Transport Canada

Final Report

Estimation of Unit Costs of Rail Transportation in Canada

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in association with
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and
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1. INTRODUCTION

This study has been carried out as part of the Full Cost Investigation (FCI) initiated by Transport Canada in collaboration with Provincial and Territorial transportation departments. The FCI is intended to estimate the total financial and social costs of transport by all of the major modes for the movement of both passengers and freight. The purpose is to reveal the total amounts of resources consumed by transport and the impacts on the environment and social well being of Canadians.

The FCI is being conducted over five phases, commencing with the estimation of annual financial costs at the national level (Phase 1) before shifting focus to determine the social costs (Phase 4) and marginal costs (Phase 5) for the major modes of transport.

1.1 STUDY OBJECTIVES AND SCOPE

The primary objective of this study is to provide estimates of the marginal unit operating costs of rail activity in Canada, and is part of the Phase 5 work that is to estimate the marginal costs of all transportation in Canada by mode and type of vehicle/service. As an additional objective, the rail unit cost estimates provided by this study may be used to contribute to developing the Phase 3 estimates of the FCI, the focus of which is the allocation of the total financial costs and revenues to the various passenger and freight modes.

This study develops estimates of both the marginal and average total costs of freight and passenger rail operations in Canada for a selected number of corridors. For freight operations, the study provides estimates of the marginal and average costs per freight train and per tonne-kilometre for thirteen major domestic freight rail routes for selected commodities. For passenger operations, the study provides estimates of the marginal and average costs per train trip and seat/passenger-kilometre for five major inter-city domestic passenger routes[1].

The study is to provide for the distinction of costs by type (e.g., labour, fuel). Also, in the case of passenger operations, the study considers the sensitivity of unit costs to different load factors. The sensitivity analysis, however, has relevance principally for unit costs measured on a per passenger-kilometre basis.

It should be noted that the average total costs or fully allocated costs as developed in this study represent only financial costs and thus exclude social costs.

The methodology used and the cost estimates developed in this study are strictly for the purposes described in the preceding paragraphs and should not be used or relied upon for

[1] Commuter rail and light rail operations, which essentially serve urban markets, are not part of the present study

any other purpose including for the purpose of assessing the cost of specific movement of traffic or for establishing range of prices for such movements.

1.2 GENERAL STUDY APPROACH

1.2.1 Rail costing concepts

The marginal costs of railway operations are the financial costs that will vary with changes in traffic volume, including amounts for depreciation and return on investment, and are considered in this study to be the same as "long run variable costs" as defined in *Reasons for Order No. R-6313 concerning Costs Regulations* published by the Railway Transport Committee of the Canadian Transport Commission on August 5, 1969. These variable costs are long run in nature, reflecting a time period to allow for all adjustments to plant and equipment necessary to accommodate changes in traffic volume. For purposes of this study, a change in traffic volume is considered to be the addition or deletion of a complete freight train or passenger service. Further, in keeping with the FCI, the costs for depreciation and return on capital will be based on the current value of assets as of the year 2000, rather than using the historic cost base as applied in traditional railway costing under R-6313.

The average costs are the estimation of unit costs on a fully allocated cost basis. The fully allocated costs for a given train or service are the long run variable costs that are assignable to the train or service plus *the allocated* portion of the fixed costs that are shared with other rail traffic movements.

1.2.2 Selection of railway corridors

The selection of passenger services and freight routes/commodities was based primarily on their relevance for inter-modal comparisons within the context of the FCI investigation. The final selection was carried out in consultation with the Project Steering Committee.

1.2.2.1 Railway freight corridors

Exhibit 1 presents the thirteen[2] rail freight corridors that were selected for the purposes of this study. Routes and commodities were selected according to where the greatest competition exists from other surface modes (trucking) and marine modes (such as St. Lawrence Seaway traffic). The corridors also reflect significant traffic volume for the commodities in question, and regional representation across the country. The selected corridors are operated by one of Canada's two Class 1 freight railways, either Canadian National (CN) or Canadian Pacific Railway (CPR). The study was assisted by the fact that

[2] There are actually fourteen because the Vancouver-Toronto corridor was costed out for each of the CN and CPR routes. Thus, 7 routes are costed out for each freight railway.

more specific expense and operating data are available in the public domain for these two railways.

EXHIBIT 1
Freight Corridors and Commodities

	Origin-Destination	Commodity and Railway	Criteria
1	Montreal-Toronto	Marine containers (CPR)	High volume, truck competitive
			Eastern Canada
2	Montreal-Toronto	Domestic containers/trailers (CPR	Truck competitive, Eastern Canada
		Expressway)	
3	Halifax-Toronto	Marine containers (CN)	High volume, Atlantic Canada
4	Montreal-Detroit	Marine containers (CPR)	High volume, truck competitive
			Eastern Canada
5	Vancouver-Toronto	Marine containers (CPR and CN)	High volume, West to East
6	Levis-Montreal	Petroleum products (CN)	High volume, marine competitive
			Eastern Canada
7	Windsor-Toronto	Salt (CN)	Seasonally marine competitive
			Eastern Canada
8	Thunder Bay-Quebec	Grain (CPR)	Significant volume, marine competitive
	City		Eastern Canada
9	Moncton-Toronto	Domestic intermodal (CN)	Significant volume, truck competitive
			Atlantic Canada
10	Saskatoon-Vancouver	Grain (CN)	Significant volume, Western Canada
11	Brandon-Thunder Bay	Grain (CPR)	Significant volume, Western Canada
12	Prince George-White	Lumber (CN)	Significant volume, truck competitive
	Rock		Western Canada
13	Quebec City-Delson	Lumber (CPR)	Significant volume, truck competitive
			Eastern Canada

1.2.2.2 Railway passenger corridors

Exhibit 2 presents the rail passenger corridors that were selected for development of the cost estimates. In the case of passenger operations, the routes were selected primarily to be representative of those in which the rail passenger mode is subject to the greatest degree of competition from other surface modes (such as intercity bus and private passenger vehicle) as well as from air passenger carriers. As with freight, there were also regional considerations involved in the selection. The rail passenger corridors are all operated by VIA Rail Canada Inc., Canada's intercity rail passenger provider.

EXHIBIT 2
Rail Passenger Corridors

	Origin-Destination	**Railway**	**Criteria**
1	Ottawa-Montreal	VIA Rail on CN tracks	Bus, automobile competitive
2	Montreal-Toronto	VIA Rail on CN tracks	Bus, automobile, air competitive
3	Moncton-Montreal	VIA Rail on CN tracks	Air, bus competitive
4	Winnipeg-Churchill	VIA Rail on CN and Hudson	Remote service, air competitive
		Bay Railway tracks	
5	Edmonton-Vancouver	VIA Rail on CN tracks	Bus, air, automobile competitive

1.3 REPORT CONTENTS

The next two chapters, Chapters 2 and 3, describe in more detail the rail costing methodology and important related issues. Chapters 4 and 5 present, respectively, the rail freight and passenger unit costs that have been calculated for each of the selected freight corridors/commodities and passenger services.

2. RAIL COSTING METHODOLOGY

This chapter presents the major guiding economic principles and philosophy behind the rail costing methodology employed by the Consultants in this study.

2.1 HISTORICAL CONTEXT

Railway costing in Canada became a highly scrutinized and sophisticated subject due in large part to the deliberations of the MacPherson Royal Commission commencing in 1959. The Royal Commission's investigation into problems facing the Canadian transportation system placed a heavy emphasis on costs and costing methods. The recommendations of the Royal Commission's Report in 1962 included the suggestion to adopt a variable costing system (as already in use by Canadian railways). It also advocated greater competitive freedom for transportation carriers, particularly in rate setting. This led to unprecedented demand for cost information, not only by railway management for internal requirements (e.g., profitability analysis) but also by external public agencies for subsidy and regulatory purposes.

The report of the MacPherson Commission led to the creation of the 1967 *National Transportation Act* (NTA) that encouraged an "economic, efficient and adequate transportation system…". It also created the Railway Transport Committee (RTC) of the Canadian Transport Commission (CTC). The RTC was charged with the responsibility for identifying factors relevant to the determination of costs for any purpose of the NTA. These included the determination of subsidies for the provision of uneconomic rail services (e.g., branch lines, passenger train services) and minimum/maximum rate cases. One of the duties of the RTC was to determine which railway costs were in fact variable with traffic. To carry out this responsibility, the RTC held a Cost Inquiry that resulted in the issuance of *Reasons for Order No. R-6313 concerning Costs Regulations* on August 5, 1969. In addition, the railways were ordered by RTC *Order No. R-6314* to develop Costing Manuals that must be confirmed by the RTC including any modifications to them. These Manuals described the methodology used by the railways in the development of each cost component. They incorporated a certain amount of flexibility necessary for each of the railways (CN and the CPR) but at the same time promoted uniformity in railway costing to the extent possible.

2.2 VARIABLE COST CONCEPT

The official definition of variable costs as per *Reasons for Order No. R-6313* is:

> *"Variable cost may be defined as the long-run marginal cost of output, being the cost of producing a permanent and quantitatively small change in the traffic flow of output, when all resource inputs are optimally adjusted to change."*

In this study, the Consultants have determined variable or marginal costs (the two terms are used interchangeably) such that they may be considered the same as the costs that are normally understood in the rail industry as "long run variable costs." In keeping with the official definition, these variable costs are long run, reflecting a time period sufficiently long to allow for all adjustments to plant and equipment necessary to accommodate changes in traffic volume.

It should be noted that *Reasons for Order No. R-6313* also recognized short-run variable costs defined as follows:

> *"Variable cost may in special cases be considered as the short-run marginal cost of output, being the cost incurred for the movement of specific non –recurring traffic over a limited period of time."*

The subsequent Railway Costing Regulations also introduced the concept of "avoidable costs" that were to apply for the subsidization of passenger train services or branch lines at the time. The definition in relation to a passenger train service was:

> *"Costs" in relation to a passenger-train service means those costs, for purposes of calculating actual loss, which, allowing a reasonable period of time for adjustment to the new condition, would have been avoided or would be avoided in the carriage of passengers by the service if, in any financial year a company did not operate the service irrespective of when, or in what manner, or by whom such costs were incurred."*

The avoidable cost concept can be considered more narrow in definition than the variable cost concept and was presented in a more sunk cost/abandonment context. It led to considerable debate in later years between VIA Rail and the freight railways over the appropriate definition and calculation of costs that should be charged to VIA Rail by the freight railways for the use of infrastructure and services provided. However, the matter was never resolved and the two terms, avoidable and variable costs became interchangeable over time.

The variable cost concept formed the basis for rail costing in Canada. The notion has continued to be used in succeeding federal transportation legislation (*National Transportation Act,* 1987; *Canada Transportation Act,* 1996). However, with the recent trend towards much greater reliance on market forces by government instead of regulation to promote economic efficiency along with the resultant elimination of most rail subsidies, the need to determine variable costs has only very limited application today in the public domain.

Revenues generated in excess of variable cost were considered to be contributing towards fixed costs and profits. There was never any attempt to determine or define "average costs," which for purposes of this study are defined to be the unit costs of rail operations determined on a "fully allocated basis." The fully allocated costs for a given transportation movement such as a freight movement or passenger trip are determined by assigning to that movement the costs that are attributable to it, plus a fraction of those fixed costs that it shares with other movements or traffic types. Fully allocated costs are therefore the sum of long run variable costs or marginal costs, which can be attributed to individual traffic movements, and the allocated portion of the shared fixed costs.[3]

2.3 CHALLENGES OF RAIL COSTING

The costing of transporting particular commodities by a freight railway or passenger movements by a passenger railway between specific origin and destination points is complicated by a variety of factors as discussed below.

1. <u>The complexities and scale of railway operations.</u>

   Railway operations on the scale of CN or CPR incorporate a number of functions. These include:

   - The basic functions to assemble and move trains including major yard operations (switching operations to assemble/disassemble trains), line haul operations (crewing, fuel), and train control (signals and dispatching). In the case of VIA Rail, this involves the operation of passenger trains between passenger stations. Since VIA Rail operates over freight railway tracks, train control is the responsibility of the freight railway, which then charges back to VIA Rail a fee for use of the right-of-way, track and any associated services (e.g., train control).

   - The maintenance and replacement of way and structures or the fixed plant that includes track, roadway, buildings, bridges and signals. These activities normally fall under the responsibility of the "engineering" department of the freight railways.

   - The maintenance and servicing of railway rolling stock including locomotives, freight cars or passenger cars. These activities are carried out under the responsibility of the "mechanical" department at specific line point facilities or at main shops in the case of major overhauls.

[3] A frequent problem in costing transportation services is how to allocate shared costs (e.g. the construction and maintenance costs of highways that are shared by private automobiles, trucks and other road vehicles). Whereas nonshared costs can be readily assigned or traced to a particular shipment, passenger or service, shared costs cannot. Shared costs and nonshared costs, it may also be noted, can be either variable or fixed, i.e. they can either vary with the level of the particular transportation service or not. Typically, the shared fixed costs that cannot be traced to particular services are grouped together as an "overhead," divided on some basis such as workload or usage among the various services, and added to the nonshared costs to create a fully allocated or fully distributed cost for the service.

- In the case of VIA Rail, on-train and off-train passenger services including on-board food and beverage services, baggage services and passenger station services (e.g., ticketing and reservations).

- The overall administrative functions of the railway including finance, marketing, information systems, legal and human resources that are found in most companies.

It requires the application of very complex information and costing systems to attribute the costs associated with each of these functions to individual traffic or car movements.

2. <u>The high degree of common or joint costs</u>

   Common or joint costs are costs shared between various kinds of traffic. It is evident from the brief description of railway functions above that the vast majority of railway costs incurred are shared among traffic types if moving in combination on the same trains and over the same track.

3. <u>Cost of Capital</u>

   Railways are a capital-intensive mode of transport due mainly to the fact that they own their roadbed and infrastructure and also utilize expensive rolling stock. There is a cost to the capital that is tied up in the fixed plant and equipment. This has led to a great deal of investigation and research into the measurement and application of the cost of capital that should be attributed to particular services. The cost of capital is made up of a number of components. These include the make-up of the capital structure (e.g., debt, equity), the costs associated to raise this capital (e.g., interest rates, cost of common shares), and the rate of income tax (since dividends are paid with after tax retained income). In the end, the notion of "opportunity cost" is employed for these already sunk assets.

4. <u>Cost causality and variability</u>

   For some elements of railway costs, the causality relationship is anything but clear and provable. Secondly, even if established, the causality relationship may not be 100% variable with traffic volume. This requires the development of cost functions in these cases, and will be discussed in more detail in the next section.

2.4 COST ANALYSIS METHODS

In general, there are four methods that have been used in the determination of the variable costs for any rail traffic movement.

1. "<u>Specific costing" or costing by "direct assignment</u>"

   This method is used when a specific cost can be identified where internal company records are available that would enable the cost to be attributed to a train service. It means that the cost is 100% variable with that service. A prime example is dedicated unit trains (e.g., coal). Many of the costs are specific to that service including crew wages and car costs. VIA Rail has also been able to determine a significant amount of cost that can be directly attributable to specific passenger train services.

2. "Direct analysis"

   Direct analysis is employed when the cost variability of an expense grouping is already known (usually 100%) as well as knowing what the logical cost driver is. In this case, internal company records do not permit the cost(s) to be attributed specifically to a particular train service (or the records are not available in the public domain). For example, locomotive fuel costs can be assigned using locomotive unit miles as the cost driver to develop a system-wide unit cost. Similarly, yard diesel fuel costs can be assigned using yard diesel unit miles. By knowing the number of yard diesel unit miles required for a particular train and yard, the yard diesel fuel costs can be determined.

3. Regression analysis

   When the variability and cost causality relationships have to be determined, regression analysis is used. Statistical cost functions are developed based on regression methods to determine the "best fit" of the relationship between the dependent variable (i.e., the cost element) and the one or more independent variables. Using a geographic cross section of operations for activities such as roadway maintenance or signal maintenance, simple or multiple regression cost coefficients have been developed. A constant term is usually specified as part of the cost function indicating that the cost element is not 100% variable with traffic volume or output.

4. Designated fixed costs

   The costing inquiry that lead to *Reasons for Order No. R-6313* concluded that certain costs are not variable with traffic volume. These include the cost of capital on land and the maintenance, depreciation and cost of capital on tunnels, bridges and culverts. Thus, there is no need to conduct any variability analysis on these cost elements. However, they must be separately identified and included in any determination of fully allocated costs.

2.5 DETERMINATION OF VARIABLE COSTS OF A TRAFFIC MOVEMENT

Based on the costing methods described above, the variable or marginal costs of any traffic movement can be determined. "Specific costing" or costing by "direct assignment" is used when costs are 100% variable with traffic and the expenses can be directly related to the movement being costed. The unit costs calculated by "direct analysis" or regression analyses are used when specific costs cannot be determined. Costing in this case is carried out by determining the various physical service or work units associated with producing a particular movement of traffic, and then multiplying these service units by their respective unit costs. The long-term variable costs of a traffic movement are then determined by adding together the various costs determined by direct assignment and the products of the different service units multiplied by their individual unit costs.

The estimation of rail unit costs by an external third party, such as that called for by the present study, requires on the part of the Consultant a thorough understanding of the Railway Costing Manuals, the review of published reports dealing with railway costing (e.g., the Snavely Commission on Grain Transportation in the early 1980's), and knowledge of the railway costing and statistical data available in the public domain as produced by Statistics Canada.[4] Computerized rail cost models have been developed by members of the Consultant group based on such research and knowledge and have been accessed to carry out this study. These models replicate in more general terms the costing relationships between the dependent variables (i.e., the cost elements) and the independent variables (i.e., the work units), and provide estimates of the degree to which the cost elements vary with the relevant work units in the form of variability percentages. Overhead or indirect costs can also be estimated and assigned to the cost elements based on the models.

2.6 SUMMARY

The costing methodology for railways in Canada has been the subject of extensive research, development and scrutiny over the years, much more than for any of the other modes of transport. In conducting this study, the Consultants have drawn upon this knowledge and their experience in this area, and have based the work of estimating the unit costs of rail transportation on the same principles and approaches that have become accepted and used by the railway industry and its government regulators.

[4] Statistics Canada, Rail In Canada , Catalogue no. 52-216-XIB

3. COSTING ISSUES OF THE FULL COST INVESTIGATION

The Full Cost Investigation (FCI) is applying across all the modes of transport, standardized approaches or methods to certain costing issues. This required the Consultants to modify their use of the generally accepted railway costing practices in two key areas: (1) the valuation of assets at the FCI base year of 2000; and (2) the use of pre-assigned FCI cost of capital rates to the depreciated value of assets as at the year 2000.

3.1 CURRENT VALUATION OF ASSETS

Railway costing methodology as outlined in the previous chapter employs historic or original costs to determine depreciation costs and the return on capital of assets. Through its research efforts, the FCI project has decided that the base year for both operating and capital cost determination will be the year 2000. Thus the operating, depreciation and return on capital unit costs of the CANARAIL cost model were calibrated to the year 2000. VIA Rail also supplied its operating and capital data for the same year where possible.

3.1.1 Depreciation and net book value

Although railway operating and capital costs are available for the year 2000 in the public domain, depreciation charges and the net book value of assets reflect historic costs. To calculate the current value of historical capital expenditures (less depreciation), the perpetual inventory method was applied to capital expenditure data (excluding land expenditures) extracted from historical rail capital expenditures collected by Transport Canada. For depreciation, the asset lives were set at 30 years for railway equipment or rolling stock and 50 years for roadway and structures[5]. These asset lives are in line with the guidelines established under the Uniform Classification of Accounts for Railways as well as general industry practice.

The resultant adjustment factors that were applied to the railway equipment and roadway and structures (excluding land) asset categories for each of the Class 1 railways are presented in Exhibit 3.

EXHIBIT 3
Capital Adjustment Factors

Asset Category	**CN**	**CPR**	**VIA Rail**
Equipment	1.0222	1.0135	1.3278
Roadway & Structures	1.3658	1.3327	1.4368

[5] Transport Canada Economic Analysis Directorate, *Preliminary Estimates of the Financial Costs and Revenues of Rail Transportation in Canada in 2000*, May 18, 2005.

3.1.2 Valuation of land

The valuation of land for the rail corridors was provided by Transport Canada. It was based on a research report conducted for the FCI.[6] This report provided unit values for three geographic categories: (1) Major Urban Centres (Census Metropolitan Areas or CMAs); (2) Non-CMA Urban (smaller urban areas); and (3) Rural (areas not considered urban).

The specific rail corridors were mapped based on Transport Canada's access to confidential railway traffic flow data. The unit values were then applied to the corridors based on the categorization of the land occupied by the rail infrastructure within each of the corridors. Land area was calculated by assuming that the rail corridors had an average width of 100 feet. This width was felt to be the most representative based on consultations with railway engineers. The Consultants were provided access to the base data and were reasonably satisfied that every effort had been made to estimate the value of rail land as accurately as possible for the defined corridors.

The land valuation results are presented in Exhibit 4 for both the gross value of rail land and the net value of rail land. The gross land values represent the "over the fence" or the market valuation of land adjoining the corridors. The net land values represent the gross land value netted of conversion and development costs that would have to be incurred if it was to be used in an alternative use. The FCI project team decided that the net land values would be employed for the purposes of this study.

[6] Litman, T., Weisbroad, G., and Woudsma, C., *A Report on the Estimation of Unit Values of Land Occupied by Transportation Infrastructures in Canada*, June 7, 2006

EXHIBIT 4
Rail Corridor Land Valuation

Railway	Corridor	Gross Land Value	Net Land Value
CN	Halifax-Toronto	$1,215,115,830	$271,426,034
	Levis-Montreal	$134,175,015	$31,227,543
	Windsor-Toronto	$734,043,059	$167,891,361
	Moncton-Toronto	$1,079,665,780	$243,294,705
	Prince George-White Rock	$363,129,381	$88,366,488
	Saskatoon-Vancouver	$664,075,052	$150,275,725
	Vancouver-Toronto	$1,555,864,310	$346,991,754
CPR	Brandon-Thunder Bay	$134,841,719	$28,341,423
	Montreal-Toronto	$737,365,166	$163,743,937
	Montreal-Windsor	$1,449,481,139	$318,595,220
	Thunder Bay-Quebec City	$445,590,747	$97,404,371
	Trois Rivieres-Delson	$164,291,683	$37,980,662
	Vancouver-Toronto	$1,615,490,365	$359,912,198
VIA	Edmonton-Vancouver	$686,926,891	$154,613,173
	Moncton-Montreal	$222,416,084	$49,808,128
	Montreal-Toronto	$573,128,422	$123,459,589
	Ottawa-Montreal	$153,519,361	$33,276,104
	Winnipeg-Churchill	$62,099,269	$13,862,592

To allocate the discounted land values to the specific train services, a net land value per gross tonne mile (GTM) coefficient was developed based on the total GTMs supplied by Transport Canada for each of the corridors in question.[7] These coefficients were then applied to the GTMs generated by the specific freight or passenger train service being costed. The specified cost of capital rate (see next section) was then applied to the land cost that had been allocated to the train service. Since land is considered a fixed cost, these results were only included in the fully allocated cost results.

It should be pointed out that the rail land values along the specified rail corridors have excluded an allocated portion of the land values of major rail yards located within the CMAs. However due to the unavailability of appropriate rail output statistics (e.g., yard switching minutes) for individual rail yards, rail yard values could not be allocated to the defined train services. Therefore, the fully allocated cost results may be slightly under-estimated in this study.

[7] These corridor GTM data are confidential.

3.2 COST OF CAPITAL

Under the railway costing methodology outlined in the previous chapter, individual cost of capital rates for each of the railways are developed and approved, using methods that follow practices employed in the private sector and take into account the firm's capital structure, costs of debt, equity and other sources of capital, associated risks, etc. For the FCI, a "social opportunity cost of capital" has been developed based on a research report prepared for the FCI that would apply across all modes.[8] Two rates have been developed: (1) 8.6% for high risk assets; and, (2) 6.0% for low risk assets. The general implications are that there are substantial differences in risk among transport assets and that these should be taken into account in the FCI. Both these cost of capital rates were applied in the present study to calculate the variable and fully allocated costs for each of the freight and passenger train services selected for analysis.

3.3 TAXES AND SUBSIDIES

The FCI is concerned with transport costs from the perspective of the economy as a whole. In this context, taxes and subsidies should be excluded, as these are transfer payments and not economic costs. Unlike economic costs such as wages that are payments for the use of resources consumed in producing transport services, taxes and subsidies are transfers that only shift control over resources from one societal group to another. With this in mind, the Project Steering Committee has requested for this particular study that one of the activity-specific taxes, namely fuel taxes, be identified in the costing exercise. Thus, an analysis was carried out to estimate the percentage that fuel taxes represent of both the marginal and fully allocated rail cost results as determined in this study.

[8] Brean D., Burgess D., Hirshhorn R., and Schulman, J., *Treatment of Private and Public Charges for Capital in a "Full-Cost Accounting" of Transportation*, March 31, 2005.

4. RAIL FREIGHT COSTS

As noted in Chapter 1, the present study required the development of costs for fourteen different freight corridor/commodity combinations. The cost results for each of CN and the CPR are separately presented for their respective seven freight corridors below.

4.1 GENERAL APPROACH AND ASSUMPTIONS

In terms of the four types of cost analysis methods enumerated and described in Section 2.4 above, the application of specific costs requires access to confidential railway data. In this study, none of the elements of freight costs have been determined by specific costing. Instead, all rail freight cost elements have been determined using the CANARAIL costing model that runs entirely on unit costs. Appendix A provides a brief overview of the model.

CANARAIL's model is divided into two main modules: unit cost development and unit cost application.

In preparing for the present assignment, the unit cost development module was reviewed and updated. A major concern was that the percent variabilities for track and roadway costs were out of date. These were originally developed from data placed in the public domain in the early 1980s. Such data has not been available since then. In the interim, there have been a number of changes in railway operations, which might put variabilities developed in this way in question. The most important such change is the concentration of traffic on CN's and CPR's main lines, as these two railways shed much of their light-density track through sale and abandonment. This would tend to raise the percent variability. This was dealt with as follows. The old coefficients were used to allocate the new (i.e., for the year 2000) total track and roadway costs into three components: fixed, line-haul related and switching related. These components, in turn, were divided by the corresponding operating statistics to generate new coefficients for track and roadway costs.

Other changes were made to the unit cost development module and to the resulting unit cost "decks" in order to accommodate the particular needs of the present study:

- Costs for CN and CPR freight cars were broken out into maintenance and capital items;
- Investment costs (depreciation and net book value) were increased to the year 2000 using the factors presented in the previous chapter;
- A second version of the main unit cost development file was produced, with all the percent variabilities set to 100% in order to accommodate the need to produce fully-allocated as well as variable costs.

The CANARAIL model can run on a minimal set of input data. The model supplies system-average default values for many aspects of rail operations. In the present case, the data supplied by CN and the CPR allowed us to over-ride many of the default values, thereby ensuring a more accurate estimation.

The model is oriented to producing costs for a single shipment by: 1) total cost for the shipment; 2) cost per carload (for multi-car shipments); and, 3) cost per net tonne-kilometre.

In the present instance, costs per train were also required. These were obtained by multiplying the per-carload costs by the ratio of gross trailing tons for the train (loaded direction) to the car-specific gross tons (shipment weight plus tare weight of the car plus, in the case of intermodal movements, tare weight of the container). In effect, costs were developed as if all shipments moved on unit or solid trains dedicated to the types of traffic under study.

The railways were requested to supply specific operating statistics for their trains in the designated corridors. Specific trains and routings within the corridor were selected that carried the majority of the commodity in question.

As directed by the FCI project team, cost of capital rates of 6.0 % and 8.6 % were employed by the model to test the impacts of these rates on the costing results. An estimate of the percentage of rail costs (both for marginal and fully allocated costs) that are accounted for by fuel taxes was also determined.

4.2 CN COST RESULTS

The train operating statistics supplied by CN for each of the seven corridors are presented in the next section. These statistics along with other cost assumptions (e.g. cost of capital rate) were then fed into the cost model to produce the cost results presented in the subsequent section.

4.2.1 Train Operating Statistics

Exhibit 5 presents the train operating statistics provided by CN for each of its seven corridors that were used to calculate the pertinent costs. All these movements involve CN trains except for the last 35 miles of the Prince George-White Rock movement from Vancouver to White Rock. This portion of the movement is in fact operated by the Burlington Northern Santa Fe Railroad but has been assumed for the purposes of this study to be operated by CN trains with the same operating characteristics as the previous 678 miles.

It should be noted that CN measures the empty return ratio for its equipment based on the distance traveled empty by the car prior to being loaded with the commodity in question.

Thus, depending upon the origin of the empty car, the empty return ratio can be greater than 100% for the movement being costed.

EXHIBIT 5
CN Train Operating Statistics

	CN Corridor						
	A	B	C	D	E	F	G
Origin	Halifax	Moncton	Vancouver	Levis	Windsor	Saskatoon	Prince George
Destination	Toronto	Toronto	Toronto	Montreal	Leaside (Toronto)	North Vancouver	White Rock
Commodity	Marine Container	Domestic Container	Marine Container	Petroleum Products	Salt	Grain	Lumber
One-way distance (kms)	1761	1463	4451	266	415	1719	1147
Type of train	Express	Express	Express	Unit	Thru	Unit	Thru
Avg. gross trailing tonnes[1]/train	5986	5986	5079	7052	4521	10816	10793
Return	5496	5496	4989	2104	4154	2866	3537
Avg. number of locomotives/train	3	3	2	2	2.3	1.7	2.5
Horsepower per train	11800	11800	8300	8620	8540	8040	9720
Return	12600	12600	8300	8620	8470	5560	9550
Rail Car Type	Multi-Flat	Multi- Flat	Multi-Flat	Tank Car	Covered Hopper	Covered Hopper	Centre Beam Flat
Tare Weight of Car (Tonnes[1])	64	55	79	34	30	27	29
Content Weight of Car and containers (Tonnes[1])	152	62	111	79	88	83	83
Empty Return Ratio (%)	4%	5%	4%	106%	16%	103%	100%
Car Turnaround Time (days)	6	4	12	2	10	13	12
Train Switching (2)-Minutes per car	-	-	-	1.3[(2)]	-	-	-
Yard Switching [(3)]-Minutes per car	26	11	14	-	30	33	36

NOTES:
(1) Tonne = Metric ton
(2) Train switching is with 2 locomotives
(3) Yard switching is usually with 1 locomotive and 1 slug

4.2.2 Cost Results

The resulting variable and fully allocated costs for the seven CN movements at both the 6.0% and 8.6% cost of capital rates are presented in Exhibit 6. The fully allocated costs are presented with and without the land costs to demonstrate the impact of the land costs on the costing results.

EXHIBIT 6
CN Freight Corridor Cost Results

	Costs per Carload		Costs per Tonne-Km		Costs per Train	
Cost of Capital Rate	***6.0%***	***8.6%***	***6.0%***	***8.6%***	***6.0%***	***8.6%***
Corridor (commodity)						
Halifax-Toronto (Marine containers)						
Marginal Costs	$2,368.20	$2,519.58	$0.0089	$0.0094	$65,672.75	$69,870.75
Fully Allocated Costs	$3,161.85	$3,413.06	$0.0119	$0.0128	$87,681.61	$94,647.94
Fully Allocated Costs (land)	$3,286.66	$3,591.95	$0.0124	$0.0135	$91,142.68	$99,608.81
Moncton-Toronto (Domestic Containers)						
Marginal Costs	$1,130.90	$1,201.88	$0.0125	$0.0133	$57,860.04	$61,491.64
Fully Allocated Costs	$1,539.44	$1,655.90	$0.0171	$0.0184	$78,762.24	$84,720.23
Fully Allocated Costs (land)	$1,594.25	$1,734.46	$0.0177	$0.0193	$81,566.53	$88,739.71
Vancouver-Toronto (Marine containers)						
Marginal Costs	$5,054.49	$5,372.78	$0.0103	$0.0109	$135,431.29	$143,959.66
Fully Allocated Costs	$6,728.31	$7,270.69	$0.0137	$0.0148	$180,280.12	$194,812.67
Fully Allocated Costs (land)	$6,838.37	$7,428.45	$0.0139	$0.0151	$183,229.23	$199,039.73
Lévis-Montréal (Petroleum Products)						
Marginal Costs	$295.85	$312.68	$0.0141	$0.0149	$18,550.01	$19,605.67
Fully Allocated Costs	$456.25	$483.45	$0.0218	$0.0231	$28,607.84	$30,313.09
Fully Allocated Costs (land)	$466.97	$498.81	$0.0223	$0.0238	$29,279.82	$31,276.27
Windsor-Toronto (Salt)						
Marginal Costs	$601.12	$634.59	$0.0165	$0.0174	$23,050.62	$24,333.95
Fully Allocated Costs	$792.34	$839.69	$0.0217	$0.0230	$30,383.20	$32,198.88
Fully Allocated Costs (land)	$851.13	$923.95	$0.0233	$0.0253	$32,637.63	$35,430.23
Saskatoon-North Vancouver (Grain)						
Marginal Costs	$1,608.78	$1,707.02	$0.0113	$0.0120	$158,550.89	$168,233.37
Fully Allocated Costs	$2,128.49	$2,288.03	$0.0150	$0.0161	$209,770.36	$225,494.25
Fully Allocated Costs (land)	$2,154.93	$2,325.93	$0.0152	$0.0164	$212,376.59	$229,229.85
Prince George-White Rock (Lumber)						
Marginal Costs	$1,209.21	$1,282.75	$0.0126	$0.0134	$116,045.03	$123,102.45
Fully Allocated Costs	$1,595.06	$1,710.69	$0.0167	$0.0179	$153,074.68	$164,170.98
Fully Allocated Costs (land)	$1,619.21	$1,745.30	$0.0170	$0.0183	$155,391.96	$167,492.42

Appendix B provides a detailed breakdown of the above cost results for both the marginal costs and the fully allocated costs excluding land. The land costs were calculated outside of the model according to the methodology described in Chapter 3 of the report. A sample of the results for a cost run is presented in Exhibit 7 below. These results represent the fully allocated costs (excluding land) for the Prince George to White Rock corridor for the movement of lumber at an 8.6% cost of capital rate.

EXHIBIT 7
Sample Cost Run Results-Prince George to White Rock (Lumber)

Operating Costs	Direct	Indirect	Total
Rail Operations			
Crew wages	$83.63	$42.05	$125.68
Fuel	$170.47	$78.08	$248.55
Other train expenses	$14.54	$6.88	$21.42
Other operation expenses	$200.72	$87.49	$288.21
Sub-total - Rail Operations	**$469.36**	**$214.50**	**$683.87**
Equipment maintenance			
Locomotives	$30.23	$26.75	$56.98
Cars	$63.48	$52.33	$115.81
Sub-total - Equipment	**$93.70**	**$79.09**	**$172.79**
Maintenance of Track and Structures			
Track and roadway	$151.51	$114.36	$265.87
Other structures	$10.13	$8.61	$18.74
Sub-total - Track & Structures	**$161.64**	**$122.97**	**$284.61**
SUB-TOTAL - OPERATING COSTS	**$724.71**	**$416.56**	**$1,141.27**

Capital Costs	Depreciation	Return on Capital	Total
Locomotives	$17.74	$27.50	$45.24
Cars	$26.69	$41.38	$68.07
Track and Structures	$95.77	$240.37	$336.14
Other assets	$46.77	$73.20	$119.97
SUB-TOTAL CAPITAL COSTS	**$186.97**	**$382.45**	**$569.42**
TOTAL COSTS (PER CARLOAD)	**$911.67**	**$799.02**	**$1,710.69**
NET TONNE-KILOMETRES	95,782	95,782	95,782
COSTS PER TONNE-KILOMETRE	**$0.0095**	**$0.0083**	**$0.0179**
COSTS PER TRAIN			**$164,170.98**

4.3 CPR COST RESULTS

The train operating statistics supplied by CPR for each of its seven corridors are presented in the next section. These statistics along with other cost assumptions (e.g. the cost of capital rate) were then fed into the cost model to produce the cost results presented in the subsequent section.

4.3.1 Train Operating Statistics

Exhibit 8 presents the train operating statistics provided by CPR for each of its seven corridors that were used to calculate the pertinent costs. All these movements actually involve CPR trains except for a portion of the Delson-Trois-Rivieres corridor between Trois-Rivieres and Montreal that is now operated and owned by the Quebec-Gatineau Railway. For the purposes of this study, it has been assumed that this section of track is owned and operated by the CPR.

EXHIBIT 8
CPR Train Operating Statistics

	CPR Corridor						
	A	B	C	D	E	F	G
Origin	Montreal	Montreal	Montreal	Vancouver	Thunder Bay	Brandon	Trois-Rivières
Destination	Toronto	Detroit	Toronto	Toronto	Quebec City	Thunder Bay	Delson
Commodity	Marine Container	Marine Container	Truck Trailers	Marine Container	Grain	Grain	Lumber
One-way distance (kms)	559	918	561	4349	1839	889	247
Type of train	Express	Express	Express	Express	Thru	Thru	Thru
Avg. gross trailing tonnes[1]/train	4304	3617	3537	4862	11975	13106	2382
Return	4455	3150	3242	3832	2839	3431	2382
Avg. number of locomotives/train	2	2	2	2.2 (2 return)	2.5 (1.7 return)	2 (1.3 return)	1
Horsepower per train	8200	7800	6400	9300	11300	8900	3000
Return	7800	8000	6400	8700	6600	5300	3000
Rail Car Type	Single stack flat, 2 platform	Single stack flat, 2 platform	Five platform flat	Double-stack flat,1 platform	Covered Hopper	Covered Hopper	Centre Beam Flat
Tare Weight of Car (Tonnes[1])	31	31	127	30	28	28	28
Content Weight of Car and containers (Tonnes[1])	58	49	93	42	92	87	80
Empty Return Ratio (%)	4%	3%	19%	7%	99%	100%	100%
Car Turnaround Time (days)	3	3	1	15	13	7	4
Train Switching (2)- Minutes per car	2	1.5	0.5	0	0	0	0
Yard Switching (3)- Minutes per car	11	26	0	14	33	33	36

NOTES :
(1) Tonne = Metric ton
(2) Train switching is the maximum time based on the schedule
(3) Yard switching minutes assumed to be the same as CN for similar movements/commodities

4.3.2 Cost Results

The resulting variable and fully allocated costs for the seven CPR movements at both the 6.0% and 8.6% cost of capital rates are presented in Exhibit 9. Appendix C provides a detailed breakdown of these cost results in the same format as for the CN corridors. The fully allocated costs are also presented below with and without the land costs to demonstrate the impact of the land costs on the costing results.

EXHIBIT 9
CPR Freight Corridor Cost Results

	Costs per Carload		Costs per Tonne-Km		Costs per Train	
Cost of Capital Rate	*6.0%*	*8.6%*	*6.0%*	*8.6%*	*6.0%*	*8.6%*
Corridor (commodity)						
Montreal-Toronto (Marine containers)						
Marginal Costs	$518.33	$541.84	$0.0160	$0.0167	$25,096.80	$26,235.02
Fully Allocated Costs	$642.62	$677.41	$0.0198	$0.0209	$31,114.64	$32,798.91
Fully Allocated Costs (land)	$678.45	$728.77	$0.0209	$0.0225	$32,849.53	$35,285.59
Montreal-Detroit (Marine Containers)						
Marginal Costs	$878.16	$916.15	$0.0195	$0.0204	$39,797.00	$41,518.00
Fully Allocated Costs	$1,049.85	$1,104.77	$0.0234	$0.0246	$47,577.00	$50,066.00
Fully Allocated Costs (land)	$1,114.01	$1,196.74	$0.0248	$0.0267	$50,484.77	$54,233.80
Montreal-Toronto (Domestic Trailers-Expressway)						
Marginal Costs	$1,033.42	$1,090.34	$0.0197	$0.0208	$16,586.00	$17,499.00
Fully Allocated Costs	$1,295.10	$1,382.48	$0.0247	$0.0264	$20,786.00	$22,188.00
Fully Allocated Costs (land)	$1,394.37	$1,524.77	$0.0266	$0.0291	$22,379.28	$24,471.70
Vancouver-Toronto (Marine Containers)						
Marginal Costs	$2,309.39	$2,428.14	$0.0127	$0.0134	$156,688.00	$164,745.00
Fully Allocated Costs	$2,834.81	$3,020.59	$0.0156	$0.0166	$192,237.00	$204,941.00
Fully Allocated Costs (land)	$2,876.73	$3,080.68	$0.0158	$0.0169	$195,081.28	$209,017.81
Thunder Bay-Quebec City (Grain)						
Marginal Costs	$1,522.21	$1,595.95	$0.0090	$0.0095	$152,256.00	$159,631.00
Fully Allocated Costs	$1,898.36	$2,019.01	$0.0113	$0.0120	$189,879.00	$201,947.00
Fully Allocated Costs (land)	$1,934.70	$2,071.10	$0.0115	$0.0123	$193,514.18	$207,157.42
Brandon-Thunder Bay (Grain)						
Marginal Costs	$902.63	$941.09	$0.0117	$0.0122	$102,701.00	$107,077.00
Fully Allocated Costs	$1,105.34	$1,165.78	$0.0143	$0.0151	$125,765.00	$132,642.00
Fully Allocated Costs (land)	$1,110.97	$1,173.85	$0.0144	$0.0152	$126,405.23	$133,559.66
Trois-Rivieres-Delson (Lumber)						
Marginal Costs	$772.52	$798.96	$0.0392	$0.0406	$17,047.00	$17,631.00
Fully Allocated Costs	$885.15	$919.43	$0.0450	$0.0467	$19,533.00	$20,289.00
Fully Allocated Costs (land)	$1,018.69	$1,110.83	$0.0518	$0.0564	$22,479.75	$24,512.68

4.4 *COMMENTS ON RAIL FREIGHT COST RESULTS*

Further observations and commentary on the rail freight cost results are provided below.

4.4.1 Fuel Tax Analysis

Based on Railway Association of Canada (RAC) data for the year 2000, fuel taxes represented 2.76% of total operating expenses for all member railways reporting to the RAC in that year. However, these operating expenses exclude the cost of capital on fixed assets. By combining the RAC percentage with the detailed costing results produced by the freight cost model output that includes a cost of capital for each of the corridors, two percentages have been calculated: (i) fuel taxes as a percent of marginal costs, where the marginal costs are based on the 6% cost of capital rate; and (ii) fuel taxes as a percent of fully allocated costs (including land), where the fully allocated costs are based on the 8.6% cost of capital rate. This allows for the widest possible range in the percentage results that were as follows:

- For marginal costs at the 6% cost of capital rate, fuel taxes represent between 2.35% and 2.54% of total costs or an average of 2.42% over the 14 cost runs.
- For fully allocated costs (including land) at the 8.6% cost of capital rate, fuel taxes represent between 1.98% and 2.27% of total costs or an average of 2.09% over the 14 cost runs.

4.4.2 CN versus CPR Cost Results

Differing train operating conditions do not allow for any direct comparison between the CN and the CPR corridor cost results. In particular, the definition of a “carload” for intermodal traffic can lead to significant differences in the carload cost results between the two railways due to variations in the number of platforms per car and whether the containers are single-stacked or double-stacked. Gross trailing tonnes of the train, the distance traveled and the weight of the individual cars can also have significant impact on the cost results.

4.4.3 Rail Costs versus Rail Rates

It should be pointed out that the cost results presented in this study do not necessarily have any direct relationship with the prices being charged by the railways for the freight commodity movements in question. Factors such as intermodal and intramodal competition, market conditions for the products being shipped, the regularity and magnitude of the traffic volumes being shipped by rail for each commodity, etc., all have key roles to play in the determination of prices charged to shippers by the railways.

5. INTERCITY RAIL PASSENGER COSTS

This chapter describes the methodology employed in estimating the unit costs of intercity rail passenger transportation and presents the results in summary form. All of the services for which costs have been estimated are operated by VIA Rail, and the bulk of the data used in the analysis has been made available by VIA Rail. The detailed results appear in Appendix D, although not all of the data that has been made available and used can be shown for reasons of confidentiality.

The study calls for estimating the following three measures of passenger rail unit costs,

- costs per trip,
- costs per seat-kilometre, and
- costs per passenger-kilometer,

and, for developing these on both a marginal cost and fully allocated cost basis.

As noted previously, estimates of these measures are to be developed for five corridors. Exhibit 10 lists these corridors along with key statistics for each corridor

EXHIBIT 10
Selected Passenger Rail Corridors

		Year 2000	
Corridor	**Route Kilometres**	**Passengers**	**Load Factor***
Montreal-Ottawa	187	277,703	40%
Montreal-Toronto	539	887,513	61%
Winnipeg-Churchill	1,697	31,469	23%
Edmonton-Vancouver	1,245	73,186**	79%***
Moncton-Montreal	1,042	139,233***	66%***

*Passenger-kilometres/seat-kilometers
**2005
***Estimated

The study also calls for developing a main set of estimates based on the actual ridership or load factors on each route, as well as estimates indicating the sensitivity of the primary results to different load factors.

As in the rest of this report, the cost estimates are developed for the year 2000. In addition, separate estimates are provided for each of the two assumed rates for the cost of capital, 6.0% and 8.6%.

5.1 APPROACH AND ASSUMPTIONS

In estimating the passenger unit costs, the study has followed a different approach from the one used to estimate freight unit costs, where the main tool has been the CANARAIL rail cost model. Instead of applying data to a rail cost model, the methodology adopted for estimating the passenger unit costs has been determined by the nature of the data that VIA Rail has provided. Importantly, the information made available by VIA Rail has included data on the actual cash operating costs of the various services, including costs on both an avoidable and fully allocated basis. The Consultants felt that these data, rather than a model of rail costs, should form the basis for the analysis. The use of “direct assignment” as a costing method is also encouraged if at all possible in the determination of variable costs.

For each service, the core information provided by VIA Rail comprised two sets of data on annual cash operating costs, one for 2000 and one for 2002. This data is part of the information regularly developed by VIA Rail for purposes of its internal reporting to management. For 2000, the operating cost data were the avoidable cash costs of the different services. These costs are considered avoidable in the sense that if the particular service were not operated, the costs would not be incurred by VIA Rail and from VIA Rail’s perspective would disappear. This is consistent with the concept of avoidable costs as adopted under the Railway Costing Regulations referred to in Chapter 2.

Beginning in 2002, VIA Rail adopted a new, more extensive reporting format which provides, for each service, not only the avoidable cash costs but the different cash operating costs grouped into avoidable, shared and corporate level categories. For each service and operating cost element (e.g. train operation, equipment maintenance) the total of avoidable, shared and corporate level costs equals that cost on a fully allocated basis

The methodology used in this study is best explained by means of an example. For this purpose, the Montreal-Ottawa service is taken as illustrative and the reader is referred to Exhibit 11 below, which shows total operating costs, total marginal costs and total fully allocated costs for the year 2000. Exhibit 11 is reproduced from Appendix D (Table D1), where there are also analogous tables for each of the other passenger services investigated.

5.1.1 Total operating costs

The operating costs for 2000 provided by VIA Rail for the Montreal-Ottawa service are summarized in Exhibit 11 under the heading Avoidable Costs. These include the avoidable costs associated with train operation and labeled as such in Exhibit 11. The train operation avoidable costs include virtually all of the train crew, fuel, on-train services crew and on-train product costs, and part of the off-train services staff and revenue driven[9] costs. Together, these costs total approximately $8.7 million.

[9] These include transaction fees for computerized reservation system, sales commissions and credit card discount.

EXHIBIT 11
VIA Rail Montreal-Ottawa Service: Total Costs for 2000

	Avoidable Costs $000		Fully Allocated/ Avoidable Cost Ratio		Fully Allocated Costs $000	
Cost of Capital Rate	***6.0%***	***8.6%***	***6.0%***	***8.6%***	***6.0%***	***8.6%***
Transportation:						
Infrastructure Use	1,245	1,409	1.75	1.75	2,180	2,462
Train Operation	8,737	8,737	1.17	1.17	10,225	10,225
Maintenance	3,098	3,098	1.64	1.64	5,081	5,081
Property Cost	29	29	47.53	47.53	1,378	1,378
Sales Cost	41	41	17.35	17.35	711	711
General and Administration	101	101	42.53	42.53	4,295	4,295
Total Operating Cost	13,251	13,415	1.80	1.80	23,871	24,153
Rolling Stock Capital Cost	2,181	2,589				
			Building Capital Cost		2,297	2,602
			Land Capital Cost		210	301
Marginal Cost	15,432	16,004	**Fully Allocated Cost**		28,559	29,645

VIA Rail also reimburses the freight railways for the use of their infrastructure and related services. The actual charges paid to the freight railways were not provided by VIA Rail. Instead, a cost-based estimate, designated Infrastructure Use in Exhibit 11, has been made by means of the CANARAIL model. As noted in Chapter 4, the CANARAIL model was updated and adapted to the present project. This included reviewing and adjusting the percent variabilities for track and roadway costs, and developing a special output format limiting the costs to those that would be charged to VIA Rail, i.e.:

- Track and roadway costs (maintenance and investment);
- Costs of signals (maintenance and investment);
- Costs of dispatching and other train control activities;
- Overhead (or indirect) costs allocated on train control and maintenance of track;
- A number of small miscellaneous cost items that are related to provision of track, signals or train control.

All of these cost elements are treated in CANARAIL's cost model as functions of either gross tonne-kilometres or train-kilometres. VIA Rail supplied these two statistics for the services under consideration. The model calculated the costs of infrastructure use at both the 6% and 8.6% cost of capital rates. It was also assumed for purposes of this exercise that the entire infrastructure is owned and operated by CN, even though in two of the corridors part of the track infrastructure is owned by other railways as follows:

- VIA Rail itself owns 105 kms of the 187 kms in the Montreal-Ottawa passenger rail corridor

- Hudson Bay Railway Company owns 920 kms of the 1, 697 kms in the Winnipeg-Churchill passenger rail corridor.

Together, train operation and infrastructure use make up the costs of transportation in Exhibit 11. In addition, total operating costs include maintenance (regular, major and third party maintenance of equipment), property costs (stations, maintenance centres, offices), sales costs (advertising, reservation systems) and general and administration. VIA Rail's avoidable part of these costs include most of regular equipment maintenance, and minor parts of the station property, sales and customer services administration costs. Adding together these and the avoidable costs of transportation, the total avoidable cash operating costs for the Montreal-Ottawa service for 2000 amount to approximately $13 million.

5.1.2 Marginal costs

As Exhibit 11 indicates, total marginal costs for passenger rail services are taken to be the sum of the total avoidable cash operating costs and the capital costs (i.e., depreciation and return on capital) attributable to the rolling stock used in providing the service. Railway costing practice would normally also include a capital cost for buildings as part of marginal cost, to the extent that these can be assigned to particular services and then would be considered avoidable. However, there has been no attempt here to include a portion of the estimated capital costs of buildings in marginal costs. For the most part, VIA Rail's costs associated with buildings are shared among train services. The variable proportion of these is not known and is considered small. Most would appear to be fixed such as the costs of stations like Ottawa, Montreal and Toronto. These stations now have excessive capacity, serve many passenger train services, and cannot be readily downsized. The study, therefore, treats the entire building capital costs as fixed and includes these as part of fully allocated costs.

Regarding rolling stock, VIA Rail provided the year 2000 assignment of locomotives and cars, including both in-service and spare equipment, for all five of the services to be costed. In the central Corridor, however, rolling stock is not dedicated to the particular services (e.g. Montreal-Ottawa) so VIA Rail provided only the total fleet. This Corridor fleet was then apportioned to the Montreal-Ottawa service, and the Montreal-Toronto service, on the basis of their share of total Corridor ridership. In addition to the 2000 fleet assignment, VIA Rail also provided information on the original cost, net book value and useful life of the various equipment making up its entire fleet.

Rolling stock capital costs are comprised of two components. One is an estimate for depreciation. The other is an estimate of the "return on capital," an amount reflecting the opportunity cost of the funds tied up in equipment ownership. To estimate depreciation, the study has followed VIA Rail's policy of calculating depreciation on a straight line basis to fully amortize the original cost, less the estimated residual value, over the useful life of the equipment. This book amount was then increased to a year 2000 value using the adjustment factor provided for this purpose by Transport Canada. The second component, the cost of capital, was determined by applying the assumed cost of capital rate (6.0% or 8.6%) to the net book value provided by VIA Rail, which was again increased to a year 2000 value using the adjustment factor provided by Transport Canada. Depending on the cost of capital rate, rolling stock capital costs in Exhibit 11 range between $2.181 million and $2.589 million.

Finally, as seen in Exhibit 11, the total marginal costs for the Montreal-Ottawa service for 2000 are estimated to be in the range of $15.432 million to $16.004 million, depending on the cost of capital rate used.

5.1.3 Fully allocated costs

As mentioned above, VIA Rail implemented in 2002 a reporting format that groups operating costs into avoidable, shared and corporate level categories. According to VIA Rail, the 2002 distribution into avoidable, shared and corporate level categories is applicable to the year 2000. Based on this, the ratios of fully allocated/avoidable costs for 2002 have been calculated and applied to the 2000 avoidable costs in order to estimate operating costs on a fully allocated basis for 2000.[10] The exception to this procedure is the charge that VIA Rail incurs for its use of CN infrastructure, which as before has been estimated using the CANARAIL model. The resulting estimate for 2000 of total operating costs on a fully allocated basis for the Montreal-Ottawa service is approximately $24 million. This is nearly twice the estimated avoidable operating costs of approximately $13 million, reflecting VIA Rail's relatively high proportion of costs considered fixed with particular train services.

In order to arrive at total fully allocated costs, it is necessary to add to the fully allocated operating costs amounts reflecting the capital costs of the buildings and land used in the particular service.[11] Including these amounts, total fully allocated costs for the Montreal-

[10] This assumes, in effect, that all of the shared and corporate level costs are fixed in relation to a particular train service.

[11] For buildings, the amount was developed by assuming the existence of normal relationships between the operating expenses reflecting the activity occurring in buildings and (i) building depreciation and amortization, and (ii) net book value. Using VIA Rail system-wide data from Statistics Canada, *Rail in Canada 2000* (Catalogue no. 52-216-XIB), two ratios were calculated: the ratio of depreciation and amortization to the pertinent operating expenses (equipment maintenance, rail operation administration, station and terminal operation, general administration), and the ratio of net book value to these same operating expenses. These ratios, which turned out to be 9.3% and 68.4%, respectively, were then applied to the pertinent fully allocated operating costs (off-train services staff, total maintenance costs, total general and administration) of the services under investigation to obtain estimates specific to these services of building depreciation and building net book value. From here, the same procedures used to obtain rolling stock capital costs were applied to obtain the building capital costs of the services. For land, the capital cost is determined by simply applying the assumed cost of capital rate to the land value specific to the service according to methodology explained previously.

Ottawa service range between $28.559 million and $29.645 million, depending on whether the cost of capital rate is assumed to be 6.0% or 8.6%.

It may be noted that, in Exhibit 11, the capital cost of land is small. As indicated in Appendix C, this is typical of the VIA Rail services investigated and reflects two factors. First, the corridor land values, which have been provided by Transport Canada, are net of the conversion and development costs that would be incurred if the land were to be put to an alternative use. Second, the corridor land values have been prorated among the various freight and passenger rail services based on train gross ton miles as described in Chapter 3. VIA Rail trains are also light in comparison to heavier CN and CPR freight trains.

5.2 SUMMARY OF PASSENGER COST RESULTS

Given estimates of total operating costs, total marginal costs and total fully allocated costs, the required unit costs can be derived. The total operating, marginal and fully allocated cost measures are divided by the appropriate measures of workload or ridership: number of trips; number of seat kilometers; and number of passenger kilometers. Exhibit 12 below shows, for both of the assumed cost of capital rates, the marginal and fully allocated unit costs for the five selected services. In addition, the fully allocated costs are presented both including and excluding costs for land.

One qualification applies to the costing of the Edmonton-Vancouver and Moncton-Montreal services. VIA Rail was not able to provide all the data required to directly determine the costs for Edmonton-Vancouver or Moncton-Montreal. Instead, VIA Rail could only provide the data to determine costs for the entire Toronto-Vancouver ("Canadian") service and the entire Halifax-Montreal ("Ocean") service.

In order to estimate unit costs for Edmonton-Vancouver and Moncton-Montreal, the study proceeded as follows. First, the total operating, marginal and fully allocated costs were determined for the full Canadian and Ocean services (see Appendix D, Tables D7 and D9). These results were then prorated by distance to obtain estimates of the total operating, marginal and fully allocated costs for Edmonton-Vancouver and Moncton-Montreal. Then, costs per trip were obtained by dividing the Edmonton-Vancouver and Moncton-Montreal total costs by the number of Canadian and Ocean trips, respectively. Costs per seat kilometre were obtained by dividing the Edmonton-Vancouver and Moncton-Montreal total costs by estimated Edmonton-Vancouver and Moncton-Montreal seat kilometres, where the available number of seats was assumed to be the same over Edmonton-Vancouver as over Toronto-Vancouver, and the available number of seats was assumed to be the same over Moncton-Montreal as over Halifax-Montreal (i.e. no change in train consists). Finally, costs per passenger kilometre over Edmonton-Vancouver and Moncton-Montreal were obtained by multiplying the seat kilometers by the load factors, assuming the same load factor over Edmonton-Vancouver as over Toronto-Vancouver, and the same load factor over Moncton-Montreal as over Halifax-Montreal (see Appendix D, Tables D8 and D10).

EXHIBIT 12
Intercity Rail Passenger Transportation: Unit Costs for 2000

Selected Service And Cost Measure	Costs per Train Trip		Costs per Seat-Km		Costs per Passenger-Km	
Cost of Capital Rate	***6.0%***	***8.6%***	***6.0%***	***8.6%***	***6.0%***	***8.6%***
Montreal-Ottawa						
Marginal Costs	$4,578	$4,748	$0.125	$0.130	$0.314	$0.326
Fully Allocated Costs	$8,472	$8,794	$0.231	$0.240	$0.582	$0.604
Fully Allocated Costs (excl Land)	$8,410	$8,705	$0.229	$0.237	$0.577	$0.598
Montreal-Toronto						
Marginal Costs	$10,063	$10,501	$0.073	$0.076	$0.120	$0.125
Fully Allocated Costs	$17,929	$18,663	$0.130	$0.135	$0.214	$0.223
Fully Allocated Costs (excl Land)	$17,856	$18,557	$0.129	$0.134	$0.213	$0.222
Winnipeg-Churchill						
Marginal Costs	$36,532	$37,843	$0.138	$0.143	$0.591	$0.613
Fully Allocated Costs	$53,954	$56,142	$0.204	$0.212	$0.873	$0.909
Fully Allocated Costs (excl Land)	$53,831	$55,966	$0.203	$0.211	$0.871	$0.906
Edmonton-Vancouver						
Marginal Costs	$50,035	$51,350	$0.149	$0.153	$0.188	$0.193
Fully Allocated Costs	$80,392	$82,989	$0.240	$0.248	$0.303	$0.312
Fully Allocated Costs (excl Land)	$80,121	$82,600	$0.239	$0.246	$0.302	$0.311
Moncton-Montreal						
Marginal Costs	$46,389	$49,299	$0.134	$0.143	$0.203	$0.216
Fully Allocated Costs	$71,367	$75,326	$0.207	$0.218	$0.313	$0.330
Fully Allocated Costs (excl Land)	$71,104	$74,949	$0.206	$0.217	$0.312	$0.329

Overall, the results in Exhibit 12 show:

- Marginal costs per trip ranging from $4,578 (Montreal-Ottawa) to $51,350 (Edmonton-Vancouver),
- Fully allocated costs per trip ranging from $8,472 (Montreal-Ottawa) to $82,600 (Edmonton-Vancouver),
- Marginal costs per seat kilometre ranging from $.073 (Montreal-Toronto) to $0.153 (Edmonton-Vancouver),
- Fully allocated costs per seat kilometre ranging from $0.130 (Montreal-Toronto) to $0.246 (Edmonton-Vancouver),
- Marginal costs per passenger kilometre ranging from $0.120 (Montreal-Toronto) to $0.613 (Winnipeg-Churchill),
- Fully allocated costs per passenger kilometre ranging from $0.214 (Montreal-Toronto) to $0.909 (Winnipeg-Churchill).

The high proportion of fixed costs in VIA Rail's cost structure is also evident in Exhibit 12, where the ratio of fully allocated to marginal costs ranges from 1.48 (Winnipeg-Churchill) to 1.85 (Montreal-Ottawa). The results indicate, in other words, a percentage of fixed to total costs for VIA Rail ranging from 32% to 46%.

5.3 LOAD FACTOR SENSITIVITY

In addition to the main results, the study calls for consideration of the sensitivity of the unit costs of VIA Rail services to different load factors. A change in the load factor is measured as a change in the ratio of the number of passenger kilometers transported to the number of seat kilometers transported. Clearly, of the three unit cost measures - cost per trip, cost per seat kilometre and cost per passenger kilometre - it is the third which has the greatest potential for sensitivity to the load factor as it is a direct function of passenger kilometers or ridership. Other things equal, any increase (decrease) in the number passenger kilometers, and hence in the load factor, will result directly in a decrease (increase) in the cost per passenger kilometre. Although operating costs, and therefore all three measures of unit costs, are to some degree affected by changes in ridership, the impact on both marginal and fully allocated costs per trip and per seat kilometre would be small. This is because only a few categories of operating costs would be affected, and for some these, the variability with respect to ridership is well below 100%.[12]

In view of these considerations, the Consultants have undertaken to provide an indication of the sensitivity of the third measure, the cost per passenger kilometre, to changes in the load factor. Holding all else constant, the costs per passenger kilometre in Exhibit 12 have been re-calculated to show the effect of assuming a 25 percent higher passenger kilometer level, i.e. a 25 percent higher load factor, as compared to the actual load factors that underlie the main results. These actual load factors are displayed in Exhibit 10. The corresponding alternate load factors are: Montreal-Ottawa, 50%; Montreal-Toronto, 76%; Winnipeg-Churchill, 29%; Edmonton-Vancouver, 99%; Moncton-Montreal, 83%.

The result of assuming load factors that are 25% above their actual levels is a uniform decline of 20% in all of the estimated costs per passenger kilometre shown in the last two columns of Exhibit 12. This, of course, follows from having held costs and all other factors constant while adjusting passenger kilometers up in every case by the same percentage. As an illustration, Exhibit 13 shows the results for the Montreal-Ottawa service. In this case, marginal costs per passenger kilometre decline from a range (depending on the cost of capital) of \$0.314-\$0.326 in Exhibit 12 to \$0.251-\$0.261. Fully allocated costs per passenger kilometre decline from a range of \$0.582-\$0.604 in Exhibit 12 to \$0.465-\$0.483, and fully allocated costs per passenger kilometre excluding land decline from a range of \$0.577-\$0.598 in Exhibit 12 to a range of \$0.462-\$0.478.

[12] The affected cost categories would be the on-train services crew, on-train product costs, off-train services staff, revenue driven costs and reservation system costs.

EXHIBIT 13
Illustration of Unit Cost Sensitivity to Load Factor

Selected Service And Cost Measure	Cost per Passenger-Km		Difference from Exhibit 10		Percent Difference from Exhibit 10	
Cost of Capital Rate	***6.0%***	***8.6%***	***6.0%***	***8.6%***	***6.0%***	***8.6%***
Montreal-Ottawa Actual Load Factor: 40% Alternate Load Factor: 50%						
Marginal Costs	$0.251	$0.261	-$0.063	-$0.065	-20.0%	-20.0%
Fully Allocated Costs	$0.465	$0.483	-$0.116	-$0.121	-20.0%	-20.0%
Fully Allocated Costs (excl Land)	$0.462	$0.478	-$0.115	-$0.120	-20.0%	-20.0%

5.4 FUEL TAX ANALYSIS

The data provided by VIA Rail has included the fuel price assumption used in determining the fuel costs incurred by the various services in the year 2000. This fuel price assumption is an average across the VIA Rail system of $0.3473, of which $0.0803, or 23.12%, is federal and provincial fuel taxes.[13] The Consultants have used this information to estimate the percentage of rail costs that are accounted for by fuel taxes.

For each of the five services, two percentages have been calculated: (i) fuel taxes as a percent of marginal costs, where the marginal costs are based on the 6% cost of capital rate; and (ii) fuel taxes as a percent of fully allocated costs, where the fully allocated costs are based on the 8.6% cost of capital rate. Determining the requested fuel tax percentages in this manner ensures that the results encompass the widest possible range. For marginal costs, the results range from a low of 1.33% to a high of 2.07%, with fuel taxes accounting on average for 1.71% of marginal costs. For fully allocated costs, the results range from a low of 0.69% to a high of 1.20%, with fuel taxes accounting on average for 1.00% of fully allocated costs.

[13] The system-wide average fuel price is combined with service-specific fuel consumption to estimate service-specific fuel costs.

APPENDIX A

CANARAIL COST MODEL

The CANARAIL model is based on the industry standard costing methods developed and refined over the years by Canadian National (CN) and Canadian Pacific Railway (CPR) and approved by the Canadian Transportation Agency and its predecessors. CANARAIL's integrated computerized cost model incorporates both CN and CPR costs. The model uses publicly available data (primarily from Statistics Canada, supplemented by a number of other Canadian and U.S. sources) to replicate CN's and CPR's costing methods as closely as possible without access to confidential data. The model is oriented to producing marginal or variable costs, but it can be readily adapted to also produce average total costs where these are required, as in the case of the present Transport Canada request. It should also be noted that the model has already been calibrated on data for the year 2000, the FCI base year; therefore, the unit cost estimates are consistent with the other work being carried out as part of the FCI.

The CANARAIL model can accept up to four segments for a single movement. For example, it can develop costs for a movement that begins on a CN way freight, is transferred to a CN through freight, then a CPR through freight, and terminates with a CPR way freight. The model also contains a number of default values for train size and consists, for both way and through freights and switching minutes per carload (to reflect switching at the origin and destination) and per car-kilometre (to reflect en route switching). The model also allows the user to override these defaults where more specific or appropriate data is available.

As regards the opportunity cost of capital rate needed to calculate the return on investment, the model uses Canadian Transportation Agency-approved rates as default values, but it can easily accept other rates. This will allow for testing other rates such as the rates that are being used elsewhere in the Full Cost Investigation project.

Finally, while the model has been developed as a freight model, it can be adapted and used to estimate some unit costs for passenger operations. Specifically, the model can be used to cost-based estimates of CN's and CPR's charges to VIA Rail for track, signals and train control

APPENDIX B

COSTING RESULTS – CN FREIGHT CORRIDORS

Not included for confidentiality reasons

APPENDIX C

COSTING RESULTS – CPR FREIGHT CORRIDORS

Not included for confidentiality reasons

APPENDIX D

COSTING RESULTS – RAIL PASSENGER CORRIDORS

Not included for confidentiality reasons

APPENDIX E

LETTER FROM CN AND CPR

CN

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CANADIAN PACIFIC RAILWAY

May 28, 2007

VIA EMAIL

Mr. Roger Roy
Director General, Economic Analysis
Transport Canada
Place de Ville
330 Sparks Street
Ottawa ON K1A 0N5

Dear Mr. Roy:

SUBJECT: Estimation of Unit Costs of Rail Transportation in Canada

CN and CPR thank you for the opportunity of providing comments on the draft report titled "Estimation of Unit Costs of Rail Transportation in Canada", prepared by Consultants as part of the Full Cost Initiative (FCI) initiated by Transport Canada. Following are the joint comments of CN and CPR. Although both railroads support the overall objective of the FCI, the purpose of which is to estimate and compare the total resources consumed by the various modes of transport including environmental and social impacts, there are a number of important areas where we disagree with the results

General

The railroads recognize that the report authors have followed specific costing methodologies and parameters provided by Transport Canada that are founded upon regulatory principles. This in itself may not be problematic to the extent that the specific purpose is strictly to compare the total cost of rail with the total cost of other transportation modes evaluated under the same approach. However, both companies operate under commercial realities, which dictate that fair market values be properly reflected in costing methodologies used for making commercial decisions. Therefore, we strongly believe that the choice of the methodologies and parameters used in this study materially underestimates the true costs incurred by the railroads. As a result, neither the rail cost estimates contained in this report nor the specific costing methodologies employed to create them, should be used in any other context or for any purpose other than to compare rail to other modes through this Full Cost Investigation.

While not exhaustive, the railroads main concerns or objections with the report are as follows:

Cost of Capital

The rates employed in this report, based on social opportunity cost, significantly understate the cost of capital the railroads actually face. Calculations by the railroads, the US regulatory body (Surface Transportation Board) and independent financial analysts all estimate the cost of capital to be roughly 50% higher than the rates chosen for this Full Cost Investigation.

Land Valuation

Land values are significantly below market values in this report, especially in respect of land in urban areas where the net salvage values employed is very low. Furthermore, as the report notes, land values for railway yards have been excluded completely. As this excludes large properties in major urban centers, arguably the most valuable land the railways own, we would take issue with the statement that the results are only "slightly underestimated".

Allocation of Land Values to Passenger and Freight Service

Land values have been allocated based on gross ton miles rather than train miles. Although weight has been shown to have a direct correlation with maintenance and replacement of track infrastructure, there is no basis to use weight as a determining factor in allocating fixed capacity costs such as land. Capacity costs are no lower for a relatively light passenger train than a relatively heavy freight train. In fact, due to tighter scheduling windows and the corridor priority granted passenger trains, those consume more of the corridor capacity than a freight train does and therefore, they should get a higher allocation of capacity costs per train. The GTM allocation methodology employed in the Full Cost Investigation significantly understates the capacity costs related to passenger traffic, which is further compounded by the understatement of land values in general.

Other Asset Valuation

The study uses historical book values as a basis for determining costs related to rolling stock and track and roadway infrastructure. The fact is that asset costs based on historical book values understate the true costs required to replace the existing asset base at current market prices.

Development and Allocation of Fixed Costs

Apart from land values, it is unclear exactly how fixed costs have been developed and allocated to specific freight movements in this report. Our current reading of the draft report suggests that the allocated fixed costs also seem to be significantly understated.

Conclusion

The cumulative impact of the costing methodologies and parameters chosen for this study significantly understates the actual costs experienced by the railroads. While the costs derived from these methodologies may be acceptable for the purpose of comparing those to the costs of other modes estimated under similar methodologies, they have no applicable use outside of this particular study. In summary, neither the rail cost estimates contained in this report nor the specific costing methodologies employed to create them should be used in any other context outside of the Full Cost Investigation.

Yours truly,

Lon Labrash
Director, Costing

Yours truly,

M. B. Cairns

Malcolm Cairns
Director, Business Research

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