FINAL REPORT

TRANSPORT CANADA
ECONOMIC ANALYSIS DIRECTORATE
TP 14662E

ESTIMATION OF COSTS OF HEAVY VEHICLE USE PER VEHICLE-KILOMETRE IN CANADA

File: T8080 - 05 - 0326

BY

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IN ASSOCIATION WITH

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EXECUTIVE SUMMARY

Transport Canada has initiated, in collaboration with Provincial and Territorial transport departments, a project called the Full Cost Investigation (FCI). The project is being steered by a Task Force reporting to the Policy and Planning Support Committee of the Council of Deputy Ministers Responsible for Transportation and Highway Safety.

As one component of the overall Full Cost Investigation project, this project estimates the costs of ownership and operation of heavy trucks and buses on a per vehicle-kilometre basis. While 22 classes of vehicles are analyzed, there can be several variations analyzed within some of these classes, usually involving different trailer or body types, such as van, flat-deck, dump, etc.

More specifically, the project develops a model for estimating the costs per vehicle-kilometre of the vehicle configurations, in the year 2000, based upon a summed up component analysis tied to:

- Labour costs of drivers
- Fuel costs
- Repair and tire costs
- Registration and licence fees
- Vehicle ownership costs (Capital costs of depreciation of the vehicle, including trailers and semi-trailers)
- Cost of capital (Financing costs for funds invested in vehicle purchase)
- Insurance, and
- Administrative costs

The approach used to develop the model is essentially an activity based costing method, similar to that used in *Operating Costs of Trucks in Canada*. This approach relates annual costs for operating a single vehicle in a fleet to factors such as distance travelled, average operating speeds, fuel consumption levels, and considers all additional work hours not driving (i.e. waiting time, loading / unloading time) where drivers and equipment are "on duty."

Vehicle related resource costs included are driver costs, fuel costs, maintenance costs (repairs, tires, cleaning and other related costs), registration and license costs.

In addition to direct operational related costs, provision is included for assignable indirect costs for the fleet operations. These include depreciation, cost of capital, insurance and administrative overheads.

To enumerate all of the foregoing cost components an Excel based costing spreadsheet that calculates annual component costs for a single vehicle

configuration -- operated as part of a fleet operation – was developed for each of the vehicle body type configurations examined.

There are four sections to the model:

- selection of vehicle configuration to be analyzed:
- region and operation selection (including province of operation, annual utilization, nation of carrier domicile, road surface type and vehicle age);
- vehicle productivity data (trip and annual usage rates, wait time, etc)
- vehicle operation costs (including such items as driver wage rate, fuel price, etc)

The user's selection of entries in each spreadsheet drives a series of "lookup tables" in the model which reflect an expert opinion based standard set of operating characteristics and component costs. If desired, the model user can “customize” the analysis by using their own specific input values to over-ride the expert values contained in the look-up tables. Input values for the look-up tables were developed from the consultant’s experience on numerous industry projects, consultation with operators and suppliers to the fleet operators to fill in gaps, and standard industry reference documents (such as J.J. Kellers vehicle registrations cost book)

In addition to model development, the consultant undertook specific investigations as follows.

Toll Road and Bridge Revenues from Heavy Trucks

There are relatively few toll facilities in Canada. There are four toll bridges located within Canada (all in Atlantic Canada), eleven international toll bridges (all connecting Ontario – U.S.) and three toll highways: Hwy 104 in Nova Scotia, Hwy 407 in Ontario and the Coquihalla Highway in B.C. It is estimated these facilities generated $206 million in revenues from heavy trucks in 2000. As actual revenue data were available for only a few of the facilities, revenues were estimated for most of the facilities from available truck volumes and published toll rates.

Cost Differences between Commercial and Private Fleets

The trucking industry consists of two main sectors: the for-hire sector which has historically been defined as consisting of those companies that haul freight owned by others, for compensation. The private sector consists of those companies who primarily haul their own freight, but may, from time to time, haul other people's goods for compensation.

In dollar terms, the two sectors are nearly the same size. However, there are some major differences in their make-up as well as some interesting similarities. Private trucking is dominated by a large number of small fleets operating in and around urban areas, where it holds an 85% market share. The majority of fleets operating in this area consist of 1 or 2 vehicles and are typically straight trucks. As haul distance increases, this market share drops. The market share is about 50% at trip distances of 200 km; decreasing to about 10% at distances of 2,000 km and greater. Truck size increases as trip distances increase to take advantage of the economics of the larger vehicles over longer distances.

Overall, it is the consultant's assessment that there are not any systematic differences in costs between private and for-hire fleets when operating under the same operating conditions.

Costs of Operating In Congested Conditions

For trucks operating in these congested conditions, considerable lost time can result leading to increased costs for driver wages (often absorbed by the driver), fuel and lost vehicle productivity.

To provide further insight into how congestion affects a truck fleet's operation and operating costs, interviews were conducted with a number of fleets who have significant operations in congested areas, particularly the Greater Toronto Area (GTA). Interviews with truck drivers were also conducted, as their views may vary from those of fleet operators, particularly when the drivers are paid by the mile or trip as opposed to by the hour.

These interviews show that where possible fleet managers and drivers try to avoid the congestion whenever they can by trip scheduling outside of the peak hours. However, for many fleets this option is limited.

Case studies of two fleets operating mainly in the Greater Toronto Area (GTA) were completed to determine how congestion affects their costs. These fleets operate 12 hour shifts, so they experience the full effects of congestion during their shift. The fleets provided vehicle utilization rates and estimates of the time lost due to congestion during a normal shirt. The truck costing model was then used to estimate costs if the trucks were to operate with and without congestion. Results indicate congestion in these particular cases increases costs of tractor-trailers by about 15% and straight trucks by about 17%. Congestion costs for other types of operations will vary depending on how much time the vehicles actually travel in congested conditions.

Factors Changing Unit Costs over Time

Several factors were identified as having the potential to change costs over time. Fuel costs and insurance costs have both increased significantly since 2000. Truck driver and diesel mechanics shortages could also create upward wage pressures, thereby increasing costs.

Another factor increasing cost is the EPA engine requirements for NOx and particulates. Regulations introduced in 2002 to reduce these emissions increased fuel consumption by an estimated 8% to 9%. More stringent regulations to be introduced in 2007 are noted by the Canadian Trucking Alliance to add $7,000 to $10,000 to the purchase price of a tractor. In addition, the associated equipment adds 140 to 230 kilograms to the unit, resulting in reduced payloads. Fuel efficiency is expected to remain much the same, or be slightly reduced. There are added maintenance costs to clean particulate filters and the oil required by these vehicle is more expensive. The diesel fuel requirement increases fuel consumption by 1% to 2% and increases fuel costs by about one cent per litre. For coach buses, capital costs are increased by up to $15,000 with a 5% loss in fuel efficiency. Similar to trucks, maintenance and fuel costs are also increased

Since the terrorist attack in the United States in 2001 border crossing border crossing delays have increased due to more careful checks and new regulations. A study completed for Transport Canada estimates the cost impacts on the Canadian trucking industry due to the U.S. border security measures range from $179 million to $406 million per annum with a mid-range estimate is in the order of $290 million per annum. This represents about 4% of total Canadian for-hire, long-distance trucking industry transborder expenses assuming an operating ratio of 0.95 on transborder revenues of $8 billion in 2003.

New hours-of-service (HOS) regulations allow drivers to have more regular on duty hours and increase the potential for quality sleep to reduce fatigue and increase driver alertness. The new regulations on long-haul trucking companies have reduced driver productivity by an estimated 3%.

There are some specific technologies being introduced within portions of the industry that will reduce costs for fleets where the technology is suitable and adopted. These include Wide Based Single Tires which allow the carrier to increase payload somewhat while improving fuel economy by 3% to 12%.

As the Trans-Canada and Yellowhead Highways are completely 4-laned across the Prairie Provinces, Long Combination Vehicles (such as Turnpike Doubles) will see increased usage under existing regulations. These vehicles offer 30% or more productivity compared to standard tractor-trailer operations. They primarily are used for light freight, such as retail goods and LTL (less than truckload) operations. They typically constitute 5% to 10% of truck traffic volumes on the routes they are allowed to operate on. Currently in Eastern Canada, the turnpike double version of these trucks is allowed to operate only in the Province of Quebec on multi-laned highways. The impact of allowing these vehicles to operate throughout Eastern Canada and into the United States is currently being examined by the Canadian Trucking Alliance.

Increasingly, trucking fleets are switching to automatic transmissions. Some fleets, especially those hauling lighter freight report fuel savings of up to 5%.

Other ongoing technology developments are expected to improve fuel economy with the 21st Century Group in USA noting a 42% improvement in fuel economy possible with improved technology. Efficiency improvements by area are: Engine 12%; Aerodynamics 10%; Rolling resistance 13%; Accessories 5% and Driveline 1.5%.

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ESTIMATION OF COSTS OF HEAVY VEHICLE USE PER VEHICLE-KILOMETRE IN CANADA

1.0 Introduction

Transport Canada has initiated, in collaboration with Provincial and Territorial transport departments, a project called the Full Cost Investigation (FCI). The project is being steered by a Task Force reporting to the Policy and Planning Support Committee of the Council of Deputy Ministers Responsible for Transportation and Highway Safety.

The FCI project is intended to estimate the total financial and social costs of transport by all of the major modes, to reveal the total amounts of resources consumed by transport, and the impacts on the environment, health and well being. It is also intended to make comparisons among alternative modes of transport, showing the resources consumed and other environmental and social impacts for realistic alternatives.

For passenger transport, these will include comparing private car/light truck with urban public transit and the various public intercity modes – air, bus and train; while for freight transport they will include realistic comparisons and combinations of truck, rail, waterway and air. Eventually, the intention is that this information on “full costs” by mode will also be used to consider appropriate infrastructure pricing strategies, and potential changes to existing charging regimes by mode.

This report develops the per kilometre operating costs of heavy road vehicles, including both trucks and buses.

2.0 Objectives

As one component of the overall Full Cost Investigation Project, this project estimates the costs of ownership and operation of heavy trucks and buses on a per vehicle-kilometre basis. The specific vehicle classes included are shown in Exhibit 2.1. While there are 22 classes of vehicles, there can be several variations analyzed within that class, usually involving different trailer or body types, such as van, flat-deck, dump, etc.

Exhibit 2.1 Vehicle Classes Evaluated

1. Single Unit, 2-axle, 6 tire truck.
2. Single Unit, 3-axle, 10 tire truck.
3. Single Unit truck with 4 or more axles. (Usually 2 steering axles, 12 tire unit).
4. Tractor and Semitrailer combination with 3 axles.
5. Tractor and Semitrailer combination with 4 axles.
6. Tractor and Semitrailer combination with 5 axles. (2 rear tandem axles)
7. Tractor and Semitrailer combination with 5 axles. (2 Split > 8 feet rear axles)
8. Tractor and Semitrailer combination with 6 axles.
9. Tractor and Semitrailer combination with 7 or more axles.
10. Truck - trailers combinations with 3 or 4 axles
11. Truck - trailers combinations with 5 axles
12. Truck - trailers combinations with 6 or more axles
13. Tractor - Double Semitrailer combination with 5 axles.
14. Tractor - Double Semitrailer combination with 6 axles
15. Tractor - Double Semitrailer combination with 7 axles
16. Tractor - Double Semitrailer combination with 8 or more axles.
17. Tractor - Triple Semitrailer or Truck-Double Semitrailer combination.
18. Inter-city bus
19. Charter coach
20. School bus
21. Urban transit bus
22. Tractor and four axle semi-trailer (Quebec Quad)

More specifically, the project develops a model for estimating the costs per vehicle-kilometre, in the year 2000, including

- Labour costs of drivers
- Fuel costs
- Repair and tire costs
- Registration and licence fees

- Vehicle ownership costs (Capital costs of depreciation of the vehicle, including trailers and semi-trailers)
- Cost of capital (Financing costs for funds invested in vehicle purchase)
- Insurance, and
- administrative costs

Other specific requirements of the project include:

- Understanding the impact and relative magnitude of road or bridge tolls.
- Numerical estimates of the influence on costs of vehicle ages, for realistic ranges of vehicles in each type of operation.
- Numerical estimates of the differences in costs to be expected between vehicles operated commercially for-hire, or operated privately (on own account).
- Differences in costs per vehicle-kilometre among functional classes of road due to geometric and surface conditions (paved surface vs. gravel),
- Differences in costs per vehicle-kilometre by operating speed, within practical operating ranges, and including operations in congested conditions, beyond maximum volume as described in the TAC Geometric Design Guide for Canadian Roads or US Highway Capacity Manual,
- Estimates of the differences in costs by province/territory, in the form of adjustment functions to the various costs described above,
- Research and advice on whether significant differences in costs per vehicle-kilometre arise between Canadian and US vehicles when using the Canadian network
- Identification of factors that are likely changing the unit costs over time, independently of routine inflation in input prices.
- Discussion of data accuracy.

Each of the above are either incorporated within the model or discussed in the subsequent Chapters of this report.

3.0 General Approach and Methodology

To develop a vehicle operating cost profile for the various configurations of interest for this project, the consultant used a variant of the same methodology used since 1972, in the Transport Canada sponsored study series, *"Operating Costs of Trucks in Canada".* Detailed documentation for the approach is found in the most recent edition in this series, the 2005 edition of this study by Logistics Solution Builders Inc.

This well published approach has been widely accepted by the trucking industry and operators of private trucking fleets and it has also been applied, on a consulting basis, for assessment of other fleets including operation of an airport bus shuttle, evaluation of commuter bussing, a review of the City of Edmonton's diesel bus fleet, and evaluation of a taxi fleet. Furthermore, this method has been presented at open industry seminars, called the “Know Your Truck Costs” series, sponsored by the Canadian Industrial Transportation League (now CITA), the Propane Gas Association of Canada, the Alberta Motor Transport Association and the British Columbia Trucking Association. In this context, the method has been widely exposed to industry review and is generally accepted.

The approach used is essentially an activity based costing method, that relates annual costs for operating a single vehicle in a fleet to factors such as distance travelled, average operating speeds, and fuel consumption levels. It also considers all additional work hours not driving (i.e. waiting time, loading / unloading time) where drivers and equipment are "on duty". In case study format, for specific vehicle types, the result is an estimate of specific resource needs and costs for over the road vehicle operations. These vehicle related resource costs include driver costs, fuel costs, maintenance costs (repairs, tires, cleaning and other related costs), registration and license costs. In addition to direct operational related costs, provision is included for assignable indirect costs for the fleet operations. These include depreciation, cost of capital, insurance and administrative overheads.

Administrative costs arise from the need for management and supervision, billing and accounting, information technology, sales and marketing, and provision of business premises for basing and operating the fleets. Insurance costs represent those expenses incurred by the fleet operation in relation to loss prevention including safety training, setting aside funds in an "insurance reserve" (in the case of fleets that "self insure"), covering accident costs where losses are not claimed against insurance as well as provision for costs associated with purchasing fleet insurance premiums.

In a normal fleet business, such an activity based costing model will also normally include having the ability to compute interest costs for moneys invested in equipment equity and for working capital of the business as well as provision for an operator profit margin from which the fleet business owner earns a "return on investment".

In relation to the foregoing, the client has requested that the costing model ignore issues related to debt and equity financing and that the "cost of capital" simply be applied in a context that allows a range of opportunity cost for equipment capital between 6% and 8.6% annual rate applied to the entire invested capital. Without re-programming our model, which permits actual business parameters to be entered and evaluated (and compared to the client assumptions), we simply have set up the model to default to an annual interest rate of 7.3% (the middle of the client supplied range), applied to a loan assumed to represent 100% of the cost of the equipment and with a default "operator margin" of 0% of revenue (since the allowed "cost of capital" has been applied to the entire investment cost in equipment -- the client has deemed the average "cost of capital" to have already taken account of the operator's return on equity for the business).

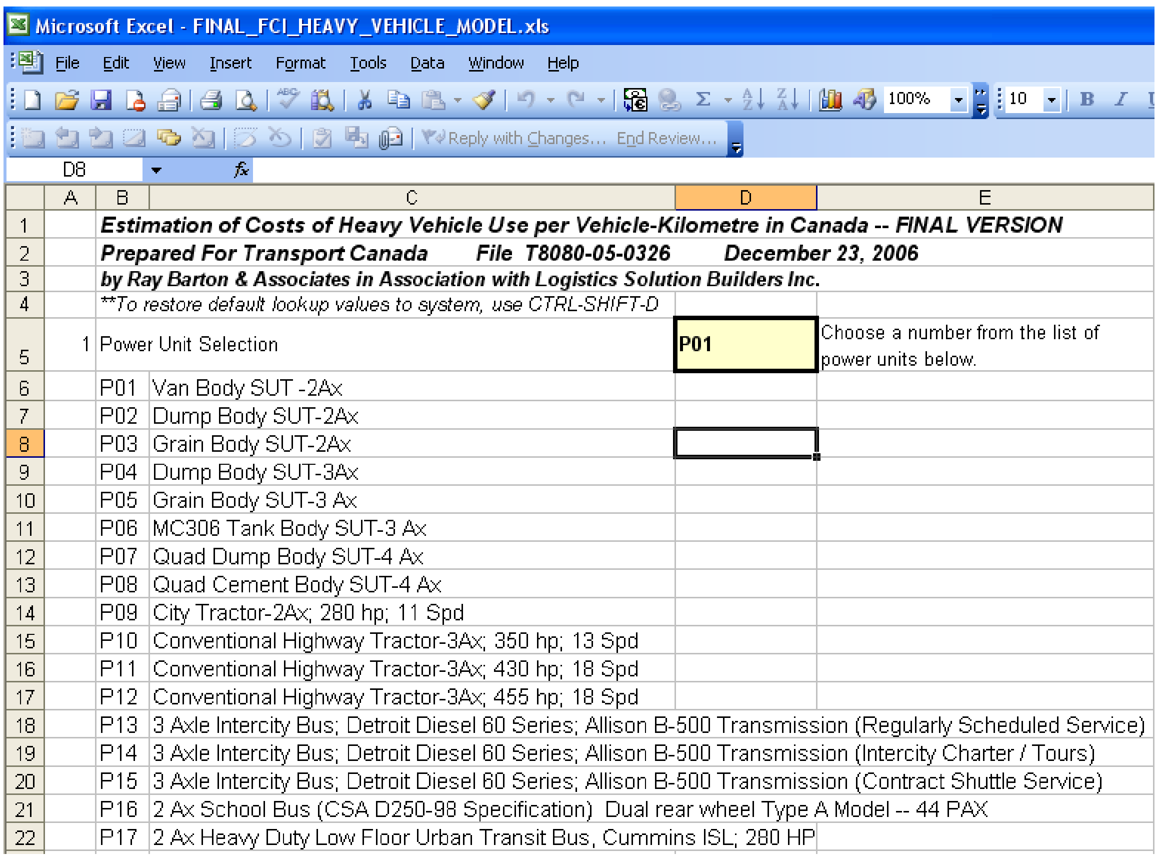
For comparison purposes, "*Operating Costs of Trucks In Canada"* for the base year of 2000 suggested that industry average financial parameters reflected 75% of equipment costs financed, average interest rates charged the trucking industry of 8%, with "operator margin" levels set between 2.5% and 5% of revenues. These operator margins were shown in that report to correspond to an internal rate of return for the fleet owners of between 7% and 10% on equity. In comparison to the client supplied assumption of between 6% and 8.6% of equipment costs as the "full cost of capital", the over-all "bottom line cost" appears to be of the same general magnitude using both methods.

While the model has been developed to identify costs by province, the costing components and over-all results can be applied to provincial activity statistics for developing weighted regional and national costs.

4.0 Overview of Modelling Approach

Equipment Selection

To enumerate all of the foregoing cost components, for vehicle classes listed in Section 2.1, we developed an Excel based costing spreadsheet that calculates annual component costs for a single vehicle configuration -- operated as part of a fleet operation -- for each of the vehicle body type configurations listed in following Exhibits 4.1 and 4.2.



	A	B	C	D	E
1		***Estimation of Costs of Heavy Vehicle Use per Vehicle-Kilometre in Canada -- FINAL VERSION***			
2		***Prepared For Transport Canada File T8080-05-0326 December 23, 2006***			
3		***by Ray Barton & Associates in Association with Logistics Solution Builders Inc.***			
4		***To restore default lookup values to system, use CTRL-SHIFT-D*			
5	1	Power Unit Selection		**P01**	Choose a number from the list of power units below.
6		P01	Van Body SUT -2Ax		
7		P02	Dump Body SUT-2Ax		
8		P03	Grain Body SUT-2Ax		
9		P04	Dump Body SUT-3Ax		
10		P05	Grain Body SUT-3 Ax		
11		P06	MC306 Tank Body SUT-3 Ax		
12		P07	Quad Dump Body SUT-4 Ax		
13		P08	Quad Cement Body SUT-4 Ax		
14		P09	City Tractor-2Ax; 280 hp; 11 Spd		
15		P10	Conventional Highway Tractor-3Ax; 350 hp; 13 Spd		
16		P11	Conventional Highway Tractor-3Ax; 430 hp; 18 Spd		
17		P12	Conventional Highway Tractor-3Ax; 455 hp; 18 Spd		
18		P13	3 Axle Intercity Bus; Detroit Diesel 60 Series; Allison B-500 Transmission (Regularly Scheduled Service)		
19		P14	3 Axle Intercity Bus; Detroit Diesel 60 Series; Allison B-500 Transmission (Intercity Charter / Tours)		
20		P15	3 Axle Intercity Bus; Detroit Diesel 60 Series; Allison B-500 Transmission (Contract Shuttle Service)		
21		P16	2 Ax School Bus (CSA D250-98 Specification) Dual rear wheel Type A Model -- 44 PAX		
22		P17	2 Ax Heavy Duty Low Floor Urban Transit Bus, Cummins ISL; 280 HP		

Exhibit 4.1: Power Unit Options for Costing Model

	A	B	C	D	E
24	2	Trailer Unit Selection		T00	Choose a number from the list of trailer units below.
25		T00	No trailer unit		
26		T01	Tandem axle Van Trailer		
27		T02	Tandem axle Flat Deck Trailer		
28		T03	Tandem axle MC307 Stainless Steel Tank		
29		T04	Tandem axle Grain Dry Bulk Hopper		
30		T05	Tandem axle Dry Bulk Pneumatic Trailer		
31		T06	Tridem axle Van Trailer		
32		T07	Tridem axle Flat Deck Trailer		
33		T08	Tridem axle MC306 Tank Trailer		
34		T09	Tridem axle End Dump Trailer		
35		T10	Tandem Lead B Train Pulling Tandem Dry Bulk Hoppers (Grain)		
36		T11	Tridem Lead B Train Pulling Tandem as Van Bodies		
37		T12	Tridem Lead B Train Pulling Tandem as MC306 Tanks		
38		T13	Tridem Lead B Train Pulling Tandem as Dry Bulk Pneumatic Tanks		
39		T14	Tridem Lead B Train Pulling Tandem as Dry Bulk Hoppers (Grain)		
40		T15	Tridem Lead B Train Pulling Tandem as Flat Decks		
41		T16	Tridem Lead B Train Pulling Tandem as Container Chasses		
42		T17	Turnpike Double Unit Vans (2-Tandem with A-Dolley Converter		
43		T18	Triple Combo Units (3-26 foot units) Van		
44		T19	Rocky Mountain Double Unit (Van)		
45		T20	Four Axle Van Trailer (Quebec Quad)		
46		T21	Single Dual Axle Van Trailer		

Exhibit 4.2: Trailer Unit Options for Costing Model

To undertake a cost evaluation, the user specifies a "power unit" through specifying a choice among P01 through P17 (Exhibit 4.1) and can then choose a "trailer unit" by selecting from T01 through T21 (Exhibit 4.2).

Note that the set of vehicle body configurations provided in Figures 1 and 2 were arrived at on the basis of the consultant's experience with the trucking sector, prior information gained in various truck traffic surveys and augmented by recommendations from the client steering committee, in a series of consultations.

The user's selection of power unit and trailer equipment drives a series of "lookup tables" in the model which will reflect standard base year operating characteristics and component costs for a vehicle configuration of the type specified for the client specified base year of 2000.

The foregoing user selection process takes place on an Excel worksheet labelled "Equipment Selection".

Region Selection, Annual Utilization, Nation of Carrier Domicile, Road Surface Selection and Specifying Vehicle Age

Once the user has selected the vehicle configuration of interest, a second Excel worksheet labelled "Region and Operation Selection" has been provided in the model. Again, the user's choices, in relation to the following parameters, drive a series of standard "lookups" in the model database.

6	3	Regional Scenario		R02	Choose a number from the list of regional scenarios below
7		R01	British Columbia		
8		R02	Alberta		
9		R03	Saskatchewan		
10		R04	Manitoba		
11		R05	Ontario		
12		R06	Quebec		
13		R07	New Brunswick		
14		R08	Nova Scotia		
15		R09	Prince Edward Island		
16		R10	Newfoundland		
17		R11	Northwest Territories		
18		R12	Yukon Territory		

Exhibit 4.3: Regional Option Selection

As illustrated in Exhibit 4.3, the user can specify the region for the fleet operation -- a factor that will drive "lookups" for standard year 2000 cost levels that vary according to province. Cost factors demonstrated to vary on a regional basis include operator wages, the wage component of maintenance costs, local fuel costs and licensing costs for carriers. An exception to this regional variation was reflected in the bus industry configurations (P13-P17), where available data constrained estimating most cost components to national average cost levels.

Operational Scenario		O2	Choose a number from the list of operational scenarios below
O1	Low annual km /year		
O2	Medium annual km/year		
O3	High annual km.year		

Exhibit 4.4: Operational Scenarios

When translating total vehicle costs of ownership to a desired per vehicle-km basis, a key variable to consider is the number of annual kilometres of use that a vehicle will experience. The ability for a user to select from "low-medium-high" total kilometre applications -- with the model driving "lookups" on the basis of user-selection, is another feature built in to this system. Again, for each vehicle type, selection of O1, O2 or O3 will select data for the analysis that reflects standardized values built in to the model for these various specifications.

National Domicile of Carrier Scenario		**N1**	Choose a number from the list of national domicle scenarios below
N1	Local Canadian Based Operator		
N2	USA Based Operator (Adjacent U.S.A. Region)		

Exhibit 4.5: Carrier Nation of Domicile

The feature illustrated in Exhibit 4.5 illustrates that the model has the capability to evaluate standardized costs assuming a local Canadian based operator (in the region of interest, already discussed under Figure 3) or to choose a USA based operator (assumed to be domiciled in an adjacent USA region, but operating in the Canadian region of interest). Again, standardized costs reflect differences in the base unit costs that were prevalent in the study year 2000, when the average annual exchange rate was $1 Cdn = $0.67363 U.S. Critical cost components that would differ when comparing a USA versus Canadian domiciled operation include base operator wage levels and burden, and base equipment purchase costs for the operation. Generally, requirements to remit fuel taxes and the opportunity to purchase fuel locally under IFTA provisions and licence reciprocity arrangements tend to minimize Canada versus USA cost differences in these other areas.

Road Surface Scenario		**80.00%**	Specify Percent of Distance Driven on Paved Routes
S1	Paved Surface	80.00%	
S2	Gravel Surface	20.00%	

Exhibit 4.6: Percent of Travel on Paved Versus Gravel Roads

Paved versus gravel operations are identified by means of the user specifying a percentage of annual travel assumed to take place on paved roads (the system requires a value between 0 and 100%). The model then assumes that the remaining percentage of travel is on high quality gravel routes. In the scenario listed in Exhibit 4.6, a standardized assumption of 80% paved travel is assumed, with the result that 20% of travel is on gravel roads. Again, this drives how the model "looks up" various unit costs that are affected by paved versus gravel road operation of vehicles.

Vehicle Age Scenario		A1	Choose a number to reflect average age of Vehicles
A1	Vehicle Age in Years: 0 - 5 Yrs		
A2	Vehicle Age in Years: 6 - 10 Yrs		
A3	Vehicle Age in Years: 11 - 15 Yrs		
A4	Vehicle Age in Years: 15 + Yrs		

Exhibit 4.7: Average Vehicle Age(s)

The feature illustrated in Exhibit 4.7 permits a user to adjust the fuel consumption and maintenance costs to reflect changes that occur as vehicles "age". For the trucking configurations modelled, fuel consumption for older vehicles tends to be more than for more recent vehicles, reflecting improvements in engine and drive technology that have been introduced over the 15 year timeframe between 1985 and 2000. In addition, as vehicles age, maintenance costs also rise.

Note that the foregoing feature does not adjust vehicle ownership costs downward, to reflect a "depreciated vehicle" scenario, so the user may be required to undertake a manual override of the standard depreciation model, when costing trucking configurations where power units are in service beyond the first 5 years. Also note that for vehicle configurations where a normally longer life in service is assumed (e.g. Bus configurations where standard costs are developed on a 15 year asset life), setting vehicle age to less than the normal asset life (e.g. A1, A2 or A3) does not adjust fuel consumption or maintenance costs upward, until the asset life is exceeded, for example by choosing A4.

Case Study Results

As noted previously, the model employs specific calculations, based on the scenario "look ups" described in Exhibits 4.1 through 4.7 using a specific instance of the same methodology that is commonly used by fleet operators to work out costs, hence rates to quote customers for undertaking specific fleet activity.

The author of this study has employed this methodology and used it to develop custom applications to consult within the for-hire trucking industry, and with operators of private trucking fleets, to undertake feasibility studies, quote new business, and benchmark cost efficiency of fleet operations. And, as described, this methodology has been widely publicized and disseminated in editions of "*Operating Costs of Trucks in Canada*" since 1972 -- most recently the report provided to Transport Canada by Logistics Solution Builders for the year 2005.

In order to employ this approach for the bus industry, the look up macros needed to be adjusted slightly, after having input from various bus fleet operators and by a bus industry reviewer. Note that the inter-city three axle bus configuration has been modelled in terms of three different "configurations" to represent three distinct types of bussing activity undertaken with the same class of road equipment. These configurations include:

- P13 representing vehicles engaged in providing ***scheduled*** intercity bus transportation.
- P14 representing similar vehicles engaged in providing tour or charter services to customers (which is often an intercity service, as well), and
- P15 representing similar vehicles operated on a contract basis as "shuttle bus services". (These can be intercity, but are more often generally over shorter distances in a local environment such as an airport shuttle, a shuttle to provide "commuting to work", etc.)

For the current application, following Exhibits 4.8 and 4.9 illustrate the nature of the calculations undertaken, and the output results generated for the Heavy Vehicle Sector in Canada for the base year of 2000.

	A	B	C	D	E
1		***Estimation of Costs of Heavy Vehicle Use per Vehicle-Kilometre in Canada***			
2		***Prepared For Transport Canada File T8080-05-0326***			
3		***by Ray Barton & Associates in Association with Logistics Solution Builders Inc.***			
4					
5	**A.**	**Vehicle Operational Productivity**			
6		1	Average Trip Travel Distance in KM	**160.00**	
7					
8		2	Number of Trips per Working Day (Fractional Allowed)	**2.00**	
9					
10		3	Number of Days Worked Per Year	**250.00**	
11					
12			***Annual Distance Travelled in KM***	***80,000***	
13					
14		4	Average Travel Speed in KM/Hour	**31.00**	
15					
16			Average Trip Driving Time (Hr)	5.16	
17			Average Daily Driving Time (Hr)	10.32	
18			***Average Annual Driving Time (Hr)***	***2580.65***	
19					
20		5	Average Waiting / Loading / Unloading (Paid) Per Trip (Hr)	**2.00**	
21					
22			Average Non Driving Time (Paid) per Trip (Hr)	2.00	
23			Average Non Driving Time (Paid) per Day (Hr)	4.00	
24			Average Annual Non Driving Time (Paid) (Hr)	1000.00	
25			***Total Annual Hours***	***3580.65***	
26					
27		6	Vehicle R.G.V.W. (kg)	14,600	
28			Vehicle Tare Weight (kg)	5,500	
29			Average Vehicle Payload (kg) or (seats)	7,500	
30			Percent Loaded Km	50.0%	
31					
32		***Per Vehicle Annual Tonne-km or Thousand Pass-km of output.***		***300,000***	
33					
34		7	Per Vehicle Fuel Consumption Rate (litres / 100 km)	37.0	
35					
36			***Per Vehicle Annual Fuel Consumption (litres)***	***29,600***	
37					
38					
39		8	Percent of Distance Driven on Pavement	80.0%	
40			Percent on Gravel	20.0%	
41					
42			***Repair Adjustment Factor:***	1.04	
43					
44			***Power Tire Adjustment Factor:***	1.14	
45					
46			***Trailer Tire Adjustment Factor:***	1.13	
47					
48			***Driving Pay Adjustment Factor:***	1.02	
49					
50					

Exhibit 4.8: Page One of Model Calculations (Vehicle Productivity)

Exhibit 4.8 illustrates the first page of model output calculations where the various "look - ups" described in earlier sections have given rise to:

- Standardized estimates for average trip distance, trips per average day and days worked per year forming the basis for estimating annual standardized kilometres of travel.
- Standardized average speed estimates which translate kilometrage to driving hours.
- Per trip waiting, loading, unloading (paid) time which translate to "other paid time" that is not driving … which also (combined with time for driving) translates to annual hours worked.
- Standardized GVW and average payload information, together with percent of operated kilometres, translate to annual tonne-km or passenger seat-km of vehicle output … when considered with annual distance travelled.
- Fuel consumption rates, in litres per 100 km of travel, translate to annual litres of fuel used by the vehicle type / operation selected.
- Percentage paved versus gravel reflected in adjustment factors applied to repairs, tires, and driving pay. (Note that 100 % paved will result in default adjustment values of 1.00 for these unit cost adjustment factors.)
- Adjustments to fuel consumption levels reflecting vehicle age beyond the standardized assumptions, if dealing with older vehicles.

In all of the foregoing, the "lookup" system developed by the consultant reflects "average information" gleaned from a variety of information sources -- combined together -- as the best available estimates for these various productivity factors for the truck and bus industries in the base year 2000.

Note that the values highlighted in yellow can be customized and overridden, by the user, if interested in testing the sensitivity of the model's output to different unit parameters -- or if dealing with a specific micro model for a particular hauling circumstance -- where the actual values are known to differ from our standardized average case study assumptions.

By altering these values, the user can modify the productivity factors on this page of output (see Exhibit 4.8) and the related costs calculation (Exhibit 4.9).

Data sources used to develop the look-up tables contained within the model are discussed in Chapter 6.

	A	B	C	D	E
59	**B. Vehicle Operational Costs**				
60					
61		1	Driver Costs		
62			Hourly Pay Rate	$17.50	
63			Cents Per Km Pay Rate	27	
64			Pay Driving by the KM (=1), otherwise Hourly Paid	0	
65			% Wage Burden	25.00%	
66			Non-Driving Paid Hourly	$17,500	
67			Driving Pay	$63,915	
68			Wage Burden (Benefits, Holiday Pay, etc.)	$20,354	
69					
70			***Total Driver Costs***	***$101,768***	
71					
72		2	Fuel Costs		
73			Fuel Price (cents / litre)	62.5	
74					
75			***Total Fuel Costs***	***$18,500***	
76					
77		3	Repair & Tire Costs		
78			Repair and Tire Costs (cents / km)	22.186	
79					
80			***Total Repair and Tire Costs***	***$17,749***	
81					
82		4	Licence Costs		
83			***Annual Licence Fee***	***$426.00***	
84					
85		5	Vehicle Ownership Costs		
86			Power Unit Purchase Cost	$77,000	
87			Power Unit Salvage Percent	0.2	
88			Power Unit No of Years	10	
89			Trailer Purchase Cost	$0	
90			Trailer Salvage Percent	0	
91			Trailer Number of Years	5	
92					
93			***Annual Vehicle Ownership (Depreciation) Costs***	***$6,160***	
94					
95		6	Overheads		
96			Interest Rate:	7.30%	
97			Percent Financed:	100.00%	
98			Insurance as Percent of Cost:	3.00%	
99			Administration as Percent of Cost:	12.50%	
100			Margin as Percent of Cost:	0.00%	
101			Interest Financing Equipment	$2,811	
102			Insurance Costs	$5,234	
103			Administrative Costs	$21,807	
104			Operator Margin	$0	
105					
106			***Annual Overhead Costs***	***$29,851***	
107					
108			**TOTAL VEHICLE OPERATING COSTS**	**$174,454**	
109					
110			**COSTS PER VEHICLE RUNNING KM**	**$2.181**	
111			**COSTS PER VEHICLE WORKING HOUR**	**$48.72**	
112		**COSTS PER TONNE-KM OR THOUSAND PASS-KM**		**$0.582**	

Equipment Selection / Region and Operation Selection / **Trip Details and Costs**

Exhibit 4.9: Page Two of Model Calculations (Unit Costs Applied)

Page Two illustrates the "work up" of annual operating costs for the user selected scenario, as developed by the model, in terms of the various cost components totalled. These are then translated, using the productivity information from Page One calculations, into desired vehicle operating costs per running kilometre travelled, per vehicle working hour, and per tonne-km (for trucks) or per thousand passenger-km (for bus applications). Once again, our model's standardized unit cost factors -- extracted by the various "look ups" are set within the yellow fields, so that a user of the model can develop sensitivity tests and customized evaluations -- where the impact of changing from our standardized values of unit cost is desired to be known. All that is required is to alter the values in the yellow fields, where a desired change needs to be evaluated.

When looking at the calculation methods in Exhibit 4.9, users should recognize that the model is a generalization being applied to an industry sector, and that individual businesses may have specific cost structure methodologies that differ from the standardized treatment shown in the model.

For example, one can find hauling situations where one company may pay drivers by the mile, a competitor may be paying a percent of revenue (total costs plus profit), and a third fleet may be paying by the hour -- all for similar hauls. Notwithstanding these differences in actual driver payment method, it is still realistic to note that the overall amount of compensation paid all three drivers reflects the local "wage market for driving services" and will therefore tend to be equal -- in terms of total compensation paid -- for all three fleets.

For modelling therefore, we have endeavoured to reflect common industry practices -- and realistic cost levels for components, which we expect to provide generally equivalent cost levels to the marketplace. We recognize that specific fleets may actually have a cost structure that would correspond to slightly different calculation methods than used in Exhibit 4.9, however component cost levels arrived at with our formulae are reasonably representative. So for example, in reference to the look-ups in the model, drivers for longer distance operations tend to be compensated by a distance pay rate and shorter distance operations tend to be compensated by the hour. As stated previously, all of the look up values can be overridden, where specific information is known and one desires to reflect the specifically known information in the model.

5.0 Cost Adjustments

Note that *vehicle size/weight* is partially accounted for by selection of vehicle type. Payload can be adjusted directly to probe unit cost implications of "light loaded" vehicles.

Vehicle age can be partially accounted for by the model coefficients included for selecting older populations of vehicles, giving rise to increased fuel consumption and maintenance costs for vehicles, as truck configurations are selected in five year increments beyond "normal" fleet practices of operating trucks over 5 years, as documented in *"Operating Costs of Trucks in Canada"*. Note that the coefficients included in this model reflect some detailed life cycle investigations undertaken by the author for Canada Post and the City of Edmonton for older fleets and for energy modelling of the diesel truck sector for the National Energy Board, however there is very limited data available directly on "aged vehicles" and their cost structure -- so the coefficients provided should be considered as preliminary estimates based on a statistically small experience base.

Note also that in the first five years of use, power units generally are depreciated to a book value that is only 20% of the purchase price of new vehicles. It has been left to the user to consider book value, residual life, and expected salvage values for truck vehicles in the aged categories -- adjusting the vehicle values accordingly and possibly selecting a lower annual utilization scenario -- reflecting the fact that older vehicles tend to be used in local and lower utilization hauls.

Trip distance can also be directly modified by the user of the model for a sensitivity evaluation.

6.0 Overview of Information Sources Used

As noted already, the consulting principal of Logistics Solution Builders has undertaken a significant number of motor carrier fleet costing evaluations for a variety of equipment fleets -- in this case over a thirty year period since 1975.

From this expertise, as a starting point for undertaking "data mining" of various prior directly relevant studies, specific projects were selected and reviewed -- and, where applicable, standardized utilization and cost coefficients were obtained and tabulated from the consultant's recollections and working notes for assignments closest in time / configuration to the desired case studies in this project.

Specific studies that were deemed most directly relevant for this undertaking included information coefficients from the following projects:

- Operating Costs of Trucks in Canada 2000, undertaken by the consulting principal, which contains utilization and cost profile information for the base year for power configurations P01, P10, P11, P12 and trailers T01, T02, T03, T05, T06, T07, T11, T12, T13, T15.
- A 1998 study of dump trucking augmented by a 2006 study of the mining sector, which contained utilization and cost profile information for the following configurations (factored to base year using "Operating Costs of Trucks In Canada" reports from 1998, 2000 and 2006): P02, P04, and T09.
- 1997 and 1999 studies of grain trucking in Western Canada, for Transport Canada, which contained utilization and cost profile information for the following configurations: P03,P05,T04,T10 and T14.
- A 1999 petroleum company distribution study which included cost profile and utilization information for the following configurations: P06, T08 and T12 configurations.
- A 1999 Vancouver Port Authority Container Study which included cost profile and utilization information for the following configurations: P09 and T16.
- A year 2000 Alberta Economic Development Study on Long Combination Vehicles which included information for T17, T18, T19.
- A year 1996 (updated in year 1998) study for Canada Post Corporation which included information for vehicle configurations P09 andT20.

The foregoing array of prior studies left information gaps in "base data" with respect to the two quad straight truck configurations (P07 and P08) as well as the busing configurations (P13 through P16). Note that the consultant had undertaken a comprehensive review of the urban diesel bus fleet operations for Edmonton Transit in year 1995 -- but significant changes were anticipated due to operational changes and life cycle management strategies implemented since that time.

Fuel Consumption Information Base

Although the foregoing projects all had fuel consumption rates associated with the various vehicle configurations, the consultant had undertaken some uniform fuel consumption / energy related projects for fleets of various sizes and weights, and this information was reviewed as a cross check / alternate source of information. These data sources included:

- Specific projects undertaken for the Office of Energy Efficiency of Natural Resources Canada for motor truck and bus fleets.
- Consultation (selective) of trucking fleets in specific operational environments of interest (e.g. Arctic operations, mountainous operations, urban fleets, specific private fleets).
- Reference to societies, suppliers and related engineering publications from authorities such as the SAE (Society of Automotive Engineers), the Cummins Engine (Vehicle Selector) Guide, and firms such as Michelin Tire / Goodyear, etc.

Industry Contacts

To augment and cross check data developed from our desk research activity, we contacted various fleet operators and suppliers to the industry including manufacturers of tractor units and single unit truck chassis, suppliers of buses and suppliers of trailer units in various configurations.

We also obtained excellent cooperation and assistance from the fleet maintenance manager responsible for Edmonton Transit who shared with us (on a confidential basis) internal cost figures and comparisons as well as an overview of Canadian transit system operational factors and costs which he has available as a "benchmarking" database from which to draw comparisons.

Contact was also made with scheduled and charter bus operators in both Eastern Canada and Western Canada as well as with some representative school bus operations.

To develop an understanding of the 4 axle quad straight truck configuration, we contacted two operators of such vehicles that use them in urban cement hauling applications -- P08. For the urban dump truck operations, using P07, pro-forma adjustments were undertaken to coefficients for tandem axle dump units, based on similar considerations found for the cement industry using this type of chassis.

Special Bus Sector Advisory Assistance Provided by the Client

In addition to our direct industry contacts, a member of the client steering committee reviewed and provided extensive commentary on our bus sector configurations, reflecting that individual's experience as a consultant to the bus industry as well as reference to CUTA (Canadian Urban Transit Association) and Statistics Canada information sources.

Following Exhibit 6.1 contains information provided to us by the bus industry reviewer for inclusion in the FCI model:

Exhibit 6.1: Bus Industry Review Supplied Coefficients

	Intercity bus - Schedule d	Intercity bus - Charter	Intercity bus - Shuttle	School bus	Transit bus
Vehicle Type Parameter	P13	P14	P15	P16	P17
Daily trip Distance	467.00	300.00	200.00	100.00	167.00
Number of Trips/Day	1.0	1.0	1.0	1.0	1.0
Number of Days	300	250	250	220	300
Average Speed	60	60	40	25	23
Paid Waiting Time	Ø	Ø	Ø	Ø	Ø
Payload Seats	22	43	27	33	15
% Loaded	96	94	92	65	92
Fuel Consumption Rate (l/100 km)	37.5	37.5	37.5	45.0	57.5
Driver's Pay ¢/Km	50	37	38	65	116
Hourly/ Mileage Cursor	1	1	1	1	1
% Wage Burden	35.0	25.0	25.0	18.0	50.0
Fuel Costs ¢/Litre	55	55	55	55	55
Repair Costs ¢/Km	29	27	23	25	69
Licensing Costs	1300	1300	1300	30	522
Insurance %	1.5	3.0	3.0	3.0	1.5
Administration %	20.0	17.5	15.0	12.5	25.0

In noting these coefficients supplied to us by the client, we are concerned with several operational aspects of the foregoing information that differ from our experience with bus fleets as well as some information provided to us by bus operators, as follows:

- Suggestion that school bus units and transit buses make only a single trip per day appears to neglect the known "split peaking" nature of these bus operations, wherein vehicles generally go in service for a period in the morning (for journey to school or journey to work) -- are less busy midday -- and then go back in service for the return journey home. We do not disagree with the client's over-all annual kilometre utilization of these buses, however we would have shown the operations to be made up of 2 trips per day, with the average trip length to be 1/2 of the value shown by the client in the table. Cost wise, the model generates the same answer using either methodology -- but we would consider our approach to make more operational sense.

- Setting "paid waiting time" equal to zero may not be accurate if the bus operator expects the vehicle operator (who is often paid hourly) to perform a pre-and post trip (or daily) inspection of the vehicle. Again, we are assuming that the client is seeking to avoid "double counting" of driver costs -- in that the apparent setting of driver pay in the exhibit has been calibrated to an annual driver cost per vehicle divided by the annual kilometres travelled.

- Working with all driver pay costs on the basis of "per kilometre" rates of pay (whether intercity or more urban / regional types of operations), as calculated by dividing an annual driver cost per vehicle by kilometres travelled may not reflect actual business practices for shorter distance / urbanized operations. We would have preferred to work with driver pay scenarios based on per km costs for intercity bus configurations (reflecting that longer distance operations frequently pay drivers by the km) and per hour costs for the school bus and transit bus configurations, where costs are more frequently incurred by the bus operator based on the hour. In the end, we acceded to the client's bus representative and built the model using the prescribed factors noted above. *Care should therefore be exercised when extrapolating the model for situations where the hourly "duty cycle" is a constraint (as in urban congested conditions) -- as* ***driver cost projections based on the per km values cited in Exhibit 6.1 may <u>understate</u> the actual costs.***

7.0 Overview of Cost Components

7.1 Labour costs of drivers

The model estimates labour costs of drivers based on non driving paid time paid at an hourly rate of pay, driving paid (optionally) by the unit of distance or by the hour, with a burden percentage added to cover costs for additional pay and benefits such as paid vacation time, costs for fleet operator contributions to medical insurance, pensions, etc.

Unit costs tabulated in the model database reflect extensive survey comparisons of costs for base wages and benefits within the various provinces and territories (and adjacent U.S. jurisdictions as undertaken in 2000 for "*Operating Costs of Trucks in Canada*" as well as on case studies for other vehicle configurations, in which actual driver rates of pay were ascertained.

Sources of driver cost information for these prior projects had been developed based on:

- Discussions with fleet operators in all the regions.
- Reference to available collective bargaining results published in internet references and trade publications.
- Review of corporate web-sites, many of which publish driver compensation information.
- Review of newspaper classified advertisements and web-based driver recruitment sites for carriers and driver pools.
- Review of transportation and other wage statistics from Statistics Canada, the US Department of Labor, Published Teamsters Wage Rates, and US County and State Wage Survey Statistics.

Considering these sources, Logistics Solution Builders developed our best estimate for average driver wages applicable for the hauling cases in our study.

Costs for Driving Activity

As noted previously in Section 4.0, the intent of our model was to provide a reasonable industry generalization of cost level…although we recognize that specific compensation calculations can and will differ between fleet operators.

For trucking, driving costs are influenced by distance, hours and tonnage associated with a haul. Larger highway vehicles are costed on the basis of calculating driver wages on either a per-kilometre rate, or an hourly rate -- whichever is highest. This is standard procedure and results in most cases in line-haul pavement kilometres being rated on a distance basis and urban and gravel kilometres paid on an hourly basis, due to slower vehicle speed.

Urban straight truck operations are costed on an hourly pay basis.

As noted previously, at the client's request, driving costs for all bus operations were costed on the basis of a per kilometer rate of cost. Our preference would have been to model regularly scheduled intercity bus operations (P13) and intercity tour and charter operations (P14) using per km bus operator cost levels. Shorter distance contract / shuttle operations (P15), school bus (P16) and urban transit applications (P17), would have been more accurately modeled using calculations that reflect hourly pay and benefits, however this differed from the client steering committee information provided.

Costs for Loading and Unloading Time

Cost for driver time resulting from loading and unloading of payloads is included using the appropriate hourly rate.

Wage Burden Costs

In addition to paying base hourly and mileage wages for driving and loading / unloading work performed, a wage burden percentage is applied to cover costs associated with non worked paid time (e.g. Vacation and Statutory Holidays), driver benefits such as pensions, medical premiums, etc. that are provided by the employer. Burden percents used have been developed from analysis and consultation with fleet operators.

7.2 Fuel costs

Fuel costs reflect average consumption levels expected for each vehicle configuration (expressed in litres per hundred kilometres) as well as the expected fuel price for fuel purchases made in the region of interest.

Fuel costs are a result of the influence of distance traveled, vehicle fuel consumption, and of course fuel prices. To support "*Operating Costs of Trucks in Canada*", Logistics Solution Builders maintains a database of realistic fuel consumption rates for each case study hauling scenario. These are based on, and updated with, consultation of fleet operators, discussions with distributors of power units to the industry and review of published literature on fleet energy management benchmarks and targets.

The fuel price values cited in *Operating Costs of Trucks in Canada* 2000 report were used in this study, for trucking fleets. In relation to that report, the methodology reviewed average annual 2000 fleet discounted fuel pricing in the most heavily populated areas of each region. Costs included provincial and state tax as well as Canadian excise tax on fuels.

These values are generally representative of averaged annual roadside cost levels determined by M.J. Ervin and Associates, reduced according to confidential consultation with petroleum industry marketers concerning the available discounts for purchasers who secure lower prices through larger annual quantity purchases of fuel.

Such discounts vary according to amount of fuel purchased. The report does not reflect maximum discounts earned by extremely large fleets. Hence, the largest international fleets, such as Yellow Roadway Corporation, or Trimac, that operate fleets in the thousands, would be expected to qualify for larger discounts -- and lower prices, than our lookup table shows.

The fuel cost levels in Operating Costs of Trucks in Canada tend to reflect discounted fuel prices paid by smaller and medium sized fleet operations (say 20 to 150 line haul vehicles in total).

For bus fleet fuel costs, the project's bus industry reviewer considered our fuel cost values for small to medium sized trucking fleets to be higher than fuel price levels he deemed to be representative for that sector. It was speculated that this difference party comes from two sources:

1. Many bus fleets are large fuel customers -- perhaps qualifying for discounts that are larger than generally noted for the trucking industry.
2. Many bus fleets provide their own facilities for storing and handling fuel (and presumably some of these costs end up being classified as "terminal" or "administration" costs). Due to product stewardship and environmental liability concerns associated with "spills", use of such dedicated fuel facilities has been significantly declining within the trucking sector.

For these reasons, using the modeled fuel prices from the trucking industry for buses may partially double count costs that have been previously included within the administration and may reflect smaller discounts than bus customers obtain.

At the instruction of the bus industry reviewer, a diesel fuel cost of 55 cents per litre (not differentiated according to province, but assumed as a "national cost level") was used in the model.

7.3 Repair and tire costs

Prior studies adopt a very disaggregated view of these costs -- the costs required to maintain a vehicle in operation over the designated lifetime of the vehicle. The current effort groups these costs together in the model.

Repair Costs

Repair costs used in our study represent expected costs of parts, lubricants, oil, and labour associated with the maintenance and repair of the particular equipment type. Our database on repair costs was updated in consultation with equipment dealerships, fleet managers, and reference to US Bureau of Commerce and Statistics Canada Industrial Price Indices.

We have assumed that repairs were undertaken under efficient shop management and that a prudent preventive maintenance system was employed that was compatible with equipment manufacturer recommended service intervals, warranties and other best practices.

Cleaning Costs

The cost of cleaning tractors, flatdeck trailers and van freight trailers has a very small effect on total operating costs.

Annual costs of cleaning bulk tanks vary with the type of commodity carried and the quantity of different bulk commodities transported during the year. An average of tank trailer cleaning costs was developed from discussions with various bulk tank truck carriers as well as a review of prices charged at commercial tank cleaning facilities.

Cleaning cost impacts can vary for the bus industry -- for many operations this is a significant cost factor that was included in our maintenance category and for some operations (for example, school bus), costs may be partially captured in the driver cost category (to extent the driver often cleans the vehicle).

Miscellaneous Costs

Under a category described as "transport costs", Operating Costs of Trucks in Canada includes a miscellaneous cost category to reflect all those factors that may be attributed to extra equipment that are not normally viewed as part of a vehicle's standard configuration. This may represent special pumps, hoses, safety equipment, dunnage, small tools, chains, tarping, cargo heaters* or refrigeration* equipment[1]. These costs will vary with area of operation and also with the specific type of product hauled.

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[1] Starred items are not included for this analysis, but such items would normally be included in the category "miscellaneous costs", when evaluating specialized trucking applications.

The consultant was advised that the bus industry uses the term "transport cost" to refer to some entirely different cost items; hence to avoid confusion, we have referred to these costs -- in this report -- as "miscellaneous costs".

Notwithstanding this minor clarification, we note that the miscellaneous cost category is not a very large cost component -- hence this project has included this small aggregated cost category within our model's maintenance costs for the various configurations.

Tire Costs

Tire unit costs in our database were updated by Logistics Solution Builders through consultation with suppliers of tires, our knowledge base from prior related fleet studies, and reference to industrial price indices published by Statistics Canada and the US Bureau of Commerce. Actual in-service costs for trucking tires are a reflection of the following factors:

- Number of tires for the particular vehicle and cost of new tires purchased in each region.
- Life of a tire in each service application.
- Cost of retreading, when retreading is desirable, and life of a retread tire for each region.

7.4 Registration and licence fees

For those configurations analysed directly in the year "*2000 Operating Costs of Trucks in Canada"* publication, annual license fees had been developed through a detailed review of Canadian license costs to reflect the provincial or territorial charges for licensing the vehicle configurations studied as found in the Truck License & Tax Manual: A Guide to Canadian Regulations, 2000 edition published by J.J. Keller and Associates. At the same time, US license costs are based on registration of a Five Axle Tractor Semitrailer Combination to the accepted interstate highway standard of 80,000 lbs (36,364 kg) gross vehicle weight.

The registration costs for equipment types not covered in the "*Operating Costs of Trucks*" publication, gaps were filled based on selected state jurisdictions, within each region, and applicable charges were secured from Trucking Permit Guide, 2005 edition published by J.J. Keller and Associates. Two axle tractors were assumed licensed at 14,600 kg in all jurisdictions.

As noted previously in Exhibit 6.1, bus registration costs were supplied by the client.

7.5 Expected variability from the model's default values

The motor carrier sector is a very diverse segment of the economy. This is one of the factors that has historically impeded the development of statistical models and is especially one that impedes the use of "statistical averages" for accurately estimating trucking costs in specific situations.

From the Central Limit Theorem, where σ (sigma) represents the statistical variance, in situations where the variance (σ) is quite large, a precise estimation of the mean value for an underlying process requires very large statistical sampling to be undertaken.

In the face of these difficulties and with the relatively small published statistical sampling of Canada's motor carrier industries, the cost modelling approach used for this assignment -- derived from the *Operating Costs of Trucks in Canada* methodology -- is essentially that of applying an ***"expert system"*** for estimating total vehicle costs per kilometre.

Accurate Determination of Truck Costs: Rate Making

In considering the question of "accuracy" of our estimates, we look to the most precise determination of fleet costs -- that which is undertaken by firms when they are setting prices to bid for their services -- the rate making process.

As stated previously, the methodology laid out for this project is an enumerative process that relates costs to unit component costs (e.g. wage rates per hour, fuel prices per litre, repair costs per vehicle km operated, etc.) The unit costs, estimated separately, are then "summed up" to derive a total cost which can be expressed as a vehicle operating cost per kilometre…for a specific situation.

If we were a trucking company using a model similar to the one developed for this project, to forecast the operating costs for a particular haul that we were bidding on -- we would require the accuracy of our cost forecast to be very precise. Given the low profit margins of the industry, and the competitiveness of the bidding process, one would expect that our over-all cost estimate -- for some new business -- will need to be accurate ± less than one percent. If we significantly over estimate the costs, our price will be too high and the business will be awarded to another bidder. If we under estimate the costs, the business will be awarded to us -- but will likely be unprofitable for us.

In this type of application of our methodology, of course, our firm would have the luxury of exact knowledge (a 100% sample, statistically) of our immediate prior unit cost structure. We would know current and immediate future wage levels of our drivers; we would have an exact recent fuel cost structure, etc.

We would also have an exact specification for the haul in question -- providing such information as trip distance, trip cycle time, specific road speeds, etc.

At the same time, our firm would generally need to be "in synch" with the best practices of the industry as a whole -- otherwise our cost components might all be "too high", and we would not be awarded business -- using our cost estimates.

This being said, we know from experience that different truck operators pay different amounts for fuel. Different truck operators have different wage structures. Different truck operators have different purchase arrangements with different suppliers.

Some of the foregoing factors favour larger fleets, who perhaps command larger discounts from suppliers with whom they book larger amounts of business. Other cost factors (such as wages paid to drivers, or administrative costs) can be lower for smaller businesses. For these components, the variability (σ) is very large (commonly, variations can be found that are ± 10 or 20 percent, when looking at the individual components).

The evidence that both types of trucking business tend to have a similar "bottom line cost structure" is provided by the marketplace. Frequently, larger firms as well as a large number of smaller fleet businesses are found coexisting within the same marketplace. That is to say, on similar routes, hauling similar products, etc. -- we find both large and small fleet operators.

Less Accurate Estimating of Truck Costs: Benchmarking

Moving one step away from the more exacting needs associated with "rate making", very often firms need to benchmark their practices against one another -- or against what would be considered "best practices" for the sector as a whole.

For this type of determination, ***over-all costs*** can be estimated within somewhat greater tolerances, perhaps ± 5 percent.

These kinds of cost determination can be useful for assessing questions such as:

- Should our company operate (or cease to operate) a private fleet?
- What transportation rates are we likely to be able to negotiate, if our company put this hauling out for bid?
- What would be the trucking costs to use for assessing investment grade feasibility of a new project (that trucking companies may be inclined not to waste much time at bidding -- since the hauling is only a hypothetical piece of business)?

For these types of exercises, the principal of Logistics Solution Builders Inc. has applied the methodology used in this present study, for over twenty years. Essentially, the model provided, and the data sources used and described for each of the cost components, is the same quality of information that we have provided with this model.

The process provided is not a statistically based model, but it is an "expert system" that uses reasonable average information -- determined from discussions with industry experts, consultation with suppliers to the industry, etc.

This information are maintained in an ongoing live database of information, that is augmented periodically with new experience -- from actual hauling applications, as they are evaluated and information gathered. As noted elsewhere in the report, we consulted specific industry operators and suppliers, where gaps existed in our prior database --which relied heavily on the *Operating Costs of Trucks in Canada* report, a document that has been widely circulated --used, and scrutinized by industry, for many years.

Over-all, and this is not a statistically tested value, such as a mathematically derived "confidence interval", but reflects in the author's experience with actual hauling applications, the benchmarking estimates developed from the system and data base provided in this report should easily answer the need for the client to estimate total trucking costs on a cents per kilometre basis, for each of the vehicle populations in the sample, to within

± 5 per cent.

The above figure, which is the author's ***conservative*** opinion of the reliability of the estimates developed using this methodology, means that if our model estimates unit costs of $1.66 per kilometre for a specific configuration of vehicle….that it is safe to expect that unit operating costs over-all are likely to be between ± 5 % of this value, or between ± 8 cents per kilometre. This degree of accuracy is expected for a casual user, employing the model methodology, coupled with using with the expert opinion database represented by the look up tables provided.

Drilling Down to Individual Cost Components in the Model

The model provided to the client was built for the purpose of answering the need to estimate vehicle costs per kilometre, over-all, for various types of vehicles operated in Canada. It was not represented as a tool for doing detailed unit cost component analyses.

The component sub estimates (such as driver costs, or fuel costs, for example) are interesting and useful by-products, of the over-all methodology…but should probably be treated with an understanding that they may have a wider tolerance for variation within them, than are the estimates derived using the over-all model.

As already described in context of "firm size", the author's experience is that some unit costs tend to be lower for smaller firms (such as wages, and very simplified administrative structures) … but these are often offset due to scale economies in purchasing fuels, tires, consumables and equipment by the larger firms. As a result of these types of factor -- when one disaggregates to a specific cost component, larger variations between companies occur.

Because of the types of variations noted, and known by the author to be present within the trucking industry, specific unit cost components derived from an expert opinion sampling, versus an over-all industry survey, are likely to be accurate only ± 15 to 20 per cent -- if compared to a specific hauling application. These are the calibre of information used within our model's look-ups, because the over-all sampling size is necessarily small -- when consulting such experts.

This is to say, for example, that if our model data "look up" quotes a unit maintenance cost of 27.8 cents per kilometre for tires and repairs, that a specific operator of similarly configured equipment may easily have a unit cost structure, for that same grouped component, that is ± 6 cents per kilometre in comparison to the lookup value noted.

Again, some of the component variation may be accounted for by different purchasing and life cycle strategies. In the author's fleet consulting and costing experience, we have encountered situations where operator A purchases a "sturdier" component or vehicle and may have a lower maintenance cost than operator B, but this is traded off with a higher capital cost. Also, some significant differences in maintenance costs are known to occur between fleet operators based on the driver skills, and management thereof -- that can vary between fleets.

Of course, when we are considering the use of the model to estimate the average maintenance costs across the entire trucking industry that uses those types of vehicles -- one would expect, from the central limit theorem of statistics -- that the mean average maintenance cost should lie within a closer tolerance than the 6 cent value reported above. Essentially we are saying that if 2σ (the 95 percent confidence limit on the maintenance costs for an individual firm) is roughly 6 cents per kilometre, then our "expert estimate" for the mean value of the industry as a whole, will be much closer -- perhaps ±2 cents per km, if we are only estimating the average value for the over all industry. (Though no one has measured this hypothetical average value -- or we would have gladly used this for our "look up" table).

Because no one has specifically done surveys for each of the cost items in question, predicting the accuracy of each cost item in our model, as an estimate of the mean value, cannot be stated mathematically using an exact statistical confidence interval.

Estimated Error: Concluding Remarks

This being said, even if wider variations are present within individual model cost sub-components, the over-all purpose for which this model is intended, the Full Cost Investigation of the Various Motor Carrier Segments, should be well served using the model, and the look up values provided. For benchmarking purposes, that no doubt do not require accuracy any higher than ±5 percent over all, our approach has been mapped back to industry numbers with excellent results.

While overall accuracy of the estimates is good, since the precision of any one specific cost item can be much more variable – especially when mapped back to specific hauling situations, the user has been given the ability to over-ride the data lookups -- and thus do any required customization.

So if the model is applied by a user who has specific knowledge of a component – for a given province or a given route application – they can override the model defaults from the lookup tables – for particular components, and undertake a sensitivity analysis directly. Such application of the model would be closer to the author's "rate making" applications for this methodology. In these instances (driven by more exact data that is mapped to a specific context), accuracy that is much closer (say ± 1 percent), is easily achieved.

For situations where a user has a specific concern about the level of uncertainty in relation to a cost component, or a factor such as the "annual miles per year" or other parameter from the lookup table (but lacks any data about what the component is, specifically), a first order of magnitude estimate of that error would be to run the model first using the look-up value (the expert opinion)… and then to simply change the parameter by 20% … observing how much this affects the bottom line cost of vehicle operation per kilometre. This difference, if it is significant, could suggest that an attempt be made to gather more precise statistical data -- or to expand the panel of expert opinion, to try to further refine (perhaps confirming) the value from what is shown in the model's data base.

8.0 Vehicle Ownership Costs

Vehicle ownership costs were developed in the model by subtracting a vehicle "salvage value" from a "purchase cost" and annualizing by dividing by the equipment life period in years. Equipment purchase cost and expected lifetime information reflects dialogue with equipment suppliers and fleet operators and comparison to prior studies.

8.1 Cost of Capital (Financing Costs for Vehicle Purchase)

Interest costs for financing equipment purchase are developed in the model by inputting an assumed borrowing cost (annual interest rate), setting loan payback to correspond to equipment life (with a final "balloon payment of the loan made on retirement of the equipment, equal to the salvage proceeds from sale of the asset), and having the user specify a percentage of equipment purchase costs that are financed.

As noted in earlier discussion, to reflect FCI over-all "cost of capital" assumptions for other modes, a single interest rate was assumed and it was assumed that 100% of equipment capital investment is financed. Under these assumptions, the average annual opportunity cost for a vehicle asset, over its useful life of t years, can be calculated using the following formula:

Opportunity Cost of Capital = SOCCR x $(P_0 + P_t) / 2$.

Where:

SOCCR: Social Opportunity Cost of Capital Rate (Interest Rate)
P_0: The initial value of the vehicle
P_t: The residual value at selling age t in years.

8.2 Insurance

Insurance rates, as a percent of revenue, reflect recent risk and claims performance of commercial fleets within the trucking industry, historically a value between 3% and 3.5% of revenue. For the bus sector, calculations reflect (at median utilization), information on annual costs for insurance, per bus, as part of a fleet.

8.3 Miscellaneous costs

Administration costs have been applied to the hauling cases based on average industry levels for fleets and taking account of normal interest charges applicable to trucking businesses in Canada and the US during 2000.

As noted in previous discussions, the levels of cost reflect the consultant's prior experience working fleet productivity and costs for the year 2000 (as previously enumerated for each vehicle configuration), which in turn was based on industry consultation, literature review and related study.

Gaps, such as the desire to include bus sector fleets and equipment types not investigated previously (such as the four axle straight truck quad configurations) were filled using similar sources to those used for the prior study -- especially through consultation with urban bus, school bus and highway coach service providers.

9.0 Road and Bridge Tolls

There are relatively few toll facilities in Canada. There are four toll bridges located within Canada (all in Atlantic Canada), eleven international toll bridges (all connecting Ontario – U.S.) and three toll highways: Hwy 104 in Nova Scotia, Hwy 407 in Ontario and the Coquihalla Highway in B.C.

Actual revenues from truck traffic are available for only the Halifax-Dartmouth bridges. To estimate revenues from trucks truck traffic volumes are multiplied by the respective published toll rates for 5-axle tractor trailers, the most common vehicle type. Revenues determined in this manner are approximate only as they do not take into account all vehicle types as well as any discounts from special passes. MTO provided truck data fro the Ontario-U.S. bridges, while provincial transportation departments provided traffic data from nearly traffic counters for the other bridges.

As truck traffic volumes for ETR407 could not be obtained in any other manner, these were estimated by the consultant. For ETR407 2000 was first full year of operation. Trucking industry reports they try to avoid this route as much as possible to avoid toll rates. Taking this into account it is assumed that truck volumes are 5% of total traffic, compared to the 10% to 20% on most provincial highways. The revenue estimates for this facility therefore assume 5% truck volume divided equally between straight trucks at twice auto rate and half tractor-trailer combinations at three time auto rate to account for 12.5% of total published total revenues

Due to the lack of traffic data for buses (where available they were typically included with miscellaneous vehicle types) toll revenues from bus trips could not be estimated.

Total truck revenues for 2000 are estimated at $206.1 million as illustrated by Exhibit 9.1. More details are presented in Appendix B.

The extent to which a toll facility affects the costs to operate a vehicle obviously depends upon the extent to which the facility is used by that vehicle. For most heavy vehicle trips, tolls are either non-existent or paid very infrequently. However, for some whose regular route includes such a facility and use it on a regular basis, the cost could become significant. As a result, per-km costs associated with tolls need to be calculated on a movement specific basis.

Exhibit 9.1: Estimated 2000 Toll Facility Revenues From Trucks.

Facility	Annual Truck Volume	Toll charge for 5-axle tractor-trailer	2000 Revenues ($ millions)
Halifax–Dartmouth Bridges	867,000	$4.50	$2.6
Hwy 104 (N.S.)	n/a	n/a	$5.0
		Total Nova Scotia	$7.6
Confederation Bridge	640,000	56.5	$36.2
		Total PEI	$36.2
Saint John Harbour Bridge	1,500,000	1.4	$2.1
		Total New Brunswick	$2.1
Ambassador Bridge	3,486,000	$10.50	$36.6
Blue Water Bridge	1,580,000	$12.50	$19.7
Detroit/Windsor Tunnel	182,000	$12.50	$2.2
Lewiston Queenston	1,020,000	$20.00	$20.4
Ogdensburg Bridge	57,000	$11.95	$0.7
Peace Bridge	1,440,000	$28.00	$40.3
Rainbow Bridge	---	----	$0.0
Sault Ste. Marie Bridge	138,000	$15.35	$2.1
Seaway International	131,000	$8.50	$1.1
Thousand Islands	543,000	$12.00	$6.5
Whirlpool Rapids	---	---	$0.0
Hwy 407 (Ont)		$0.345 per km	$23.0
		Total Ontario	$152.6
Coquihalla Highway (B.C.)	180,000	$40.00	$7.2
		Total B.C.	$7.2
	Total Revenues ($millions)		$206.0

10.0 Differences between Commercial (for-hire) and Private (own account) Fleets

The trucking industry consists of two main sectors: the for-hire sector which has historically been defined as consisting of those companies that haul freight owned by others, for compensation, and the private sector consisting of those companies who primarily haul their own freight, but may, from time to time, haul other people's goods for compensation.

In dollar terms, the two sectors are nearly the same size. However, there are some major differences in their make-up as well as some interesting similarities. Private trucking is dominated by a large number of small fleets operating in and around urban areas, where it holds an 85% market share. The majority of fleets operating in this area consist of 1 or 2 vehicles and are typically straight trucks. As haul distance increases, this market share drops. Its market share is about 50% at trip distances of 200 km; decreasing to 10% at distances of 2000 km and greater. Truck size increases as trip distances increase to take advantage of the economics of the larger vehicles over these haul distances.

Some specific comparisons follow[2]. These comparisons are based on the national Roadside survey which basically covers intercity trips.

Trans Border traffic:

- While both sectors make extensive use of tractor-trailer for these movements, the private sector is more likely to use straight trucks.
- Body styles are very similar, although private trucking does make more use of certain specialized body styles such as tankers, flatbeds and containers.
- Commodities hauled are very similar
- Private vehicles tend not to be as fully loaded

For Interprovincial traffic:

- Private fleets tend to make more use of straight trucks, although tractor-trailer units are the dominate vehicle type for both private and for-hire movements.
- Commodity types hauled are very similar
- The van trailer type dominates both private and for-hire movements, with the private sector making more use of specialty trailers such as tankers and flatbeds
- Private vehicle are not as likely to be fully loaded.
- Private fleets are less likely to use owner-operators.

[2] From Profile of Private Trucking in Canada, January 1998. Prepared for Private Motor Truck Council of Canada by L.P Tardif & Associates.

For Intra-provincial traffic:

- Ontario and Quebec account for three quarters of intra-provincial private trucking in Canada.
- Private fleets are again less likely to be fully loaded and more likely to use straight trucks
- Truck body styles are very similar, with the van style accounting for the majority of trips
- Commodities hauled as very similar, with private fleets more likely to haul food related products
- Private fleets are less likely to use owner-operators

The three cost main cost variables that could result in a cost differential between private and for-hire fleets are vehicle utilization (annual kilometres driver), driver wages and fuel. Each of these was examined as follows.

Information available from the NRCan 2000 Fuel Economy Benchmarking Survey indicates that the utilization of both private and for-hire fleets can vary considerably depending upon how the vehicles are utilized. However, similar vehicles operated in similar circumstances have similar fuel consumption rates.

Fuel haulers tend to use their vehicles with two shifts a day, sometimes seven days a week resulting in annual utilization rates around 250,000 km whether private or for-hire. Single driver intercity van fleet utilization rates typically vary between 95,000 and 180,000 km Vehicles used for single shift weekday delivery locally or regionally more typically have a utilization rate in the range of 40,000 to 80,000 km a year (although lower utilization rates are possible). This data indicates there are not any systematic differences in utilization rates between private and for-hire fleets. Rather, differences are application specific.

Confidential data available to the consultants also indicate that wage rates paid are similar for both sectors for similar operations, although there is a widely held perception that private fleets pay higher wage rates. Similarly, fuel consumption rates are similar.

Overall, it is the consultant’s assessment that there are not any systematic differences in costs between private and for-hire fleets when operating under the same operating conditions.

11.0 Cost of Operations in Congested Conditions

The Cost of Urban Congestion in Canada by Transport Canada Environmental Affairs (2005 2006) developed congestion indicators for the nine largest urban areas in Canada[3]. The study found that urban recurrent congestion costs Canadians between $2.3 billion and $3.7 billion in 2002 dollar values[4]. These costs are for private cars only; trucking costs are not included. More than 90 per cent of this cost is time lost in traffic by drivers and passengers; 7 per cent is attributable to increased fuel consumption; and 3 per cent is from increased greenhouse gas emissions. Increased fuel consumption would therefore annually cost in the order of $176 to $213 million annually. However, this project did not identify costs for heavy trucks. Consequently additional review of the literature was undertaken to identify impacts on a per vehicle kilometre basis and, if possible, by different traffic levels (levels of service). Trucking activity and congestion cost reports for Vancouver, Calgary, Edmonton and Montreal were reviewed. Only the Montreal study identified trucking related congestion costs. These were estimated at $52 million per annum.

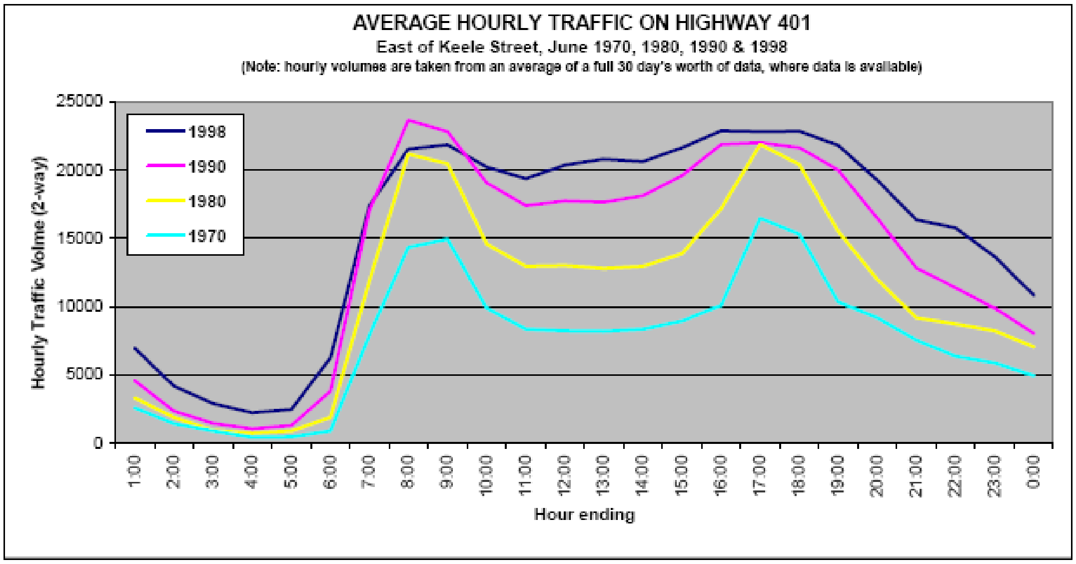
The literature review identified traffic characteristics in the Greater Toronto Area. Exhibits 11.1 and 11.2 show traffic volumes by hour of day for one location on Highway 401 within the GTA.

Total traffic builds quickly after 5:00 AM and peaks by 7:00 AM and stays at or near this peak until 6:00 PM or later. This traffic buildup also occurs earlier, and lasts longer, than it did in the past. Also, the AM and PM peak periods have basically disappeared.

[3] For more detail visit www.tc.gc.ca/mediaroom/releases/nat/2006/06-h006e.htm.

[4] Another study aimed at identifying non-recurrent congestion levels is underway. Initial results indicate these costs are of the same order of magnitude as recurrent congestion costs.

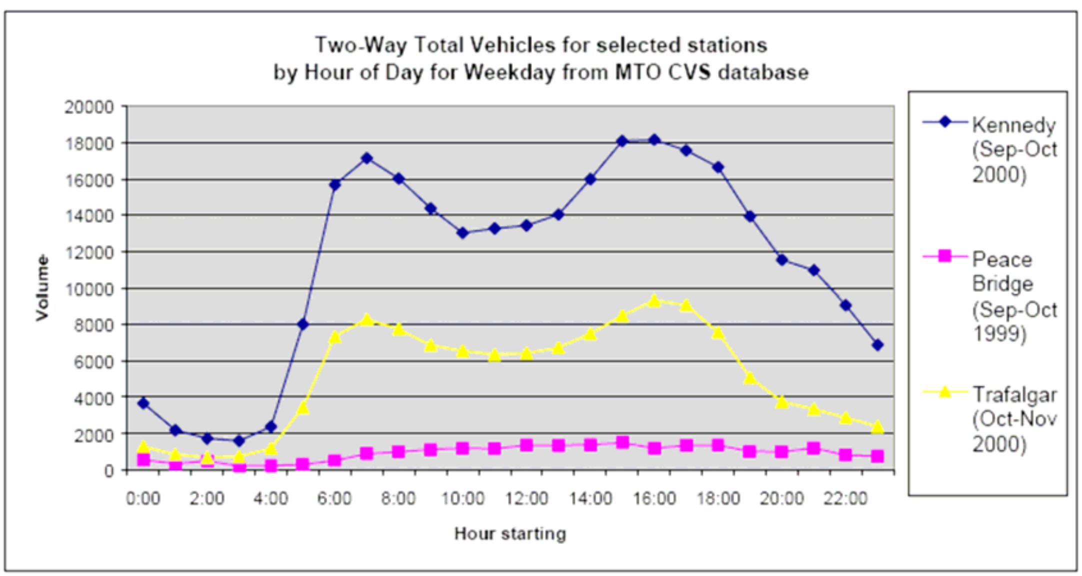
Exhibit 11.1: Historical Hourly Traffic Volumes on Highway 401 near Keele Street



Source: Goods Movement in Central Ontario: Trends and Issues Technical Report Dec. 2004. Prepared for MTO by iTrans Consulting.

Exhibit 11.2 shows truck traffic building earlier than total traffic, confirming interviews with fleet managers that when they can they will dispatch trucks to avoid the congested periods. However, within the GTA, the bulk of truck traffic still operates between 7:00 AM and 5:00 PM indicating this option is limited.

Exhibit 11.2: Two-Way Truck Volumes for Selected Locations



Source: Goods Movement in Central Ontario: Trends and Issues Technical Report Dec. 2004. Prepared for MTO by iTrans Consulting.

Interviews were conducted with fleet managers and truck drivers to determine what strategies they employ to avoid congestion, and where congestion cannot be avoided, how this affects their costs.

Exhibit 11.3: Results of Fleet Manager and Driver Interviews

Company	Type of Operation	Mitigation Strategy and Additional Costs
A	Retail goods delivery	Congested periods are avoided whenever possible. A significant portion of their deliveries are made when the stores are closed allowing them to avoid congestion. Also, they have distribution centres (DC) located east and west of the GTA so they can ship goods from the DC that minimizes travel within the GTA. DC location decisions were not made for this reason; this is simply a positive by-product of the decisions. Drivers are paid by the hour. Congestion typically adds 30 minutes to a 35 km trip. Biggest immediate additional cost is driver wages to cover the additional time; then fuel to cover additional idling, stops and starts, etc.
B	Food product delivery	They have purposely changed shift start times to 3 AM to avoid congestion. However, with a 12-hour shift much of their operations still occur in congested conditions. Drivers are paid by the hour. The fleet manager estimates that 1 to 1.5 hours on each shift are lost due to traffic delays (8% to 12%). Fleet size and driver costs could be reduced accordingly if congestion was removed.
C	Food product delivery	Due to receiving/unloading requirements they cannot delivery outside of congested times. They carefully monitor idling time and feel that congestion adds 10% to their idling time. Fleet cost and driver wages could be reduced accordingly if no congestion. Drivers are paid by the hour. Deliver 7 days a week and don’t notice much of a change on weekends compared to weekdays.
D	Auto parts	Delivers auto parts from Michigan to Oshawa. As a result trips use HWY401 through the GTA. Trucks must arrive within plus or minus 15 minutes of delivery time. Trucks leave Michigan at night for delivery the next day. Drivers will rest at company facilities and wait for their delivery time. During the daytime, drivers try to use the 401 after 9 AM and before 3 PM. However, about 15% of trips get caught in traffic, typically adding one hour to their trip time. Do not use ETR407 due to high toll costs.

		Most of drivers are owner-operators paid by the mile so the extra time costs and any extra operating costs are incurred by the driver. As time delays in traffic are count against hours of service, the delays affect what a driver earns. They cannot make up the losses by working additional hours.
E	Owner-operator	Hauls auto parts from southern Ontario to Oshawa. Tries to avoid highly congested periods but this is not always possible as deliveries are scheduled and must arrive within plus or minus 15 minutes of schedule. Trips during congested periods take about an additional hour of time to complete. This delay occurs mainly over an 80-km stretch of highway. The delays impact hours of service and pay cheque. Does not use ETR407. He absorbs the costs of any delay.
F	Owner-operator	Hauls general freight in southern Ontario and neighbouring states (New York, Michigan, Illinois). Uses ETR407 on occasion to avoid congestion. Listens carefully to CB and traffic/news radio stations to identify where congestion is occurring and plans accordingly. Tries to avoid congestion whenever possible by trip scheduling and strategic nap breaks (out of service, time does not count against hours of service). Where delivery time is set, can't always avoid congestion. Drives about 50 to 60 hours a week, spending 5 to 10 hours in congestion. He has lost trips due to congestion. Also, if driving just-in-time, some companies fine drivers for being late. In some cases, one can lose a full day if receiver makes you wait until the next day to deliver load if you are late. Paid by the mile or by the trip, so he has to absorb any congestions costs.
G	Bulk Hauler	They are aware that congestion presents a cost, but are unable to provide any estimates of time losses, etc.
H	Retail Goods Delivery	Fleet manager estimates that cost impact to the fleet is less than 10%. Divers are paid by the mile so they absorb the delay costs. Many of their trips can avoid the most heavily congested periods.

To illustrate the impact the congestion levels noted in Exhibit 11.3 have on per-kilometre truck costs, case studies companies B and C were completed using the cost model developed by this project. Additional data required to complete this analysis were obtained from the two companies. Interestingly, there operations were so similar that one costing analysis was applicable to both firms. These companies deliver to restaurants within the GTA. They operate 12 hour shifts 7 days a week, with their vehicles each travelling 60,000 kilometres per annum. Both use straight trucks and tractor-trailers for this work, with the majority vehicle being the tractor-trailer. Both fleets indicated they would save about 1.5 hours per shift if there was no congestion. Over the 12 hour shift, 7.5 hours is spent loading/unloading while 4.5 hours is spent driving. Without congestion, the driving time would be reduced to 3 hours.

Results are shown in Exhibit 11.4. Appendix A presents the costing model inputs and outputs.

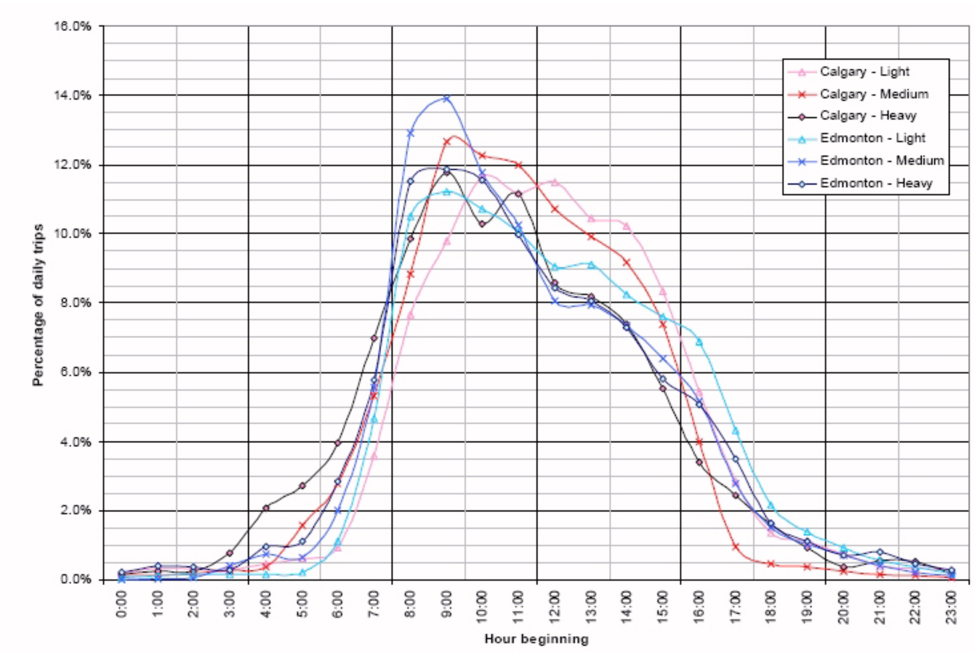
Exhibit 11.4: Estimated Per-Km Truck Cost for Sample Fleet in GTA

Truck Type	Per Kilometre Costs		Congestion Premium
	With Congestion	Without Congestion	
Straight	$2.97	$2.53	17%
Tractor-trailer	$3.58	$3.12	14.5%

These results are for a specific fleet operating within primarily within the GTA. The congestion premium noted would obviously be less for fleets that operate for longer periods of time in non-congested traffic areas.

Congestion in Edmonton and Calgary

Both Edmonton and Calgary recently undertook comprehensive in-depth Commercial Vehicle Movement Studies and modelling of commercial vehicle operations in those centres.



Comparison of daily travel patterns by vehicle type

**Source: The Nature of Urban Commercial Movements in Alberta, authored by STEFAN (City of Calgary), BROWNLEE (City of Edmonton), MCMILLAN (City of Calgary) and HUNT (University of Calgary).*

Exhibit 11.5: Congestion Impact during AM Peak (7AM-9AM)

Exhibit 11.5 shows the significant numbers of commercial travel movements during the business day between 6 AM and 6 PM together with a significant "peaking" of activity during the morning peak congestion period -- which we are advised extends principally between 7 AM and 9 AM. The afternoon peak period from 4 PM to 6 PM shows a significant falling off in commercial vehicle movements. At time of preparing this report, no estimates were available to the consultant for the reduction of travel speed to be expected during those congested periods -- enabling an analytical comparison to be made using the model -- between "free flow" and congested conditions, as done for the GTA.

However we do note from the graph above that approximately 20% of daily commercial vehicle movements are occurring during the morning peak hour in these cities and possibly a further 5% in the afternoon peak.

12.0 Factors Changing Unit Costs

This chapter highlights some of the cost factors that have changed since the report's reference year of 2000, or may occur in the coming years. The intent is to illustrate how these factors might affect costs as opposed to completing a detailed costing analysis.

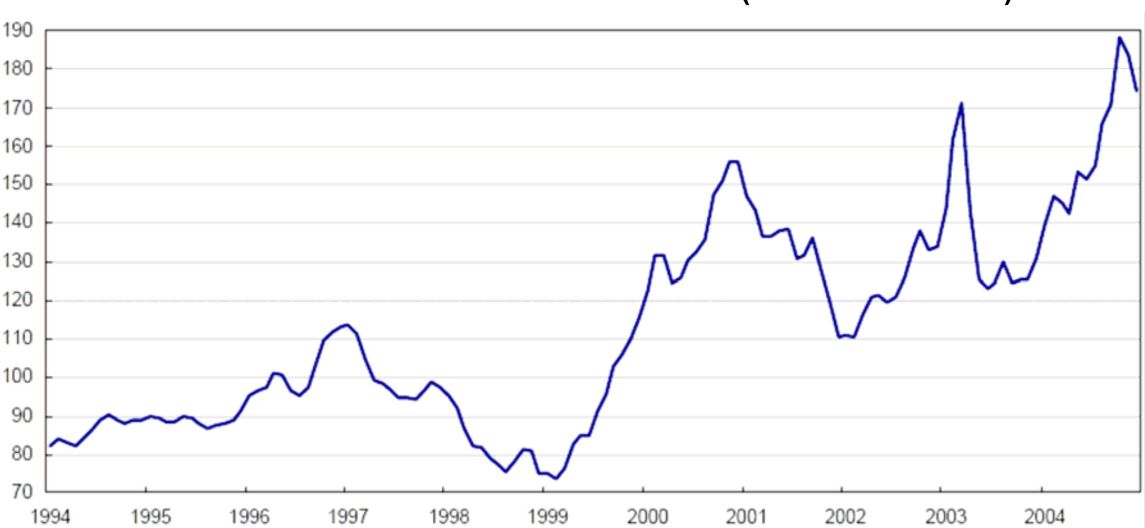
Insurance:

Insurance costs have increased rapidly since 2000, with trucking industry representatives noting increases of 20% to 50% for Canada only firms and by up to 200% for firms involved in trans-border activities. Insurance costs are usually 5% or less of a carrier's cost. In response to these increases, 25 of the larger carriers have started their own insurance coverage making these carriers more or less self-insured. This trend will likely continue if insurance rates continue to increase.

Fuel:

Fuel costs have increased rapidly in recent years as illustrated by Exhibit 12.1.

Exhibit 12.1: Diesel Fuel Price Index 1994 – 2004 (Index 1997 = 100)



Source: Statistics Canada, Trucking in Canada 2004. Cat. No. 53-222-XIE

Hours of Service:

New hours-of-service (HOS) regulations allow drivers to have more regular on duty hours and increase the potential for quality sleep to reduce fatigue and increase driver alertness. Many drivers apparently favor the new regulations because they have resulted in reduced turnaround time at docks. Since waiting time at customer sites is now charged against duty time, in the current capacity constrained environment, trucking companies are succeeding in imposing holding charges on shippers for delays in loading and unloading. The main impact of the new regulations on long-haul trucking companies, however, has been to reduce driver productivity by an estimated 3%[5].

Border Crossing Regulations

Since the terrorist attack in the United States in 2001 border crossing border crossing delays have increased due to more careful checks and new regulations. It is estimated these delays are imposing increased costs and operational management concerns for motor carriers.

A study completed for Transport Canada6 estimates the cost impacts on the Canadian trucking industry due to the U.S. border security measures range from $179 million to $406 million per annum with a mid-range estimate is in the order of $290 million per annum. This represents about 4% of total Canadian for-hire, long-distance trucking industry transborder expenses assuming an operating ratio of 0.95 on transborder revenues of $8 billion in 2003.

US Customs and Border Protection (CBP) have put in place at the land border a procedure to collect agricultural inspection fees beginning November 24, 2006. The fee, which was recently announced by the US Animal and Plant Health Inspection Service (a branch of the US Department of Agriculture), is designed to pay for inspections of loads in search of fruits, vegetables and flowers entering the US which are labeled as products of Canada but originate elsewhere. As a result, the single crossing rate for trucks will more than double to US$10.25 and the annual transponder cost will rise to US$205. All trucks, regardless of domicile and commodity carried, will be required to pay.

[5] Source: Global Insight

[6] The Cumulative Impact of U.S. Freight Transportation Security Measures on the Canadian Trucking Industry. DAMF Consulting and L-P Tardif & Associates ,May 2006

Driver Shortage:

The Canadian Trucking Human Resources Council has documented the shortage of qualified truck drivers in Canada[7]. The same problem exists in the United States. A recent survey by GE Capital indicates that the shortage is beginning to affect freight deliveries 22% of U.S. respondents reporting a shortage of drivers will impact their ability to deliver goods on time to existing customers. Canadian respondents suggested 13% of freight opportunities are at risk of being impacted. The consultant's interviews with industry indicate some fleets are currently experiencing up to 10% idle trucks due to lack of drivers. This shortage will create upward wage pressures and lower fleet utilization rates, both of which could result in increased costs.

As well as with drivers, there is also a shortage of diesel mechanics which could create upward wage pressures.

Wide Based Single Tires

Axles using wide-based single tires have had lower allowable weights, due primarily to concerns about the impact these tires have on pavement wear compared to dual tires. However, tire technology improvements are addressing these concerns and provincial authorities are considering removing the weight restriction. As these tires are lighter than standard dual tires, they allow the carrier to increase their payload. At the same time, fuel efficiency is improved 3% to 12%

Increased Use of Long Combination Vehicles (LCV's)

As the Trans-Canada and Yellowhead Highways are completely 4-laned across the Prairie Provinces, these vehicles will see increase usage in Western Canada under existing regulations. These vehicles offer 30% or more productivity[8] compared to standard tractor-trailer operations. They primarily are used for light freight, such as retail goods and LTL (less than truckload) operations. They typically constitute 5% to 10% of truck traffic volumes on the routes they are allowed to operate on.

Currently in Eastern Canada, the turnpike double version of these trucks is allowed to operate only in the Province of Quebec on multi-laned highways. New Brunswick has a pilot demonstration underway. With completion of four-laning of Transcanada in N.B. and in Quebec near the N.B. border in the near future a four-laned highway will be available from Halifax to Windsor, increasing pressure

[7] Canada's Driving Force. Profile of Driver Shortage, Turnover and Future Demand. Canadian Trucking Human Resources Council. 2002.
[8] The productivity improvement depends on the specific LVC and the nature of the operation.

to allow use of these vehicles in Ontario and the Maritimes. The impact of allowing these vehicles to operate in Eastern Canada and into the United States is currently being examined by the Canadian Trucking Alliance.

Automatic Transmissions

Increasingly, trucking fleets are switching to automatic transmissions. Some fleets, especially those hauling lighter freight report fuel savings of up to 5%.

EPA engine requirements for NOx and particulates:

Since 2000, the EPA has on two occasions invoked more stringent emission standards for diesel engines. The first set was introduced in 2002 and the Canadian Trucking Alliance (CTA) advises these regulations resulted in a fuel penalty of between 3% and 15%, with most estimates in the range of 8% to 9%.

The regulations which come into effect in 2007 include two components: emission standards, and diesel fuel regulation.

The first component of the regulation introduces new, very stringent emission standards, while the diesel fuel regulation limits the sulfur content in on-highway diesel fuel to 15 ppm (wt.), down from the previous 500 ppm.

The Canadian Trucking Alliance (CTA) advises these regulations add $7,000 to $10,000 to the purchase price of a tractor. In addition, the associated equipment adds 140 to 230 kilograms to the unit, resulting in reduced payloads. Fuel efficiency is expected to remain much the same, or be slightly reduced. There are added maintenance costs to clean particulate filters and the oil required by these vehicle is more expensive. The diesel fuel requirement increases fuel consumption by 1% to 2% and increases fuel costs by about one cent per litre. For coach buses, capital costs are increased by up to $15,000 with a 5% loss in fuel efficiency. Similar to trucks, maintenance and fuel costs are also increased

Improved technology (aerodynamics etc) improving fuel economy

The 21st Century Group in USA notes a 42% improvement in fuel economy possible with improved technology. Efficiency improvements by area are: Engine 12%; Aerodynamics 10%; Rolling resistance 13%; Accessories 5% and Driveline 1.5%.

APPENDIX A

WORKSHEETS FOR CONGESTION COST CALCULATIONS

Tractor-trailer operation congested conditions

Estimation of Costs of Heavy Vehicle Use per Vehicle-Kilometre in Canada
Prepared For Transport Canada   File T8080-05-0326
by Ray Barton & Associates in Association with Logistics Solution Builders Inc.

A. Vehicle Operational Productivity

1	Average Trip Travel Distance in KM	**170.00**
2	Number of Trips per Working Day (Fractional Allowed)	**1.00**
3	Number of Days Worked Per Year	**350.00**
	Annual Distance Travelled in KM	***59,500***
4	Average Travel Speed in KM/Hour	**37.00**
	Average Trip Driving Time (Hr)	4.59
	Average Daily Driving Time (Hr)	4.59
	Average Annual Driving Time (Hr)	***1608.11***
5	Average Waiting / Loading / Unloading (Paid) Per Trip (Hr)	**7.50**
	Average Non Driving Time (Paid) per Trip (Hr)	7.50
	Average Non Driving Time (Paid) per Day (Hr)	7.50
	Average Annual Non Driving Time (Paid) (Hr)	2625.00
	Total Annual Hours	***4233.11***
6	Vehicle R.G.V.W. (kg)	54,000
	Vehicle Tare Weight (kg)	14,340
	Average Vehicle Payload (kg) or (seats)	16,000
	Percent Loaded Km	80.0%
	Per Vehicle Annual Tonne-km or Thousand Pass-km of output.	***761,600***
7	Per Vehicle Fuel Consumption Rate (litres / 100 km)	64.0
	Per Vehicle Annual Fuel Consumption (litres)	***38,080***
8	Percent of Distance Driven on Pavement	100.0%
	Percent on Gravel	0.0%

B. Vehicle Operational Costs

1	Driver Costs	
	Hourly Pay Rate	$19.00
	Cents Per Km Pay Rate	25.5
	Pay Driving by the KM (=1), otherwise Hourly Paid	0
	% Wage Burden	20.00%
	Non-Driving Paid Hourly	$49,875
	Driving Pay	$30,554
	Wage Burden (Benefits, Holiday Pay, etc.)	$16,086
	Total Driver Costs	***$96,515***
2	Fuel Costs	
	Fuel Price (cents / litre)	85
	Total Fuel Costs	***$32,368***
3	Repair & Tire Costs	
	Repair and Tire Costs (cents / km)	23.3
	Total Repair and Tire Costs	***$13,864***
4	Licence Costs	
	Annual Licence Fee	***$2,280.00***
5	Vehicle Ownership Costs	
	Power Unit Purchase Cost	$126,360
	Power Unit Salvage Percent	0.2
	Power Unit No of Years	5
	Trailer Purchase Cost	$44,280
	Trailer Salvage Percent	0
	Trailer Number of Years	8
	Annual Vehicle Ownership (Depreciation) Costs	***$25,753***
6	Overheads	
	Interest Rate:	7.30%
	Percent Financed:	100.00%
	Insurance as Percent of Cost:	2.00%
	Administration as Percent of Cost:	10.00%
	Margin as Percent of Cost:	5.00%
	Interest Financing Equipment	$6,228
	Insurance Costs	$4,265
	Administrative Costs	$21,326

Operator Margin	$10,663
Annual Overhead Costs	***$42,483***
TOTAL VEHICLE OPERATING COSTS	**$213,262**
COSTS PER VEHICLE RUNNING KM	**$3.584**
COSTS PER VEHICLE WORKING HOUR	**$50.38**
COSTS PER TONNE-KM OR THOUSAND PASS-KM	**$0.280**

Tractor-trailer operation uncongested conditions

Estimation of Costs of Heavy Vehicle Use per Vehicle-Kilometre in Canada
Prepared For Transport Canada   File T8080-05-0326
by Ray Barton & Associates in Association with Logistics Solution Builders Inc.

A. Vehicle Operational Productivity

1	Average Trip Travel Distance in KM	**170.00**
2	Number of Trips per Working Day (Fractional Allowed)	**1.00**
3	Number of Days Worked Per Year	**350.00**
	Annual Distance Travelled in KM	***59,500***
4	Average Travel Speed in KM/Hour	**56.00**
	Average Trip Driving Time (Hr)	3.04
	Average Daily Driving Time (Hr)	3.04
	Average Annual Driving Time (Hr)	***1062.50***
5	Average Waiting / Loading / Unloading (Paid) Per Trip (Hr)	**7.50**
	Average Non Driving Time (Paid) per Trip (Hr)	7.50
	Average Non Driving Time (Paid) per Day (Hr)	7.50
	Average Annual Non Driving Time (Paid) (Hr)	2625.00
	Total Annual Hours	***3687.50***
6	Vehicle R.G.V.W. (kg)	54,000
	Vehicle Tare Weight (kg)	14,340
	Average Vehicle Payload (kg) or (seats)	16,000
	Percent Loaded Km	80.0%
	Per Vehicle Annual Tonne-km or Thousand Pass-km of output.	***761,600***
7	Per Vehicle Fuel Consumption Rate (litres / 100 km)	43.0
	Per Vehicle Annual Fuel Consumption (litres)	***25,585***
8	Percent of Distance Driven on Pavement	100.0%
	Percent on Gravel	0.0%

B. Vehicle Operational Costs

1	Driver Costs	
	Hourly Pay Rate	$19.00
	Cents Per Km Pay Rate	25.5
	Pay Driving by the KM (=1), otherwise Hourly Paid	0
	% Wage Burden	20.00%
	Non-Driving Paid Hourly	$49,875
	Driving Pay	$20,188
	Wage Burden (Benefits, Holiday Pay, etc.)	$14,013
	Total Driver Costs	***$84,075***
2	Fuel Costs	
	Fuel Price (cents / litre)	85
	Total Fuel Costs	***$21,747***
3	Repair & Tire Costs	
	Repair and Tire Costs (cents / km)	23.3
	Total Repair and Tire Costs	***$13,864***
4	Licence Costs	
	Annual Licence Fee	***$2,280.00***
5	Vehicle Ownership Costs	
	Power Unit Purchase Cost	$126,360
	Power Unit Salvage Percent	0.2
	Power Unit No of Years	5
	Trailer Purchase Cost	$44,280
	Trailer Salvage Percent	0
	Trailer Number of Years	8
	Annual Vehicle Ownership (Depreciation) Costs	***$25,753***
6	Overheads	
	Interest Rate:	7.30%
	Percent Financed:	100.00%
	Insurance as Percent of Cost:	2.00%
	Administration as Percent of Cost:	10.00%
	Margin as Percent of Cost:	5.00%
	Interest Financing Equipment	$6,228
	Insurance Costs	$3,710
	Administrative Costs	$18,548

Operator Margin	$9,274
Annual Overhead Costs	***$37,760***
TOTAL VEHICLE OPERATING COSTS	**$185,478**
COSTS PER VEHICLE RUNNING KM	**$3.117**
COSTS PER VEHICLE WORKING HOUR	**$50.30**
COSTS PER TONNE-KM OR THOUSAND PASS-KM	**$0.244**

Straight truck operation congested condition

Estimation of Costs of Heavy Vehicle Use per Vehicle-Kilometre in Canada
Prepared For Transport Canada File T8080-05-0326
by Ray Barton & Associates in Association with Logistics Solution Builders Inc.

1	Average Trip Travel Distance in KM	**170.00**
2	Number of Trips per Working Day (Fractional Allowed)	**1.00**
3	Number of Days Worked Per Year	**350.00**
	Annual Distance Travelled in KM	***59,500***
4	Average Travel Speed in KM/Hour	**37.00**
	Average Trip Driving Time (Hr)	4.59
	Average Daily Driving Time (Hr)	4.59
	Average Annual Driving Time (Hr)	***1608.11***
5	Average Waiting / Loading / Unloading (Paid) Per Trip (Hr)	**7.50**
	Average Non Driving Time (Paid) per Trip (Hr)	7.50
	Average Non Driving Time (Paid) per Day (Hr)	7.50
	Average Annual Non Driving Time (Paid) (Hr)	2625.00
	Total Annual Hours	***4233.11***
6	Vehicle R.G.V.W. (kg)	14,600
	Vehicle Tare Weight (kg)	5,500
	Average Vehicle Payload (kg) or (seats)	7,500
	Percent Loaded Km	50.0%
	Per Vehicle Annual Tonne-km or Thousand Pass-km of output.	***223,125***
7	Per Vehicle Fuel Consumption Rate (litres / 100 km)	55.0
	Per Vehicle Annual Fuel Consumption (litres)	***32,725***
8	Percent of Distance Driven on Pavement	100.0%

B. Vehicle Operational Costs

1 Driver Costs

Hourly Pay Rate	$19.00
Cents Per Km Pay Rate	25.3
Pay Driving by the KM (=1), otherwise Hourly Paid	0
% Wage Burden	20.00%
Non-Driving Paid Hourly	$49,875
Driving Pay	$30,554
Wage Burden (Benefits, Holiday Pay, etc.)	$16,086
Total Driver Costs	***$96,515***

2 Fuel Costs

Fuel Price (cents / litre)	85
Total Fuel Costs	***$27,816***

3 Repair & Tire Costs

Repair and Tire Costs (cents / km)	19.9
Total Repair and Tire Costs	***$11,841***

4 Licence Costs

Annual Licence Fee	***$592.00***

5 Vehicle Ownership Costs

Power Unit Purchase Cost	$83,160
Power Unit Salvage Percent	0.2
Power Unit No of Years	10
Trailer Purchase Cost	$0
Trailer Salvage Percent	0
Trailer Number of Years	5
Annual Vehicle Ownership (Depreciation) Costs	***$6,653***

6 Overheads

Interest Rate:	7.30%
Percent Financed:	100.00%
Insurance as Percent of Cost:	2.00%
Administration as Percent of Cost:	10.00%
Margin as Percent of Cost:	5.00%
Interest Financing Equipment	$3,035
Insurance Costs	$3,529

Administrative Costs	$17,645
Operator Margin	$8,822
Annual Overhead Costs	***$33,031***
TOTAL VEHICLE OPERATING COSTS	**$176,448**
COSTS PER VEHICLE RUNNING KM	**$2.966**
COSTS PER VEHICLE WORKING HOUR	**$41.68**
COSTS PER TONNE-KM OR THOUSAND PASS-KM	**$0.791**

Straight truck operations uncongested conditions

Estimation of Costs of Heavy Vehicle Use per Vehicle-Kilometre in

Canada
Prepared For Transport Canada   File T8080-05-0326
by Ray Barton & Associates in Association with Logistics Solution Builders Inc.

1	Average Trip Travel Distance in KM	**170.00**
2	Number of Trips per Working Day (Fractional Allowed)	**1.00**
3	Number of Days Worked Per Year	**350.00**
	Annual Distance Travelled in KM	***59,500***
4	Average Travel Speed in KM/Hour	**56.00**
	Average Trip Driving Time (Hr)	3.04
	Average Daily Driving Time (Hr)	3.04
	Average Annual Driving Time (Hr)	***1062.50***
5	Average Waiting / Loading / Unloading (Paid) Per Trip (Hr)	**7.50**
	Average Non Driving Time (Paid) per Trip (Hr)	7.50
	Average Non Driving Time (Paid) per Day (Hr)	7.50
	Average Annual Non Driving Time (Paid) (Hr)	2625.00
	Total Annual Hours	***3687.50***
6	Vehicle R.G.V.W. (kg)	14,600
	Vehicle Tare Weight (kg)	5,500
	Average Vehicle Payload (kg) or (seats)	7,500
	Percent Loaded Km	50.0%
	Per Vehicle Annual Tonne-km or Thousand Pass-km of output.	***223,125***
7	Per Vehicle Fuel Consumption Rate (litres / 100 km)	37.0
	Per Vehicle Annual Fuel Consumption (litres)	***22,015***
8	Percent of Distance Driven on Pavement	100.0%
	Percent on Gravel	0.0%

B. Vehicle Operational Costs

1	Driver Costs	
	Hourly Pay Rate	$19.00

	Cents Per Km Pay Rate	25.3
	Pay Driving by the KM (=1), otherwise Hourly Paid	0
	% Wage Burden	20.00%
	Non-Driving Paid Hourly	$49,875
	Driving Pay	$20,188
	Wage Burden (Benefits, Holiday Pay, etc.)	$14,013
	Total Driver Costs	***$84,075***
2	Fuel Costs	
	Fuel Price (cents / litre)	85
	Total Fuel Costs	***$18,713***
3	Repair & Tire Costs	
	Repair and Tire Costs (cents / km)	19.9
	Total Repair and Tire Costs	***$11,841***
4	Licence Costs	
	Annual Licence Fee	***$592.00***
5	Vehicle Ownership Costs	
	Power Unit Purchase Cost	$83,160
	Power Unit Salvage Percent	0.2
	Power Unit No of Years	10
	Trailer Purchase Cost	$0
	Trailer Salvage Percent	0
	Trailer Number of Years	5
	Annual Vehicle Ownership (Depreciation) Costs	***$6,653***
6	Overheads	
	Interest Rate:	7.30%
	Percent Financed:	100.00%
	Insurance as Percent of Cost:	2.00%
	Administration as Percent of Cost:	10.00%
	Margin as Percent of Cost:	5.00%
	Interest Financing Equipment	$3,035
	Insurance Costs	$3,010
	Administrative Costs	$15,049
	Operator Margin	$7,525
	Annual Overhead Costs	***$28,619***

TOTAL VEHICLE OPERATING COSTS	**$150,492**
COSTS PER VEHICLE RUNNING KM	**$2.529**
COSTS PER VEHICLE WORKING HOUR	**$40.81**
COSTS PER TONNE-KM OR THOUSAND PASS-KM	**$0.674**

APPENDIX B

TOLL BRIDGES AND HIGHWAYS REVENUE

CANADIAN TOLL BRIDGES AND HIGHWAYS TOTAL ESTIMATED REVENUE 2000.

Facility	Annual Volume (trucks)	Truck Rate ($)	Annual Revenue trucks ($)
Ambassador Bridge	3,486,110	10.50	36,604,155
Blue Water Bridge	1,576,839	12.50	19,710,488
Detroit/Windsor Tunnel	182,392	12.30	2,243,422
Lewiston Queenston Bridge*	1,019,494	20.00	20,389,880
Ogdensburg Bridge	56,949	11.95	680,541
Peace Bridge*****	1,439,824	28.00	40,315,072
Rainbow Bridge*	127	20.00	2,540
Sault Ste. Marie Bridge	137,804	15.75	2,170,413
Seaway International Bridge	131,359	8.50	1,116,552
Thousand Islands Bridge	542,703	12.00	6,512,436
Whirlpool Rapids Bridge*	-	20.00	-
Saint John Harbour Bridge****	1,500,000	1.40	2,100,000
Confederation Bridge*******	640,000	56.50	36,160,000
Halifax - Dartmouth Bridges**			2,600,000
Hwy 407 (Ontario)***			23,000,000
Coquihalla Highway (BC)******	180,000	$40	7,200,000
Hwy 104 (Nova Scotia)	580,000	axle	5,000,000
			205,805,497

Sources of traffic data: MTO for Ontario-U.S. Bridges

* Operate under the authority of the Niagara Falls Bridge Commission. In 2000 truck toll rate was by ton. 2004 per axle weights used as tonnage data is not available to make calculation.
**Source: Includes the A. Murray MacKay Bridge and the Angus L. MacDonald Bridge. Revenues provided by Bridge Authority
***2000 was first full year of operation. Trucking industry reports they try to avoid this route as much as possible to avoid toll rates. Revenues assume 5% truck volume (half straight trucks at twice auto rate and half tractor-trailer combinations at three time auto rate to account for 12.5% of total revenues).
****Total traffic count from Bridge Authority via NBDOT. Trucks are estimated by consultant assuming trucks comprise 15% of total traffic stream.

*****Truck rates in 2000 were based on gross vehicle rates. Rate shown is an approximation for a 5-axle tractor trailer.

******Truck Volume estimated by consultant from published traffic counts.
*******One way traffic counts taken by NBDOT 2.5 km from bridge doubled. Truck split estimated using data from traffic counter located east of traffic circle at Route 15 intersection.
104 data from Hwy Corp.

Estimated Daily Traffic Volumes

	ADT Cars	ADT trucks	total autos 2000	total trucks 2000
Ambassador Bridge	16912	9237	6172880	3371505
Blue Water Bridge	10306	4930	3761690	1799450
Detroit/Windsor Tunnel	15841	438	5781965	159870
Lewiston Queenston Bridge*	7958	2758	2904670	1006670
Ogdensburg Bridge	1141	274	416465	100010
Peace Bridge	15410	3562	5624650	1300130
Rainbow Bridge*	9345	1	3410925	365
Sault Ste. Marie Bridge	4526	367	1651990	133955
Seaway International Bridge	6538	433	2386370	158045
Thousand Islands Bridge	4460	1313	1627900	479245
Whirlpool Rapids Bridge*	472	0	172280	0