

INTERMODAL TRANSPORTATION AND THE VEHICLE

by

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## ABSTRACT

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This paper traces the evolution of CP Rail's intermodal operations and the various equipment configurations that have been in use. The impact of frequent changes in dimensions of highway vehicles upon intermodal equipment costs is addressed along with the sensitivity of the rail/truck competitive balance to such impacts. Other factors influencing market shares are identified. Potential investments in new intermodal equipment and facilities are examined: the highway and tax policies which may hamper their realization are explored.

### 1.0 INTRODUCTION

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At one time, land transportation of people and goods was mostly by rail. The construction of paved highways along with the emergence of aviation significantly altered the role of railways in serving the transportation market. Today, railway market niches are principally (1) long-distance movements, and (2) high-volume bulk commodities.

This paper addresses a third sector, one where the traffic easily shifts between rail and truck.

### 2.0 HISTORY OF CP RAIL INTERMODAL

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In the 1950s, CP Rail established a department known as Piggyback Services. It was designed to counter traffic erosions to the truck mode by integrating the flexibility of truck delivery with the cost efficiencies of long haul rail. Its goal was to convert, and thus retain, traffic then moving in boxcars to an equipment configuration that would be price competitive and at the same time provide shippers the service characteristics of trucks.



The first piggyback system was dedicated to transporting trucker-owned trailers on flatcars. Pick-up and delivery at both origin and destination were performed by the truck carrier, while the railway supplied the flatcar and the rail service. This has now become known as Plan I and is a relatively small portion of CP Rail's current intermodal movements. The trailers supplied at that time by the truck lines were generally 36 and 38 feet in length. Accordingly, CP Rail's first piggyback flatcars were 41 feet in length so as to accommodate both sizes.

During the years that followed, the trailers supplied by the truck carriers changed several times, and consequently so did CP Rail's flatcar fleet. Forty-foot trailers emerged in the late 1950s, followed closely by the first 45-foot trailers. Railway flatcars first went to 46 feet and then to 54 feet to allow the handling of the 45-foot trailer or two 26-foot pups.

In the mid-1960s CP Rail instituted its own piggyback trailers (Plan II) to better and more directly compete with the highway carrier for truckload traffic.

In 1979, CP Rail introduced the first domestic container program in North America. This second generation intermodal system was designed to be more competitive with trucks, whose technological advances, and increases in vehicle weights and dimensions, had made possible the entry into longer haul markets. CP Rail designed the domestic container at 44'3" in length, with a cubic capacity of 3115 feet. This allowed two things. First, the container was competitive with the 45-foot trailer, whose cubic capacity was in the order of 3150 cubic feet. Second, it allowed the loading of two containers on one flatcar: this improved the economics of CP Rail's intermodal operations, as the piggyback style of operation had only permitted one 45-foot trailer to be loaded per flatcar.

### 3.0 SCOPE OF CP RAIL INTERMODAL

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Today, through its piggyback, domestic and marine container services, CP Rail constitutes a very large commercial carrier of the intercity door-to-door movement of merchandise in Canada. Substantial investments have been made in flatcars to carry trailers and containers, in the trailers themselves for the Plan II operations, in containers for domestic operations, in the frames and wheels (chassis) to move the containers to/from the customer, and in the relatively sophisticated rail collection/distribution centres.

These investments constitute a significant component of railway costs: today CP Rail's net book investment in these kinds of assets exceeds \$100,000,000. Table 1 provides additional statistics on CP Rail Intermodal. Similar numbers are shown for Canadian Pacific Express and Transport (CPET) and two other large truck common carriers: Federal Industries and Trimac.

Table 1 - Comparisons to Others

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	CP Rail		(1)	(2)
	Intermodal	CPET	Federal	Trimac
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Trucks	-	1500	400	-
Tractors	-	1000	2400	1400
Trailers	1200	4200	5600	3100
Containers	2100	-	-	-
Railcars	3700	-	-	-
Gross Revenues (\$ Million)	350+	450+	450+	200+

- (1) Truck Fleet, November 1987 "The Top 100" - Includes Consolidated Kingsway and Canadian Motorways.  
 (2) Annual Report 1988.

Thus, the type of changes in vehicle weights and dimensions that have occurred to date would have had an impact not only on those freight carriers operating solely on highways, but also on the intermodal business sector of railways, both upon the magnitude of traffic handled by CP Rail and the manner in which it is moved.

And, highway trailer lengths continue to increase. Today interprovincial carriage can occur in 48-foot trailers. Limits are higher within the Western Provinces, and special permitting occurs within individual provinces; for example, Quebec allows twin 48-foot trailers on divided highways. Marine containers have also undergone change; the first were 20 feet long; currently 40-foot containers are popular and there is some talk about 49 and 50-foot lengths.

#### 4.0 IMPACT ON COSTS

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Frequent changes in lengths, and even weights, for highway vehicles lead to the premature obsolescence of railway flatcars. To some extent, the domestic containers are also vulnerable to early retirement. As the vehicle length grows, to 48 and potentially 53 feet, the acceptability of lower cube units shrink, forcing the acquisition of competitive units. As container sizes increase this, in turn, precipitates the secondary requirement to adjust the existing flatcar equipment to accommodate the longer containers.

Conventional intermodal flatcars are very expensive; they have a physical life of 30-odd years and need to be utilized for this length of time in order to fully recover the capital expenditure. This compares to highway trailers where seven years can represent a reasonable physical life and recovery period.

Equipment costs constitute a significant part of railway variable costs and, therefore, frequent changes in equipment specifications will lead to higher variable costs. Table 2 shows how different lives change the cost of owning a large container flatcar, the flow-through impact upon movement costs, and the resulting percentage increase in the movement costs.

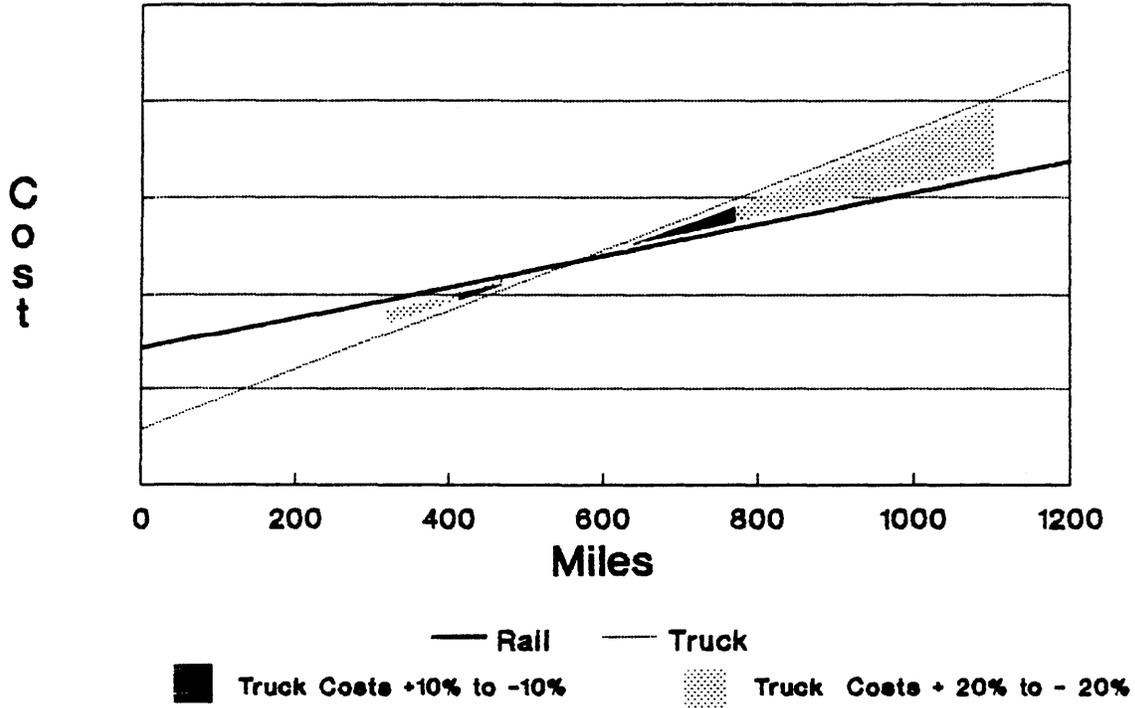
Table 2 - Change in Costs

Life	Annual Cost	Increase in Movement Cost
	\$	%
30 Years	11,000	-
20 Years	13,000	1
10 Years	18,000	5
5 Years	28,000	15

These changes, although not of enormous magnitude, in fact have a significant impact on the competitive balance that exists between trucks and the rail mode. Small changes in the cost structure of either the rail intermodal or the trucking mode greatly affect the mileage where the costs of the two modes are equal.

Figure 1 illustrates a cross-over mileage of approximately 550 miles. This cross-over mileage can easily range from a low of 400-odd miles to almost 800 miles simply by increasing or decreasing the costs of one mode by 10 percent. If twin 48-foot trailers were to replace single 48-foot trailer movements without any accompanying increase in highway user fees, the mileage of 550 would shift to well over 1,500 miles.

Figure 1 - Cross-Over Mileage



Hence, although increasing vehicle lengths may reduce truck costs, frequent change can lead to additional railway costs, subsequently altering the cross-over mileages, and ultimately yielding less modal competition.

#### 5.0 OTHER REGULATORY PRESSURES

Along with the continued liberalization of vehicle weights and dimensions, CP Rail has been subjected to changing regulatory environments.

There were two events in the United States (US) that have indirectly impacted upon CP Rail. Deregulation of both the trucking industry (Motor Carrier Act of 1980 and the Surface Transportation Assistance Act of 1982) and of the railroads (Staggers Act of 1980) led to lower US costs and a change in the nature of competition in the United States. These outcomes in turn exerted downward pressures upon the transborder traffic carried by CP Rail and also upon east-west traffic within Canada, particularly where alternate US routings were readily available.

Additional revenue and traffic erosions have occurred since the passage of the National Transportation Act, 1987. It increased rate regulation of Canadian railroads, while Bill C-19 acts to deregulate the Canadian trucking industry. The NTA imposes CLRs and provides shippers with the ability to use final offer arbitration. The former (CLRs) can be utilized by US roads to bleed traffic from Canadian routings, although Canadian railroads do not have a similar right or opportunity to divert traffic away from US routings.

The different tax regimes in Canada and the United States have been another factor. The US laws apply a lower overall business income tax rate and they also allow firms to realize tax deductions for long-lived equipment sooner than for Canadian counterparts. The resulting lower cost base for US operators represents a competitive handicap for both Canadian truck operators and CP Rail and constrains the ability to readily acquire the latest in equipment technology.

#### 6.0 MARKET SHARE SHIFTS

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At this juncture, it would be appropriate to examine the behaviour of rail market shares.

Statistics Canada maintains traffic information for both the rail and truck mode, however data for the trucking industry is not complete. Periodic changes in survey objectives make it difficult to ascertain and compare truck volumes over an extended period.

Information on private carriage is particularly elusive. Statistics are not available for the seventies to the early eighties. For the early sixties, Statistics Canada data show tonnage moved by the private sector to exceed that for the common carriers. A new survey begun in the eighties suggests private tonnage to be less than 50% of for-hire's, but this new survey does not cover those private carriers with fleet sizes under 15 vehicles.

There is another limitation to using unadjusted Statistics Canada data for modal comparisons. The data include certain types of traffic which are outside of the competitive zone where shifts between modes are plausible. Coal, grain and iron ores have traditionally been in the rail domain while distances under 100 km are truck oriented.

And, to obtain a true picture of modal changes, it is really necessary to look at a more disaggregated level than overall national results. For example, shifts within mileage bands would constitute a more appropriate analysis.

At this writing, research into the data which is available, and the adjustments that can and should be made, is still underway. But, based on the analysis to date, and on intimate knowledge of the rail business, a general shift of no less than 15% is considered to have occurred from rail to truck during the last twenty years. The shift is considerably higher for the lowest mileage ranges.

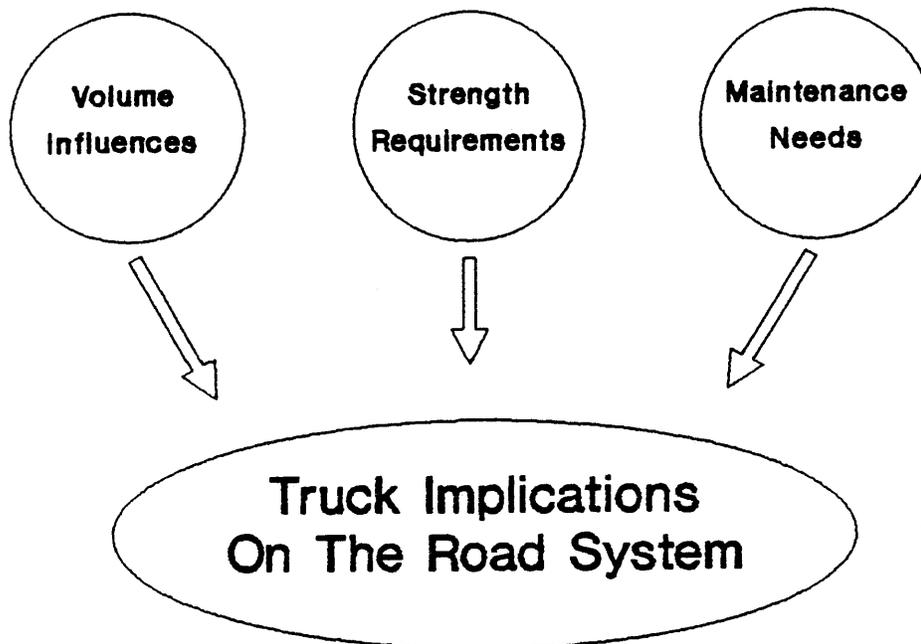
The items identified in Sections 1 through 5, along with changing economies, have had a part in determining the current market shares. Another reason is rooted in the significant growth of the national highway system which has been funded and maintained by government bodies. Shippers who utilize the truck mode benefit from the availability of these rights-of-way, whereas the rail industry (and its customers), must, of necessity, bear the full cost of owning and maintaining its infrastructure.

Yet trucks do add to highway costs; they necessitate greater capacity due to the extra volume of vehicles and to their larger size, also they lead to higher construction and maintenance costs due to the

higher axle loads that are involved with trucking operations. Figure 2 illustrates these components.

Figure 2 - Cost Components

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Some consider that truck-induced highway costs are offset by a combination of license fees and fuel taxes. But, today, fuel taxes act as general sources of revenue to governments. This second notion is consistent with Table 3 which shows the provincial and federal diesel taxes paid by truck and rail in each of the provinces in which CP Rail operates. A simple average indicates that truck taxes marginally exceed those paid by rail. This suggests that 3.4 cents per litre, or some 20 percent of truck fuel taxes, would represent an upper bound of the amount that might be considered as an offset to government expenditures on highways.

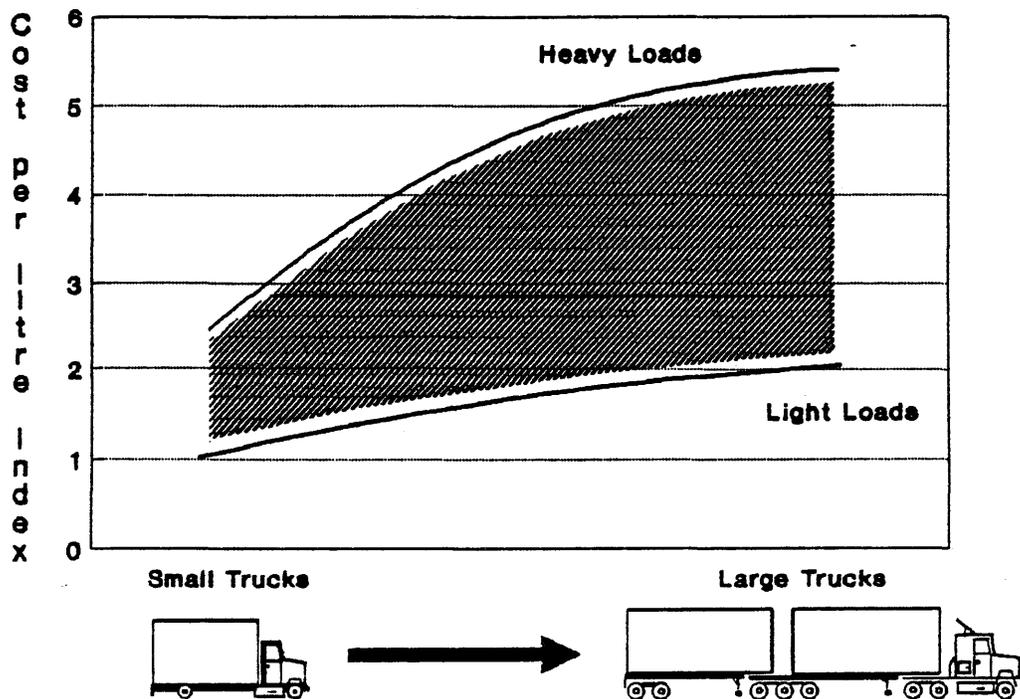
Table 3 - Taxes Levied on Diesel Fuel

Province	Cents Per Litre		
	Truck	Rail	Net
B.C.	14.8	9.0	5.8
Alta.	11.5	11.5	-
Sask.	13.5	21.5	(8.0)
Man.	16.4	20.1	(3.7)
Ont.	16.4	9.6	6.8
Que.	19.0	8.6	10.4
N.B.	17.7	10.1	7.6
N.S.	15.0	6.5	8.5
Average	15.5	12.1	3.4

Also relevant is the fact that the relationship between fuel consumption and truck-induced highway cost is not uniform for all types of trucks. As truck axle loads increase, so also do road costs but, at the same time, fuel consumption per tonne declines rapidly. Figure 3 illustrates the result of these diverging actions. It portrays the road cost/litre consumed for a light-loaded small truck at an index value of 1; this infers that some magnitude of fuel tax levy will match perfectly with the road cost incurred by a small truck. To maintain the exact match for heavy-loaded large trucks would require the tax levy to be over 5 times higher than that of the light-loaded small truck.

Figure 3 - How Road Cost and Fuel Consumption Diverge

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### 7.0 AT THE CROSSROADS

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The foregoing sections have touched on several issues impacting upon CP Rail's participation in intermodal transportation. Uncertainties are the norm, rather than the exception. Competition in the marketplace is steadily on the rise among the railways and truck transporters. This, in turn, depresses the price and the profit margin of all carriers.

At the same time, new technologies are being introduced in the equipment supply field. From an intermodal perspective, the US railways are on the leading edge in equipment designs and

applications. They have introduced both spine and double stack container cars. Some designs, of both of these equipment types, allow for the handling of containers and trailers on the same unit. Both have multi-platform capabilities which reduce unit handling costs.

Roadrailleurs have also been introduced in the US to allow the railways to compete again in the service sensitive shorthaul marketplace. Since they command cabooseless operations due to their structural design, the recent agreement reached between CP Rail and its operating union, will hopefully permit these type of operations in Canada.

Technological advances are also being made in the intermodal facilities area. New top loaders and new facility designs will improve the cost efficiencies of handling individual containers and trailers, while also improving the service level to the customer.

All of these technological advances are welcome within a rail industry that requires these efficiencies to remain competitive in an aggressive marketplace. These technological initiatives are expensive so they will require significant capital investments. For example, a spine or double stack car costs in the neighbourhood of \$200,000.

Today, CP Rail is reflecting upon its intermodal business and examining the investments to be made in the future if it is to continue in this business sector. To finance these kinds of expenditures there has to be an assurance that the money will be recovered at a significant enough rate to warrant the investment. That recovery is critically dependent upon two things: that the volume and price will meet forecast levels, and that the vehicle will endure a sufficient economic life. In the current environment, neither of these may be achievable.

It is now critical for policymakers to also reflect upon the long-term direction that transportation is heading. Today's policies are fragmented among various levels of government, they lead to more expenditures for roads, billion-dollar demands upon government funds,

a diversion of traffic from the railways, a subsequent loss of rail service through line closures, and carry the unseen influence of discouraging reinvestment in intermodal equipment. These conditions may not necessarily be in the long-term interests of transportation efficiency, shippers, or society in general.

## 8.0 CONCLUSIONS

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What do the above trends and information suggest?

One is that CP Rail Intermodal is not isolated or insulated from changes to vehicle weights and dimensions. They can lead to higher costs since equipment investments will need to be recovered over a smaller volume. This will cause modal competition to diminish as the competitive balance is quite sensitive to cost changes. It would therefore be wise to also incorporate the impact upon railway equipment into the decision-making process.

A second is that the policies of numerous government bodies significantly affect the transportation marketplace. A greater integration and alignment of highway, tax, environment, and user pay policies of the varied jurisdictions is needed if modern transportation systems are to be delivered at the lowest cost to governments and society. CP Rail Intermodal can be an active participant but, in the end, it is simply an interface between the suppliers of investment funds and the condition of the marketplace as created by governments and shippers.

Third, the time to act is now; major investment decisions are on the horizon.

# **WORKSHOP 4 – HIGHWAY SAFETY AND HEAVY VEHICLE ACCIDENTS**

Chairman: John Edgar, Land Transport, New Zealand

## **Presentation**

1. **Safety Experience of Large Trucks – An Analysis of Sample Size Requirements**  
G. Sparks, University of Saskatchewan

## **OPEN DISCUSSION**

