated in the classification. This results in the

two greatest weight categories displaying over-involvement in accidents based on the number of registered vehicles.

One must question the validity of using the number of registered vehicles as a means of normalization, as different vehicle types can travel vastly different distances. Similar to the Polus and Mahalel study, the quality of the data is not addressed.

2.4 Conclusion on the Effects of Gross Vehicle Weights

It must be emphasized that the results of all three studies mentioned are applicable only to the range of G.V.W. analyzed. All three studies considered ranges of the G.V.W. which are much lower than the maximum weights allowed in Canada (140 kips or 63,500 kgs). Mere extrapolation of these results would not be appropriate.

In summary of the findings regarding the effects of gross vehicle weights on accident rates, it seems that there is very little information available regarding this matter. The available information is either not applicable to the range of gross vehicle weights experienced in Canada or no rigorous statistical analysis is performed (or presented) on the results, making evaluation of the strength of the conclusions difficult.

3.0 TRUCK SAFETY RECORDS BY THE NUMBER OF TRAILERS

Along with gross vehicle weights, the number of trailers is an issue at the centre of debate regarding physical restrictions on heavy trucks. The greater length of multi-trailer vehicles is often viewed as intimidating to other road users, and the issue of amplified lateral movement through each additional trailer and the problems encountered by overtaking vehicles raise the question of the effects of the number of trailers on the accident experience of large trucks. The comparison of single trailer trucks and double trailer trucks in terms of accident rates seems to be an issue fairly well discussed. Information about triple trailers on the other hand, is quite limited.

3.1 Valette et al. [ref.1]

As alluded to earlier, the study by Valette et al. compared accident rates for singles and doubles as a function of gross vehicle weight. Their study had also attempted to analyze safety records of triple trailer configurations. No accidents involving triple trailer combinations occurred during the period of their study, and exposure of triples was also substantially less and insignificant when compared to the other truck types. For these reasons they were left out of the final analysis. For the states, in which comparisons between doubles and singles were made, doubles showed a consistently higher accident rate than singles for configurations of the same G.V.W. (Table 2). This difference was most significant in the empty or lightly loaded state, and lessened at the more heavily loaded state near the top of the range of gross vehicle weights considered. Distributions by accident severity and accident type seemed largely

indistinguishable between doubles and singles.

The normalization of accidents on the basis of tonnage hauled is rare, based on the papers reviewed. The study by Valette et al. was the only one that addressed this issue in any detail. The accident rates for singles and doubles are compared in Table 4 for each roadway type. Doubles displayed a significantly higher accident rate than singles, when normalized on the basis of ton-miles, on rural non-freeways and urban freeways. There was no significant difference displayed between the two configurations on rural freeways and urban non-freeways.

As mentioned earlier, the study by Valette et al. performed statistical tests to determine the quality of their data. Without the occurrence of any triple trailer accidents, it could be tempting to state that the triple trailer configurations operate more safely than both doubles and singles, but because the exposures are so much less, it is more responsible to refrain from making a conclusion under this type of situation. For the comparison of singles and doubles care was taken to ensure that the data used for comparison purposes was from those states where both singles and doubles were allowed to operate. This aided in making the operation of the two types of trucks more equivalent for comparison purposes and lends to the credibility of the final results.

3.2 Carsten [ref. 4]

Carsten compared the accident occurrences of singles and doubles in the U.S. He found that in terms of fatal accident rates and injury rates, singles and doubles displayed no significant difference. For 1980-1982, the fatal accident involvement per 100 million VMT was 7.2 for singles and 7.6 for doubles using combined data from all sources available to him. The rate for injury (including fatal) for 1981-1984 from NASS data source was 123.2 for singles and 115.5 for doubles. However, Carsten cautions that the exposure data was based on vehicle-miles travelled over all roadway types, and that there is evidence that doubles put a significantly larger portion of their miles on their vehicles on higher standard roads. Carsten also concluded that doubles were more involved in loss of control type accidents such as jackknifing and overturning and are also more likely to incur more serious injuries. This is contrary to the results of the study by Valette et al., that concluded a largely similar distribution by accident type and injury severity (note: the means of evaluating injury severity were somewhat different for the two studies). Eicher et al. [ref. 5] quote an earlier study by Campbell and Carsten [ref. 6] in which data from 1976-1978 yield a 50% higher fatal accident rate for doubles than for singles and a non-fatal injury rate for doubles 2.5 times as great as shown by singles.

Carsten [ref. 4] concentrated his analysis almost entirely on the double trailer configuration, considering accident types where it experienced higher accident rates and the possible reasons for the greater rates. Like many other studies no form of statistical

analysis performed on the results is mentioned. Because of inconsistencies or variance in any data source, a statistical analysis is important and necessary in defining at what points results can be declared different.

3.3 Chirachavala [ref. 7]

For a doctoral thesis completed in 1984, Chirachavala developed models designed to predict truck accidents rates as functions of vehicle configurations. Chirachavala determined that doubles of certain types (such as tanker doubles and flatbed doubles) showed consistently higher accident rates than their single counter part (Table 5). This was true for all types of accidents, single-vehicle accidents, with car accidents, fatal accidents and non-fatal accidents.
Similar results are presented in a previous study by Chirachavala and O'Day [ref. 8] with data from 1977.

Chirachavala's study represents a highly statistical analysis. Models are developed with the use of contingency tables. One must however, question whether the quality of the data sources justify such a refined analysis. The data sources are acknowledged by Chirachavala as questionable, yet the analysis goes into great detail, analysing configurations by number of trailers, flatbeds, tankers, etc., and evaluating the accidents under all sorts of environmental conditions for each truck type identified. It is important that any analysis not go beyond the limitations of the data source.

3.4 Sparks and Bielka [ref. 9]

In a study based on the analysis of fleet data supplied by two large Western Canadian fleets, Sparks and Bielka determined that no significant difference existed between the accident rates of singles and doubles (Table 6). However, only one company provided accident rates for both singles and doubles, and in both years of comparison the doubles showed a higher accident rate. They also presented the findings of a literature review that showed the conflicting results of many studies comparing single trailer and double trailer safety performance. One of the references specifically the Transportation Research Board's Special Report 211 [ref. 10], presents another literature review reflecting further inconclusive results.

Sparks and Bielka's study did not go into great depth, they state that the emphasis was on developing a procedure. The practice of using fleet provided data should be cautioned against. Such data has potential for biased recording or presentation from its source.

3.5 Popoff [ref. 11]

As part of an in-depth analysis of truck accidents in Saskatchewan, Popoff determined accident rates for singles and doubles. Singles (semi-trailers) experienced a higher rate of accidents with 1.37 accidents/10^6 miles while doubles experienced an

accident rate of 1.12 accidents/10^6 miles. This is contrary to the Valette et al. study [ref. 1] and the Chirachavala study [ref. 7] which found consistently higher rates for doubles, and the other two references which found the rates to be approximately equal. However, like Carsten [ref. 4] Popoff also warns that the operating environments are not taken into account in the accident rate determination and comparison.

Popoff's study made use of the Traffic Accident Information System, designed by the Saskatchewan Department of Highways and Transportation. The system involves accident forms filled in by police at the time of the accident. This appears to be a fairly reliable data source, and the author states that any data for accident categories resulting in insignificant quantities were not utilized in the study. This appears to be a fairly sound study. It has gone into far more detail in its analysis of double trailer accidents, than it did for single trailers. The double trailer analysis considers accidents by time of day, day of week, road condition, accident type, accident configuration and year of power unit, but no parallel study of single trailer accidents was presented.

3.6 Peterson and Gull [ref. 12]

This study tried to address triple trailer accident rates in a quantified way. Based on the analysis of data obtained from 6 fleets operating in Utah and Nevada, Peterson and Gull determined that the accident rates for triple trailers were statistically similar (based on the Chi square test) to the accident rates of double and single trailer trucks combined. The accident and exposure data are presented in Table 7.

On examination of the table it is clear that the exposure of triple trailer vehicles is much less than for doubles and singles. Perhaps it is best that a conclusion not be made, similar to the Valette et al. study, when such a substantially smaller exposure occurs. Like the Sparks and Bielka study, fleet data is used and the potential is introduced for bias.

3.7 Conclusion on the Effects of the Number of Trailers

It can be said that though information regarding the comparison of accident rates between double and single trailer combinations is moderately available, the results are too varied to make a definitive conclusion. It appears not enough information is available that distinguishes distances travelled by roadway classification, which could bias the results in favour of the double trailer vehicles which tend to operate more on higher classed roads. Distinction by road class is important in order that the various vehicle configurations can be compared under similar operating circumstances. Information regarding the safety performance of triple trailer configurations is extremely limited for both accidents and exposure.

4.0 OTHER VEHICLE DIMENSIONS

The other vehicle dimensions (length, width, height) are very lightly dealt with in the literature. Only the study by Valette et al. [ref. 1] directly tried to assess the effects of these dimensions on accident rates, with minimal results. For their study, findings regarding the effects of truck length and width were inconclusive while higher trucks did not appear to be over involved in accidents (provided adequate clearance existed).

5.0 OTHER CONSIDERATIONS

During the literature review certain issues arose that did not deal directly with the effects of vehicle combination, or vehicle size and weight, on accident rates or severity, but which can still be considered pertinent to any study regarding truck safety. These points may help form guidelines for any future studies that will also address the concerns of vehicle configuration, weight, and dimension, and are therefore worth some consideration.

5.1 Accident Rate Comparison Between Trucks and Automobiles

The comparison of accident rates between trucks and automobiles and other vehicles is important. In order to determine if there is a problem with any type of vehicle, one must know the operating characteristics and performance of other vehicles. Available material in regard to this matter, did not present the data in a very refined level of aggregation. Often accident rates for all trucks as a single group are compared to that for passenger cars, or at the most trucks are broken down into two groups, combination vehicles or straight trucks. Large degree of agreement, amongst various studies, on two points of concern are worth noting. When compared on the basis of accidents normalized by distance travelled:

1) Large trucks often show similar or lower total accident rates than automobiles, but

2) Large trucks also demonstrate greater fatal accident rates or greater probability of a fatality occurrence in an accident.

5.2 The Indirect Involvement of large Trucks in Accidents

The Nishida et al. [ref. 13] study addressed an issue that was not dealt with by any other paper of those reviewed. They addressed the issue of the possible indirect effects of trucks on accidents that the truck may actually not have been involved with. That is, does the mere presence of trucks on the roads increase the likelihood of other vehicles getting into accidents? For example, a vehicle attempting to pass a truck may collide with an opposing, non-truck. The contribution of the truck to such an accident would not be evident in typical accident data. In order to determine the effect of large size vehicles on the accident rate of all vehicles they

studied total vehicle accident rate, obtained from various roadway sections, as a function of the Large Size Vehicle traffic percentage. They did not find any distinct relationship but the average accident rate actually declines somewhat with increased Large Size Vehicle traffic percentage. There was no evidence to suggest that an increase in Heavy Goods Vehicles traffic would increase the total accident rate.

5.3 Quality of Data Base

One concern mentioned in many papers reviewed was the quality of the data source. Inconsistencies between provinces, states, or territories, in methods of accident interpretation and data recording made aggregation quite difficult. Many papers warn that the final results should be carefully considered while keeping in mind poor or questionable data sources. In our study we found that the accident reporting criteria varied from study to study, and some studies were unclear with regards to this or did not bother to define the criteria used at all. This finding echoes those of Sparks and Bielka [ref.9].

Police accident records or files were a common source of accident information. Polus and Mahalel [ref. 2] used the police accident files of Israel which states that all accidents involving an injury or death must be reported, while those accidents involving property damage only may be reported. The "total" accident rate reported by Polus and Mahalel may therefore be somewhat under-reported. One of the sources used by Carsten [ref. 4] was the U.S. Department of Transportation's National Accident Sampling System [NASS] which is a probability sampling of all police-reported traffic accidents in the continental United States. No formal definition is reported, and one must question whether all police forces across the United States have a common criteria for accident reporting. Similarly, Valette et al. [ref. 1], though they partially dealt with the problem by performing their own accident investigation, responded to those accidents reported by the police within the states of concern.

Theis [ref. 3] recognized the problem of under-reporting in property damage only accidents, stating, "It can be suspected that data of accidents with personal injury are more reliable than data of accidents with property damage", and therefore limits his use of the property damage only accidents, relying primarily on the personal injury and fatality occurrence data.

Other sources of data have a more refined definition of an accident. Chirachavala [ref. 7] and Carsten [ref. 4] also used the Bureau of Motor Carrier Safety file which requires the reporting of all accidents involving all interstate motor carriers subject to the Department of Transportation Act resulting in death, injury or property damage exceeding $2000. Sparks and Bielka [ref. 9] in analysing tractor-semi-trailer accident rates used the Saskatchewan Traffic Accident Facts file which defines reporting criteria as accidents causing $500 of property damage or more, death or injury. However, for the double trailer versus single trailer accident rate

comparison mentioned earlier (section 3.4), Sparks and Bielka used the corresponding fleet accident files, for which no accident reporting criteria was mentioned.

Other studies discussed were unclear or did not bother to define criteria used in their corresponding data files. Some, such as May and Scully [ref. 14], who carried out a national level study (Australia), express problems with inconsistent definitions amongst states and territories, and recommend the development of a national criteria. Considering the fact that both trucking and highways are operated under provincial jurisdiction, creating a heterogeneous trucking industry, one can predict that a similar problem would also face any attempt at a national level study in Canada. By performing their own accident investigation, Valette et al., help significantly to make the aggregation of multiple state accident occurrence data more consistent. This is contrary to the popular method of using external sources of data provided by some national, provincial or territorial government, or some other second hand source.

6.0 CONCLUSION

In conclusion, though there is a reasonable degree of agreement on the issue of truck to car comparisons regarding fatal and total accident rates, there is little consensus on issues dealing with the effects of factors such as gross vehicle weight or the number of trailers on truck accident rate. Valette et. al [ref.1] and Polus and Mahalel [ref. 2] reported declining accident rates with increasing G.V.W. The evidence suggests that doubles tend to have higher accident rates if one considers the effects of roadway classification. It is clear from the literature review that the use of other countries' results should not be encouraged, due to the lack of consensus on these issues. Differences may be due to many factors such as definitions and classifications of accident type, and truck type, quality of data sources and different operating environments.

The issue of different operating environments between countries is of particular importance. For example, Nishida et al., [ref. 13] found that Heavy Goods Vehicle collisions with bicycles is one of the largest contributors to truck accidents in Japan. No other study mentioned bicycles as a major source of truck accident occurrence. Another example is provided by May and Scully in Australia's "National Road Freight Inquiry" [ref. 14] which states that, "Overtaking plays a disproportionate role in fatal truck accidents", which seems to be a larger problem in Australia than other countries. This may be due to imposed speed limits to trucks that are 20-30 km/hr lower than those imposed on other vehicles. Perhaps the point of prime consideration with regard to this is that Canada represents a country that allows some of the greatest vehicle weights and sizes in the world and therefore relevant data for our size ranges is extremely hard to come by. No Canadian study found attempted a detailed analysis of truck safety records as a function of vehicle weight and dimensions except for some distinction between doubles and singles.

Because of the recent debates over the restrictions on vehicle size and weights, the effects on safety due to possible adoption of less restrictive regulations is an important issue in Canada. It seems that an in-depth analysis of truck safety on the Canadian road scene is in order. One needs a dedicated comprehensive study which is specifically directed at studying the effects of vehicle weight and dimensions on the safety of large trucks, one in which data is both collected and analysed as part of the same research effort. An in depth relevant study should include:

1) Exposure rates by truck type including truck configuration, vehicle weights, and dimensions.

2) Exposure rates as in 1) distinguished by road type which is important to ensure comparisons are made under similar operating conditions.

3) Accidents distinguished by fatality and injury to accommodate the total accident rates.

4) Accidents distinguished by accident type so that problem areas can be identified.

At the outset of this review it was desired to attempt a comparison of rail safety records to truck safety records. However, exposure rates for trucks determined on the basis of ton-miles or tonne-kilometers was uncommon, rendering such a comparison difficult. Therefore, any Canadian study should also include:

5) Exposure rates calculated on the basis of both kilometers and tonne-kilometers.

It is important that this study be coordinated at the national level covering all regions of Canada in order that a wide range of operating conditions be investigated. Present problems with inconsistencies between provinces in terms of data collection and definitions should be negated by a national study, so that information regarding exposure and accidents will be uniformly collected throughout the country.

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ACKNOWLEDGEMENTS

The authors wish to acknowledge Dr. John Heads for his very useful comments during the preparation of this paper and Leonnie Duffus, who was involved in this project at the earlier stage.

Table 1. Distribution of Accidents and Accident Rates* by Gross Vehicle Weight and Truck Type....(ref. 1)

Gross Vehicle Weight (kips)	Truck Type: Straight Trucks N	Straight Trucks Rate	Singles N	Singles Rate	Doubles** N	Doubles** Rate
10-20	71	30	18	76	-	-
20-30	51	78	162	132	38	1215
30-40	13	111	92	63	26	416
40-50	7	129	71	72	11	156
50-60	-	-	66	80	6	77
60-70	-	-	70	59	7	69
70-80	-	-	118	46	27	71
80-90	-	-	8	59	7	149
90+	-	-	12	***	5	***

*Accident rate per 100 million vehicle miles.
**Includes all doubles in all states.
***Exposure values not available to calculate rates.

Table 2. Distribution of Accident Rates for Singles and Doubles by Weight Category (California and Nevada Combined)*

Truck Type	Weight Category (KIPS) 10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90
Singles	291	136	49	61	37	44	45	-
Doubles	-	606	260	134	68	101	103	26[1]

*per 100 million vehicle miles.

Table 3. Distribution of Property Damage Only and Injury Accidents for Singles and Doubles by Weight Category...(ref. 1)

Weight Category (kips)	Truck Type and Severity: Singles PDO N	Singles PDO %	Singles Injury %	Singles Injury N	Doubles PDO N	Doubles PDO %	Doubles Injury %	Doubles Injury N
20-30	133	82	18	29	28	74	26	10
30-40	63	68	32	29	19	73	27	7
40-50	53	75	25	18	5	45	55	6
50-60	49	74	26	17	3	50	50	3
60-70	47	67	33	23	6	86	14	1
70-80	80	71	29	32	19	70	30	8

Figure 1. Accident Involvement of Various Weight Groups...(ref. 2)

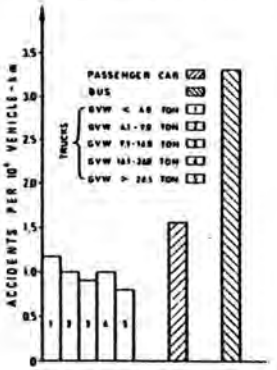


Table 4....(ref. 1)

Comparison of Ton-Mile Accident Rates of Singles and Doubles (California and Nevada)

	Rural Freeways	Rural Non-Freeways	Urban Freeways	Urban Non-Freeways
Singles	3.7	3.5	8.3	3.3
Doubles	6.9	16.7	11.8	11.5
Significance	N.S.	.05	.1	N.S.

NOTE: Rates shown are in terms of accident involvements per 100 million ton-miles.

Table 5. Approximate Projections for Accidents for 10^8 Vehicle Miles...(ref. 7)

Truck Type	Single-Truck	With-Car
Straight trucks	18	29
Van singles, tanker singles	45	55
Flatbed singles	62	80
Van doubles	65	65
Tanker doubles	80	80
Flatbed doubles	100	100

Truck Type	Fatal Accs	Non-Fatal Accs
Straight trucks	8	37
Van singles, tanker singles	10	90
Flatbed singles	12	130
Van doubles	15	115
Tanker doubles	20	140
Flatbed doubles	24	176

Table 6. Accident Rates of Doubles and Singles...(ref. 9)

Company	1983			1984			1985		
	OVA	SING	DBL	OVA	SING	DBL	OVA	SING	DBL
A	1.07*	N/A	N/A	1.15	1.09	1.23	1.52	1.27	1.70
B	1.43		1.43	1.55		1.55	.74		.74

* The accident rate is an overall intercity accident rate because only the total fleet vehicle kilometers could be obtained.

OVA = Overall Accident Rate
SING = Single Semi-Trailer Accident Rates
DBL = Double Semi-Trailer Accident Rates

Table 7. Truck Accident and Exposure...(ref. 12)

COMPANY	LOCATION	TRIPLES		DOUBLES & SINGLES		TOTAL ALL COMBINATIONS	
		No. Accidents	Miles	No. Accidents	Miles	No. Acci-dents	Miles
GARRETT	Utah	0	21,700	0	522,900	0	549,600
	Nevada	0	71,100	9	1,815,000	9	1,886,100
	TOTAL	0	92,800	9	2,342,900	9	2,435,700
IML	Utah	0	179,200	2	917,100	2	1,096,300
	Nevada	3	607,200	2	3,099,800	5	3,707,000
	TOTAL	3	786,400	4	4,016,900	7	4,803,300
MOTOR CARGO	Utah	0	18,200	0	68.100	0	86,300
	Nevada	0	36,000	0	143,000	0	179,000
	TOTAL	0	54,200	0	211,100	0	265,300
PIE	Utah	0	293,200	1	327,100	1	620,300
	Nevada	3	961,900	0	1,051,500	3	2,013,400
	TOTAL	3	1,255,100	1	1,378,600	4	2,633,700
FBI	Utah	0	1,200	0	6,200	0	7,400
	TOTAL	0	1,200	0	6,200	0	7,400
RINGSBY	Utah	1	43,700	1	249,000	2	292,700
	Nevada	1	223,500	1	1,273,900	2	1,497,400
	TOTAL	2	267,200	2	1,522,900	4	1,790,100
TOTALS	Utah	1	557,200	4	2,095,400	5	2,652,600
	Nevada	7	1,899,700	13	7,353,200	20	9,282,900
	TOTAL	8	2,456,900	17	9,478,600	25	11,935,500

TRUCK SAFETY AND FINANCIAL DISTRESS: A PRELIMINARY ANALYSIS

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1.0 Introduction

Safety on Canadian highways is a serious and potentially critical problem as Canada moves towards a less regulated trucking industry. The Motor Vehicle Transportation Act, 1987 (MVTA) relaxes economic regulation of extraprovincial trucking by easing market entry regulations and by discontinuing rate regulation in extraprovincial markets. One of the potential side effects of this trucking deregulation is increased turnover of firms in the industry. Firms exiting the industry frequently do so under bankruptcy and financial distress. Conventional wisdom indicates that such financially distressed firms tend to use older equipment, spend less on maintenance and less on safety programs. Therefore two relationships need to be examined to support informed policymaking in the future. First, is there a linkage between economic regulation and the number of vehicle miles operated by financially distressed motor carriers? Second, is there a relationship between the financial condition of a motor carrier and its safety performance? This study examines the latter issue, the relationship between bankruptcy and safety. It does not examine the first issue in depth or empirically. If a relationship does exist between the financial condition of a motor carrier and its safety record, the results of these comparisons may help public authorities responsible for safety enforcement to identify carriers with potential safety problems by screening the financial condition of motor carriers periodically. Regulatory authorities could also consider a financial test of fitness based on these relationships.

2.0 Economic Regulation and Truck Safety

One of the most controversial safety issues is the role of economic regulation in promoting truck safety. It is important to investigate the linkages between economic regulation and safety not as a basis for bringing the pre 1988 regime of economic regulation back but to fine tune the regulatory system, both economic and safety, that exists today. This is particularly important as the new MVTA empowers promulgation of federal safety regulations covering all extraprovincial truck and bus operations.

Academic and industry literature suggests that the most important rationale linking economic regulation and safety is the profitability-safety relationship. Decreased profitability of the industry and individual carriers result in poor financial condition which provides an incentive for the carrier to reduce expenditures on maintenance and in other areas that effect safety or engage in operating practices that are not conducive to safety.

The logic of this argument has often been described as follows: "The only way for a marginal carrier to stay in business...is to cut costs and there are few places to cut costs in motor freight operations. Fuel prices are market set and fuel usage is, in large part, a function of new technology and maintenance, either of which costs money. The only alternative is to run older equipment, pay less in wages, work drivers longer, and/or skimp on maintenance."[1] Such behavior belies the maxim that safety pays. It is claimed that carriers look at safety activities like any other expenditure or investment and invest in safety when it yields a good return. The return might be reduced insurance cost, operating cost, or the maintenance of the carriers reputation for future business. Said a Bureau of Motor Carrier Safety (BMCS) spokesman, "Shippers will shun those carriers with poor safety records".[2]

There is actually little contradiction in these views once we recognize that these descriptions apply to carriers in significantly different financial situations. Obviously safety pays for the profitable carrier for whom a reputation of unsafe operations will have an impact on future earnings which are reasonably likely. Even a marginally profitable carrier must maintain minimum levels of safety if it expects to compete effectively in the future. In contrast, the attitude of the carrier in financial distress may be different for two reasons. Such a carrier has sustained a long period of low profits or losses resulting in cash flow difficulties. When the demand for funds exceeds the supply of funds the carrier must choose between various expenditure catagories. Safety related expenditures are largely deferrable. The carrier can continue to run trucks in the short run without proper maintenance or without a safety program but it cannot run the vehicles without gas, employee wages and other costs which are variable with volume in the short run. Similarly, such a carrier would not exhibit sufficient potential to justify the acquisition of new equipment to replace older, less safe equipment.

More importantly, the risks of the financially distressed carrier are bounded from below and this may encourage risky behaviour not expected from the non-financially distressed carrier. A carrier that is unprofitable and nearing bankruptcy, may not view future earnings as dependent on safety and if the firm is incorporated, the losses from unsafe operation are limited, especially if the assets of the carrier have declined to a point where the liabilities already exceed the assets (e.g. the carrier is in technical insolvency). This is especially true for the small carrier whose maximum cost of an accident is limited to a small asset base.[3]

.This distinction between the potential behavior of financially distressed versus non-financially distressed carriers go a long way in explaining the results of studies which do not find a relationship between safety performance and profitability.[4] These studies really examined the behavior of less profitable versus more profitable carriers. There are, after all, diminishing returns to safety expenditure just as there is for any other expense area. Doubling the profit margin of a carrier who already earned enough profit to maintain his vehicles or train his drivers to industry standards will probably not call for additional maintenance and training. However the doubling of profits for the financially distressed carrier will mean that the carrier may not be faced with the difficult tradeoffs that favor deferring safety related expenditures.

3.0 Analyses

3.1 General Methodology

This study compares the safety performance of bankrupt and non bankrupt carriers in the post deregulation period in the U.S. Three areas of performance are examined: expenditures that support safety within trucking companies, compliance with Federal safety regulations, and actual accident experience. The primary source of data on the latter two safety performance dimensions is safety program evaluations and accident statistics collected by or reported to the Bureau of Motor Carrier Safety of the U.S. Department of Transportation.[5] The deficiencies of these data bases are documented elsewhere.[6] Additional carrier specific information, particularly concerning financial condition and expenditures are collected by the Interstate Commerce Commission annually.

Previous studies attempting to determine the relationship between financial condition and safety performance measured financial condition as a continuous variable using some measure of profitability. Such an approach is inherently biased because the procedure would result in cases where each observation (firm) reported both safety and profit measures voluntarily. A bankrupt firm of course would not report either statistic after bankruptcy and in many cases, does not report statistics properly as it approaches bankruptcy. Thus the sampling procedures normally under-represent the portion of the carrier population which is in genuine financial distress and eventually go bankrupt. In this study we identified a

set of carriers which have gone out of business for financial reasons and compare their safety performance with non bankrupt carriers.[7]

In order to minimize the influence of factors other than financial distress on the safety performance of carriers, this study focuses on general freight carriers only.

3.2 Safety Conduct of Bankrupt versus Non Bankrupt Motor Carriers

Carrier performance can be reflected by expenditures in the following safety related areas:

insurance and safety expenses
maintenance expenses
equipment replacement

A well developed body of literature supports the premise that greater expenditures in each of these areas per vehicle mile result in safer trucking operations.[8]

A comparison of these safety related expenditures is made between financially and non-financially distressed general freight carriers. A carrier is defined as financially distressed when it is known to have declared bankruptcy or be in a prolonged state of technical insolvency. Between 1982 and June 1986, 106 general freight carriers reporting to the ICC were classified as financially distressed. All general freight carriers not in the financially distressed category as of 1986 were classified as non-financially distressed. A simple comparison is performed on the two populations and the results are shown in Table 1. The table shows that the mean (arithmetic) performance of the non-financially distressed carriers is uniformly superior with respect to activities related to accident prevention. The average financially distressed carrier spends less on insurance and safety, and maintenance despite having older equipment. However, none of these differences are statistically significant as a wide range of values exist in each group. Note that these are arithmetic averages and that the weighted averages (not shown) are even more distinct since the non-financially distressed group is dominated by very large and very profitable carriers such as Yellow, Roadway and Consolidated.

3.3 Safety Compliance of Bankrupt versus Non Bankrupt Motor Carriers

Carrier performance with regards to safety can be measured by the carriers compliance to Federal safety regulations. The BMCS performs safety audits of carriers to ascertain compliance to various Federal safety regulations and issues a three level rating, Satisfactory, Conditional, and Unsatisfactory. Such ratings are issued on the premise that a carrier with a Conditional or Unsatisfactory rating is more likely to operate its vehicles in an unsafe manner on the highways.

TABLE 1

Safety Conduct of Financially Distressed Verses Non-Financially Distressed General Freight Carriers

Variable	Population: Non-Financially Distressed[1]	Financially Distressed[2]	All
$ Insurance and Safety Expense per Intercity Vehicle Mile	.147	.069	.130
$ Maintenance Expense per Intercity Vehicle Mile	.322	.105	.274
$ Linehaul Maintenance Expense per Intercity Vehicle Mile	.173	.094	.155
Net Carrier Operating Property to Total Carrier Operating Property	.438	.399	.429

Notes:

[1] 1985 financial statistics used for non-financially distressed carriers.

[2] Financial data refers to year prior to bankruptcy for carrier exiting industry for financial reasons. If such data is not available, financial data two years prior to bankruptcy is used. For technically insolvent carriers, 1985 financial statistics were used.

Sources: Tabulated from American Trucking Associations, Inc., Motor Carrier Annual Reports, (Annual).

A shorter time frame, 1983 to 1986, was used to select bankrupt carriers from the population used in the analysis above to be matched with safety audits conducted within three years of the bankruptcy of the carrier. The resulting sample of 30 carriers was compared to a sample of 50 highly successful non bankrupt carriers. The non bankrupt sample was selected by computing the 1986 C score for all general freight carriers reporting to the ICC in 1986. The C score is a weighted index of selected financial ratios.[9] The higher the C score, the lower the probability of the firm going bankrupt in the next three years. The C score has been shown to be a superior indicator of financial condition and is used here to identify the carriers least likely to go bankrupt in the near future. The 50 carriers with the highest C scores and with safety audits conducted in 1982 or after were selected for the non bankrupt sample.

In Table 2, the proportion of carriers in each group with Satisfactory, Conditional and Unsatisfactory ratings are shown. Bankrupt carriers have a larger proportion of carriers with Unsatisfactory ratings but the difference between the two proportions are not significantly different from zero at a 95 percent level of confidence. We feel that this may be due to the small sample size.

3.4 Accident Experience of Bankrupt versus Non Bankrupt Motor Carriers

Carrier performance with regards to safety can be measured by the accident record of the carrier. Historically, empirical studies of truck safety use all accidents to calculate an accidents per vehicle mile figure. However, many accidents involving intercity trucks are not the fault of the truck driver or his equipment. Trucks share the road with many other moving objects and in 1984, 65.9 percent of all accidents reported to the BMCS were collisions with other vehicles, persons or animals and trucks. Trucks are certainly not the cause of all of these accidents as supported by California Highway Patrol estimates, that trucks were at fault in 50.8 and 50.9 percent of the accidents in which they were involved in 1985 and 1986 respectively.[10] A study conducted at the University of Michigan Transportation Research Institute (UMTRI) found that in fatal crashes involving cars and all types of trucks, the car driver was twice as likely to be at fault as the truck driver and in fatal crashes between cars and tractor-semitrailers, the study found that the car driver was nearly three times as likely to be at fault.

Yet the overwhelming majority of safety research concerned with aggregate accident performance (as opposed to individual accidents) does not differentiate between truck at fault and truck not at fault accidents. A related concept is preventability. A study done for the Federal Highway Administration showed that 68 percent of all accidents reportable under the Federal Motor Carrier Safety Regulations were preventable under the normal standards used by the industry. Preventability is meant to designate whether or not there was any action that the driver could reasonably have taken to avoid the occurrence of the accident. The BMCS does have a "preventable"

TABLE 2

Safety Compliance of Bankrupt Versus Non Bankrupt Motor Carriers

Rating	Bankrupt N-30	Non Bankrupt N-49
% Satisfactory	60.0	69.4
% Conditional	26.6	28.6
% Unsatisfactory	13.9	2.0
	99.9	100.0

95% Confidence Interval of difference in proportions between two groups.

$$.694 - .60 \pm 1.96 \sqrt{\frac{(.694)(1-.694)}{49} + \frac{(.60)(1-.60)}{30}}$$

$$- .1237 \text{ to } .3113$$

accident classification that has been applied to its accident data base since 1983 yet accidents classified as preventable have not been used in policy research yet.

Accident statistics were collected from two sources for the sample of bankrupt and non bankrupt carriers used in Section 3.3. First, an accident ratio is given on the MCS 32 form used in the safety audit of the carrier. This accident ratio is determined by a safety inspector conducting the safety audit. A second source is the actual accidents reported to the BMCS as required by Federal law. Carriers are required to report all fatal, injury and property damage accidents resulting damage exceeding $2000 involving an interstate movement on Form MSC 50T. The BMCS accumulates these accident reports by carrier and in some cases computes an accident rate. However, the BMCS records do not always show how the accident rate is computed, ie. does not show vehicle miles used in the denominator of the accident rate equation. As noted above, the BMCS classified an accident as preventable or not preventable on the part of the carrier beginning in 1983. The sum of fatal, injury, and property damage accidents divided by the vehicles miles reported by the carrier to the ICC results in an annual carrier accident rate. The sum of preventable accidents divided by vehicle miles of the carrier results in an annual carrier preventable accident rate. Thus a variety of accident ratios measures can be estimated and compared between bankrupt and non bankrupt carriers.

First we compare the accident rate reported in the safety audit. We were able to find such ratios for 25 bankrupt and 25 non bankrupt carriers out of the 28 and 49 carriers in the original sample. These ratios were applicable to the year of the safety audit and are shown as ARATIO1 in Table 3. The average number of accidents per million vehicle miles is nearly 15 percent higher for bankrupt carriers than non bankrupt carriers, however the T value indicates that the difference is not statistically significant.

Next we compare the accident ratio reported in BMCS record of reported accidents, shown as ARATIO2 in Table 3. An ARATIO2 estimate was sought for the three years prior to bankruptcy for the bankrupt carriers and for non bankrupt carriers, these ratios were sought for the year of the audit and the two preceding years. Thus we display the average ARATIO2 for each of these three years (year 1, year 2, year 3). It should first be observed that the reporting of ARATIO2 is significantly lower for bankrupt carriers than for non bankrupt carriers. This could be expected in the year just prior to bankruptcy where in this sample no ARATIO2 was found for the bankrupt carriers. However only 3 and 5 values for ARATIO2 were found for these carriers two and three years prior to bankruptcy. Thus the small and imbalanced samples limit the strength of our observations which are none the less suggestive. Again we observe that the accident rates of the bankrupt carriers are generally higher than the accident rates of the non bankrupt carriers and the differences are statistically significant for the year 3 accident rate. Both the year 2 and year 3 accident rates indicate that bankrupt carriers had nearly double the

TABLE 3

Accident Experience of Bankrupt Versus
Non Bankrupt Motor Carriers

	Population				T Value	Significance Level
	Non Bankrupt		Bankrupt			
	N	X	N	X		
ARATIO1	25	.9952	25	1.1544	- .57	.573
ARATIO2 (year 1)	9	.9189	--	--	--	--
ARATIO2 (year 2)	14	.7793	3	1.4180	-1.31	.211
ARATIO2 (year 3)	21	.9548	5	1.8164	-2.64	.014
ARATIO3 (year 1)	34	.9483	2	.2812	.88	.384
ARATIO3 (year 2)	32	.9040	8	1.3528	-1.33	.192
ARATIO3 (year 3)	35	.8471	9	1.0817	- .75	.458
ARATIO4 (year 1)	35	.4925	2	.2812	.38	.707
ARATIO4 (year 2)	35	.4289	8	.7983	-1.78	.082
ARATIO4 (year 3)	35	.2769	9	.4462	- .95	.349

number of accidents per vehicle mile that non bankrupt carriers incurred.

Two accident rates can be computed for comparison. ARATIO3 is a total accident rate computed from sum of accidents (fatal, injury and property damage) reported to the BMCS divided by vehicle miles reported to ICC. ARATIO4 is a preventable accident rate computed from sum of preventable accidents (fatal, injury and property damage) reported to the BMCS divided by vehicle miles reported to ICC. As in the preceding analysis, these accident rates were estimated for each of three years (prior to bankruptcy for bankrupt carriers and the year of safety audit and two years prior for non bankrupt carriers).

The arithmetic mean of these accident rates for each group of carriers is also shown in Table 3. The year 1 accident rates indicate that the non bankrupt carriers had more accidents per vehicle mile but this is based on only two observations of bankrupt carriers and the differences are not statistically significant. In contrast, the accident ratios are higher for bankrupt carriers for the other years and in the case of year 2 for the preventable accident ratio there was some statistical significance at the 90 percent confidence level.

Finally a comparison between ARATIO3 and ARATIO4 shows that both the total and preventable measures of accident experience are consistent with each other.

4.0 Summary and Implications

This study examines the relationship between financial condition and various measures of safety performance in the post deregulated U.S. trucking industry. The study focused specifically on the general freight carrier segment of the industry which was, in turn, segmented into two groups, carriers which have gone bankrupt since 1981 and carriers which have been highly successful since 1981. Measures of safety performance were expenditures on safety, compliance with Federal safety regulations and accident rates.

The empirical evidence suggests that bankrupt carriers are not as safe as carriers which are not in financial distress. Bankrupt carriers tend to allocate less on safety related expenditures. The average bankrupt carrier spent less per vehicle mile on maintenance, on insurance and safety programmes, and had older equipment than non bankrupt carriers. A larger proportion of bankrupt carriers had unsatisfactory safety compliance ratings as a result of Federal auditing of the carrier. Finally, bankrupt carriers typically had higher accident rates prior to cessation of business. We emphasize that with the exception of the third set of observations, these relationships were not statistically significant at a high confidence level (i.e., 95 percent) and that the samples utilized were quite small. The consistency of the signs in each comparison however bring some robustness to each separate observation.

This suggests, of course, that more research is needed to further investigate the hypotheses weakly confirmed here. The authors intend to expand the sample and include demographic variables which recognize the impact of exposure. For example, carriers which operate primarily on certain types of roads, move certain types of commodities or operate in certain parts of the country may be more or less susceptible to accidents per vehicle mile operated. With the enlargement of the sample, more degrees of freedom will be obtained and multivariate statistical techniques can be employed.

Our empirical results and our experience with Federal safety statistics suggest that a problem in the current data bases is lack of priority in enforcement of Federal safety regulations. A large proportion of the bankrupt carriers had no safety audits conducted for the carrier within three years of bankruptcy which suggests that the group of carriers with the tendency towards more accidents is the least audited. Further, as observed in our analysis of accident rates, the reporting of accidents as required by law is minimal compared to the reporting by non bankrupt carriers. Some type of predictor of the likelihood of bankruptcy and other forms of financial distress could provide an early warning system to safety enforcement officials who could then prioritize carriers in the scheduling of safety audits and reporting compliance enforcement.

The issue of how economic regulation impacts safety is still unanswered. If deregulation results in a greater proportion of the trucking industry (number of carriers weighted by vehicle miles) in financial distress, then it is likely that highway safety will deteriorate. There is little doubt that the rate of bankruptcy in the U.S. trucking industry has increased since 1980. What is crucial is whether it was deregulation or some other factor that caused this increase in bankruptcy, and whether the current rate of bankruptcy in the industry is a permanent fixture of the structure of the industry or merely a transition to competitive equilibrium. These are important issues to be resolved not to bring back regulation but to recognize the potential byproducts of deregulation and act effectively to neutralize those impacts, such as decreased safety, that are undesirable.

ENDNOTES

1. See Baker (1985).

2. See Strah (1985).

3. A theoretical model of this behavior is developed by Golbe (1981).

4. See for instance Corsi et al.

5. All carriers subject to Federal Motor Carrier Safety regulations must report all accidents involving fatality, injury or property damage aggregating $2000 or more on Form MCS 50T to the DOT. Safety audits are conducted by DOT field staff and summarized on Form MCS 32 until 1986 when a new procedure was implemented to monitor safety compliance. Also in 1986, the BMCS was replaced by the Office of Motor Carriers in Washington, DC and the Office of Motor Carrier Safety in the field. Since the BMCS was the relevant data collection and safety enforcement arm of the U.S. DOT during the periods used in this study, we will continue to refer to the BMCS.

6. See Chow "What Do We Really Know About Truck Safety?" Transportation Executive Update.

7. A data base of carriers going bankrupt or entering technical insolvency was developed in Chow et al (1987).

8. See for example, Garland Chow, "Deregulation, Financial Condition and Safety in the General Freight Trucking Industry" (forthcoming).

9. See Chow et al (1987).

10. See California Highway Patrol (1987).

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THE NATIONAL TRANSPORTATION POLICY - OPPORTUNITIES FOR SECOND THOUGHTS

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The National Transportation Act (1987) came into force in January of this year. This major legislative initiative offers a revised national transportation policy, new dispute resolution provisions, and altered regulations governing the air, railway, northern marine, and commodity pipeline modes of transportation. It also includes new provisions for the review of mergers and acquisitions of transport companies, establishes a new National Transportation Agency, and provides for the periodic review of the effects of the legislation. However, much of the argument and hand wringing that went on before the legislation was enacted focussed on the various changes that the Act makes in the rail mode - gone are common tariffs, and in their place are competitive line rates, extended interswitching and confidential contracts. Another innovation, final offer arbitration, will be available, in theory, to shippers in all modes, but in practice will probably only be invoked by rail shippers. These changes will no doubt continue to attract much attention as shippers and carriers sniff around them and make initial forays into the new territory. They will also be the areas that the NTA, the new Agency (acronymically synonymous with the Act, which was pretty dumb) will probably be concentrating on in its annual review of the Act as called for in Section 266.

Regulatory changes governing the air mode have received a great deal of media attention because they effect the travelling public, including journalists. Actually the legislation only formalizes the *de facto* regulatory reform which has existed since the early '80's. It will certainly be easier to enter into, exit from, and lower the fares for, the air transport business.

Perhaps of more fundamental concern should be the 'national transportation policy' enunciated in Section 3 of the Act. It produced little excitement during the hearings which preceded the passing of the legislation, even though its purpose is to provide the underlying rationale for everything that follows.

Part of the reason for this lack of attention is that Section 3 looks familiar. It is, in fact, the old Section 3 from the 1967 NTA with a number of additions, a few of which are significant. Section 3 now reads as follows:

(additions to the 1967 version are in *italics;* deletions from the 1967 version are put in square brackets [ ])

3. (1) It is hereby declared that a[n] ***safe,*** economic, efficient and adequate network of viable and effective transportation services making the best use of all available modes of transportation at the lowest total cost is essential to serve the transportation needs of shippers and travellers and to maintain the economic well-being and growth of Canada and its regions and that those objectives are most likely to be achieved when all [modes of transport] ***carriers*** are able to compete, ***both within and among the various modes of transportation,*** under conditions ensuring that, having due regard to national policy and legal and constitutional requirements,

(a) the national transportation system meets the highest practicable safety standards,

(b) competition and market forces are, whenever possible, the prime agents in providing viable and effective transportation services,

(c) economic regulation of carriers and modes of transportation occurs only in respect of those services and regions where regulation is necessary to serve the transportation needs of shippers and travellers and such regulation will not unfairly limit the ability of any carrier or mode of transportation to compete freely with any other mode of transportation,

(d) transportation is recognized as a key to regional economic development and commercial viability of transportation links is balanced with regional economic development objectives in order that the potential economic strengths of each region may be realized,

(e) each ***carrier or*** mode of transportation , so far as practicable, bears a fair proportion of the real costs of the resources, facilities and services provided to that ***carrier or*** mode of transportation at public expense,

(f) each ***carrier or*** mode of transportation, so far as practicable, receives ***fair and reasonable*** compensation for the resources, facilities and services that it is required to provide as an imposed public duty, and

(g) each ***carrier or*** mode of transportation, so far as practicable, carries traffic to or from any point in Canada under [tolls] ***fares , rates*** and conditions that do not constitute

(i) an unfair disadvantage in respect of any such traffic beyond that disadvantage inherent in the location or volume of the traffic, the scale of operation connected therewith or the type of traffic or service involved,

(ii) an undue obstacle to the mobility of persons including those who are disabled,

(iii) an undue obstacle to the interchange of commodities between points in Canada, or

(iv) an unreasonable discouragement to the development of primary or secondary industries or to export trade in or from any region of Canada or to the movement of commodities through Canadian ports,

and this Act is enacted in accordance with and for the attainment of so much of those objectives as fall within the purview of subject-matters under the legislative authority of the Parliament of Canada relating to transportation.

under the legislative authority of the Parliament of Canada relating to transportation.

(2) The Minister may, with the approval of the Governor in Council and on such terms and conditions as the Governor in Council may specify, enter into such agreements in support of the national transportation policy set out in subsection (1) or in respect of such transportation matters as the Minister considers appropriate.

Government actions and direction following the 1967 Act showed a rather selective and patchy adherence to these policy objectives. A similar behaviour pattern this time around might have been expected, if it were not for Section 266. This section requires that, four years from the proclamation of the Act, in January 1992, a Commissioner shall be appointed to enquire into the workings of the legislation, and in particular, to examine the effectiveness of policy enunciated in Section 3.

This prospect should encourage a little more interest in the application of the policy objectives; this in turn suggests it would be worth while exploring what they really mean.

3.(1)(a) **Safety**

The government is adamant that economic regulations have nothing to do with safety regulations. Unfortunately repeating that position with fervour and deep conviction does not necessarily make it so. Despite a concerted effort to maintain the dichotomy, nagging questions remain and must be answered.

Perhaps the most disturbing of these relates to the effects upon safety considerations of heightened competition. One of the underlying hypotheses of the legislation is that increased competition will lead to "leaner, meaner" carriers, who will become more efficient in order to be more competitive.

While this seems to be more of an ideological position than one based on the results of research and analysis, one cannot help but wonder if, in this new highly competitive era, carriers will be tempted to cut corners relating to safety practices or take chances in certain circumstances. Do the drafters of this legislation, many of whom have spent their careers inside government, understand the pressures on a private sector firm with a bottom line to worry about?

While we have been glibly assured by civil servants and politicians that transportation accidents are bad for business and, therefore, carriers will take every precaution possible. One might feel confident if they could cite professionally conducted analyses which demonstrated that, in other countries where steps have been taken to increase competition within and between modes, safety standards have not suffered. In fact, the available evidence is inconclusive. However, it is less than reassuring to hear that one of the U.S. senators who led the fight for air de-regulation is now publicly arguing for re-regulation. It appears that the increased traffic generated by lower air fares and the "hub and spoke configuration" of the new air routes have resulted in over-crowding of key hub airways. This congestion has caused increased incidence of delays and, one has to wonder if the congestion does not also constitute a concern vis-à-vis safety considerations. Certainly the situation south of the border should be closely monitored, as the government has seriously misjudged the desires of the Canadian public if it thinks that cheaper air fares make decreased safety standards acceptable. As we have not yet enjoyed many of the benefits of reduced airfares because we have lagged behind the U.S. in de-regulating, we should at least be sure to benefit from a thorough analysis of U.S. de-regulation, especially in terms of its impacts upon safety standards.

While the above comments on safety standards have focussed on the air mode, they also apply to the other federally-regulated modes. However, the provinces should have input and involvement as Canada's new safety standards evolve. This does appear to have occurred relating to the National Safety Code for trucking; however, one cannot help but be

concerned that, in the see-saw battle between federal and provincial powers, the shipping and travelling public does indeed have the protection of the highest practicable safety standards.

Carriers are in rather a dilemma. To a large extent, current safety regulation in all modes has concentrated more on process than on outcome. The primary onus on the carrier is to conform to regulations, father than operating safely. Operating licences are revoked or restricted for regulatory infractions, not for having accidents. In a perfect world, all might be well under this regime. In the real world, the best way of achieving better safety is to make the operators fully responsible, leaving them to decide the best way of achieving safe operations.

3.(1)(b) and (c) Competition and Reduced Regulation

These two paragraphs contain the rubric of "Freedom to Move" - competition is the primary solution to transportation choices and conflicts. In this new Act, intramodal competition has been added to the intermodal competition first introduced in the 1967 version. For freight transportation this addition is aimed primarily at the railways, who heretofore were free to cooperate and set common rates.

While there is general agreement and acceptance of this change, the concept of competitive line rates (CLRs) that has also been introduced under the policy in 3.(1)(c) to protect the so-called 'captive shipper' potentially vitiates much "free" competition between rail carriers. Railways are unlike other carriers; they still own and pay for the upkeep of their own right of way. With CLRs, they are now prevented from using a significant portion of their own assets to their own competitive advantage. A railway required to give access to another may not even be able to recover the full costs of so doing. Not only does this make a mockery of the free competition concept, it practically ensures that, in future, no railway will take the initiative to lay trackage to serve new resource or industry development.

This development, taken in conjunction with the extension of interswitching limits which is also part of the legislation, moves us a long way toward the concept of a common user rail right of way. If this really is the underlying policy intent, then it would have been preferable to state it directly, so that the longer term planning needed to make such an idea a reality could be started. We will have to wait until 1992 when the policy is reviewed; however, it is fairly clear that access to a public rail right of way for all carriers who were "fit, willing and able" would at least make intramodal competition in the rail mode a reality.

CP's and CN's competitive dilemma is further compounded by the incomplete application of the new rules. U.S. and provincial railroads are not subject to the legislation or the regulations that stem from it and will be free to exploit the advantages without suffering the disadvantages. This can hardly be called free competition between carriers.

Another major difficulty with the "competition and market forces" as prime agents is the distortions introduced as a result of a complete failure to make progress with implementing the policy objective 3.(1)(e). This particular policy will be examined later in this paper; suffice to say that with widely varying approaches to cost recovery by governments in the road and marine modes, true price competition between water, rail and road is not very meaningful.

3.(1)(d) **Regional Economic Development**

This provision, added to Section 3 as a result of pressure from the provincial premiers and such organizations as the Atlantic Provinces Transportation Commission, could be a very important policy statement or it could be simple window dressing: part of the "poetry" of the legislation. Already, the APTC has argued that some of the provisions of Bill C-52, concerning Coastwise Shipping, contravene the intent of this provision. Given the sometimes stormy relationship between Transport Canada and the many incarnations of federal economic development portfolios, a healthy degree of scepticism concerning the seriousness of this objective is warranted.

This provision is, however, critical to the provinces concerned with regional economic development and it is surely in their best interest to monitor the effects of this legislation upon their economies. In fact, section 266 requires the undertaking of "a comprehensive review of this Act" and it further directs that its effects upon "shippers, travellers and carriers and on **regions** and trade" be assessed. Section 266 also specifically refers to the "national transportation policy set out in section 3" as being subject to amendment on the basis of the findings of the comprehensive review.

While it is tempting to allow the new National Transportation Agency to conduct most of the monitoring required by these provisions, this may not be a wise strategy for some provinces. It should be kept in mind that the provinces who need be most vigilant, in terms of adverse impacts on regional economic development, are also the least able to invest in new monitoring activities of their own. They should, however, assess very carefully what kinds of information they will require, establish a base line of data, and commence specific monitoring activities immediately. The main intent of this activity should be aimed at the four year review of the legislation (required in section 266), which is to take place in 1992; however, if negative regional economic impacts begin to surface prior to 1992, it goes without saying the the NTA should be advised.

3(1)(e) **Cost Recovery** This policy objective is not new; it has, however, been augmented from the 1967 NTA version with the addition of the word **carrier**. This addition makes it more necessary to develop an acceptable, definition of what exactly is intended. There are a number of possible implications that can derived from the policy objective as it stands:

1. The modes should be treated equitably.
2. The carriers within a mode should be treated equitably; no distinction is made between Canadian or foreign carriers, or between public and private ownership.
3. The use of the term "carrier" leaves the position of other non-transport users of infrastructure unclear.
4. The costs of resources, facilities and services include both capital and operating costs.
5. Resources, facilities and services provided at public expense includes those provided by all levels of government.
6. No category of facility or service is excluded.

However this policy objective may be defined, it is very doubtful that it has come close to being met at any time since 1967. Transport Canada has made considerable progress in extending cost recovery in the air mode in recent years, but its almost complete failure with the services provided by the Coast Guard just means that it is still far away from achieving the equitable treatment among modes that the policy requires. even in areas over which the Department has direct control and responsibility.

The issue of modal equity, however, does not stop there. Apart from licensing fees and fines, the provinces do not collect direct revenues from road users. Taxes on fuel, collected by both federal and provincial governments, while roughly related to road usage, are not directly allocated to road construction and maintenance. In any case, railways also

pay fuel tax to the provinces, and receive no services in return. Sales taxes on new vehicles are another form of tax related revenue which could arguably be allocated to road maintenance and construction costs. In fact, no real accounting has been attempted since Dr. Harritos's work in the early 70's, and not even approximations are available that are comprehensive enough to allow for modal comparisons.

As railways do not have any infrastructure or facilities provided at public expense in the same way as the other modes do, it can be argued that the only level of cost recovery for the other modes that would be equitable would be 100% - i.e., full recovery of all costs. As the possibility of this ever coming about is remote, the only alternative will be, as suggested earlier, for governments to take over the rail right of way and recover the costs from rail carriers in the same proportion as it does from the other modes.

3.(1)(f) Imposed Public Duties

This commitment, present in the old NTA, has been given teeth by the addition of "fair and reasonable". The further addition of "carrier" probably helps CN, as it eliminates the government's excuse for failing to recompense the corporation for imposed services.

The longest running example of imposed public duty was the Crow, the statutory rate for the movement of grain by rail, that was fixed at about half a cent a ton mile in the early part of the century. Some fifty years later, the government eventually started to provide compensation with the passage of the Western Grain Transportation Act, after the lengthy (and costly) costing hearings that were needed to establish what was painfully obvious - that moving grain at a revenue level that was only 25% of the cost really meant that the railways were losing money, and had been for many years.

Fortunately, there are not many remaining situations that require action under this policy. While the subsidy payments for the operation of uneconomic branch lines will continue, the most significant one is the Newfoundland railway, that CN has been required to operate, without adequate revenues, for many years. Recently, (G&M, Feb 13 '88) the Minister of Transport agreed that CN should be compensated for this imposed public duty, quoting this paragraph of the Act as the reason. By implying that the policy had only just been introduced in the new NTA, any question of recompensing CN for past losses is neatly sidestepped. The extra words added this time around have clearly served a purpose.

3.(1)(g) Common Carrier Obligations

This policy objective is a hangover from the past, and is really a formal statement of the obligations of a common carrier. As was the case in the Railway Act, which was superseded by the new NTA, the common carrier obligations of railways are significant. Sections 143 to 146, which are backed up by this sub-section, are restatements, with modernized language, of the common carrier provisions contained in the Railway Act. Their preservation in the new legislation is inconsistent with its philosophy in three ways:

- imposing common carrier obligations on railways, but not the other modes, contradicts the objective of treating the modes equally;
- these obligations are anti-competitive in legislation which claims to to be based on the philosophy that competitive forces are essential to the creation of an efficient transport system; and,
- preserving the extensive powers of the National Transportation Agency to enforce adherence to common carrier obligations contradicts the objective of decreasing the interventionist role of the Agency in its regulation of the transportation system.

Essentially, these sections require the railways, and not the other modes, to accept all traffic offered to them and to provide this service in accordance with the very considerable detail laid out in sections 143 and 144. No other mode of transport is faced with these kinds of obligations. Trucking, for instance, which is the most common competitor to the railways, is allowed to select the kind of traffic which is most lucrative or convenient to it. Consequently, truck operators can position themselves in the marketplace and devise a business strategy to maximize profits. While the railways may be able to manoeuvre their way around certain kinds of traffic - possibly through pricing policy or branch-line abandonment - the existence of the provisions adds yet another consideration in devising a long term business strategy.

The preservation of common carrier obligations obligations for railways also seems archaic and inconsistent with the new philosophy underlying the legislation. To have preserved these essentially anti-competitive provisions in a legislative initiative which so exalts the role of competition in what is described as Canada's mature transportation system undermines the rhetoric of the Act.

Furthermore, the powers which these sections give the new National Transportation Agency contrast sharply with another expressed intention of the legislation which was to have the new NTA playing a much less interventionist role in its regulation of the transportation system. Section 146, for instance, allows the Agency to order a railway to construct new facilities, buy property, allocate equipment, and implement systems, if the Agency deems that the railway's common carrier obligations are not adequately being met. Given the business of a railway company, it is difficult to imagine a more interventionist stance for the regulatory agency! A reconsideration of the utility of continuing to enshrine common carrier obligations for railways in legislation should be undertaken during the 1992 review, if not before.

With the arrival of confidential contracts that allow carriers to customize rates, terms and conditions for individual customers, there is no means (or reason) to impose these obligations. While carriers' open , published tariffs can still be challenged by shippers on the grounds enunciated in this paragraph (and a whole new arbitration mechanism is being established by the Agency to deal with such challenges) there is nothing to prevent carriers from withdrawing all public tariffs and working entirely with confidential contracts.

Subparagraph (ii) is completely new, and reflects the greater awareness of the needs of the disabled. While most carriers can provide facilities to accommodate those passengers with disabilities, it generally costs money to do so. The real test of this policy will be to see whether meeting it will be seen as an "imposed public duty", thus making the costs recoverable under subparagraph 3.(1)(f).

3.(2) Federal-Provincial Cooperation

While at first glance, this section looks like the kind of standard legalese which one expects to find in legislation, on closer inspection it offers a rather hopeful prospect. It is essentially an enabling provision, which gives the Minister authority to enter into agreements such as the Memorandum of Understanding with the provincial transport ministers which preceded the Motor Vehicle Transport Act, (Bill C-19). Presumably this section allows the Minister to enter into other such agreements where he is promoting national uniformity in transportation matters. Possibly this authority will encourage the Minister to enter into a variety of discussions on emerging transportation issues with his provincial counterparts.

CONCLUSION

In this paper, we have examined Section 3 of the NTA from the perspective of its potential use as a yardstick against which positive and negative effects of the Act can be measured. It would appear to be somewhat deficient, both in clarity and substance. Section 3, and indeed the entire Act, was assembled very quickly. In fact, just as this paper is being written, the Calgary Olympics are ending; we cannot help but feel that if rapid legislative production were an Olympic sport, then the drafters of this legislation would win a gold medal. However, they will have to wait four years before medals, if any, are awarded and, at that time, speed will not be a factor.

When this legislation was prepared, a "window of opportunity" was open and no one was sure just how long it would remain so. This window had a lot to do with the determination of the then Minister, Don Mazankowski, the post-election popularity of the conservative philosophy, and the frustrated aspirations of Canadian travellers, shippers and carriers (especially as the gazed south of the border). It required near heroic efforts to produce an Act of this scope and consequence in such a short period of time - and, indeed, its preparation might well have broken some record for speed. There was no time for a Royal Commission, as there was before the 1967 NTA and, in fact, there was very little research and analysis conducted for this legislation at all. Recognizing this, it was very prudent that Section 266 was written in to the Act, requiring that a major review of the legislation take place in four years time.

In this paper we have attempted to indicate some of the ambiguities and problems contained in Section 3. As the yardstick against which the Act is to be examined, it requires considerable clarification and refinement, a process that should be initiated now, not in four years time. We hope that this paper may be of some contribution to this process.

REFLECTIONS ON THE WESTERN GRAIN TRANSPORTATION ACT

by John Heads*

I. INTRODUCTION

The theme of Transportation Research in Changing Environments chosen by the CTRF for its Annual Meeting this year is particularly appropriate in light of the extensive changes in transport legislation which have occurred in Canada over the last five years. The regulatory changes introduced under the new National Transportation Act, 1987, have only been in effect since the beginning of this year and the new Motor Vehicle Transport Act, 1987 is being implemented in a five year transition period starting this year. It is too early to review the success or otherwise of this new legislation, but not too early to continue the critique as addressed in a companion paper in this session.

New legislation on transport safety has not yet proceeded as far as that on economic regulatory reform. The Canadian Aviation Safety Board came into operation in late 1984 as an independent investigatory body for air accidents. The government has announced that this is to be merged into a new Multimodal Safety Board covering all transport modes, but legislation is not yet (February 1988) in Parliament. A new Railway Safety Bill is presently before the House of Commons and this will transfer rail safety responsibilities from the National Transportation Agency to Transport Canada, so that the federal responsibility for safety in all modes will be consolidated within one department. It is interesting that these legislative changes are being made against a background of increased rather than decreased safety in Canadian transportation and it is possible that these changes will have more effect on the process of safety enforcement and accident investigation than on the incidence of transport accidents. However, it is not possible to assess the actual effect, as distinct from the likely effect, of changes still in the legislative mill.

The third major change in the legislative environment was the Western Grain Transportation Act passed in late 1983 and coming into effect on January 1, 1984. The Act has since been amended effective August 1, 1985, and the administration of the legislation has been subject to two major modifications, as discussed below. An early review of the operations of the Act was carried out in the 1985-86 crop year by the Grain Transportation Agency, on instructions from the Minister in accordance with the requirements of section 62 of the Act. The purpose of the present paper is to comment on the successes and failures of the legislation in the light of the longer time frame of over four years.

II. BACKGROUND

The history of the regulation of grain transport rates in Canada is well-documented in the literature.[1] In 1897, the Canadian Pacific

Railway agreed to a reduction in freight rates on grain and flour moving eastward in return for financial assistance in building a new rail line from Lethbridge through the Crow's Nest Pass to the Kootenay area of British Columbia. With railway competition in the years up to the first World War, these rates were in fact higher than those actually assessed on grain and flour movements.

Following the end of the war and the amalgamation of a number of insolvent railways to form Canadian National Railways, a confused situation existed in respect of grain rates and the extent to which the Crow's Nest Agreement applied. This was resolved in 1925 legislation, which made the freight rates on grain and flour statutory, with these applying also to export movements to Vancouver and other Pacific ports as well as on all movements, export and domestic, eastward to Thunder Bay and Armstrong. The statutory requirement now covered all present and future railways subject to federal jurisdiction in Canada and not just Canadian Pacific. Thus, when the rail link to Churchill was opened in 1929, the statutory grain rates also applied to export traffic on this line.

The statutory rates have been popularly described as providing for the transport of grain at half a cent per ton-mile and, while purists may quarrel with the precision of this definition, it is a useful summary of the statutory rate structure. This rate structure, established in 1897, continued in operation until January 1, 1984. While the railways may not have suffered too greatly from the statutory rates until the Second World War, the inflation of the war years soon meant that the rates fell appreciably below the variable costs of transporting grain. In its submission to the MacPherson Commission in 1959, Canadian Pacific estimated that, as early as 1948, the statutory rates were covering only two-thirds of the variable costs of moving grain and only one half of the fully allocated costs, including an allowance for the fixed costs borne by the railways.[2] However, there has always been considerable argument on railway costing methodologies and, for almost the first two decades after the war, there was an unwillingness in the Western Provinces to accept the railway claims that the statutory freight rates did not cover the variable costs of the movement of grain.

With the modest but continuing inflation of the 1960's and the substantial rates of inflation starting in 1972, it became increasingly clear that the statutory freight rates for grain were no longer even approaching the variable costs of the movement. In 1975, the Federal Government established a Commission on the Costs of Transporting Grain by Rail, with Carl M. Snavely as the Commissioner. The Commission report showed that in 1974 the statutory grain rates were covering only 38.9% of the variable costs of moving grain.[3] Snavely updated his material again for the years 1977 and 1980. With frozen freight rates and the heavy cost inflation of the 1970's, the position continued to deteriorate and in 1980 the statutory rates covered only 24.3% of the variable costs of moving grain.[4]

Government had alleviated the situation of the railways to some extent by branch line subsidies, payments for branch line

rehabilitation and the purchase of hopper cars for the movement of grain and there was a tendency to regard these payments as "conscience money for the Crow"! However, Snavely argued that, in 1980, 44.6% of the variable costs associated with the movement of grain were met neither by grain shippers nor by government and were therefore a charge on the railways and the users of transportation services for commodities other than grain.[5] While the area of dispute in railway costing methodologies would allow some debate on Snavely's precise figures, the overall conclusions from his examination were unarguable.

The commencement of Snavely's 1980 cost examination had been approved by government on August 6, 1981. On February 8, 1982, the Honourable Jean-Luc Pepin, Minister of Transport, announced that Dr. J.C. Gilson would head a formal consultation process on western grain transportation with "representative groups, particularly western farm organizations and the two national railways". In the terms of reference given to Dr. Gilson, the Minister had recognized the heavy losses suffered by the railways in the transport of grain and stated that the Government would commit a total of $3.2 billion over the next four years towards seeking a solution to this problem. Grain producers would also be required to make an increased contribution to the cost of moving grain. In return for additional compensation, commitments were sought from the railways, mainly in respect of performance, service, and investment programs. A statutory framework was to be created to implement change after the conclusion of the Gilson consultation process.[6]

Dr. Gilson produced his report to the Minister of Transport on June 15, 1982, after several months of intensive discussion with parties who had widely conflicting interests. This process was important, not only for what it achieved, but also for setting a precedent for meaningful consultation in the subsequent preparation of the Western Grain Transportation Act and later in the administration of this Act by the Grain Transportation Agency and the Canadian Transport Commission.

The recommendations of the Gilson Report were lengthy, as they detailed the process for change and were not confined merely to generalizations of principles. The present paper can therefore give only a brief summary, which does not do justice to the quality of the report. The movement of grain in the crop year 1981-82 was 31.5 million tonnes, and the government contribution, hopefully augmented to the extent of some 10%, should be used towards the cost of this movement. However, future cost increases should be shared between shippers and government and government should not make a contribution towards the cost of movement for any volume in excess of 31.5 million tonnes. The likely result of this would be that the producers' share of total railway revenue requirements would be increased from 18.7% to approximately 39% within a decade.

The railways should be fully compensated for the variable costs incurred in the movement of grain. They should also be allowed a contribution to constant costs, set at 20% of the volume-related

variable costs of moving grain, but this would be phased in over four years. The report dealt comprehensively with the administrative arrangements necessary to establish the legislative framework, the estimation of freight rates under the new legislation, the review of railway costs and the monitoring and enforcement of railway performance.

Finally, the report addressed the knotty issue of whether the government payments on the movement of grain should be made directly to the railways or to the producers, with the railways then recouping their total costs through the freight rates charged. The report advocated initial payment of all the government commitment to the railways and a graduated change to payment to the producers by 1989-90, apart from that part of the government payment which would be directly tied to the need for railway performance guarantees.[7]

III. THE WESTERN GRAIN TRANSPORTATION ACT

It was clear that by 1982 the government had decided to take action on the thorny issue of the statutory rates for grain and grain products. The speed of this action was impressive, especially as this had followed decades of inaction, even though there had been many proposals for change which would have been superior to a continuation of the status quo. Gilson had made it clear that there were still matters requiring further examination before legislation was prepared and he urged the need for continued consultation with all the interested parties. The government therefore set up four task forces to address specific areas, with very tight reporting deadlines. Each task force was composed of representatives of shippers, carriers and civil servants.

The Task Force on Rates reported on detailed matters relating to rates and costs in November, 1982, achieving consensus on a remarkably large number of issues, but still leaving some important matters to be resolved before the legislation was drafted.[8] The second task force, covering organization and the monitoring of railway performance, reached a consensus reasonably quickly. Rather surprisingly, this watered down the Gilson recommendations on monitoring of railway performance but, equally surprisingly, subsequent experience with the Act has vindicated this judgment. The third task force, charged with recommending whether the government payments should be made to the railways or to the producers, was unable to reach a consensus and this issue has continued to be perhaps the most intractable of all the problems associated with the legislation.

The Legislative Task Force, which included many of the members of the three other Task Forces, commenced work in late 1982 and proceeded at a hectic pace in the early months of 1983. The bill which was to become the Western Grain Transportation Act (WGTA) was with the legislative draftsman early in the year and received First Reading in the House of Commons in June, 1983. The legislative process proceeded thoroughly and expeditiously, including cross-Canada hearings by the House of Commons Standing Committee on

Transport, and the Act became law on November 17, 1983, taking effect on January 1, 1984.

Space does not allow an extensive description of the WGTA but, with one exception, the main thrusts of the Gilson report were implemented, in principle if not always in detail. The government commitment to the cost of transporting grain was written into legislation and the future size of this commitment was limited in the ways suggested by Gilson, through a sharing of cost increases between grain producers and government and through the limitation of the government commitment to the amount of grain moved in the 1981/82 crop year. The administrative responsibilities of government agencies were spelt out, with the Grain Transportation Agency (GTA) responsible for ongoing improvements to system efficiency and the Canadian Transport Commission (CTC) responsible for the estimation of costs and rates, the processing of payments and the monitoring of investments.

A rather complicated system was introduced to adjust the financial burden between the government and the shippers for inevitably inaccurate forecasts of the volume of grain to be moved. This involved the concepts of interim and final adjustments, but this was soon abandoned in subsequent legislation. The government contribution to the cost of moving grain was to be paid directly to the railways, but a further committee was to be set up to examine this. The Act also provided for a review of the entire working of the WGTA to be carried out in the crop year 1985-86 and for the first costing review to take place at that time.

The WGTA took effect on January 1, 1984, with the most visible change the replacement of the statutory grain rates by a rate scale established by the Canadian Transport Commission in accordance with the Act. This specified the rates to be paid by shippers and government in respect of grain moved over various mileages.

IV DEVELOPMENTS SINCE 1984

This section examines only five developments which have taken place since the WGTA became law, but note should also be made of the ongoing work of the GTA and the CTC in the administration of the Act. Major studies into the efficiency of the grain handling system have been initiated by the GTA and the Senior Grain Transportation Committee. This has promoted a cooperative consultative process for the resolution of problems. The CTC has carried out its duties to determine the rate scale for the movement of grain each crop year and this has again been carried out in consultation with the interested parties, coordinated through the Senior Grain Transportation Committee.

Although the interests of the parties do not coincide, there has been a remarkable degree of consensus in the consultative process, agreements to differ have been made objectively and without rancour, and there has been almost a complete absence of posturing and rhetoric on the part of the participants. The constructive nature of

this consultation augurs well for grain transportation in Canada and is a legacy owed very largely to Dr. Gilson.

The five major events of the last four years are now reviewed.

1. As required by the WGTA, on April 24, 1984, the government appointed a five man committee to examine whether the government contribution to the costs of moving grain should be paid directly to the railways or to the producers, with the railways then enabled to recover their costs through higher freight rates. The chairman of the Committee was Mr. Justice Gordon C. Hall of the Manitoba Court of Appeal - not to be confused with his namesake, the Hon. Emmett M. Hall, Chief Commissioner of the Grain Handling and Transportation Commission which reported on the prairie branch line situation in 1977.

Mr. Justice Hall and his colleagues submitted their report to the Minister of Transport on March 29, 1985. Their recommendation was in favour of paying the producer, with this to be accomplished through the establishment of a Grain Transportation Refund. Total government payments in support of grain transportation would be paid to individual grain producers on the basis of their net sales of eligible grains in each crop year, regardless of whether these grains were used for export, for processing or for the feeding of livestock. Payments would vary to individual producers depending on their location in the various rail freight zones of western Canada, so that producers faced with long distance movements would be compensated more than those faced with short distance movements.[9]

The recommendations of the Hall Committee were perhaps the inevitable conclusions that would flow from an economic analysis of the issue. The "pay the railways" option has two disadvantages. Firstly, it gives an artificial incentive for the transport of grain for export at the expense of its use on the prairies, both in livestock production and in other processing. Secondly, it prevents truck transport from competing with rail on a level playing field. The option of paying the railways is administratively less costly, but Hall claimed that the cost difference was modest.

The government did not take any action following receipt of the Hall Report. The main opposition to paying the producer had come from the Prairie Wheat Pools, fearing that this would convert a transport subsidy into an agricultural subsidy, and from Quebec livestock producers, fearing a rise in the cost of feed grains, even though the price in Eastern Canada is determined by the price of U.S. corn more than by the feed grains supply situation in the prairies. The issue still smolders, but no action has been taken.

2. In early 1985, the new Conservative Government decided to introduce amendments to the Western Grain Transportation Act. These amendments came into effect on August 1, 1985 and are the only changes made to date in legislation. Apart from some minor administrative provisions, the main change was to replace the

cumbersome arrangements in the WGTA for adjustment in payments between government and shippers as a result of the impossibility of forecasting the crop movement precisely. The new legislation substituted a tally adjustment mechanism, whereby no monies are to be exchanged between government and shippers as a result of forecasting errors until the point where one party owes the other in excess of $150 million. This approach decreases the likelihood of wide fluctuations in grain freight rates from year to year in response to changes in the volume of grain moved. However, it is not a perfect solution as sooner or later random movements may take the tally to one or other of its outer limits and fluctuations may occur requiring year-to-year adjustments.

The 1985 amendments to the WGTA included two penalties to the railways. Firstly, the railways were required to hold public meetings with producers each year so that the railways would "gain an improved understanding of transportation problems encountered by actual producers", but no costs incurred in this process were eligible for recovery under the WGTA. Secondly, the amount of the tariff to be paid by the shipper in respect of the 1985/86 and 1986/87 crop years was not to exceed the rate paid in the 1984/85 crop year. Through a mechanism known as the "transitional tally adjustment", the railways had to make the financial contribution to ensure that this came about. In the event, this provision did not become operative in 1985/86, but for 1986/87 the railways were subsequently required to refund some $74 million to government. The railways were therefore $74 million short of covering the costs incurred in the transportation of grain and it is difficult to understand either the economic or moral justification for this expropriation.

3. In 1985/86, the Canadian Transport Commission was required to carry out its first four yearly costing review. This was conducted for the calendar year 1984 and railways costs were re-stated to the 1984 base from that of 1980 used in the WGTA. Each year between costing reviews, railway costs are indexed for inflation and the railways are allowed any productivity increases that have been made. The productivity increases are then captured every four years and transferred from the railways to government and possibly the shippers, but the railways have the incentive to improve productivity through enjoying the results in the interim period.

It was expected that the costing review for the year 1984 would yield considerable productivity gains and a reduction in the cost base for the transport of grain. Unfortunately, these gains were modest and wiped out by an under-estimate of railway roadway costs in 1980 and an undercount of the number of branch lines which were grain dependent.[10]

4. Section 62 of the WTGA required a comprehensive review of the operations of the Act to be carried out during the 1985-86 crop year. On August 2, 1985, the Minister of Transport requested that the Grain Transportation Agency conduct this statutory review and the report to the Minister was submitted in April, 1986.[11] The GTA was also asked

to examine the report submitted by the Hall Committee earlier in 1985. Although, supporting the "pay the producer" option, the GTA rejected the Hall Committee mechanism of the Grain Transportation Refund on the grounds of administrative difficulties and the extra costs that would likely be incurred to compensate the losers from this approach. The GTA wanted the establishment of a task force to develop the detailed implementation of its own proposed pay the producer option.

Probably the most significant recommendation in the GTA Review was that the trucking industry should be eligible for government payments on the movement of western grain to terminal points, in just the same way as the railways are presently paid. There were some useful comments on facilitating productivity sharing agreements between shippers and the railways. Support was given to the popular view in the grain trade that the costs of the rail line to Churchill should not borne by the grain producers.

The remaining recommendations of the GTA Review covered more mundane, although still important, matters relating mainly to car supply and costing. The present writer has problems with some of the costing recommendations. In particular, accepting the GTA view that parity on freight rates to Prince Rupert and Vancouver should be maintained, it is difficult to understand why the GTA would wish to eliminate the compensation presently given in the WGTA to Canadian National for the extra costs incurred in carrying out this public duty.

In the event, there was little reaction by government to the GTA Review. Because of a statutory requirement, this review had commenced when the WGTA was only nineteen months in existence and this was far too early. In addition, the government had only recently passed amendments to the WGTA, as discussed above. Finally, the major recommendation of the GTA Review was to open up yet again discussion of the "pay the producer" option, an unwelcome invitation to bring exhausted combatants back to the battle field.

5. A major thrust of the WGTA was to unfreeze the freight rate paid for the transportation of grain by the producer. The average distance that grain is transported by rail is in the range of 901-925 miles and the rate paid by the producer for transporting a tonne of grain this distance was $4.85 before the WGTA was in force. Effective January 1, 1984, this increased to $5.72. As a result of a very heavy grain movement in the crop year 1983/84, the producers owed government money which had to be recovered in the subsequent crop year. Effective August 1, 1984, the cost paid by the producer for the transport of a tonne of grain in the distance range 901-925 miles increased to $7.70. Following the low grain shipments in the crop year 1984/85 the government owed money to the producers and the freight rate paid by the shipper in the specified distance range fell to $6.00 per tonne in the crop year 1985/86.

The situation in the crop year 1986/87 was most intriguing. The GTA initially produced a forecast of the volume of grain to be moved

of 30.6 million tonnes. In its calculation of the rate scale, the CTC was obliged to accept the GTA forecast of the volume movement. The CTC forecast the changes in railway costs and, from these calculations, the cost to the producer for moving a tonne of grain in the specified price range would have been $7.50 per tonne in the crop year 1986/87. However, given the state of grain markets in early 1986 and heavy criticism of GTA for forecasting too high, the GTA was directed to lower its forecast and a volume of 28.5 million tonnes was chosen.[12] This resulted in a freight rate for the specified distance range of $5.97 for the crop year 1986/87 or virtually the same as in the previous crop year. In actual fact, the volume of grain moved in the crop year 1986/87 turned out to be 35.2 million tonnes and the appropriate rate to be paid by the shipper would have been $9.50 per tonne for a movement of 901-925 miles.

The experience in the crop year 1986/87 has been a salutary lesson in the dangers of adjusting volume forecasts; figures put forward by the GTA have been accepted without argument for the crop years 1987/88 and 1988/89. The GTA forecast of the movement in 1987/88 was 31.8 million tonnes, which was a considerable increase over the figure used in the previous year. The consequence of this was that the CTC produced a rate to be paid by the producer of $8.32 per tonne for 1987/88 in the specified distance range of 901-925 miles. In view of agricultural conditions, the government decided to pay a special subsidy to the producer which kept the rate for the distance range of 901-925 miles at a modest $6.34. A further large increase in the rate is in prospect for 1988/89, but it is too early to indicate what will be the ingenious reaction this time.

V. REFLECTIONS

The final part of this paper commences with the successes of the WGTA and then proceeds to the problems which have still to be resolved. As in any critical discussion, more space is inevitably given to problems than to achievements and this is apparent below. However, in spite of this imbalance, the WGTA has been a vast improvement on the situation under the statutory rates before the Act was passed.

The greatest achievement of the WGTA is to have found a solution to the problem of inadequate freight rates for grain. The extent of government support for the transport of grain is very substantial, amounting in the calendar year 1986 to $671 million.[13] Without this infusion of funds, a continued requirement for the railways to carry grain at freight rates so far below variable cost would have inevitably led to the bankruptcy of the Canadian railways and /or to the collapse of the grain transportation system. Compensation provided by the WGTA has, in this way, averted a major disaster.

Secondly, the WGTA has fostered a spirit of cooperation between the various stakeholders in Canadian grain transportation. This has been demonstrated in the GTA work on system efficiency and in the CTC work on the freight rate scale and costing. This constructive environment owes much to the consultative processes introduced by Dr.

Gilson during his 1982 review. In the event, the WGTA did not impose as strong performance requirements on the railways as were advocated in the Gilson Report, but experience over the last few years seems to show that these were not needed in the spirit of cooperation which has developed. With an adequate rate of compensation from shipper and government, grain traffic is now wanted by the railways and is not a commodity to be avoided as in the days before the WGTA.

In establishing the rate scale, there is always a serious problem in determining the volume of grain to be moved and this is discussed later. However, accurate forecasting of changes in railway costs has not presented too much of a problem to the CTC and the error here has never exceeded one percent. Further exposition of meaningful consultation and sound administration would become repetitive, but these have been important products of the WGTA.

Turning now to the negative side, the approach will be to address three major issues, to enumerate a number of less important matters, and to conclude with a final major issue.

1. The debate between the options of paying the government contribution to the railways or to the producers continues. The economic arguments are overwhelmingly in favour of paying the producer to prevent market distortion leading to excessive movements of export grain and to allow intermodal competition. Administrative costs are less when paying the railways, but the Hall Committee suggested that the difference in administrative costs was not substantial. However, the present writer does not necessarily accept all the calculations contained in this report, particularly the studies that suggest that making payments to the producer rather than to the railways "would, by 1995-96, result in net farm incomes being higher by 35 percent in Manitoba, 14 percent in Saskatchewan, and 25 percent in Alberta".[14]

The problem with the option of pay the producer is twofold. Firstly, there are a number of alternative criteria on which payments could be based - crop production, crop acreages, confinement or non-confinement of the benefit to the grain transported under the WGTA and so on. Secondly, the substitution of pay the producer for pay the railways would involve substantial income redistribution between producers. While this statement is obvious, perhaps it has not been addressed in a sufficiently explicit manner to allow resolution of the issue.

During the discussions preceding the WGTA, it was pointed out that a substantial rise over time in the amount paid by the shipper for the transport of grain covered under the WGTA would mean that any advantage in shipping feed grain over livestock production in the prairies would tend to diminish. However, from the description above of government action on freight rate increases under the WGTA, it is clear that this tendency has been blunted. Free trade requirements are also liable to affect the relative viability of the two payment options. Resumption of the public debate on this matter is virtually inevitable within the next two years.

2. The freight rate paid by shippers of grain is subject to considerable fluctuation. The government has decided on a fixed financial contribution to the movement of grain, the volume moved changes from year to year, and hence the burden of fluctuation is forced on to the producer. The interim tally adjustment can modify the fluctuation, but ultimately one or other boundary of the tally may be reached and the fluctuations may return. The forecasting of the volume of grain to be moved is inevitably subject to error, primarily because of climatic variations, and the most refined forecasting techniques are unable to avoid this problem. However, it is not errors in forecasting that cause the freight rate paid by shippers to fluctuate, but rather the government insistence that the producer bear all the cost of changes in the volume of grain moved and that the government commitment be kept constant, apart from sharing in the effects of inflation.

The only way to avoid fluctuations in the freight rate paid by shippers is for government to take a longer time horizon and to vary its commitment, both upwards and downwards, directly with random - as distinct from trend - changes in the volume of grain moved. This would not be a difficult approach to develop and staff of the University of Manitoba Transport Institute (UMTI) have been asked by some of the WGTA participants to consider contract research in this area. However, it must be clearly understood that these fluctuations can only be reduced if government clearly recognizes that it must not insist on certainty in the size of its financial commitment each year. In fact, this insistency has been unsuccessful, as witnessed by the ad hoc action taken on the freight rate to be paid by producers in both 1986/87 and 1987/88. The cost of abandoning the search for an inflexible government commitment could be modest, compared to the costs of the distortions that have taken place in these two years.

3. The achievement of greater efficiency in the Canadian grain handling system is being prevented by a number of constraints, of which the freezing of the branch line network to the year 2000 is of substantial importance. The Senior Grain Transportation Committee has already drawn attention to the problems here. The CP Lac du Bonnet subdivision has now been unfrozen and abandoned, but the rationalization should not stop here for the next twelve years.

As far as the WGTA is concerned, the line-related costs of grain dependent lines and the volume-related costs of moving grain are aggregated, with all these costs recovered through the freight rate. Each railway must then meet the costs of maintaining its own branch lines. In principle, it would seem, for example, that the interests of CP Rail could lie in seeing the continuation of as many CN Rail branch lines as possible and the abandonment of as many CP Rail lines as possible, as this would maximize the total revenues available through the rate scale and minimize the CP Rail costs. This incentive would be blunted by other factors, particularly the extent to which CP Rail might lose originating grain traffic to CN Rail as a result of branch line abandonment. Conversely, CN Rail would have the precisely opposite interests to CP Rail. In fact,

neither railway has pursued its own self-interest in this way, but the freezing of the branch lines to the year 2000 would in any event make exploitation of such an approach unsuccessful.

In a 1987 article, Tyrchniewicz and Wansbutter pointed out that fluctuations in the freight rate could be reduced if the railways were paid separately for costs related to the operation of branch lines, rather than have all line-related and volume-related costs recovered through the freight rate.[15] A similar proposal had been advanced by the CTC and the Wheat Pools in 1982, but this was opposed by the railways and some shipper groups and did not find its way into the legislation.[16] The Tyrchniewicz and Wansbutter argument was also advanced in 1982. It was also stressed that the payment of on-line costs in respect of each branch line would sharpen public perceptions of high cost branch lines and give a greater incentive for taking action on alternative transportation arrangements. This issue should be re-opened to public debate.

4. As matters which are less important or transitional in nature, the following should be noted:

(i) The cost base for the transport of grain is increased by the legislative requirement to include an allowance for income tax in the cost base for both major railways, even although Canadian National Railways is not in a tax paying position.

(ii) The total costs for the movement of grain, as defined in the WGTA, are recovered through the rate structure. However, the rate scale for movements of different distances are not strictly cost based, but largely mirror the distance-related differentials which existed under the Crow Rate structure. For example, the rate for transporting a tonne of grain 1200 miles is 1.5 times the rate for 600 miles, but there is no guarantee that this reflects the relative difference in cost between moving over these two distances. Work carried out in the CTC has suggested that the freight rate structure does not allow fully for the reduction in cost per mile, as distance travelled increases, but the distortion does not appear to be great.

(iii) It has been argued that the costs of the Churchill line should not be assessed to the grain trade as this line is required more for national sovereignty and defence purposes than for the transport of grain. While this is partly a matter of opinion, not susceptible to objective analysis, the present writer has some sympathy for this view.

(iv) As explained earlier, the freight rate paid by the shipper in the crop year 1986/87 was $5.97 per tonne for a distance of 901-925 miles. If the volume movement could have been forecast correctly, the freight rate would have been $9.50. The amendments to the WTGA of 1985 prevented the rate payable by the shipper from exceeding $7.70 and required that the difference between $9.50 and $7.70 be borne by the railways. The railways have therefore been required to repay some $74 million to government on this account. This repayment does not represent the recovery of any over-compensation made to the

railways, but rather the legislation of 1985 required that part of the cost of the heavy grain movement in 1986/87 had to be borne by the railways. It is very difficult to offer any economic or moral justification for this, but at least it was a temporary requirement not operating beyond 1986/87.

5. Turning to the final point in this paper, a major thrust of the WGTA was to transfer an increasing proportion of future cost increases in the transport of grain to the account of the shippers. Thus, as explained earlier, the freight rate to the shipper for the transport of a tonne of grain over a the distance of 901-925 miles increased sharply to $7.70 effective August 1, 1984. The fall to $6.00 per tonne in the crop year 1985/86 was completely in accordance with the requirements of the WTGA (although the part of the WTGA that required this was not too sensible). The legislation called for increases in the rate paid by the shipper in both 1986/87 and 1987/88, but we have seen that government did not allow these to materialize. Government reaction to the expected rate increase in 1988/89 will be known by the time this paper is released.

If government refuses to allow the rates paid by the shippers to increase as specified in the WGTA, the burden on the public treasury will grow substantially. Effectively, there will be a "new Crow Rate" in the range of 0.7 cents per tonne-mile. Clearly, government has the right to reverse the thrust of the 1984 legislation, but there is obvious dangere in doing this by a series of ad hoc decisions without comprehensive consideration of the overall situation.

On November 2, 1987, the Minister of Transport announced that he did " not propose to amend the Western Grain Transportation Act during the balance of the government's mandate". This may well be a justifiable position over the relatively few months remaining before the next election. However, a major thrust of the legislation has already been amended by government intervention and it will be interesting to see whether this will continue.

ENDNOTES

* University of Manitoba Transport Institute and formerly Executive Director, Railway Transport Committee, Canadian Transport Commission.

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3. Report of The Commission on the Costs of Transporting Grain by Rail (Snavely), Volume I, Supply and Services Canada, Ottawa, October 1976, p. 207.

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5. ibid., p. 192.

6. J.C. Gilson, Western Grain Transportation: Report on Consultations and Recommendations, Supply and Services Canada, Ottawa, 1982, Chapter I.

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8. Report of the Task Force on Rates, Canadian Transport Commission, Ottawa, November 1982.

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11. Review of the Western Grain Transportation Act, Grain Transportation Agency, Winnipeg, April 1986.

12. E.W. Tyrchniewicz and E.R. Wansbutter, "Forecasting for Subsidy Purposes: Idiosyncracies in the Western Grain Transportation Act", Journal of the Transportation Research Forum, Vol. XXVIII, Washington D.C., 1987, pp. 444-450.

13. The Twentieth Annual Report of the Canadian Transport Commission 1986, Supply and Services Canada, Ottawa, 1987, p. 99.

14. Hall, op. cit. - reference 9 above, p. 123.

15. Tyrchniewicz and Wansbutter, op. cit. - reference 12 above, p. 449.

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Shipping Conferences Exemption Act, 1987: The Review

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SHIPPING CONFERENCES EXEMPTION ACT, 1987: THE REVIEW

INTRODUCTION

This paper will discuss the review process for the Shipping Conferences Exemption Act, 1987 (SCEA). As the SCEA, 1987 came into force only on December 17, 1987, the development of the review process has just begun. This paper should, therefore, be seen as a "snapshot" of a work in progress rather than a definitive manual on a process already fully decided upon.

Before we begin, let us define some terms:

Conference - a formal association of shipping lines (carriers) who have joined together to operate under common terms and conditions. Members of a Conference have a common tariff and provide regular, scheduled service,. There are over 30 Conferences serving Canada at the present time.

Shippers' group - a group of shippers designated under the Shipping Conferences Exemption Act with whom the Conferences must meet. Under the SCEA, 1979, the Canadian Shippers' Council was the designated group. The Minister of Transport has not yet designated any group under the SCEA, 1987.

The National Transportation Agency - Formerly the Canadian Transport Commission. The body with whom tariffs are filed by Conferences. The Agency is also responsible for administering the Act.

BACKGROUND

The first Shipping Conferences Exemption Act came into force on April 1, 1971 and expired on March 31, 1979. It was replaced by the Shipping Conferences Exemption Act, 1979 which was replaced by the Shipping Conferences Exemption Act, 1987. This current Act will be referred to throughout this paper as the SCEA.

Liner shipping conferences are accepted internationally as an important element of international shipping. In addition, the U.S. Shipping Act of 1984 has affirmed

and strengthened anti-trust immunity for certain liner conference agreements and activities. For these and other reasons, Parliament decided that the exemption previously provided to shipping conferences should continue with strengthened provisions to ensure protection of the public interest and to encourage greater competition.

The consultations which took place throughout the period preceding the introduction of the new Act revealed, not surprisingly, deep differences between shippers and Conferences as to the effectiveness of the SCEA, 1979. Proposed modifications to the Act reflected each group's perspective and assessment of the effectiveness of the SCEA, 1979.

In general, shippers felt that the SCEA, 1979 provided Conferences with too much power, while Conferences maintained this was not so. The situation was exacerbated by the depressed shipping market in which everyone found themselves in the several years leading up to the revision of the legislation.

The new Act, among other things,

(a) provides for the use of confidential service contracts, under terms and conditions established by the conference;

(b) establishes procedures whereby any person may complain to the Commission if an agreement or practice has the effect of producing an unreasonable reduction in service or an unreasonable increase in transportation costs;

(c) establishes the right of independent action for conferences members. A conference member intending to take independent action must give notice of its intention to do so, to the other members of the conference; the maximum notice period that a conference may require of its members is determined by Order-in-council and has been set at 15 days;

(d) establishes the right of conference members to jointly fix and quote multimodal rates but prohibits conference members as a group from negotiating with inland carriers;

(e) requires conferences to give 30 days notice of a freight rate increase and 14 days notice of an increase in surcharges or the introduction of a new surcharge;

(f) provides for fines for violation of the Act of not more than $1,000 a day.

Unlike its predecessor, the SCEA has no sunset clause. The Act will be reviewed in 1992 as required by the National Transportation Act, 1987.

National Transportation Act - Requirements to Review

On August 28, 1987, the new National Transportation Act (NTA, 1987) received Royal Assent.

Sections 266 and 267 of the NTA, 1987 deal with review. There are two types of reviews required:

1. An annual review which is to be carried out by the Agency. The items which must be reviewed are numerous and are set out in detail in the Act (See Appendix A). Annual reviews will be prepared for years beginning in 1988 and continued through 1991; and

2. A comprehensive review which will be carried out by a person or persons appointed by Governor-in-Council. This is meant to be a comprehensive review of the effect of the legislation (see Appendix B). This review will be broader in scope but will draw from the annual reviews of the four preceding years.

A. Annual Review

The following are six key areas which the Agency is planning to monitor:

1. Traffic
2. Pricing
3. Service Levels
4. Structure
5. Performance
6. Regulatory Activity

This list is not exhaustive; however, it serves to highlight major target areas.

Each of the target areas on the list has its own sub-list. Under the heading of pricing, for example, lies the whole world of rates. This type of data can be compiled, arranged, analyzed and presented in many ways. On the other hand, one could take a less numerical example; structure, for example. This item is more qualitative but no less complex. Examination can be

made of the changes in organization of shipping conferences, entries and exits to the market, number of conferences by route, and so on. There is a large amount of work to be done and with the first annual review on May 31, 1989 not a great deal of time to get at it.

B. Comprehensive Review

Obviously much of the information that will be required to conduct the comprehensive review can be drawn from the annual reviews which the Agency will conduct.

However, the 1992 review is, in essence, a policy review and could lead to changes in the Act.

At the very least, it should provide users of the SCEA (both shippers and carriers) an opportunity to provide information to the government as to the impact and effectiveness of the legislation.

Transport Canada is developing a review plan. In doing so, it was natural to look at the U.S. experience.

U.S. Shipping Act of 1984

International liner operators calling at U.S. ports and non-vessel operating common carriers (NVOCC's) currently are regulated under the U.S. Shipping Act of 1984 which became effective on June 18, 1984. Although the U.S. legislation is broader in scope than the Canadian SCEA because it has a broader purpose, it is important to note that many of the conferences serving American ports have within their membership the same shipping lines as served by Canadian ports. In fact, it is often the same ships.

Section 18 of the Shipping Act of 1984 requires the Federal Maritime Commission (FMC) to review the economic behaviour of the ocean shipping industry.

For a period of 5 years following the enactment of the Act, the FMC must collect and analyze information concerning the impact of the Act upon the international ocean shipping industry. A list of areas to be covered is included in the Act, and it does not differ significantly from the list in the Canadian National Transportation Act with respect to the annual review.

Within 6 months after the expiration of the 5 year period, the FMC must report this information, with an accompanying analysis of the impact of the Act, to Con-

gress and certain other bodies, including an appointed Advisory Commission. The Commission must submit a final report to Congress within a year containing a statement of findings and recommendations for changes to legislation and/or regulations.

One of the major tools which the FMC used in beginning its review was to conduct a survey in 1986 of carriers, shippers, ports and non-port marine terminal operators. The results of that survey reflect one full year of implementation of the Act. A similar survey will be sent each year through 1989. It is clear that a survey based on one year's experience provides only a starting point for information gathering and therefore no significant conclusions should be drawn from the results of the 1986 survey. The FMC intends to build on this data as future surveys are completed. The five year compilation may alter dramatically preliminary conclusions that could be drawn from the one year survey. The FMC and others in the United States are attempting to assess the impact of the Shipping Act of 1984 by exchanging information through formal seminars, and through informal consultations.

Canada vs. U.S.

Although the review process has a different legislative configuration in each country, the overall objectives are the same. At a fixed point in time, the legislators must be told if new legislation has been effective. If it has not been, changes can be made based upon information collected throughout the interim period.

In all review processes of similar environments, common threads emerge. It is not surprising that the Canadian list of fundamental issues to review matches closely the U.S. list.

Such items as rates, levels of service, types of service, ship productivity, and market share will appear on both lists.

Canada may add the negotiating process, confidential service contracts, and independent action to its list. Each of these major headings may have many elements and indeed, new elements may appear as time passes.

Where do we go from here?

It is time to point this paper in a very specific direction. Let us attempt to do so by reiterating the

basic questions of journalism, modified only slightly to suit the issue:

1. What should be reviewed?

As previously discussed, some major target issues, with their annual elements, have been identified in legislation. Other issues arise as a direct result of the new SCEA provisions, for example, service contracts and independent action. In addition, work should be done on larger transportation and economic questions such as port developments, relevant government policies, and inland load centre evolution to name a few. In addition to hard data, work should be done on the qualitative side, including the impact of the legislation on negotiations between conferences and shippers, and the shift of cargo between types of contracts.

2. Who should be reviewing?

Clearly, the Agency will conduct the annual reviews. Just as clearly, the persons appointed in 1992 will conduct the comprehensive review. However, the information for that comprehensive review must be compiled throughout the 4 year period beginning in 1988. It is the responsibility of all partners in the system to review: Transport Canada, to set up the overall framework, conduct the analyses supplementary to the Agency annual review work, and guide any consultant's studies; the conferences, shippers, freight forwarders and others in the transportation chain who have a stake in the outcome, to provide useful and timely information; and the Agency, to determine the need for data and to advise those who must provide it. In short, it is everyone's responsibility.

3. When to review?

We must start almost immediately. The first annual report is due within 18 months.

4. How and where to review?

The quick answer is wherever and however is found to be effective. That means through consultation formally and informally. It can mean through committees, seminars or conferences, or on an individual basis. It should mean that users will suggest methods of review and will participate fully in the process.

To conclude, everyone has a stake in seeing good legislation on the books.

This review process provides access to the policy process and an opportunity to influence future legislation. It only requires effort and interest.

National Transportation Act, 1987

Appendix A

PART VIII

GENERAL AND TRANSITIONAL PROVISIONS AND RELATED AND CONSEQUENTIAL AMENDMENTS

Division I

Review of Act

266.(1) The Governor in Council shall, in January, 1992, appoint one or more persons to carry out a comprehensive review of the operation of this Act, the provisions of the Railway Act amended by this Act, the Shipping Conferences Exemption Act, 1979, the Motor Vehicle Transport Act and any other Act of Parliament for which the Minister is responsible that pertains to the economic regulation of a mode of transportation.

(2) The person or persons conducting the review shall assess the effect of the legislation referred to in subsection (1) on shippers, travellers and carriers and on trade, regions and their economic development, and where necessary or desirable, recommend amendments to

(a) the national transportation policy set out in section 3; and

(b) the legislation referred to in subsection (1).

(3) The following matters shall be considered in connection with any other matters dealt with by the review:

(a) the overall effectiveness of the policy and Acts referred to in subsection (2) in achieving an economic, efficient and adequate network of viable and effective transportation services that are responsive to the needs of shippers and travellers with a minimum of government intervention;

(b) the effect of confidential contracts for the transport of rail freight on shippers and on the efficiency of the rail transportation system in the various regions of Canada;

(c) the advisability and necessity of having a compensatory rate requirement in respect of railway transportation;

(d) the extent to which competitive access to railway transportation has been achieved by shippers in the various regions of Canada;

(e) the impact of this Act on air service in the various regions of Canada particularly on routes having low traffic volumes;

(f) the advisability of retaining or modifying the special economic regulation applicable to northern and remote area air services;

(g) the adequacy and effectiveness of legislation referred to in subsection (1) that pertains to trucking as it affects shippers and carriers;

(h) the need for retaining, modifying or terminating any or all of
(i) the shipping conference practices that are exempt from the Competition Act, or
(ii) the terms and conditions pertaining to the exemption referred to in subparagraph (i);

(i) the effect on employment and management-labour relations;

(j) the effects of sections 134 to 142 on the revenues, financial viability, capital investment and service levels of railway companies; and

(k) such additional matters as the Governor in council may, by order, specify.

(4) Every person appointed to carry out the review has, for the purposes of the review, the powers of a commissioner under Part I of the Inquiries Act and may engage the services of experts, professionals and other staff deemed necessary for making the review at such rates of remuneration as the Treasury Board approves.

(5) The review shall be completed and a report thereon submitted to the Minister on or before January 31, 1993.

(6) The Minister shall cause a copy of the report to be laid before each House of Parliament on any of the first thirty days on which that House is sitting after the report is received by the Minister.

Appendix B

Annual Reviews

267.(1) After the expiration of each of the years 1988, 1989, 1990 and 1991, the Agency shall make a review in respect of that year of the operation of this Act, the provisions of the Railway Act amended by this Act, the Shipping Conferences Exemption Act, 1979, the Motor Vehicle Transport Act and many other Act of Parliament for which the Minister is responsible that pertains to the economic regulation of a mode of transportation.

(2) In conducting the review in respect of a year the Agency shall, without limiting the generality of subsection (1) and having regard to section 3 and the matters referred to in subsection 266(3), consider on a national basis in respect of the year

(a) changes in tariffs of carriers;

(b) changes in the level of service provided by carriers to shippers and travellers;

(c) changes in the structure and performance of the transport industry, including the number of carriers that have commenced or ceased to carry on business;

(d) changes in employment levels in the transportation industry;

(e) the time required to deal with any application, complaint or other matter referred to the Agency under any Act of Parliament;

(f) the effect of sections 134 to 142 on the revenues, financial viability, capital investment and service levels of railway companies; and

(g) such other matters as the Minister may refer to the Agency.

(3) A report of the findings of the Agency on the review in respect of a year

(a) shall include a summary of notices made under subsection 160(1), applications made under subsection 160(4) and abandonment dates fixed under sec-

tion 168 during the year, as well as of the plans of every railway company under its jurisdiction for the giving of such notices and the making of such applications during the following year; and

(b) shall be submitted by the Agency to the Minister on or before May 31 of the following year.

(4) The Minister shall cause a copy of each report submitted under this section to be laid before each House of Parliament on any of the first fifteen days on which that House is sitting after the report is received by the Minister from the Agency.

(5) The Agency shall collect and analyse information for the purposes of making its reviews under this Part, make regulations requiring carriers to provide information to the Agency or its representative for those purposes at such times and in such form and manner as the regulations may specify.

(6) In conducting its review and reporting its findings under this section, the Agency shall not knowingly disclose or cause to be disclosed any information obtained by the Agency from an identifiable person if it is possible from the disclosure to relate the information to that person and it is likely that the disclosure would cause substantial harm to the person.

(7) Every person who fails to comply with a regulation made under section (5) is guilty of an offence punishable on summary conviction.

(8) An individual who is convicted of an offence under this section is liable to a fine not exceeding five thousand dollars.

(9) A corporation that is convicted of an offence under this section is liable to a fine not exceeding twenty-five thousand dollars.

(10) On or before March 1, 1988, the Agency shall submit to the Minister a report containing the summary referred to in paragraph (3)(a) in respect of the year 1987.

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