THE ASSESSMENT OF MOTOR CARRIER LANE PROFITABILITY:
METHODS AND IMPLEMENTATION

by

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ABSTRACT

The traffic moved between two cities by a long-haul carrier is commonly termed a lane. The purpose of this study is to demonstrate methods to assess the profitability of individual lanes.

To tackle the problem of lane profitability, one needs to have accurate and valid data of revenue and costs. In view of the importance of properly prepared data, a secondary purpose of this study is to recommend accounting procedures to record data in a usable form for further studies of this kind.

The concept of revenue for a lane is not difficult to understand. However, the concept of cost for a lane raises some difficult questions.

Since a terminal handles traffic from a variety of lanes, the crux of the problem is to disaggregate the terminal costs to each individual lane.

Statistical costing is the main tool used in this study. It is not the most accurate method but is less costly than most other methods. Thus, it is often an ideal substitution for detailed engineering studies. Statistical methods have applicability when direct observation of the relationship between cost and output is difficult or impossible.

To this end, regression analysis was proposed extensively in the study to examine the behaviour of different cost elements. With a good grasp of the relationship between terminal costs and terminal output (activities) one can apportion the related terminal costs to the lanes of interest.

This study presents a normative model. To construct the model, the examination of a common motor carrier's operation has provided much
insight regarding (1) the kinds of data that are generally available, (2) how the available data can be improved, and (3) how the constructed model relates to the motor carrier examined.

To appreciate the subtleties inherent in this study, a general understanding of the industry as well as the daily operation of a motor carrier is required.

To assess the profitability relating to different lanes, one requires some workable methods, and above all, workable data.
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CHAPTER 1

INTRODUCTION

Purpose

Most of the activities of a long-haul trucking concern involve the movement of commodities from one city to another. The traffic moved between a given city pair is generally termed a lane. The revenues generated by the lanes served by a trucking firm determine the profitability of the whole operation, after the required operating costs are deducted.

The first objective of the study is to demonstrate how to construct a model and develop a set of procedures to determine the contribution margin of individual lanes.

The second objective is to propose proper procedures for recording accounting data pertaining to the construction of the model.

To facilitate discussion, a model carrier is used as a basic reference. The model carrier provides a general framework upon which to build the model, and, at the same time, sheds some light on what kinds of data are generally available and how data should be properly recorded.
Importance of the Study

One of the most important operating objectives of a going concern is to maximize its wealth. In the face of the ever-increasing cost/price squeeze, the improvement, or merely the maintenance, of profits requires clear identification of profit and loss.

Most of the trucking companies have an operating ratio (operating expenses divided by revenues) of around 95 percent. A one-percent reduction in costs would thus allow a 20 percent increase in the profit margin. It is not difficult to see why the assessment of profitability becomes the focus of a motor carrier's attention.

Year-end reports and financial statements are often inadequate for investigating the causes of unsatisfactory performance. It becomes obvious that small segments of the company's operation need to be examined. The essential question is: What segments of the whole operation should be examined individually?

Because of the heterogeneous nature of the transportation output, and the uniqueness of each unit of product, it is generally impractical to segregate costs to the level of individual shipments to determine profitability.

Alternatively, the efficiency or performance of trucking terminals could be examined to see if poor profits are due to high operating costs.

---


* Operating ratio above 95% is interpreted as unsatisfactory in a trucking firm.
Since most of the controllable costs occur at the terminal, this approach has the merit of effective cost control. However, cost control alone does not suffice if revenues are lacking in various segments of the operations (such as the lanes) to cover costs. A terminal is a cost center but is not usually considered a profit center. A cost center is the smallest unit of activity or area of responsibility for which costs are accumulated. A profit center is a segment of a business that is responsible for both revenues and expenses.

The lanes are the revenue-generating units. Examination of lane performance would shed light on (1) where the lucrative markets are and (2) where revenues are lacking.

The identification and assignment of costs and revenues to the various lanes are necessary to determine profitability. The assignment of costs and revenues is not a simple matter, partly due to the difficulty of measuring transportation output,* and partly due to the subjectivity involved in some cost assignments.

The long and colorful history of the railroad operation in North America has undoubtedly prompted many authors to delve into the rail costing problems. Because of the great differences between the rail and the truck modes, in terms of cost structures, capital investment requirement, flexibility of operation, ease of entry and withdrawal, it is evident that the emphases of their costing problems are considerably different. Because of these differences and the differences

*Output is considered in this context to be the work done or the activities performed as part or all of the transportation function, including the supporting functions such as clerical work.
in the kinds of costs incurred by the two modes, it would be unwise to apply rail costing techniques indiscriminantly to a trucking operation.

The literature review in Chapter 4 lends some support to the importance of initiating a study like this one. A brief review of the current literature reveals that:

1. Cost-accounting literature should not be expected to deal with transportation, although the background knowledge provided is invaluable.

2. Literature on transportation that addresses the question of lane profitability can not be found. However, literature relating to transportation is enlightening.

3. The U.S. government-prescribed costing methods suggested by the Interstate Commerce Commission are not applicable for two reasons. First, the methods are used for the sake of uniformity (among carriers for rate-making purposes). Second, some of the factors developed are based on regional data in the U.S. and are not applicable in Canada.
Background

To understand the particular problems created by the complexity of a motor-carrier operation, it is crucial to gain an understanding of the nature of the transportation output.

A wide spectrum of commodities is hauled by a common carrier from one city to another. Because these commodities come in all different forms, shapes, and sizes, the measurement of transportation output is a formidable task. By the same token, costing is a rather complex matter.

How does one compare the effort required to haul a hundred pounds of nails with that required to haul the same amount of feathers by weight? How does one compare the cost of handling one thousand pounds of canned foods in small cartons with the same commodities in big crates or pallets?

There are many factors affecting the costs of handling commodities. These factors are, for example: (1) the level of traffic being handled at a particular point in time, (2) the types of vehicles used and how fully they are loaded, (3) the value of the commodity and the amount of care required for its handling, (4) the speed at which it is moved, and (5) the location of the terminal.

These factors add another dimension to the cost problems for it is evident that it may cost a different amount to move the same commodity over the same distance at different times, or different commodities of the same weight over the same distance at the same time.

It is also necessary to understand the general activities of the motor-carrier industry, the day-to-day operation of a representative carrier, and the nature of the various costs problems in transportation
Specific knowledge of the manner in which costs are recorded is often helpful to see if input data are reasonable. To illustrate this point, a model carrier is necessary because it serves as an example in a real-life situation.

Recommendations regarding the questions of how and when input data should be recorded will be based on the framework provided by the model carrier.

The constructed model is based on the operation of a single common carrier which the author considers a representative carrier of its kind (common carrier). Discussions with people in the field indicate that other carriers do have similar problems in conducting a lane profitability study. It is hoped that the model suggested in this paper has some value for general application.
Uses of the Study

Results and conclusions of the study can be used to serve the following purposes:

1. To help management determine which of the lanes call for more marketing efforts with respect to the volume and types of traffic.
2. To help management determine which of the lanes need to be re-routed or deleted.
3. To provide insight for rate-structure decisions.
4. To enable management to observe the overall effects on profitability when variables such as shipment characteristics and rate structures are changed in a particular lane.

It should be noted that decisions such as those mentioned above should not be based solely on the results of the study. Other considerations such as: competition, side effects of certain courses of action, and shipper-trucker relationships should come to bear. For example, the existence of some of the lanes in spite of low contribution margins may be explainable on practical grounds. The maintenance of an unprofitable lane may foster a good shipper-trucker relationship, promote good will, and avoid drastic loss of traffic in other lanes when the unprofitable lane is deleted.
A general description of the common motor-carrier industry is presented to the remaining section of this chapter. The discussion covers the general economics, the rate structure, and the measurement of overall operating effectiveness of a trucking firm.

Chapter 2 gives a description of the organization and the day-to-day operation of the model carrier under study. The chapter aims to provide an understanding of the way commodities are handled and moved. The flow of intercity shipments through a general commodity carrier and the kinds of people involved in the production of the transportation service are discussed in some detail.

Chapter 3 discusses the meaning of a lane and the concept of profitability.

The literature review in Chapter 4 examines the past research regarding trucking cost, and profitability.

Chapter 5 contains the model itself and the suggested procedures to determine profitability. Statistical testing methods are also included to ensure that the findings are significant.

Chapter 6 discusses how and when accounting records should be kept to provide the needed ingredients using the model carrier as an example.

Chapter 7 contains conclusions and recommendations.
General Description of the Motor Carrier Industry

An understanding of the general nature of the motor-carrier industry enables one to come to grips with the types and classifications of carriers, the economics of the industry, and the rate and cost structure. This section provides readers who are not involved in the trucking mode with an understanding of the general issues arising out of the industry.

Classification:

Motor carriers can be classified by types, namely, for-hire and private. A for-hire carrier could either be a common carrier or a contract carrier.

The common motor carrier is defined by statute as any person or company which engages in the transportation of goods for the general public on regular or irregular routes.

A contract carrier is a carrier that provides transportation services for shippers like the common motor carrier, except that the services are in general provided for a specific client or group of clients through the assignment of vehicles for a given period of time under the terms of the contract.

A private carrier is a carrier whose sole purpose is to provide transportation service for a corporation's primary business. The carrier is privately owned and does not provide its service for other corporations for profit-making purposes.

Carriers can also be classified by the types of commodities carried, such as, carrier of general freight, carrier of household goods, and
carrier of special commodities.

Yet another way to classify carriers is by the gross revenue generated. Indirectly, this is a classification of carriers by the size of operation.

Statistics Canada classifies carriers in the following manner:

- **Class I:** revenue per annum above $2 million
- **Class II:** revenue per annum between $500,000 and $2 million
- **Class III:** revenue per annum between $100,000 and $500,000
- **Class IV:** revenue per annum between $25,000 and $100,000
- **Class V:** revenue per annum below $25,000

**Economics:**

Regarding the economics of commercial motor carriers, a few areas are of interest and have received much attention.

1. **Size of shipments:** Shipment sizes in terms of weight are either classified as truckload (TL) or less-than-truckload (LTL) traffic. Note that the terms TL and LTL cannot be strictly defined because what constitutes a TL shipment depends on how a particular carrier defines TL and on the kinds of commodities being shipped. By the same token, what constitutes a small shipment is also arbitrary at best. Small shipments are usually more costly to handle because they often involve as much paperwork as large shipments. They are, in general, short haul traffic.

2. **Types of traffic:** Most of the freight movements are single-line hauls (i.e., only one carrier is involved in the haul). When the movement involves another carrier for the completion of the haul, it is called interline.
3. Length of haul: Typically, the motor carrier serves the shorter-haul market as compared to the rail mode. (See Exhibit 1-1) The Interim Report on Freight Transport in Canada indicates that the average haul for rail is 600 miles and that for truck is 150 miles.

Since terminal cost is the same irrespective of the length of haul, short haul traffic is therefore more expensive to handle because the terminal cost is a larger percentage of the total cost. On a cost-per-mile basis, longer-haul traffic shows a lower cost figure because the terminal cost is spread over the number of miles.
NOTE 1: PRAIRIE REGION INCLUDES YUKON AND NORTH WEST TERRITORIES

Rates

Theoretically, seven items should be considered in rate determination. They are: (1) density of traffic, (2) distance of haul, (3) fragility of commodities, (4) value of service, (5) weight of shipment, (6) class, and (7) packaging.

There are three common kinds of rates, namely, class rates, point-to-point rates and commodity rates.

Class rates, giving a basic rate structure, are derived from the Canadian Railway Freight Classification No. 22. The classification of commodities is expressed as percentage of the First Class rate which serves as a reference point. For example, the First Class rate for a distance of 60 miles is $1.20 per unit weight; thus the rate for a commodity hauled over a distance of 60 miles is between 100 percent and 40 percent of $1.20. The appropriate fraction depends on the type of commodity in question.

In addition, there is considerable use of specific tariffs that one can apply between specific points. In general, they are lower than class rates. They may reflect the influence of intermodal competition, or in some cases, the volume of shipments.

Commodity rates are point-to-point rates developed to meet the varied characteristics of the demand for trucking services.\(^2\)

The control of trucking rates is largely in provincial hands. There exists considerable diversity among provinces in their regulation.

of rates.\footnote{Ibid p. 199.} Filing of tariffs and adherence to these tariffs is required in all provinces except Alberta.

**Operating Cost Structure**

A large portion of the costs of the Canadian trucking industry are variable. For Class I and II carriers, fuel costs represent between 7 and 12 percent of total operating costs, while labour costs represent between 40 and 60 percent. The ratio of variable costs to total costs in the trucking business is generally believed to be higher in the trucking mode than most other transportation industries.

**Measurement of Operating Effectiveness**

Several crude methods are used in the industry to measure a trucking firm's ability to generate revenues and ability to control costs. These methods are:

1. Turnover ratio: the turnover ratio shows how many dollars of gross revenue the carrier generates from a dollar of assets. It is given by:

   \[
   \frac{\text{total operating revenue}}{\text{net operating property + working capital}}
   \]

2. Operating rate of return: a measure of the profit generated by each dollar invested. In the motor-carrier industry, the rate of return is conceived to be higher than in the rail industry because of its relatively low capital investment requirement.

3. Operating ratio: a measure of the amount of operating expenditure
required to generate the operating revenue. It is equal to operating expenses divided by operating revenue. This is by far the most commonly adopted method for evaluation purposes. However, the ratio does not explain how each input is used, or does it explain whether a high ratio is due to inefficient use of resources or to other external factors.

One can interpret the ratios by comparing them with other similar firms in the industry or with the industrial average. Alternatively, one can compare the present ratios with the past ratios if the industrial averages are not readily available.

On many occasions, it may be necessary to go beyond the superficial figures reported from the ratios to properly analyse the firm's performance. A great deal of caution should be exercised when using ratios.

Whichever of the above ratios is used, it serves as a signal for further investigations. For example, if a firm's operating ratio is too high, it may be necessary to examine segments of the operation, such as terminal performance or lane performance, to see if the root of the problem can be traced. On the other hand, even if overall performance is satisfactory, it may still be sensible to carry out the same kind of investigation to see if knowledge about successful segments of the operation can be tapped to improve the less successful ones.

Financial Structure

The trucking industry is typified by operations with low real capital investment. It has been observed that motor carriers can

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support substantial revenues on relatively thin capital structures. The capital investment depends on the type of carrier (general-commodity vs. special-commodity carrier, or common vs. contract carrier) and the style of operation. For example, a contract carrier can rents its equipment for a short-term contract to reduce initial capital investment.

Most carriers are able to collect their accounts receivable within a short time. Because of this and the fact that inventories do not exist, working capital is reduced.

Many trucking firms finance the acquisition of their required capital assets (i.e., trucks) through loans from various financial institutions. Nevertheless, compared to other modes of transportation, the average ratio of debt to equity of trucking firms is quite low.

Operating ratios tend to be lower for smaller firms. This may be due to the fact that smaller firms have lower overhead and administrative expenses. 5

The general-commodity carriers do not operate under a rate structure that is related to the cost structure. Many shipments are actually subsidized by more lucrative ones, even though the overall profitability picture is satisfactory. It has been observed that not all the shipments hauled by U.S. general-commodity carriers produce an operating ration below 100%. 6 However, one cannot conclude that one type of shipment is more lucrative than another or that a carrier should discard the less profitable shipments. Rather, it simply illustrates the point that some

5 Ibid, p. 15.

shipments do not pay their own way and should therefore be identified as such. Darly Wyckoff, in his book "Organization Formality and Performance", indicates that there have been some recent efforts to align rates with costs for smaller shipments.
CHAPTER 2
MODEL CARRIER

Background

There seem to be two generally accepted ways to impart knowledge or ideas. One way is to lay out the theoretical concepts in some logical or chronological order. The other way is to illustrate the ideas by means of hypothetical or real-life examples.

Either method is workable if properly handled. Thus, it is conceivable that the combination of the two ways is a suitable vehicle to present this study.

Much reference will be made to the model carrier, which is of necessity a representative carrier of its type (common carrier). However, the constructed model for lane profitability should be amenable to general applications.

Before describing the procedures used to determine lane profitability, it is therefore important to get acquainted with the general operation of the model carrier.

Model Carrier Description

The model carrier, ALLTRANS EXPRESS LTD., is a general-commodity, long-haul concern. It is a common motor carrier serving the major eastern and western cities in Canada.

The types of commodity carried are many and varied. The weight of a shipment carried in the company can be as small as fifty pounds or as large as forty thousand pounds. In other words, the company hauls
truckload and less-than-truckload traffic.

The organization of the company can be viewed from the head office and the branch terminals. The general head office is not directly involved with the movement of traffic and is therefore not discussed here. A discussion of the branch terminals' organization provides adequate background knowledge for this study.

Organization of Branch Terminal

The organization of a typical branch terminal is shown in Exhibit 2-1. The functions performed in each branch are (1) office, (2) sales, (3) traffic and (4) terminal operation. The manager of each of these functions reports to the branch manager who in turn report to the head office.

The terminal operation manager is responsible for the city dispatch and dock operation. The former controls the pickup and delivery function, and the latter controls the movement of freight across the dock. The dock foreman is also responsible for the proper arrangement of dock and yard equipment.

The sales manager supervises the personal door-to-door selling function performed by a few salesmen.

The office manager is responsible for the inspection functions and affairs relating to overage, shortage and damage (O.S. & D.) of commodities. He also tries to reduce claims through correction of errors at their sources.

The traffic supervisor manages the quoting, the extending and cutting of rates, and billing.
EXHIBIT 2-1
ORGANISATIONAL CHART OF A BRANCH TERMINAL

Branch Manager

Terminal Manager

City Dispatch

P & D Drivers

Dock Foreman

O.S.&D. Claim

Tracing

Accounts Receivable

Salesmen

Rating

Billing

Office Manager

Sales Manager

Traffic Manager

Loaders

Yardmen

Strippers
The following section discusses the day-to-day operation of the model carrier. The day-to-day operation is directly related to the actual movement of goods.

Day-to-Day Operation

The transportation activity begins when a shipper phones to request a pickup. Prior to that, however, he may wish to inquire about the rate before deciding which carrier to patronize. The rate clerk whose duty is to answer rate questions and offer advice to shippers, generally provides the needed information.

Following the flow of intercity shipment in Exhibit 2-2, the next step is to pick up the shipment with a pickup and delivery (P & D) truck. A bill of lading is prepared at the same time.

Before the P & D truck is dispatched, the driver has to obtain the following information about the shipper: (1) destination, (2) special equipment requirement, (3) name of shipper and address, and (4) type and weight of freight.

A bill of lading is usually prepared by the shipper using a pre-printed form provided by the carrier. It has information such as, (1) point of origin, (2) shipper's name and address, (3) consignee's name and address, (4) number of pieces, (5) description of goods and special remarks, (6) weight of shipment, (7) rate, (8) amount shipped, and (9) terms of the contract.

The weight of the shipment is provided by the shipper, and the carrier only does spot checks from time to time to ensure accuracy. The city dispatcher's overall responsibility is (1) to control P & D truck
EXHIBIT 2-2
Schematic of flow of LTL intercity shipment through a general
Commodity carrier operation

Requested or Scheduled pickups

Picked up by P-D trucks

Delivery to O/B terminal

Receipt by O/B Terminals

Removed from P-D Truck & check

move to staging area

move to O/B line-haul trucks

Prepare B/L

Receipt by I/B terminal

removed from trucks, & check

move to staging area

load onto P-D trucks, & check

delivery to consignee

Rate quote, extend & cut

Prepare freight bills

P.D. = pickup and delivery
O/B = outbound
I/B = inbound
B/L = bill of lading
check = count, compare, labels, spotweight

--------- = document flow
--------- = freight flow
drivers, (2) to supervise P & D operation, (3) to co-ordinate P & D with the dock operation, and (4) to handle pickup requests and gather pickup information.

The city dispatch has to be in close contact with the line-haul dispatcher, the dock foremen, and city drivers to ensure smooth operation.

Once the shipment has been picked up from the shipper, and taken to the terminal, it is moved across the dock into the line-haul trailer that takes the shipment to its destination city. Otherwise, it is placed in a staging area or warehouse to be loaded into a line-haul trailer at a later stage.

A freight bill is typed after the rates are quoted and extended. It shows the amount the shipper or consignee is to pay for the shipment.

The movement of freight across the dock is controlled by the dock foreman. He supervises the loaders and strippers. The loaders and strippers load and unload P & D trucks and line-haul trailers. They also perform the checkers' function to ensure proper loading of shipments to the correct destination.

Improper labelling of packages, poor scheduling and routing, and insufficient dock space, impede efficient dock activities.

The procedure repeats itself after the shipment reaches its destination city.

The ensuing chapter discusses the essentials of lane profitability to provide some insight regarding the meaning of a lane and the concepts relating to profitability.
CHAPTER 3
ESSENTIALS OF LANE PROFITABILITY

The meaning of "lane" and "profitability" should be understood before proceeding to the ensuing chapters. The discussion of profitability involves the discussion of its components, revenues and costs; and each of the components will be covered in some detail.

Definition of a Lane

A lane is defined for the model carriers as well as in the trucking industry as the traffic flow between a city pair or between two terminals.

In essence, the traffic between terminal A and B is the combination of traffic moving from A to B and from B to A. From the standpoint of terminal A, the traffic moving from B to A is the inbound traffic, and the traffic moving from A to B is the outbound traffic.

It is not unusual in transportation to have more traffic in one direction than in the reverse direction. The traffic moving in the higher-density direction is generally termed the headload traffic. The traffic moving in the lower-density direction is termed the backhaul traffic.

With a possible combination of nearly one hundred lanes in the network, it is practical to select certain lanes of interest for analysis. In the first place, an examination of all the lanes in existence is time consuming. Some lanes have a negligible amount of traffic (in terms of revenue) and do not warrant research efforts. Secondly, lanes with negligible traffic are the ones that do not have regular business. In a
period of say, two years, one cannot obtain twenty four monthly data points from those lanes which do not have regular traffic. Thus, lanes of this nature do not provide adequate data points for analysis.

One can pick out major lanes between various big cities to drastically reduce the amount of research work required without sacrificing the completeness of the study. An examination of a few selected lanes rather than all the lanes will enable management to concentrate their effort on lanes of most interest.

The following section will be a discussion on the concept of profitability and the components of profitability.

Concept of Profitability

Profitability, according to Ezra Solomon, is an operational concept, not an owner-oriented concept. By this, one can say that when management is given the job to maximize profitability, in a conditional situation, management has to see to it that within the various constraints it has to work under, the operation, on the average, has more inflow than outflow in terms of funds or in other measurable terms. For an operation to be profitable then, the operating revenues generated from the summation of all its segments, on the average, should be above costs which are essential to generate the revenues.

Since profitability is an operational concept, this study, a profitability study, will not deal with the owner-oriented objectives (often

nebulously defined) such as those of the maximization of wealth or of profits.

It should be noted, however, that profitability maximization is a necessary but not sufficient condition for the attainment of the aforementioned owner-oriented objectives. 8

Components of Profitability

Revenue

The explanation of the notion of revenue can best be done with the aid of symbols. Let

- \( R_{A,B} \) = revenue of traffic moving from city A to B
- \( R_{B,A} \) = revenue of traffic moving from city B to A
- \( R_{AB} \) = revenue of the above combined = revenue for lane AB

Suppose there are four terminals, A, B, C, & D under consideration.

EXHIBIT 3-1 - Notion of Revenue

The outbound revenue associated with terminal A is:

\[ R_{A,B} + R_{A,C} + R_{A,D} \]

The inbound revenue associated with terminal A is then:

\[ R_{B,A} + R_{C,A} + R_{D,A} \]

The total revenue associated with terminal A is equal to the sum of the above, or simply the sum of the lane revenues:

\[ R_{AB} + R_{AC} + R_{AD} \]
Cost

Basic Concepts

The prime objective of a going concern is to be able to price its service, on the average, above costs. The importance of costs to data collection, identification, and control is attested to by the fact that knowledge of costs has been used traditionally as an invaluable decision-making tool.

There is, in general, a lack of awareness regarding the implication of "cost" for rate levels, traffic volumes, and service standards. Fallacious decisions are sometimes made without an understanding of the assumptions underlying the cost figures gathered and the limitation of the use of cost knowledge.

First, many transportation costs cannot be measured with complete precision. Some costs can be directly traced to specific traffic but others cannot. Arbitrary methods have to be designed, in some instances, to apportion costs to different segments of traffic.

Second, past cost data have to be related to the future. It must be realized that data of recent months are not usually used to make decisions for the indefinite future. Another point worth mentioning is that, in spite of the seemingly complicated mathematical manipulations and high-sounding statistical techniques that surround cost analyses, the results obtained from the analyses are merely predictions of the future. Complex formulations often create a false sense of precision.

Third, costs mean different things at different times. In practice, it does not always cost the same to haul two identical commodities the same distance, depending for example, on whether it is the headload or
backhaul traffic, or whether workers are paid over-time wages to handle the traffic.

In spite of the above limitations of the uses of cost, knowledge of costs is used for a multitude of routine and non-routine decisions. However, before one can use costing to make decisions, it is essential to understand the various cost terms and the characteristics of the cost elements in a trucking terminal.

**Cost Classification and Relevant Cost**

In light of the fact that cost terms are often defined slightly differently in different situations, it is appropriate to define the following terms in the context of this paper.

**Direct costs:** direct costs are those that are immediately traceable to a particular type of output, or costs that can be traced to particular traffic. A line-haul driver's wages, for example, can be traced directly to the particular run he performed.

**Indirect costs:** indirect costs are those that cannot be easily traced to a particular traffic, or those that are not directly connected with output. Taxes of various kinds, phone bills, are examples of indirect costs.

It should be noted that direct and indirect costs are not synonymous with fixed and variable costs. Not all variable costs are direct costs, and not all direct costs are variables. Furthermore, when speaking of direct costs, it is essential to specify the unit being costed. Costs which are direct with respect to one unit are often indirect with respect to other units. For example, the branch manager's salary is directly
assignable to the cost of running a branch, but it is not directly assignable to the costs of operating a lane.

Fixed costs: fixed costs are those costs that remain fixed in total even with changes in output. A fixed cost is fixed, only in relationship to a given period of time and a given range of activity, called the "relevant range". Fixed costs vary on a unit basis with changes in output level but do not change in total.

Variable costs: variable costs are those that are uniform per unit, but fluctuate in total in direct proportion to changes in the related total activity or volume in a given time period and range of activity. The distinction between fixed and variable costs cannot be made without first specifying the time span and the level of activity. The time span should be the time in which management has had ample time to adjust costs to traffic volume.\(^9\)

Semi-variable costs: semi-variable costs are those that have both fixed and variable elements. The fixed elements represent the minimum cost of supplying a service. The variable element is that portion of the cost influenced by changes in activity.

Incremental costs: incremental costs are those added costs involved in a change of level of output. Theoretically, there is a difference between variable cost and incremental costs. While variable cost is uniform per unit of output produced, an incremental cost is not. For example, it cost very little to haul an additional hundred pounds

in a half-full trailer; however, if several many additional hundred pounds were added until another trailer was required, the added costs would be very high. In practice, another truck will not be dispatched just to carry the additional hundred pounds. The fine distinction between incremental and variable cost is an academic one.

Fully distributed costs: fully distributed costs are those costs that are based on the out-of-pocket or variable costs plus an apportionment of the constant expenses. They show the extent of the constant costs which are present in the operation and which must be recovered out of the revenues received over and above the variable expenses.

Many authors question the usefulness of fully distributed costs for decision making in other modes of transportation such as rail. Professor Edwards contends that fully distributed costs have no relevance in the establishment of freight rates. Poole, in his book on Railway Costs, mentions that the only cost finding that has any validity is that which concerns itself with costs that vary with the volume of production.

Cost Elements

The two major components of cost to be examined in this study are terminal costs and line-haul costs.

Terminal costs are many and varied in nature. Each terminal cost


demonstrates peculiar characteristics of its own, and a brief exposition of the different nature of each cost may be helpful for understanding the following chapters.

Note that the pickup and delivery cost is also considered as a terminal cost in this paper.

Line haul costs are costs required to perform the "over-the-road" functions.

An explanation of the different costs are shown separately in Table 3-1 and Table 3-2 for the terminal and line-haul functions.
TABLE 3-1

Terminal Costs

<table>
<thead>
<tr>
<th>Costs</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wages - P &amp; D</td>
<td>wages for drivers &amp; helpers doing P &amp; D within the terminal city.</td>
</tr>
<tr>
<td>Wages - dock</td>
<td>wages for loaders, strippers, checkers (if applicable) and yard jockeys.</td>
</tr>
<tr>
<td>Welfare</td>
<td>fringe benefits like medical plans, dental plans, and company-paid life insurance.</td>
</tr>
<tr>
<td>Leased equipment</td>
<td>tractors and trailers for P &amp; D are rented for hours or days when the existing equipment is inadequate.</td>
</tr>
<tr>
<td>Hired Cartage</td>
<td>same nature as leased equipment except hired cartage involves the hiring of drivers as well as cartages from a cartage company.</td>
</tr>
<tr>
<td>Accidental repairs</td>
<td>accidental repairs are an expense when the company is self insured. Otherwise, this expense is replaced by insurance expense.</td>
</tr>
<tr>
<td>Licenses</td>
<td>a fixed annual expense based on the size of the fleet and the type of service performed.</td>
</tr>
<tr>
<td>Fuel &amp; Oil</td>
<td>fuel &amp; oil used for P &amp; D trucks within the city of a particular terminal.</td>
</tr>
<tr>
<td>Radio communication</td>
<td>maintenance of radio equipment for the city dispatch function.</td>
</tr>
<tr>
<td>Dock supplies</td>
<td>supplies such as pellets, dunnage, staples and floor absorbent.</td>
</tr>
<tr>
<td>Tires &amp; tube</td>
<td>replacement of tires and tubes for P &amp; D operation.</td>
</tr>
<tr>
<td>Maintenance</td>
<td>maintenance of P &amp; D equipment including parts and major overhaul.</td>
</tr>
<tr>
<td>Salary - Branch &amp; term manager</td>
<td>straight monthly salary for the administration of the branch terminal.</td>
</tr>
<tr>
<td>Salary - dispatch &amp; formen</td>
<td>straight monthly salary for the operation of the terminal and P &amp; D function.</td>
</tr>
<tr>
<td>Salary - Office &amp; Janitors</td>
<td>straight monthly salary to carry out the routine work of an office.</td>
</tr>
<tr>
<td>Category</td>
<td>Description</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Welfare</td>
<td>fringe benefits, unemployment insurance, etc. for salaried employees.</td>
</tr>
<tr>
<td>Office equipment</td>
<td>leasing and maintenance of office equipment like adding machines, typewriters, &amp; photocopiers</td>
</tr>
<tr>
<td>Postage, printing &amp;</td>
<td>postage for mailing out bills, sales literature and so forth. Printing &amp; stationery are used on a regular basis.</td>
</tr>
<tr>
<td>stationery</td>
<td></td>
</tr>
<tr>
<td>Property maintenance</td>
<td>refurbishing of the terminal premises.</td>
</tr>
<tr>
<td>Utility</td>
<td>heat, light, and water.</td>
</tr>
<tr>
<td>Telephone &amp; Teletype</td>
<td>the long-distance telephones and teletype expenses increase as more transactions take place.</td>
</tr>
<tr>
<td>Business &amp; Property tax</td>
<td>fixed annual expenses to be spread over the year.</td>
</tr>
<tr>
<td>Security</td>
<td>a hired service to safeguard the terminal properties and equipment.</td>
</tr>
<tr>
<td>Rent</td>
<td>fixed monthly payment.</td>
</tr>
<tr>
<td>Sales &amp; Traffic</td>
<td>salesmen commissions, car allowances, advertising.</td>
</tr>
<tr>
<td>Depreciation</td>
<td>depreciation of trucks and tractors. If equipment wears out quickly on usage, depreciation should reflect this. See discussion in Chapter 6.</td>
</tr>
<tr>
<td>Interest</td>
<td>interest for bank loans and overdrafts.</td>
</tr>
<tr>
<td>Claims</td>
<td>payment made for lost of damaged shipments as a compensation.</td>
</tr>
<tr>
<td>Bad debt</td>
<td>a bad debt expense is incurred if the collection of a payment is unsuccessful.</td>
</tr>
</tbody>
</table>
### TABLE 3-2

#### Line-haul Costs

**Operating Expenses:**

- **Piggyback**: Cost to send a line-haul trailer by rail
- **Wages**: Line-haul drivers and helpers' wages
- **Welfare**: Dental plans, life insurance, medical plans
- **Lease equipment**: Occurs when there is inadequate equipment on hand
- **Accidental repair**: Outside repair due to accidents
- **Fuel & Oil**: Diesel fuel and motor oil for line-haul trucks
- **Licenses**: Fixed operating fee
- **Maintenance**: Repairs and upkeeping
- **Tires & tubes**: Replacement of worn-out tires
- **Depreciation**: Line-haul tractor and trailer depreciation

**Overhead Expenses**

- **Executive Salary**: Self explanatory
- **Welfare**: Medical and dental plans, life insurance, etc.
Contribution Margin Approach to Costing

Importance of Contribution Approach

The contribution margin approach theorizes that, if the revenue generated is greater than the variable cost, then the difference, called the contribution margin, can be used to recoup the fixed costs. As long as there is some contribution towards fixed costs, traffic should move, provided of course no better alternatives are available. The contribution margin theory does not deny the importance and relevance of the fixed cost, but the distinction between the behavior of fixed and variable costs is helpful for answering questions such as:

1. Which of the lanes requires more marketing efforts?
2. Which of the lanes should be dropped?
3. If the rate structure cannot be adjusted at will, how much variable cost is allowable before a zero margin is reached?
4. How does one utilize resources more effectively for lanes with low contribution margins?

Departure from Contribution Margin-Approach

The contribution margin approach is less effective as a decision aid when the proportion of variable costs is relatively small. This is so because, if the variable portion of the total cost is so low, almost

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any amount of revenue shows a positive contribution margin. The contribution margin then loses its discriminatory power in choosing among alternatives.

The author estimates that about 70 to 80 percent of the terminal cost of the model carrier is variable judging from the available data. It is likely that the contribution margin approach will remain to be a useful tool for some time to come.

The increasing incidences of guaranteed wages for hourly-paid workers, and union-stipulated minimum number of workers in a shift often affect the validity of the contribution margin approach. Judging from the relatively high proportion of variable cost in relation to terminal costs in the model carrier, unless the activity level is so low that stipulated wages are constantly paid for little or no productivity, such incidences will not greatly undermine the usefulness of the contribution margin approach.

This chapter enhances better understanding of the ensuing chapters. The following chapter examines the research that has been undertaken relating to transportation costing.
CHAPTER 4
LITERATURE REVIEW

Background

The literature review in this chapter examines the extent to which current transportation literature is relevant to this study.

It appears that most standard cost accounting texts and articles are geared to manufacturing. Costing in the transportation industry is different from that in manufacturing. This is due to the fact that manufactured products are more homogeneous. This fact diminishes the usefulness of cost accounting literature for transport costing.

On the other hand, transportation literature alone does not provide a background of cost accounting theory sufficient to pursue the problem of lane profitability. Clearly, there is a need to fill the void.

The literature review will not include theoretical works on cost accounting, since they can be found in any standard text. Much of the transportation literature was examined to determine its applicability to this study.

Four studies are examined in this review. The first two are cost determination formulae prescribed by the Interstate Commerce Commission (I.C.C.) in the United States. The third is an article on measuring pick-up and delivery costs for small shipments. The fourth is a case study dealing with the implementation of a profitability system.

The two U.S. government prescribed cost formulae, entitled, "Highway Form A" and "Highway Form B" are being considered for mandatory use by all carriers in presenting cost data at rate hearings. Although the formulae are developed mostly for statutory purposes, it is interest-
ing to find out if the formulae have any contribution in the determination of lane profitability.

The study on measuring pickup and delivery costs for small shipments was based on actual data collected from a metropolitan trucking firm. The study may be of interest to small trucking firms which do not want to do extensive research. The case study depicts some practical problems that one may encounter when implementing a shipment profitability system. Most of the discussions are of much interest in this case study.

(1) Formula for the Determination of the Costs of Motor Carrier of Property. (Highway Form A)

The Highway Form A cost formula was developed in March 1973 to ascertain motor carrier costs for rate-making purposes. The original intent was to establish some procedures which all carriers can use as a uniform method of developing and presenting cost data.

It should be emphasized at this point that the Highway Form A prescribed by the Interstate Commerce Commission was not introduced as an innovative technique to estimate cost. Rather, it was meant to be a uniform way to estimate cost among carriers.

Although the I.C.C. cost formula was frequently referred to when the author discussed trucking costs with trucking firms and governmental agencies, the Highway Forms A & B do not directly relate to the profitability study in this paper.

Most of the forms, schedules, and summaries are quite detailed. Some of them involve a breakdown of some kind, such as cost by weight bracket, and cost by mileage block, to perform a function.
The approximate order in which the schedule, forms and summaries are filled out are represented diagramatically below:

- Assemble data to fill out the worktable
- Fill out the various forms to provide pertinent information
- Fill out schedules. Some schedules (B&C) require information from the forms
- Fill out summary sheet in numerical order 1-5 using the information from the forms and schedules

Below is a brief summary explanation of the various schedules, forms, and summaries. It is a formidable task to follow every line and every step of the formula. Because of this, the discussion below will only highlight the methods used rather than discuss the details.

Schedule A:

Expenses of operation, taxes, and rents are distributed among the four major services, namely (a) line haul, (b) pickup & delivery, (c) terminal platform, and (d) billing and collection. Sheet one to four of the schedule assigns individual accounts to a particular service. For example, line-haul drivers' wages are assigned to the line-haul service. Apportionment factors are used only when direct assignment is not feasible. The apportionment factors are provided by one of the following
three sources: (a) simple percentage based on other apportioned costs, (b) results taken from the work tables which can be used to provide supporting statistics, (c) factors provided by the commission in the appendix of the I.C.C. formula.

Sheets 5 and 6 provide guidance for the calculation of the out-of-pocket and constant portion of the operating expenses based on a special study conducted by the commission. The out-of-pocket costs are the expenses incurred, in addition to the fixed costs which have been expended, to perform a service. I.C.C. deemed 90% of the total operating expenses to be the variable portion.

Schedule B:

Pickup and Delivery costs are apportioned, based on the time factors provided by the I.C.C. special study, to different weight categories for the stop time and running time of the P & D activities. The stop time is the total time spent at each stop and the running time is the time spent on running between stops. Performance factors in the P & D service such as vehicle running minutes per ton can be computed.

Schedule C:

The purpose of this schedule is to compute the P & D costs for small shipments, 300 pounds or less, on a cost per shipment basis.

The same method is used for computing costs for a specific weight shipment as in schedule B, except that this time the specific weight of the shipment, rather than the average weight per shipment, is used for cost calculation.
Schedule D:

This schedule develops factors to adjust costs for the effect of density on pickup and delivery, platform handling, and line-haul running services. Sheet 1 provides for adjustments of the pickup and delivery costs affected by density. Most of the information is obtainable from schedule B to arrive at the results in this schedule. Sheet 2 establishes the ratios of the adjusted pickup and delivery, platform handling, and line-haul costs to the average costs.

Adjustment ratios are, for the most part, provided by the I.C.C. from the work tables or from footnotes, e.g., the expenses of running costs affected by density can be found by multiplying the expenses in schedule B by a set of provided ratios for different density groups as shown:

<table>
<thead>
<tr>
<th>Density group</th>
<th>0-4.9</th>
<th>5-9.9</th>
<th>10-14.9</th>
<th>15-19.9</th>
<th>20-29.9</th>
<th>30-39.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ratios</td>
<td>1.71</td>
<td>1.47</td>
<td>1.26</td>
<td>1.13</td>
<td>1.00</td>
<td>.89</td>
</tr>
</tbody>
</table>

Similarly, for terminal handling a set of ratios is provided for different density groups.

Form 1

Form 1 summarizes the basic information of miles and hours spent for P & D and line-haul services. The information thus gathered is used to compute the unit-costs in schedule A described previously.

The line-haul and P & D speed factors are developed in the work-tables. The speed factors for the P & D service take into consideration items such as the number of stops, numbers of shipments, productive
vehicle-minutes at stops and productive vehicle man-minutes when running. For the line-haul service, performance factors by mileage blocks contain the average load and the ratio of total vehicle-miles to loaded vehicle miles.

With the speed factors, one can calculate the intercity hours by dividing the intercity miles by the speed, and the P & D miles by multiplying the P & D hours by speed.

Form 2

Form 2 is simply a summary of the carriers' freight bills used to obtain statistics of weight and the number of shipments by weight bracket and type of traffic. This form is used for the purpose of apportioning tons, ton-miles and shipments to single-line or interline traffic by selected brackets.

Form 3

Form 3 is another basic breakdown of a carrier's total tons, shipments, and ton-miles by weight category. The percentage distribution of shipments at origin and destination are computed also by weight brackets as for pickup and delivery and terminal handling services.

Summary 1:

This summary develops the weighted average cost per cwt. for pickup and delivery, platform handling, and billing and collection. Different weight brackets are considered. Information from Form 3 and
and schedule B is necessary for some calculations.

Summary 2:

Its purpose is to establish line-haul costs by mileage blocks and major weight brackets. Specific items to be computed include: a) non-driver hourly costs b) average line-haul speed c) non-driver hourly costs in cents per vehicle mile d) driver's wages and expenses per vehicle-mile e) mileage costs in cents per vehicle mile f) total cost per hour and per mile g) ratio of cost for each mileage block to cost for all mileage blocks.

Previous calculation from schedule A is necessary to complete this summary. The ratio of cost for each mileage block to cost for all mileage blocks is instrumental to the calculation of line-haul costs per 100 pound-miles.

Summaries 3, 4 and 5:

These summaries represent various types of cost scales developed in Highway Form A such as cents per shipment and cents per 100 pounds.

The voluminous amount of schedules, forms and worktables to be filled are often discouraging and confusing. They tend to be too complex for small and medium-sized carriers which do not have cost experts on their staff. Also, the tables cannot be completed in a streamlined manner because there is too much cross referencing among tables.

Arbitrary percentages (derived from an I.C.C. special study) used for cost estimation are not always realistic. For example, 90 percent of the operating expenses is deemed to be the variable portion.
Obviously the fixed and variable portion of the cost makeup varies from time to time and from company to company.

The regional factors provided to aid calculation will be less valid with the passage of time. Most of the factors need to be updated constantly to keep up with different kinds of changes. Failure to do so will undermine the usefulness of the formula. Since regional factors do not include any Canadian regions, the factors are not applicable to a Canadian trucking firm and thus the usefulness of the study is limited to a U.S. trucking company.

The next review, Highway Form B, shares some of the shortcomings of Form A. However, Form B is a somewhat simpler version of the I.C.C. formulae.

(2) Simplified procedures for the Determination of Costs of Handling Freight by Motor Carriers (Highway Form B).

The simplified version, the Highway Form B, does not require carriers to fill out the various forms and summaries. Instead, it is only limited to Schedule A and Form 1, which are basically the same as those of Highway Form A. The summary schedule then, in lieu of the five summary schedules in Form A, facilitates the computation of the approximate out-of-pocket cost of selected sizes of shipments moving in given weight loads for various distances.

Since the unit costs by services was determined in Schedule A in the same manner as in Highway Form A, the details will not be discussed here. Using the results from Schedule A such as:
Line haul cost per cwt. mile.................... .47¢
Line haul cost per vehicle mile....................34.0 ¢
Pickup & delivery cost per cwt. ....................20.0 ¢
Platform cost per cwt. ............................32.0 ¢
Billing and collection cost per shipment............95.0 ¢

one can start to develop out-of-pocket costs for specific hauls.*

To do that, heavy reliance on the various tables of factors is necessary. The tables provide such items as the speed and time factors which specify the average line-haul speed and stop time, the wage distribution among the various functions, the percentage of P & D costs attributable to TL or LTL traffic, and ratios for adjustment of P & D costs by size of shipment, etc.

Using the above figure for an example, the total out-of-pocket cost for a shipment of 5000 pounds shipped over a distance of 1000 miles would be equal to: 47¢ x 1000 + 20¢ x 50 + 32¢ x 50 + 95¢ x 1.

Adjustment factors are applied on top of the expression to reflect the speed, time and regional differences. The following page illustrates how the adjustment factors are used.

**Pickup and Delivery:**

Supposing one wants to calculate the pickup and delivery cost per 100 lb. of a 5000 lb. shipment, and supposing the system average weight is 1000 lbs., the calculation is as follows.

According to the result in schedule A, the pickup and delivery cost per cwt. is 20¢, therefore 5000 lbs. will cost $10 before adjustment.

* Cost figures derived need to be revised to reflect price level changes, presumably every time a major rate adjustment takes place.
Looking at table M (of Form B), the adjustment factor for a firm whose system average weight is 1000 lbs. and is carrying a 5000 lb. shipment, is .87. Therefore, the total cost is $10 \times 0.87 = $8.7. The cost per cwt. for P & D service is then $8.7 + 50cwt. = 17.4\text{c}.

Platform

The platform cost for the 5000 lbs. before adjustment is $32\text{c} \times 50 \text{ cwt.}$ according to results in schedule A. Table D in the I.C.C. appendix suggests that for 5000 lb. shipments, the percentage of tons handled over the platform for a given region, say the central region, is 31.93\% of total tons handled. Thus, the platform cost is $32\text{c} \times 50\text{cwt.} \times 31.93\%$. The platform cost per cwt. is therefore $32\text{c} \times 31.93\%$.

There are few advantages in using Form A instead of Form B, since the latter is a simplified version of the former and yet serves a similar purpose. Nevertheless, Form B is still too complex for small and medium-size companies to understand and use.

Like Highway Form A, the cost formula in Form B assumes that the unit costs of each function can be added linearly. However, according to a study by Warner and Burstein,\textsuperscript{13} there are some economies of scale in trucking, meaning that unit trucking costs are a function of volume of business. Unfortunately, the I.C.C. cost formula appears to give little weight to the effects of capacity utilized on unit costs.

The following article is an illustration of how cost estimation can be done using very simple methods.

\textsuperscript{13} Warner and Burstein, \textit{op. cit.}, p. 40.
Based on the data obtained from a trucking firm, the author attempted to measure pickup and delivery costs for small shipments using mainly regression analysis. The method developed can be applied to trucking firms without the need for complex calculations and detailed cost data.

The method is relatively crude, perhaps somewhat simplistic. The idea of using time as a common denominator to regress against work done (such as weight handled) appears workable. Simple regression was used in this study. It is conceivable that it can be improved if multiple regression is used so that more variables can be included.

The study was presented in three stages. First, it was necessary to determine which were the "small" shipments. A frequency distribution of the weight and piece counts can provide insight. Second, it was ascertained if the weight handled and piece counts related to the running time and dock time. Third, if a relationship was found to exist, it was possible to determine, for example, how much time would be required at the customer's dock to handle 2000 pounds of shipments. Since the wage scale is known, the cost is easily determined.

To determine which are small shipments, a frequency distribution of the piece count per shipment and weight per shipment of the sample trucking firm were plotted as follows to give some indication of what "small" shipments are.
After determining the composition of the traffic, the relationship between time and shipment size and that between size and weight were established. The average dock time was plotted against the respective weight and piece categories to determine the correlation. The former plot is shown below.
The dock time plotted consisted of the interval between the dock and the departure time. A linear relationship is observed, and by using stepwise linear regression, a relationship of either \( T = a + bW \) or \( T = a + bP \) was developed, where:

- \( T \) = time
- \( W \) = weight
- \( P \) = number of pieces
- \( a \) = constant term
- \( b \) = slope of regression line

\( R^2 \) of .98 and .92 was obtained for the two equations respectively. Since the first equation had a higher \( R^2 \), and both equations are statistically significant, it was chosen.

The results for P & D are approximately the same, and can be expressed as \( T = 6 + 0.01W \).

A 900-pound shipment, for example, will require \( 6 + 0.01 \times 900 \) or 15 minutes dock time. Since the transit (running) time is independent of weight, it is considered a constant and is averaged to be 11 minutes. Thus for a pickup of delivery, the total time will be

\[
T = 11 + 6 + 0.01W = 17 + 0.01W
\]

The equation can be used to determine cost if the labour wage scale is known or if the cost of equipment use per hour is predetermined.
The next article to be discussed is perhaps most relevant to this paper because it deals with the issues of profitability study.


The case deals with the implementation of a shipment profitability system of a trucking corporation. A number of questions were discussed: what lead up to the decision to develop the system?; how the system had been developed?; and what data were available from the system?

In the case of Carolina Freight Carriers, the decision to develop the system was triggered by the sudden drop in profits. Before the system was implemented, the explanation of poor profits was, at best, a guess. In order to find the root of the problem, the management eventually decided to develop a profitability system.

Prior to the introduction of the system, the company used the following methods:

(a) Terminals' operating costs are compared with their respective inbound and outbound traffic.

(b) Developed schedules are used to show the revenues required on truckload traffic between each two points to operate at a satisfactory profit level.

(c) Manual methods based on I.C.C. Form B are used to calculate the cost of individual less-than-truckload shipments.

It is indicated in the case that each of the three tools has its own drawbacks. The standard cost analysis uses cost figures by terminal that are too general to relate directly to profit, since the various
types of freight have different published tariffs. The schedule is only useful for truckload traffic but is of no use for less-than-truckload shipments. The adoption of I.C.C. Form B is time consuming and is therefore not suitable for repeated usage.

The steps involved in the design of the shipment profitability system deserve some mention.

The steps are:

(a) identify traffic categories which receive different handling.
(b) devise a listing of work activities or cost functions.
(c) create a traffic costing matrix showing which traffic types are associated with which work activities.
(d) assign the general ledger expense items to one or more cost functions or activities.
(e) determine the basis of allocation for assigning specific costs from the functions to the various types of traffic.

Steps (a) to (c) are quite straightforward. Step (d) facilitates the association of cost with work done. Prior to these steps, revenue figures should be recorded.

Step (e) is a significant challenge. The following are some of the allocation bases suggested in the case. Dock costs are allocated on the basis of number of shipments and weight of shipments. Detailed time studies are required to determine how much emphasis to put on the number of shipments and weight of shipments. Accounts receivable costs are allocated on a per-shipment basis. Each truckload is allocated the same pickup and delivery costs. Less-than-truckload traffic is given its share of pickup and delivery costs on a shipment and weight basis.
Sales and traffic costs are allocated using the bases of other related costs that have been successfully allocated. If a shipment is given a bigger share of dock costs, pickup and delivery costs, than other shipments, its sales and traffic apportioned cost will proportionally be greater.

Thus far, the allocation bases have not considered density. The case suggests that when a shipment is over 10,000 lbs. or takes up 50% of the trailer or more, density is a major consideration. To adjust for the density factor, one needs to know the amount of space the shipment occupies, the weight of the shipment, and the outbound load average. If the outbound load average is 24,000 lbs., and the capacity of a line-haul trailer is 3,000 cubic feet, then the cube factor is 8 lb./cu. ft. on the average. If the given shipment weighs 5,000 lbs. and takes up 1000 cubic feet, the cube factor is 5 lb. per cubic feet. It is necessary to charge more costs per pound to the shipment than for a shipment with a cube factor 8 pounds per cubic foot.

The case illustrates the weaknesses of some of the methods to detect profitability. Since the case study deals with the implementation of a shipment profitability system, it does not directly suggest how one can go about determining lane profitability. Nevertheless, one can gain much insight from this study to develop a lane-profitability model.

One possible drawback of the shipment profitability system suggested in the case is that the system's usefulness diminishes in the case of a carrier which hauls mostly small shipments and in relatively small quantities.

The case did not mention anything about the procedures to record actual current costs on an accrual basis. The timeliness of the data
should be emphasized.

All in all, the literature reviewed did not specifically deal with the costing or profitability study of a lane. It is hoped that the next chapter, which contains the lane profitability model, will have some contributions to this end.
CHAPTER 5
LANE PROFITABILITY MODEL

Abstract

This section is an abstract of the procedures used for the determination of lane profitability -- an overview of the model itself.

Since the movement of traffic from terminal A to terminal B utilizes terminal facilities at both terminals, it follows that the movement should be given some burden of both terminals' costs. (See Exhibit 5-1.) Instead of examining the lane as a whole, it is often useful to examine the headload and backhaul traffic individually when performing cost allocation. An obvious advantage of investigating the two types of traffic separately is that the profitability of the headload and backhaul traffic can be compared while doing a lane profitability study.
EXHIBIT 5-1

Illustration of lane definition

- Pickup from shipper to terminal
- Delivery from terminal to consignee
Two interesting features should be noticed in the cost assignment process.

First, truckload traffic in many common carriers does not require the use of terminal facilities such as dock and P & D facilities. It is for this reason that some of the terminal costs can be completely done away with. In the model carrier, however, truckload traffic is hauled to the terminal with city P & D tractors to fill the empty space with small shipments. Although some costs are incurred in moving the line-haul unit to the terminal, it is debatable whether the TL traffic should be responsible for such cost, since the movement is solely for the purpose of loading small shipments.

This paper takes the position that TL traffic should be assigned the P & D costs, because by filling the empty spaces with small shipments, one reduces the line-haul costs of the TL shipments and make TL traffic more lucrative. Besides, small shipments have already incurred their share of the P & D costs. It can be argued that not allocating the P & D costs to the TL traffic means double counting for the small shipments.

Second, depending largely on the style of operation of the carrier, some of the terminal costs are only applicable to outbound traffic and should not be assigned to inbound traffic. Examples of these costs are: billing, sales, bad debts and claims.

The main tool proposed to develop the set of procedures to assess lane profitability is regression analysis. Regression analysis is useful in this study in examining the cost behaviour and to obtain the marginal cost for one additional unit of output.

The alternatives listed below are used to assign terminal costs to lanes by detecting the existence of cost-output relationship or
otherwise.

1. Each potentially variable cost can be regressed with the
variables which adequately explain the cost behaviour at different
levels of output. For example, dock wages are regressed with weights of
different weight categories handled and number of shipments.

2. The percentage distribution of costs that have been previously
allocated using alternative 1 is used as an allocation basis for costs
that cannot be allocated with reasonable accuracy by other means. The
use of this alternative is very common in the costing procedures recommended
by the I.C.C. Highway Form A and B.

3. Subjective evaluations or simple engineering studies (like time
and motion studies) are required in some instances to replace or accom­
pany alternatives 1 and 2 above.

If alternative 1 is used to assign a particular terminal cost for
the movement of traffic from A to B, the portion of cost assigned to such
a movement is equal to the regression coefficient multiplied by the exist­
ing quantity of output (such as weight or number of shipments handled)
summed over the measure of output.

The use of alternative 2 is straight forward. It is used when no
explanatory variables are available. In alternative 3, additional studies,
such as time and motion studies, can often provide an allocation basis
as a percentage distribution or simple ratio to prorate costs.

After terminal costs have been allocated to traffic segments, the
line-haul cost has to be determined.

Because it generally costs the same to run a truck from city A to
city B whether it is half full or completely full, it is fruitless to
use weight (e.g., cwts) or the product of weight and distance (e.g.,
cwt-miles) as an output measure in observing the cost-output relationship.

Two ways to develop line-haul cost on a per-mile basis are suggested here. First, one can divide the total variable costs by the total number of miles travelled during a given time period. Second, one can regress the total costs (fixed and variable costs combined) of each month with the total number of miles travelled. The slope of the regression line, or the coefficient of the explanatory variable is the unit cost per line-haul mile. Exhibit 5-2 is an illustration of the regression line plotted.

EXHIBIT 5-2: Line-haul Unit Cost Estimation
Referring to Exhibit 5-3, the total variable cost of traffic moving from A to B ($TVC_{A,B}$) is composed of:

1. apportionment of terminal A's variable costs ($Term_{A,B}$)
2. apportionment of terminal B's variable costs ($Term_{B,A}$)
3. line haul cost from A to B ($LH_{A,B}$)

The total variable costs for traffic moving from A to B can be expressed algebraically as:

$$TVC_{A,B} = Term_{A,B} + Term_{B,A} + LH_{A,B}$$

The flow chart in exhibit 6-4 demonstrates the procedure to determine $TVC_{A,B}$.
EXHIBIT 5-4

FLOWSHART OF THE PROCESS OF DETERMINING TOTAL VARIABLE COST OF TRAFFIC MOVING FROM A TO B

1. Identify terminal variable costs
2. Propose independent variables to explain each cost
3. Do regression analysis
4. Test statistical significance
   - Does relationship exist?
     - yes
     - no
6. Is engineering study useful?
   - yes
   - no
7. Use arbitrary basis or % distribution based on other allocated costs
8. Multiply b coefficient by output quantity or terminal cost times % distribution
9. Is allocation basis completed?
   - yes
   - no
10. Add Line-haul cost to apportionment of both terminals' costs to traffic moved from A to B
11. Calculate Line-Haul costs by multiplying distance by variable cost per mile
12. Add Line-haul cost to apportionment of both terminals' costs to traffic moved from A to B

Assigning Terminal A's Costs. Likewise for Assigning terminal B's Costs.
Let the revenue for traffic moving from A to B be \( R_{A,B} \). The contribution margin for the movement of traffic from A to B, expressed as \( CM_{A,B} \) is equal to:

\[
R_{A,B} - \text{Term}_{A,B} - \text{Term}_{B,A} - LH_{A,B} \quad \ldots \quad (1)
\]

By the same token, the contribution margin for the movement of traffic in the opposite direction is \( CM_{B,A} \) which is equal to:

\[
R_{B,A} - \text{Term}_{B,A} - \text{Term}_{B,A} - LH_{B,A} \quad \ldots \quad (2)
\]

Since lane AB is the combination of both the headload and backhaul traffic between A and B, the contribution margin for lane AB is equal to:

\[
CM_{A,B} + CM_{B,A} \quad \ldots \ldots \quad (3)
\]

The abstract discussed thus far in this chapter is a general framework. The fundamental knowledge required to build the model upon this framework is discussed in the following section.

Considerations Regarding Cost-output Analysis

Basic Requirements

Before statistical costing, or more specifically, regression analysis for costing purposes, can be applied, several basic requirements must be established. These requirements set the stage for meaningful regression analysis and at the same time outline the implications for cost recording. The requirements address the issue of how data should be recorded properly for this kind of analysis.

a) Length of time periods: If the terminal costs are available
on a monthly basis, \* and most other data are available on either a weekly or a monthly basis, it is impossible to choose time periods for observations of less than a month each.

If there are possibilities of time lags in the order of three or four days between revenue recognition and the cost occurrence, a monthly period will be less affected than a weekly period. This point will be elaborated in the discussion of matching revenue and costs in the next chapter.

b) Number of time periods for sample size: In a time series analysis, there is always a trade off involved in using a large sample. A long time span is affected by inflation, technological changes, organizational changes and the like. While changes in the general price level can be adjusted for by using inflation indices, many other changes are often unquantifiable. In the case of labour cost, increased wages as a result of union contracts or other negotiation processes should be adjusted for. Labour costs incurred prior to a wage increase should be elevated by some percentage to be in line with the current wage scale.

Consider the time span between January, 1975 and December, 1976. Suppose a union contract which called for a wage increase of ten percent was negotiated in September, 1975 and September, 1976. Then, wages prior to the most recent contract negotiation must be brought to the present wage scale.

\* "Monthly basis" here refers to time periods of four or five weeks to approximate a month. Since the payroll system is on a bi-weekly basis in the model carrier, and since many other records are on a weekly basis, a 4-or-5-week period is better than a calendar month, in that a calendar month is not a multiple of weeks.
Diagramatically, the time horizon is represented as below.

I------------------I------------------I

first contract negotiation  second contract negotiation

Theoretically, one dollar's worth of labour productivity prior to September, 1975 is equivalent to $1.10 worth of productivity for the year after. Consequently, the dollar's worth of labour productivity prior to September, 1975 is also equivalent to $1.21 of the present productivity. Thus, to bring wages up to the present scale, wage expenses prior to September, 1975 should be all multiplied by 1.21, and similarly, wage expenses prior to September, 1976, but after September, 1975 should be multiplied by 1.10.

Inflation is treated in a similar manner, except that the cutting point is traditionally the end of the calendar or fiscal year. In this case, an inflation index is used.

A two-year time period, with a sample size of twenty-four, is recommended. Although the time period should be as recent as possible, consideration should be given to the representativeness of the chosen time period. Atypical events such as the purchase of a substantial amount of equipment, or unusually high or low sales volumes in a particular year should be avoided in the chosen time span. The former will inevitably reduce the repair costs to a minimal amount and will yield an artificially low annual operating cost. The latter will make the average total cost unrealistically low or high.
c) Choice of output units measure: The problem of selecting the proper units for measuring output is an important one because the relationship of output to cost is of primary concern in this study. The problem is a difficult one because of the uniqueness of the transportation output. Note that the output referred to here is made up of terminal activities such as pounds handled on the dock, number of shipments carried by a P & D crew, and number of bills cut at the branch terminal (not to be confused with output related to a line-haul situation such as ton-miles).

The approximated output units for wages should fully reflect that (1) shipments of different weight brackets require a different degree of effort for labour costs, and (2) shipments of light density take up more space and require more P & D trips than denser shipments of the same weight.

Instead of using the weight handled by a terminal (both inbound and outbound), it is more accurate to express output in terms of the weight handled in different weight brackets.

Density should somehow be reflected in the output units. Most of the statistical reports in a trucking firm do not include density of shipments because such information is hard to obtain. An approximation is required to reflect density in the output units.

In a situation where most or all of the line-haul trailers have the same capacity, the total weight handled in a given time period divided by the number of line-haul trucks that come in and go out of the terminal within that timer period, will provide some indication as to the density of the shipments of that terminal in general. This estimation of density assumes that each line-haul trailer is loaded with an equal load factor and
similar stowability.*

In terms of the physical movement of commodities, the number of shipments alone is not a good measure of output. For example, a shipment of 50 pounds does not cost the same to move as does a shipment of 600 pounds. In terms of billing costs, for instance, the number of shipments is a good measure of output by clerical workers.

The number of parcels in a shipment — collectively, the number of parcels in shipments of different weight groups handled by a terminal — can be utilized to reflect the amount of handling. Therefore, it can be used as one of the explanatory variables along with weights, number of shipments, and density mentioned above.

The use of revenue as an output unit has been suggested by some transportation authorities. It has been used as a measure of output for statistical determination of cost behaviour by Professor Joel Dean. Using revenue to represent output leads to the assignment of costs to segments of traffic on the basis of revenue. The drawback of this method is that it penalizes success by levying higher costs to lucrative lanes.

* Stowability is related to density for it affects the running costs per cwt-mile in the same manner as density. It is the space occupancy of the articles that prevent the vehicle from being loaded to its weight capacity.


**Important Issues**

In order to understand the procedures described in the next section, several important issues should be addressed.

(a) Time lag: Time lag may appear in many different situations. Time lag due to the failure to record costs on an accrual basis can often be remedied by following proper accounting procedures. Chapter 6 is partially devoted to a discussion of data recording. If such a time lag is of a fixed time period, then the regression equation can be expressed as

\[ Y_t = a + b X_{t+1} + u_t \]

An example of this situation is when a certain cost is incurred but is not billed for until a month later.

Time lags due to the peculiar nature of the cost itself are more complex than the kind of time lag mentioned above. An advertising expense, for example, could have an effect on the next few months; a time lag like this is called a distributed lag. An equation for a distributed lag is

\[ Y_t = a + b_1 X_{t+1} + b_2 X_{t+2} + \ldots + b_n X_{t+n} + u_t \]

The equation becomes more lengthy and less effective for lags which extend to more than two or three periods.

(b) Linearity: Most of the multiple regression analyses presuppose a linear relationship between the explanatory variables and the costs. Not only does this imply that the relationship between cost and each of the variables is linear, but it also implies that the combined effects of independent variables are additive.\(^{16}\)

When linear functions do not yield satisfactory results, one can manually plot the cost with its explanatory variable(s) to see if a linear relationship exists. If the relationship between cost and output is nonlinear, the shape of the curve can be postulated using one's understanding of the nature of the cost-output relationship; following this a function can be found to fit into the theoretical curve.

(c) Materiality: The concept of materiality is important when one is facing the decision of whether or not the absence of "vigorous" allocation methods is detrimental. A cost is "material" if it is greater than a predetermined percentage of some figures, such as revenue or total costs. The cumulative effects of using the materiality criteria should also be considered.

**Statistical Testing**

The model described in the first section of this chapter is only valid if the regression results have been tested for significance, and found to be satisfactory.

The existence of statistical significance and satisfactory results in multiple regression imply the following:

1. \( R^2 \), the squared multiple correlation coefficient is "significantly" greater than zero.
2. The regression coefficients are significantly different from zero.
3. The explanatory variables are not highly correlated with each other, i.e., they are not multicollinear.
4. The disturbance term, \( u \), is not serially correlated so as to
underestimate the regression coefficients and produce misleading estimates of costs.

Most computer outputs of multiple regression provide information for significance testing such as the t-ratios, the F-ratios of the entire equation and those of each regression coefficient.

Condition (1), (significance of $R^2$) is satisfied if the F-probability of the entire equation is small. A predetermined acceptance level should be established. If the F-probability is less than .05, it is generally concluded that $R^2$ is significantly different from zero.

To satisfy condition (2) (significance of regression coefficients), one simply examines the F-probability of the coefficients in the regression equation.

Both conditions (1) and (2) can also be tested for by inspecting the F-ratios, which should in general exceed the value of 4.0. Alternatively, the t-value (determined by dividing the coefficients of the regression by their standard errors*) could be used for the same purpose. If the t-value exceeds 2.0, it is generally concluded that the coefficient is significantly different from zero.

To ensure that there is no multicollinearity problem (condition (3)), one has to examine the correlation matrix, provided in many computer printouts, to see if the correlation coefficient $R$ between each pair of explanatory variables is unduly high. The decision as to what constitutes a high value of $R$ is mostly a subjective one. Multicollinearity is an important problem in multiple regression analysis. When the independent variables (X) are highly correlated with each other, their coefficients

* The larger the standard error, the less confident one is regarding whether or not the result is due to chance.
many be unreliable.

Consider the traffic volume in different weight categories. If the demand for small shipments increases simultaneously with the demand for medium and large shipments, it is likely that, if the variables representing the three kinds of shipments are used in the same regression run, the situation of multicollinearity occurs. It becomes impossible in this situation to isolate the marginal costs of handling each type of shipment in a straightforward manner.

The problem can be tackled in two ways. First, one can substitute or eliminate some endogenous variables. The discussion of "some troublesome aspects of terminal costs" on page 78 gives an example of this. The elimination of some endogenous variables can be done by way of the so-called "backward-stepwise" regression. This is a process of deleting variables considered not meaningful or significant to prediction.

Second, one can incorporate parameter estimates derived from extraneous data.

To test whether the disturbance term, u, is serially correlated (condition (4), it is necessary to look in a table of Durbin-Watson statistics to determine if the calculated Durbin-Watson statistic is greater than, less than, or between the two values specified for the relevant number of degrees of freedom ( = number of samples minus one). If the calculated value is less than the table values (both upper and lower bounds), then serial correlation exists. If the calculated value


is greater than the table values, then there is no evidence of serial
correlation. If the calculated value is between the table values, then
the test is inconclusive.

Serial correlation is a serious pitfall in regression analysis when
one is dealing with time-series data. When observations are taken in
successive time periods, the disturbance term, \( u \), that arises in a time
period, \( t \), is not independent of that which arose in previous time periods
\( t-1, t-2, \ldots t-n \). The condition indicates that randomness is lacking in
the data.

One cause of serial correlation is the tendency of costs to be
"sticky". That is, costs may rise in response to increases in volume over
time. However, those costs may not decline in the same way as traffic
decreases.\(^{19}\) When serial correlation exists, the predictions of cost made
from the regression equation will be more variable than is ordinarily
anticipated from least-square estimation.\(^{20}\)

Apart from the four tests of significance mentioned earlier, it is
important to note that none of the assumptions of multiple regression
analysis should be violated. Most of the assumptions relate to the dis-
turbance term, \( u \), and tests of the underlying least square assumptions
cannot be done before the regression is done. The assumptions are the
following:

1. Randomness: the individual errors or disturbances \( u_{ij} \) are
random variables, with finite means, variances, and covariances.

2. Zero mean: every disturbance term has zero expected value,

\(^{19}\) Horngren, \textit{op.cit.} p. 834.

\(^{20}\) Ibid.
irrespective of the value of $X_j$.

3. Homoscedasticity: the variance of each $u_j$ is the same for all $j$ (where $j=1,\ldots,N$) and is independent of $X_j$.

4. Normality: the density function $f(u)$ is normal.

5. Properties of $X$: The exogenous variable $X$ is measured without error and has finite mean and variance. 

The theoretical aspects of the above assumptions are beyond the scope of this study. A few simple methods are introduced here to test the assumptions underlying the regression analysis.

The test of randomness of the disturbances or the residuals can be done by visually inspecting the plotted values of the residual along the X-axis.

A simple way to detect heteroscedasticity, the absence of homoscedasticity, is to plot the $X$ values against the $Y$ values. A graphical example of heteroscedasticity is:

![Graph showing heteroscedasticity](image)

21 Kane, p. 355.

* This example of heteroscedasticity has the variance of the error term increasing as $X$ increases.
Normality of the distribution of \( u \), the disturbance term, can be examined visually by plotting frequency distribution graphs of the residuals.

These visual inspection methods are relatively easy to use and do not require much work of calculation, since the graphs are either provided by the statistical packaged programs or can be produced by the computer with "canned" plot programs.

This section has discussed the considerations regarding cost-output analysis. In essence, it has provided a basic understanding of the kinds of things one need to know before discussing the details of the allocation procedures.

**Details of the Allocation Procedures**

The abstract in the earlier part of this chapter explicity outlined the general procedures used to calculate the contribution margin of each lane. What are left at this stage are the specifics. In the process of allocating terminal costs, this section attempts to specifically indicate (1) the possible costs that relate to outbound traffic only, (2) the possible costs that relate to TL traffic only, (3) the proposed explanatory variables that affect each of the costs, and (4) the use of arbitrary bases of allocation when a cost-output relationship does not exist. This section also attempts to depict some of the troublesome aspects of terminal costs.
Assigning Terminal Costs

Exhibit 5-5 is a summary chart of the entire cost assigning process. Note that fixed costs are not assigned. Column (2) shows the costs that are assigned to outbound traffic only. Such costs are considered to be postage, sales and traffic, bad debts and claims. The reason for not assigning postage costs is that the receiving terminal is presumably not involved in mailing bills, answering queries, or doing paperwork regarding the shipments. If the sales and traffic expenses of a branch terminal are mostly incurred for the promotion of traffic moving out of that city, then such costs should be charged to outbound traffic. If bad debts and claims are associated with shippers but not with receivers, they pertain to outbound traffic only.

Column (3) depicts the fact the TL traffic does not usually need dock handling, such as loading, stripping, or checking. One can simply state that dock-related expenses should not be assigned to TL traffic. Note that P & D-related costs are still assigned to TL traffic, based on the argument presented earlier in this chapter.

Column (4) is a list of variables proposed to explain the cost behaviour. They are, based on the understanding of the model carrier's terminal operation, suggested to begin the regression analysis. The variables can be replaced or reduced in order to improve results.

The rationale behind the choice of explanatory variables are explained as follows.

For wages P & D, weight of shipments from 4 weight categories, number of shipments, and density were chosen. Presumably, the breaking down of the total weight handled by a terminal into different weight categories reflects the possibility that small shipments and bulky ship-
EXHIBIT 5-5 --

<table>
<thead>
<tr>
<th>Cost (X variable)</th>
<th>Assigned to Inbound Traffic also TL Traffic</th>
<th>Assigned only to TL Traffic</th>
<th>Proposed cost-explaining variables/Output measures (Explanatory X var)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wages - P &amp; D</td>
<td>yes</td>
<td>yes</td>
<td>( W_1, W_2, W_3, W_4 ) no. of shpmt, density ( \Delta )</td>
</tr>
<tr>
<td>2. Wages - Dock</td>
<td>yes</td>
<td>no</td>
<td>( W_1, W_2, W_3 ) no of LTL shpmt, density</td>
</tr>
<tr>
<td>3. Welfare - workers</td>
<td>yes</td>
<td>yes</td>
<td>refer to column 6.**</td>
</tr>
<tr>
<td>4. Lease equipment</td>
<td>yes</td>
<td>yes</td>
<td>same as row 1</td>
</tr>
<tr>
<td>5. Hired Carriage</td>
<td>yes</td>
<td>yes</td>
<td>same as row 1</td>
</tr>
<tr>
<td>6. Accidental repairs</td>
<td>yes</td>
<td>yes</td>
<td>refer to column 6.</td>
</tr>
<tr>
<td>7. Licenses</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>8. Fuel &amp; oil</td>
<td>yes</td>
<td>yes</td>
<td>same as row 1</td>
</tr>
<tr>
<td>9. Radio communication</td>
<td>yes</td>
<td>yes</td>
<td>refer to column 6.</td>
</tr>
<tr>
<td>10. Dock supplies</td>
<td>yes</td>
<td>no</td>
<td>( W_1, W_2, W_3 ) no of LTL shpmt, density</td>
</tr>
<tr>
<td>11. Dock equip. repairs</td>
<td>yes</td>
<td>no</td>
<td>do</td>
</tr>
<tr>
<td>12. Tires</td>
<td>yes</td>
<td>yes</td>
<td>same as row 1</td>
</tr>
<tr>
<td>13. Maintenance</td>
<td>yes</td>
<td>yes</td>
<td>same as row 1</td>
</tr>
<tr>
<td>14. Salaries Br. &amp; Term Mgrs.</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>15. Salaries Disp. &amp; Fore.</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>16. Salaries Office</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>17. Welfare-salaried employees</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>18. Office eqt. Lease &amp; maint.</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>19. Postage, printing, staten.</td>
<td>no</td>
<td>yes</td>
<td>no. of shipments</td>
</tr>
<tr>
<td>20. Property Maintenance</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>21. Utility</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>22. Telephone, Teletype</td>
<td>yes</td>
<td>yes</td>
<td>no. of shipments</td>
</tr>
<tr>
<td>23. Business &amp; Property Tax</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>24. Security</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>25. Rent</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>26. Rent income</td>
<td>xxx</td>
<td>xxx</td>
<td>xxx</td>
</tr>
<tr>
<td>27. Sales &amp; Traffic</td>
<td>no</td>
<td>yes</td>
<td>( W_{1,2} + W_{3,4} ) (outbound)</td>
</tr>
<tr>
<td>28. Depreciation</td>
<td>yes</td>
<td>refer to column 6</td>
<td>( \Delta )</td>
</tr>
<tr>
<td>29. Interest</td>
<td>xxx</td>
<td>refer to column 7</td>
<td>( \Delta )</td>
</tr>
<tr>
<td>30. Bad Debt**</td>
<td>no</td>
<td>yes</td>
<td>( W_1 )</td>
</tr>
<tr>
<td>31. Claims***</td>
<td>no</td>
<td>yes</td>
<td>( W_1 )</td>
</tr>
</tbody>
</table>

Symbols Interpretation:

- \( W_1 = \text{weight of shpmt between 1-500 lbs} \)
- \( W_2 = \text{weight of shpmt 501-2000 lbs} \)
- \( W_3 = \text{weight of shpmt 2001-5000 lbs} \)
- \( W_4 = \text{weight of shpmt above 5000 lbs} \)
- \( W_5 = \text{terminal weight at time t} \)
- \( W_{1,2} = \text{terminal weight at time t+1} \)
- XXX = no action for fixed
- \( \Delta \) = not applicable or not available

<table>
<thead>
<tr>
<th>ALLOCATION SCHEME (5)</th>
<th>Basis of Allocation</th>
<th>Remarks &amp; Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( V_{123} ) total ( \Delta ) of shpmt</td>
<td>coeff. as marginal cost</td>
<td>If no relationship exists, allocate on basis of weight.</td>
</tr>
<tr>
<td>( V_{123} ) no. of LTL shpmt</td>
<td>n.a.</td>
<td>If no relationship exists, allocate on basis of weight.</td>
</tr>
<tr>
<td>( V_{123} ) no. of TL shpmt</td>
<td>coeff. as marginal cost</td>
<td>Int. expenses is not related to the amount of traffic.</td>
</tr>
<tr>
<td>( V_{123} ) no. of LTL shpmt</td>
<td>coeff. as marginal cost</td>
<td>If no relationship exists, allocate on basis of weight.</td>
</tr>
</tbody>
</table>

Footnotes:

* Density refers to the density factor discussed earlier and can be approximated by total terminal weight handled divided by no. of line haul trailers served within a given month.

** Refer to column 6 when arbitrary allocation bases is required. Little success can be expected with the regression method for some costs.

*** The bad debt or claim cost variable # payment made at time t; rather, they are costs that can be traced back to shpmtls hauled at time t.
ments do not require the same amount of handling. It is conceivable that if a company handles a lot of small shipments during a particular month, the number of trips (made between the terminal and the customer and from customer to customer) is increased. Concurrently, the number of shipments will also increase making it necessary to include this as an explanatory variable.

Density is also an important variable to include because it is obvious that light-density commodity takes up more space and incurs more P & D wages than heavier commodity for the same weight.

The choice of explanatory variables for dock wages follows similar rationale. Note, however, that \( W_4 \) is not included, and total number of shipment is replaced by number of LTL shipment as compared to P & D wages. This is because, in most trucking firms, TL traffic does not require dock handling.

Costs that relate to the P & D function use the same explanatory variable as P & D wages, and costs that relate to the dock functions use the same variables as the dock wages.

Number of shipments alone is used as an explanatory variable for postage and stationery expenses. Conceivably, the number of active accounts is a more precise variable, since a piece of mail sent to a customer may possibly include in it the papers relating to several shipments. The sales and traffic expenses incurred now may have an effect on the volume of business for the next few months to come. Thus, the weight handled for the months at time \( t+1, t+2, t+3 \) was used to explain cost incurred at time \( t \). If the sales and traffic expenses are only incurred to promote outbound traffic, then the variables \( W_{t+1}, W_{t+2}, W_{t+3} \) should be restricted to outbound only.
Total weight handled by a terminal over a time period is chosen as an explanatory variable for both the bad debt and claim expenses. The total weight handled is perhaps somewhat crude, but the information is readily accessible.

Column (5) suggests the alternate explanatory variables. The technique of backward-stepwise regression (mentioned earlier in this chapter), or the use of engineering studies to reduce excessive variables is often helpful.

Column (6) suggests bases for allocating terminal costs. When a cost-output relationship can be established, the coefficients of the output (explanatory) variables represent the marginal costs for one unit increase of such output. An allocation based on the percentage distribution of other allocated costs can be simple but useful. The welfare expenses use such a basis. The justification is that welfare is approximately a fixed percentage of the actual wages paid out to P & D and dock workers.

Simple proration is sometimes necessary when no vigorous statistical, accounting, or engineering costing methods are available. Accidental repairs and radio repairs are expenses that cannot be traced to their causes in terms of transportation output.

An important point should be noted. Whether an arbitrary proration would be distorting depends on the materiality of the expense in question. A test of materiality is recommended for arbitrary bases. However, the cumulative effects of treating individual immaterial costs should also be watched for.
Some Troublesome Aspects of Terminal Costs

The preceding section described the suggested cost assignment process. However, there are subtle areas that call for more than mere general treatment in the process.

1) Wages: Although wages are generally conceived of as a variable cost, several things make it difficult to reduce costs to zero when activity is at zero level. For practical reasons, a basic crew must be maintained at all times even though little or no work needs to be done. Problems are created by stipulations such as the minimum paid hours once a worker is called in to work or the maintenance of a certain percentage of the previous week's working crew on the present week's payroll. Because of these, wages are not one hundred percent variable.

Another problem is that of the measure of output. The productivity of P & D drivers depends on the number of trips made, the number of stops made in a trip, and the time spent at each stop. Most of these data are not recorded or available in any usable form. The productivity of dock workers, measured by weight moved across dock after checking for address and other particulars, depends on the size of the shipments. To avoid the pitfall of multicollinearity among the variables $W_1, W_2, W_3$ in line 2 of column (4) in Exhibit 5-5, indices can be developed to reflect the degree of difficulty involved in loading and unloading shipments of different weight brackets. To this end, time and motion study can be used.

2) Leased equipment and hired cartage: These are expenses that occur only after a certain output level is exceeded unless a lot of equipment and trucks are out of order. Plotting any of these two costs against an output measure gives the following type of graph:
The marginal cost \( \frac{a}{b} \) is only applicable to output levels above level \( Q \). For output levels between zero and \( Q \), the marginal cost is zero. However, a problem arises when one is trying to assign costs to lanes because it is necessary to subtract \( OQ \) from the output before applying the marginal rate.

For the two-dimensional case, the distance of \( OQ \) is equal to the absolute value of the cost-intercept divided by the slope \( \frac{OR \times b}{a} \). For a multi-dimensional case, i.e., when cost is regressed with two explanatory variables, the region of \( OQ \) is hard to determine. One would have to resort to other methods such as percentage distribution based on allocated basis developed for P & D wages.

(3) Tires: Tires wear out with usage. Any time a tire is replaced, it is the cumulative effect of work done in the past. If one can assume a fairly even usage of all the P & D vehicles and can assume a known fixed
life span of tires, it is possible to detect the relationship between the cost of tire replacement and mileage.

If there is a great variance in the price of tires over time, the cost of a tire taken from the storeroom would vary, depending, for example, on whether the last-in-first-out (LIFO) or first-in-first-out (FIFO) inventory valuation basis is used.

(4) Repair and maintenance: The situation for maintenance is similar to that for tires. The time lag between an upsurge in traffic volume and an increase in maintenance cost is indeterminate. Visual plotting of the cost and output variables sometimes helps, but does not promise results. In the case of an overhaul, maintenance is clearly a result of accumulated usage. In theory, the overhaul cost should be spread out over the past years, but in practice this is never done. Depending on the size of a particular trucking firm, the percentage-distribution method based on some developed allocation basis like P & D wages is reasonable.

(5) Bad debts and claims: These are not a case of fixed time lag, but a case of distributed lag. Since bad debts and claims can be distributed over a very long time period, the equation for the distributed lag model has many variables which use up many degrees of freedom and thus hampers the results. It is obvious that the methods suggested in lines 30, 31 of Exhibit 5-5 does not invariably give a workable model.

(6) Depreciation: Depreciation of tractors, trailers, and trucks in a trucking firm is a sizable cost item. G.L. Wilson classifies depreciation of equipment as a variable cost when depreciation varies
with use.  

Depreciation can be estimated on a per-mile basis. Consider the case where a new piece of equipment cost $X has a salvage value $Y with a life expectancy of N years. In this case, the annual depreciation expense on a straight-line basis is equal to \( \frac{(X - Y)}{N} \). If the total number of miles the equipment has run is recorded, the depreciation expenses can be determined on a per-mile basis. Consequently, the depreciation expense for each month can be estimated.

Thus far, the discussion has mostly centered around terminal cost. The task of assessing lane profitability would not be complete without discussing the treatment of line haul costs and determining the contribution margin of a lane.

Calculating Line-haul Cost on a Per-mile Basis

The two methods to determine a per-mile line haul costs have been discussed previously in this chapter. The methods suggested deal with highway line-haul cost. In some cases, the line-haul function is performed by means of piggyback. That is, the line-haul trailer is carried on top of the flat deck of a train from one city to another. The cost on a per-mile basis to perform the line-haul function via piggyback is usually given.

---

Determining the Contribution Margin

The contribution margin can be determined by following the algebraic equations given earlier in the chapter.

It is not enough to determine the profitability or contribution margin of a lane for a short time period, such as one or two months in order to evaluate its performance. Performance evaluation of a lane for a period of at least over a year is recommended.
CHAPTER 6

A MANAGEMENT INFORMATION SYSTEM
FOR LANE PROFITABILITY STUDY

Background

A management information system is a system for providing information to support the operations, management, and decision-making functions in an organization.23

The system utilizes computer hardware, software, manual procedures, management and decision models, and a data base. It is the primary intent of this chapter to discuss the kinds of accounting records that make the data base appropriate for the decision-model, i.e., the lane profitability study. The secondary purpose of this chapter is to discuss how data, which are instrumental to the study, should be stored in order to be retrieved easily.

Much of the discussion will emphasize the importance of matching the recording of costs with that of revenues, in other words, "coordinating" the accounting data.

Information is a vital ingredient to management. The information system is sometimes hampered by the costs of obtaining, processing and storing data.

In general, the "value" of information is the value of the change in decision behaviour caused by the information less the cost of obtaining

the information. Discussions in this chapter are based on the premise that information should be gathered only if its value is greater than zero.

Data Versus Information

Data are isolated facts and figures. Information is processed data used for decision-making. The two definitions simply suggest that the analysis of data or the processing of data is able to yield information valuable for decision-making.

Criteria of Data to be Collected

Data should be collected for a purpose and be decision impelling. To conduct a lane profitability study in the future, data collected should be accurate, regular and coordinated, i.e., able to match costs with their associated revenues. Needless to say, the value of the information derived from the data should exceed the cost of recording them.

Data Base

in Relation to the Lane Profitability Study

This section depicts the portion of the data base of the model carrier that relates to lane profitability. The important questions arising out of the collected data are: (1) what data should be recorded, (2) when data should be recorded, and (3) how data should be recorded.

As far as profitability is concerned, three major categories of data are of interest. These are revenues, costs, and output measures such as weight handled, number of shipments, and number of trips. Each of the major categories will be discussed in some detail in a later section. The discussion addresses the questions of when data should be recorded and how data should be recorded.

Exposition of the Model Carrier's Data

To facilitate discussion on the issues arising out of the collected data mentioned above, it is perhaps helpful to start with a discussion of the model carrier's available data.

The model carrier's data are in general not usable for conducting a lane profitability study. Regarding the invalidity of the collected data, the following observations can be made.

(1) Data are in general not user-oriented. In many cases, they have to be aggregated or disaggregated manually before they can be used.

(2) Some accounting records are not kept promptly. For example, sporadic negative signs indicate that reverse entries have been made to negate the expenses previously over-recorded. The interest expenses recorded in the Toronto terminal, for example, have a value of -10687
dollars.

(3) Reasonableness is lacking in some cost items. For example, the oil and fuel expenses in the Calgary terminal for the month of September 1976 were as low as $80 while for most other months were over $2000.

(4) Accounting principles and procedures were not followed closely. For example, the depreciation expenses for November 1975 and January 1976 were recorded as "zero" in the Calgary branch.

(5) Wages are recorded as they are paid out rather than on an accrual basis. This makes the matching of costs with revenues difficult.

The harmful effects of unsatisfactory data are as follows. First, the cost-output relationship determined by using the faulty data is bound to be misleading. In many cases, such relationship cannot be established at all. Second, the cost of performing a particular function, such as dock handling, is grossly under or over-estimated depending on the amount of wages paid out in the time period examined. Third, it is impossible to compare the performance of a lane over the months.

The next section suggests ways to record and collect data which are usable and useful for a lane profitability study. The discussion centers around ways to avoid the above pitfalls, and means to facilitate the determination of lane profitability by the inclusion of pertinent information in the data base and modification of the existing data base.

**Discussions on Scrutinizing Data Collection**

Revenue:

As the time interval was chosen to be a period of four or five weeks
for sampling purpose, it is necessary to use the same time period for recording revenue.

When examining what kinds of revenue data are available, it is necessary to understand the relationship between the kinds of revenue data recorded. See page 26 in Chapter 3 for discussion of revenue.

Revenues are given in the form of terminal revenue as well as revenue of traffic moving from one city to another (such as $R_{A,B}$). The former is not broken down by weight categories while the latter is. See Figure 4 and 3 respectively for reports that include revenue data.

Revenues are recorded when a bill of lading or a freight bill is prepared. This is roughly the time pickup and dock activities take place. At the starting point of the haul, the revenues and costs necessary to produce them fall into approximately the same time period. However, when the shipment arrives at the other terminal, unloading and delivery and other related activities take place. These activities incur further costs a few days later when the revenues are recorded at the point of origin.

For a period of a month, such a time lag does not create problems, since the time lag is a relatively small percentage of a month, except when the time lag straddles over two months. However, if the time period for sampling is a week, the time lag is detrimental. Thus, a longer time period for sampling is preferred to diminish the undesirable effects of time lag.

There is no simple solution to this problem. Recording part of the revenue when the commodity is at the originating terminal and the other part when it is at the receiving terminal is not practical. In the first place, the revenue-recording procedure will become unduly complicated.
Secondly, there is no readily available mechanism to split the revenue for every shipment.

Terminal Cost:

Table 3-1 in Chapter 3 (page 33) is a list of the terminal costs for the model carrier. Each of these will be discussed with respect to how and when they should be received. See Table 6-1 for a summary of this discussion.
# Table 6-1

<table>
<thead>
<tr>
<th>Costs</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Wages - P &amp; D</td>
<td>Daily or weekly accrued wages should be reported. At the end of each month, these accrued wages can be summed up.</td>
</tr>
<tr>
<td>2. Wages - dock</td>
<td>- do -</td>
</tr>
<tr>
<td>3. Welfare</td>
<td>Report the same time wages are recorded.</td>
</tr>
<tr>
<td>4. Leased equipment</td>
<td>Possible to identify the cost with the days during which equipment is leased.</td>
</tr>
<tr>
<td>5. Hired cartage</td>
<td>- similar to 4 -</td>
</tr>
<tr>
<td>6. Accidental repairs</td>
<td>The cost cannot be reported at the time of the accident. No reporting can be done until the truck is repaired or the repair cost is assessed. However, estimates of accidental repairs can be prorated with respect to weight handled by month.</td>
</tr>
<tr>
<td>7. Licences</td>
<td>It is a set amount to be reported every month.</td>
</tr>
<tr>
<td>8. Fuel &amp; Oil</td>
<td>Measurement of the diesel pump meter daily gives an accurate assessment of the amount of fuel used. If fuel is purchased from gas stations in the city, P &amp; D drivers should turn in records of money spent on fuel every day.</td>
</tr>
<tr>
<td>9. Radio maintenance</td>
<td>Report as soon as the repair cost is assessed.</td>
</tr>
<tr>
<td>10. Dock supplies</td>
<td>Record the supplies taken out of the storeroom every day.</td>
</tr>
<tr>
<td>11. Dock equipment repairs</td>
<td>- similar to 9 -</td>
</tr>
<tr>
<td>12. Salaries</td>
<td>These do not post any time-lag problem since salaries are a fixed cost.</td>
</tr>
<tr>
<td>13. Office Equipment Repairs</td>
<td>Should be reported as soon as possible.</td>
</tr>
<tr>
<td>14. Postage and Stationery</td>
<td>For postage, careful records of the postage machine enable one to determine how much postage was used. Printing &amp; stationery supplies are recorded as they are taken out of the storeroom.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Costs</th>
<th>Discussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>15. Property maintenance</td>
<td>Accrual basis is irrelevant here since it is a fixed cost.</td>
</tr>
<tr>
<td>16. Utility</td>
<td>- do -</td>
</tr>
<tr>
<td>17. Telephone and Teletype</td>
<td>The long distance telephones are the variable portion of the cost item. Record the expense at the time the phone bill is paid is not a good practice.</td>
</tr>
<tr>
<td>19. Security</td>
<td>- do -</td>
</tr>
<tr>
<td>20. Rent</td>
<td>- do -</td>
</tr>
<tr>
<td>21. Sales &amp; Traffic</td>
<td>Due to the difficulty of investigating the effects of sales expenses on the amount of traffic, an accrual basis is difficult to implement.</td>
</tr>
<tr>
<td>22. Depreciation</td>
<td>Record depreciation expense based on miles travelled during a month and depreciation charge on a per-mile basis. See previous discussion of depreciation in page</td>
</tr>
<tr>
<td>23. Bad Debts</td>
<td>It is virtually impossible to record bad debts expense on an accrual basis since this cost occurs a few months after the service was rendered. However, if detailed records of bad debts are kept in computer records, it is possible to redistribute the bad debt expenses at the end of the year to the time the service was rendered.</td>
</tr>
<tr>
<td>24. Claims</td>
<td>- do -</td>
</tr>
</tbody>
</table>
Output Measure and Supporting Data:

As described in the previous chapters, the data used to reflect output or work done as a result of different kinds of expenses are:

1. weight handled by different weight categories in a month
2. number of shipments handled in each month
3. Number of trips or miles travelled in each lane in each month
4. accessories such as (a) the number of parcels per shipment and (b) number of accounts handled by terminal and lane

Figure 2 of the appendix gives data for traffic originating at Calgary. In order to find the total weight handled by the Calgary terminal in the weight category 1-500 pounds (weight code 1 to 5) it is necessary to add the first five lines of each lane's weight handled and sum over all relevant lanes. It can be seen from figure 2 that to repeat the above process for other weight categories, the amount of manual work involved is discouraging.

Clearly, it is easier and less error-prone to extract data from computer storage than to add figures manually. If data shown in figure 2 of the appendix are stored in off-line storage facilities, such as tapes, the access and reproduction of modified data would be more efficient and accurate. Alternately, one can produce "custom-made" and more user-oriented reports for the purpose of conducting a lane profitability study.

Figure 5 in the appendix is a weekly report on revenue, weight, miles and trips on a province-to-province basis. In this form, the information is too general for the study. Province-to-province information is not necessarily the same as terminal-to-terminal information because there
may be more than one terminal in a province. A slight modification of the data is recommended. The revenue, weight, miles and trips information after the modification is very helpful to the study.

Accessories, such as the number of pieces per shipment and number of accounts per lane, are not too difficult to obtain and record. Many of the pro bills in use now have a column to record the number of pieces in a shipment. This information is vital to control the physical movement of the shipment to avoid shortage or losses. This information is also important as an explanatory variable for dock labour costs.

The number of active accounts was recommended as an allocation basis for some costs so it is essential that such data are available. The number of shipments can be recorded in lieu of the number of active accounts, but the two are not the same because a shipper may ship many times in a month.
To really appreciate the difficulties involved in the determination of lane contribution one would have to look more deeply into how costs occur and the ways the transportation outputs are produced.

To do so requires a general understanding of the organization and day-to-day operation of a trucking form or the firm in question. Likewise, a precise and clear understanding of the concept of the different kinds of costs (such as fixed cost, variable cost, direct cost, indirect cost, common cost, joint cost) as well as the nature of the various cost elements (such as P & D wages) is important to realise the problems involved.

The quest for methodologies that can do a competent job on this topic is challenging.

The intricate nature of the trucking costs and the difficulties in measuring the transportation output are the two major deterrents to the area of costing or profit determination. At the present state of the art, even the best developed methods cannot escape arbitrary assignment of costs.

Whether the determination of profitability can be done successfully depends on how useful and valid the accounting records and other related data are.

It is nothing but disastrous to conduct a study without asking about the underlying accounting procedures that produce most of the cost
and revenue figures.

One has to realize that accounting data are prepared for a variety of purposes. Invariably, it calls for some planning if one wishes to implement a lane profitability study in the future. It is important to decide before hand: (1) What kinds of data are essential to a lane profitability study? and (2) What format should data be presented? One can avoid laborious manual work, unnecessary adjustments, and above all, costly errors, and faulty conclusions from this study with some carefully thought out planning.

However, it is up to management to decide if a lane profitability study is of importance to one's operation and if the effort is worthwhile.

Recommendations

While this study can be instrumental to many types of decision making, its importance should not be over-emphasized. In the first place, the arbitrary allocation of costs expose the study to criticism. Secondly, decisions as vital as the deletion of addition of lanes cannot be done without giving due regard to the overall effect of such action. Thirdly, the study cannot be used indiscriminately as a cost control device. This is because the profitability of a lane is dependent on the cost occurred at the terminal.

In the process of doing this study, it was realized that several things need to be done now if future studies of this kind are to be facilitated.

1. Costs should be recorded on an accrual basis as far as possible.
2. Revenues, costs and other supporting statistics should be in formats readily usable without having to sort them out manually.

3. Data for the past two or three years should be in off-line computer storage for easy retrieval and manipulation.

4. There should be documented allocation bases of past studies for future reference.
BIBLIOGRAPHY

Books


Periodicals


Government Publications


Personal Interview


Cathpole, Terry, Alltrans Express Ltd., Burnaby, British Columbia, April, 1977.


APPENDIX

Figure

1. Weight Code Table


5. Interprovincial Weight, Revenue, Mileage Report
Figure 1: Weight Code Table

<table>
<thead>
<tr>
<th>WEIGHT CODE</th>
<th>FROM LBS</th>
<th>TO LBS</th>
</tr>
</thead>
<tbody>
<tr>
<td>DOMESTIC LTL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>101</td>
<td>200</td>
</tr>
<tr>
<td>3</td>
<td>201</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>301</td>
<td>400</td>
</tr>
<tr>
<td>5</td>
<td>401</td>
<td>500</td>
</tr>
<tr>
<td>6</td>
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Figure 2: Example of Model Carrier's Monthly Statistical Report - Inbound Traffic

CALGARY INBOUND

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% OF DOM TOTAL

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% OF LANE TOTAL

% OF STN TOTAL
Figure 3: Example of Model Carrier's Monthly Statistical Report - Outbound Traffic

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% OF DOM TOTAL

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<td>DOM LTL</td>
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<tr>
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% OF LANE TOTAL

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% OF STN TOTAL

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% OF DOM TOTAL
Figure 4: Terminal Weight, Revenue, Pro Reports

Analysis of Statistical Reports for:

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Figure 5: - Inter Province Weight, Revenue, Mileage Reports

**ALLTRANS EXPRESS LTD. - D.A.R. ANALYSIS AS AT**

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