**A MODEL OF PORTS' COMPETITIVE POSITION
IN NORTH AMERICA**

A thesis submitted

by

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(M.A., Economics)

A thesis submitted to
the Faculty of Graduate Studies and Research
in partial fulfillment of
the requirement for the degree of
Master in Management Studies

School of Business
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ABSTRACT

This research examined the competition between Canadian and U.S. ports. An assessment of the ports' competitive position in the context of North American trade and transportation patterns was performed. The influence of international trade was explored. This thesis attempted to identify the factors of ports' competitive success by evaluating financial, operational and locational factors. The total cost of transportation became the determining factor in assessing ports' competition. Two competing ports, one Canadian and one American were compared based on the total transportation costs. The total transportation costs, consisting of the marine, port and ground transportation costs, were computed for each port for the period of ten years. These costs were utilized in the calculation of the Weighted Average Cost Competitive Index for ports, which was the primary finding of this thesis. The secondary theme dealt with the correlation between the transportation cost and the port's throughput. Even on a limited set of data it was possible to conclude that ports need to compete for customers in order to increase the throughput and reduce the cost of transportation to remain competitive. In view of the economic globalization, the findings of this thesis should assist port managers and transportation policy decision-makers in responding accordingly to today's highly competitive transportation environment.

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THESIS RESEARCH PROBLEM STATEMENT

This research will examine the issue of competition among Canadian and U.S. ports. To facilitate this analysis, an assessment of the ports' respective competitive positions will be performed. The research will attempt to answer the question of whether there are significant differences in the competitive position of the ports and what are the factors of success. Measures of competitive position are complex. However, the research will attempt to construct a single model, test it, using data from all ports under examination, and conduct a comparative analysis. Influence of intentional trade agreements such as NAFTA on the transportation industry and the relationship between trade and transportation will be explored. Through the literature review, key variables will be identified. Financial, operational and locational factors will be analyzed for each port for a period of ten years. Results of the data analysis should yield a model for the overall measure of competitiveness and the factors contributing to success. An overview of current media sources will provide information on modern trends in trade and transportation. For the purpose of comparison, two ports on the East Coast, such as Montreal (Canada) and New York (USA) will be analyzed. The study will utilize primary and secondary data sources. The primary data will be obtained directly from the ports and ports' managers. The secondary data will be obtained from the existing literature on the subject and official statistical sources. In view of economic globalization, the findings of this analysis should assist port managers in their assessment of the port's position vis-à-vis its competition. Conclusions from such an analysis should also aid transportation policy decision-makers in responding to the rapidly changing and highly competitive transportation environment.

I. INTRODUCTION

1.1 INTRODUCTION TO THE PROBLEM

An old saying, attributed to Ben Franklin, about two certainties in life such as death and taxes, in the business context, can be expanded to two more – technology and increased competition. Especially after the introduction of the North American Free Trade Agreement (NAFTA), competition in North America is not limited to one specific country any more. To successfully compete, any enterprise, including ports has to reduce its costs, increase productivity and revenues and respond to customers, who are the primary focus, all at the same time.

These days, ports around the world, including U.S. and Canadian ports, feel competitive pressures. While the competitive situation together with new technologies are changing the way ports used to do business, they are struggling to generate additional cargo throughput (Ircha, 1995), to effectively compete at home and abroad. The question, thus, is what is required for an enterprise to successfully compete domestically and internationally and how to measure competitiveness?

International competitiveness is often assumed to be an objective measure of performance in foreign markets, a measure that applies across firms regardless of size or industrial context. The findings of the international competitive measures study for small and medium-size enterprises by Coviello, et al (1998) were expanded later by the same group of researchers to larger firms in manufacturing and financial service industries. The comparative results suggest that at a general level, international competitiveness

measures are multidimensional and firms of all types benefit from "managing for international competitiveness". However, while performance measures often reflect universal views of success (e.g. profitability, growth), sector specific measures are also important. Similarly, the results of the same study show that the approach to enhancing a firm's potential is sector specific.

The implications of Coviello and her colleagues' findings suggest that managers seeking to improve their firms' international competitiveness should integrate their organizational processes, resources, and sources of advantage with the operational industry context and sector-specific environment. That conclusion helps to narrow down the search for measures of competitiveness, focusing the current research around a transportation specific context.

1.2 COMPETITIVE ADVANTAGE

The key to exploring competitive advantage, according to Brooks (1993), is knowledge – knowledge of the sources of such advantage, of a company's strengths and weaknesses, knowledge of the market and, most of all, knowledge of the company's performance vis-à-vis its competitors.

Each port should identify its competitive strengths and weaknesses to align its performance accordingly. Brooks' (1993) argument, similarly to Coviello et al's (1998), also suggests that the assessment cannot be done in isolation but should reflect the dynamics within the industry and the economy as a whole.

Further, Brooks (1993) provides a strategic framework for carriers that was adopted with some modification, as illustrated below, for ports, where the initial assessment leads to strategic decisions allowing for the exploitation of the identified competitive advantage.

Figure 1.1 – Strategic Framework for Ports' Competitive Assessment

Her theoretical framework of competition is based on Michael Porter's five competitive forces. Porter (1985) argued that for businesses to stay competitive, they must respond to five competitive forces:

1. The threat of new entrants;
2. The bargaining power of suppliers;
3. Threats from substitute products or services;
4. The bargaining power of buyers;
5. Rivalry among competitors.

Upon initial analysis, it appears that all five forces would apply to ports to a certain extent. For example, since in the past few years, ocean carriers have lost some market share to other modes of transportation, a real threat of substitutes exists. To illustrate that, data from Statistics Canada, Catalogue 15-001, showed that in 1997, Transportation industries accounted for almost 3.7% of the total GDP, while in 1996, it was closer to 3.6%. Although the share of transportation industries in the total GDP had increased in 1997 over 1996, the truck and rail transports had shown the fastest growth with 9.3 and 9.0 per cent respectively, followed by air with 5.9% increase and marine with only 3.2% increase (Statistics Canada, Catalogue 13-001). The modal distribution of transportation

GDP has also changed. For instance, the share of rail transportation has grown from 16.7% in 1991 to 18.3% in 1997, the share of truck transportation has increased from 29.8 to 35.4 %, while the share of water transportation has declined from 9.7% to 8.7% (Statistics Canada, Catalogue 15-001).

1.2.1 The Bargaining Power of Buyers

As it is applicable to ports, the bargaining power of buyers plays a role of a driving force in the competitive environment. For ports, shipping lines and carriers, like Maersk and Sea-Land, represent the biggest segment of its customers, providing a great opportunity for a port to generate revenue. Naturally, ports compete to attract such customers. The competition translates into convenient and fast service for the customer and a healthy revenue source for the port. However, taking into consideration that alternative means of shipping goods do exist today, ports' customers (buyers) certainly enjoy and exercise their bargaining power. As for the shipping lines, they are looking for a number of additional conditions, like intermodal connections, to satisfy their requirements. Thus, port services and fees, remaining as vital components, in addition to intermodal connections and other favourable conditions, are being cultivated by those ports, which want to get ahead of their competition.

In certain cases, where a port has excess capacity, buyers (customers) have more bargaining power. The buyer's power is also product-specific as most carriers operate on a commodity-based tariff rating system. On the other hand, as the Canada-Europe eastbound leg is close to its capacity due to the fact that Canada's economy is export

carriers will make room for a higher revenue product at the expense of the low-rated ones (Brooks, 1993). At the same time, European shippers of any value goods have little difficulty finding space westbound into Canada.

Furthermore, transportation services today do not include just one point of delivery or departure, like a port. Globalization of trade has expanded opportunities, while putting more demands on the entire transportation system. The capacity and conditions of one mode directly affect the competitive position of others. This is why a port can benefit from the other modes' sufficient capacity and ability to deliver goods to its final destination. For example, since CN still has considerable capacity on its line from Halifax to central Canada and recently expanded routes further south and west, the port of Halifax can offer customers a much stronger rail network or intermodal link. The merger of Canadian National Railway (CN) and Illinois Central Railway (IC) connected shippers through the Port of Halifax with the U.S. heartland, including major centres in Iowa, Nebraska, Missouri, Tennessee and Alabama. The shippers have recognized the one-line travelling time of approximately 54 hours between Halifax and Chicago as an efficient transportation system (The Halifax Chronicle Herald, September 15, 1999). Considering the port's naturally deep harbour, Halifax has increased its efforts to develop post-Panamax capabilities. Such conditions attract customers to the port and provide a competitive advantage for Halifax, while intensifying competition among the East Coast ports.

1.2.2 Rivalry Among Competitors

With the introduction of NAFTA and elimination of many trade tariffs and customs barriers, trans-border trade between Canada and the United States has expanded vastly, while the rivalry among competitors has intensified. Many shipping lines, in seeking competitive advantage for themselves, are trading established relationships with their service providers (ports) in search for the lowest possible costs and best service. In addition, the introduction of NAFTA created new opportunities for other modes, such as rail and truck, providing wider choices for the customers and creating a shift in the traditional modal distribution. For example, the rail share of Canadian exports to the U.S. by value rose from 12% in 1988 to 28% by 1995 (RFIC Interchange, Spring/Summer, 1999, Pages 10-11). Expanded doublestack container trains have helped to drive this share even higher since then. Canadian National and Canadian Pacific have integrated their U.S.-Canadian operations to encourage seamless service. CPR's intermodal terminals in Vancouver are an important part of its business strategy. Working with marine and trucking partners in the intermodal business, CP positions itself to provide premier service in and out the Vancouver gateway, attracting traffic and jobs to Vancouver rather than to other West Coast gateways, including Seattle. That is why rivalry among competitors, in today's transportation context, means intensified competition, putting even more pressure on ports to survive.

Since the trend of reducing inventory costs in manufacturing has led to transit time as a criterion, various freight forwarders are seeking the best possibility for fast delivery service. However, if several locations offer approximately the same transit time, the

shipping lines' next incentive is cost in choosing one port over another.

Competitive advantage grows fundamentally out of the value a firm is able to create for its buyers that exceeds the firm's cost of creating it (Porter, 1985). Porter provides a framework for examining strategic choices, recommending generic strategies to out-perform competitors or maintain a market position. However, implementation of selected strategies remains equally important.

1.2.3 Overall Cost Leadership

Overall cost leadership for a port means offering the same or better service at less cost than a competing port or, at certain times, another mode of transportation. For instance, the cost of rail-based transportation to shippers in Canada, an average of 2.35 cents per tonne-kilometre, is the lowest in the industrialized world (RAC President Bob Ballantyne, RFIC Interchange, Spring/Summer, 1999, Pages 10-11). Railways have become an important part of the production and distribution system of their customers, competing with each other, trucks and even ports. At the same time, in this era of free trade, they are also partners in Canada's competitiveness as never before.

A number of areas within the port services itself can offer potential cost savings. Internally, careful capital asset (land, wharves, and warehouses) management can bring important savings. In addition, efficient use of equipment and ports' resources utilization provides another source of cost reduction. However, more and more recently, attention to labour issues has become a focus of further cost savings. Strikes by port or other

transportation workers affect the cost of a port's business a great deal. For example, a trucking strike that ended in August, 1999 at the Port of Vancouver caused an estimated financial loss of about \$55 million (Pacific Shipper, September 13, 1999). After an agreement with the trucking companies was reached, the port's authorities recognized that this might increase the cost of doing business at the Port of Vancouver.

The consequences of labour disputes within the port could be very serious, leading to the loss of customers and a port's competitive position. An increase in a port's service fees could push shipping lines to search for a better deal, unless a port could provide extra and desirable services. Since there are alternative ways to ship goods to and from various destinations, as noted earlier, cost leadership seems to be a key element in ports' ability to succeed. That is why the Port of Vancouver put a lot of effort in resolving the labour dispute with the trucking companies before the port's customers decided to divert their traffic. Moreover, not only ports benefit from a stable and efficient transportation environment. Trucking companies should also benefit from increased container movements that will translate into greater profitability.

The strike has had its effect on Vancouver's goal to handle 1 million TEUs (Twenty-Foot Equivalent Units) in 1999. Before the strike, the port was on its way to surpassing the Port of Montreal, Canada's top container port, while ocean-going carriers have made significant business commitments to Vancouver's port in recent months. China Ocean Shipping Company (COSCO), Zim Container Service and Norasia Lines made Vancouver their first port of call in 1999 for their Asia services, ahead of the U.S. Pacific

Northwest ports of Seattle and Tacoma. In addition, Canada Maritime and Contship Container lines introduced all-water services between the Mediterranean and the North American West Coast also via Vancouver, meaning that today Vancouver can meet the needs of any Canadian shipper in the trade (Pacific Shipper, September 13, 1999).

Furthermore, utilization of modern technological means can decrease a cost per unit of output while generating the same or higher revenues. A wide use of subcontracting services at a lower cost is just as popular with ports as with many other industries.

In addition to internal factors, external factors, allowing cost savings for ports, do exist as well. In time of globalization and just-in-time production, shippers, in order to compete globally, must be able to move cargo rapidly plus offer a cost advantage over the competition, as pointed out previously. A President and CEO of Montreal Port Corporation Mr. Dominic J. Taddeo, illustrated that very well in a recent interview with Canadian Sailings on February 1, 1999. He acknowledged that the port's management is fully aware of the fact that today it is simply not enough to provide top-notch facilities in order to stay competitive. The port has to also offer highly competitive tariffs. In fact, the Montreal Port Corporation announced a freeze of all tariffs in 1999 for a seventh consecutive year.

Economies of scale provide favourable conditions for pursuit of a lowest cost. In fact, the 1997 Transport Canada Annual Report confirmed that transportation prices had low increases. In response to that and in combination with other factors, effective customer

information management at the port can help in developing a most effective system within existing capacities. While this sounds quite reasonable, it has been proven that finding sufficient investment capital and maintaining discounted prices remains very difficult for ports.

1.2.4 Product/Service Differentiation

Differentiation implies a better/different product/service from others. Perhaps, the most important element in service differentiation is the understanding of the customers' needs and the ability to meet their expectations. In a constantly evolving environment, door-to-door service used to offer a competitive advantage. Now, it has become a competitive necessity (Brooks, 1993).

For this type of "just-in-time" delivery, the truck mode is well equipped, prompting shippers to use a better quality service. With some 87% of the total amount of investment in transportation for 1997 going to the road infrastructure and equipment (Transport Canada, Statistics Canada, Catalogue 15-001), surface transportation is providing a viable alternative to shippers and room for differentiation. With Canada's economy's expansion at a 3.3% annualized rate, as reported by Statistics Canada in the second quarter of 1999, and the truckers' ability to provide shippers with on-time and short-notice delivery, door-to-door is powering the trucking boom.

At the same time, both CN and CP, Canada's two biggest railways, are hoping to compete better with the booming trucking industry by taking it along for a ride. Canadian

National and Canadian Pacific are investing in new piggybacking technologies, betting that if it is easier for truckers to get a lift, they'll take it. Two different systems are being used. Canadian Pacific has begun operating Expressway, a series of lightweight flatcars on which highway trailers are loaded from ramps. Meanwhile, CN is using RoadRailer, a hybrid, high-capacity trailer system that inserts railway wheelsets directly under the trailer. Both systems are supposed to improve transportation companies' bottom line at the time when there is growing public concern over the hazards of increasing truck traffic on the roads. While the public may support shifting some truck traffic back to railways, the problem of whether the railways can match the just-in-time performance demanded by the industry still exists. The railways focused their investment to take advantage of the international marine container revolution that was generating long-haul traffic from seaports to inland centres, and curtailed investment in piggyback. Terminals, equipment and rolling stock were adapted to handle both forms of intermodal traffic.

A port's cooperation with its inland connections, as noted prior, for a customer that wants door-to-door delivery, may provide such value added and a desirable service. In the past decade, according to Brooks (1993), railways and trucking companies in North America have been a target of mergers and strategic alliances initiated by the ocean carriers trying to achieve just that.

Value added services, in addition to high efficiency and low cost, may attract customers to the port. The level of service and ability to accommodate special requests adds advantage to the competitive position of one port over another. Effective implementation

of a good service strategy and intelligent management of customer service can secure a competitive advantage. Therefore, a port needs to integrate those issues with its competitive strategy, as well as the means of its implementation to sustain its competitive advantage.

While there may be more room for service differentiation, there is less room in cost and price competition. At the same time and in a number of instances, some shippers may be willing to pay a premium for a particularly desirable service. However, Porter warns, "A sustained period of price cutting can undermine differentiation."

1.2.5 Market Niche/Segmentation

Market niche generally implies focusing on a section or a group of the buying public or an area of a geographic market. For ports, it can mean both. The depth of a port's harbour is a significant factor for super shipping lines like Maersk and SeaLand because they operate gigantic vessels that are too big to use the Panama Canal. Those vessels are the so-called post-Panamax. Perhaps, a port that does not have adequate harbour depth for these vessels should focus on a different group of carries with smaller vessels. However, the revenue potential with large container carriers is much greater. That is why U.S. ports on the East Coast are investing considerable amounts into dredging to provide the necessary depth for such lucrative customers.

As for the geographic market, there have been some interesting developments lately. Historically, East Coast ports served European and Middle East external routes, while

West Coast ports naturally provided services for shipping lines bringing cargo from Asia. Today, for example, with the rapid growth in intermodal transportation, cargo arriving at Vancouver on the West Coast is being shipped by rail to the Central United States. It seems that large international ports do try to focus on a specific group of customers, unfortunately, it is the same group!

1.2.6 Sources of Competitive Disadvantage

In addition to identifying its ability to exploit opportunities, each port must also explore its weaknesses and evaluate specific competitive disadvantages (Brooks, 1993) which must be overcome if possible. Some of these disadvantages are temporary, others are permanent. For example, depth of the harbor can be an advantage for some ports and a disadvantage for others, as pointed out previously. If Canadian ports on the East Coast enjoy natural conditions that allow large vessels to come into the harbor, U.S. ports are not so lucky. The requirement for constant dredging, which gets to be quite costly, provides a source of competitive disadvantage. In such a case, the management has to make a strategic decision whether to invest into dredging or simply service different customers with smaller ships. The issue is whether smaller customers will provide sufficient revenues that will exceed the port's costs.

Another example can be found in the U.S. – Canadian currency difference. In a situation where the delivery time and other conditions of the shipment are similar for a U.S. and a Canadian port, the lower value of the Canadian dollar will attract the customer, thus, creating a competitive disadvantage for a U.S. port. The difference in the Canadian –

U.S. currencies provide a favourable condition for growing exports in Canada, making the volume of shipments out of Canadian East and West Coast ports grow.

To summarize some of the points discussed in the introduction, the main objective of this research is focused around the issue of competition, specifically in the transportation industry. A number of factors defining competitive position, such as cost leadership and service differentiation, were discussed. Preliminary analysis of information sources reviewed so far indicates that shipping lines and ocean carriers, the main customers of international seaports, are mostly interested in obtaining the desired service for a low price and within a reasonably short time. Therefore, ports' ability to satisfy such customers translates into ports' competitiveness, indicating that time or cost or both could serve as a measure of ports' competitiveness. Furthermore, ports' ability to provide certain services required by the customers depends on the existence and capacity of intermodal links, as well as on the stability of the labour situation. Those issues will be discussed later and in greater detail to explore the relationship between them and measures of ports' competitiveness such as cost and time.

II. BACKGROUND

2.1 ROLE OF TRANSPORTATION IN THE ECONOMY

The transportation industry plays an important role in the economy. Although it might generate a relatively small part of a country's GDP, its strategic and economic impact on the competitive position of a country or a region can not be overstated. Because it touches almost every economic transaction, transportation is vulnerable to variations in the business cycle. With its derived demand, transportation grows with the economy. The transportation sector is tied more closely to the production of goods than to total economic activity, with the movement of goods accounting for about two thirds of all transportation activity. Although, the transportation share of total GDP has fallen from about 4% in 1990 to about 3.6% in 1996, it started climbing again and reached 3.7% in 1997, consistent with the rise in the economy. The decline of the ratio of transportation GDP to total GDP between 1990 and 1996 was due to higher productivity and lower prices. Wages, interest payments and rent in transportation had increased at a slower rate than the average increase in the economy. This translated into a relative decline in the overall cost of transportation, compared with costs in the economy. Consequently, transportation's share of the economy has declined (Transportation in Canada, Statistics Canada, Catalogues 15-001, 15-201, 13-001).

At the same time, a study by the U.S. federal government (1998) has established that transportation services contribute a greater share of the value generated by the U.S. economy than previously measured. The study showed that the services sector, like

manufacturing, is highly dependent on transportation. Further, the study suggested that improved transportation efficiency could play a more important role than previously understood in supporting the competitiveness of U.S. products.

The magnitude of transportation services in the United States has long been underrepresented in national economic data used by government and private sector decision-makers (Nagle, 1998). One reason is that, until now, national measures of transportation services only counted the value of for-hire transportation. The true value of transportation services in the economy was unknown, and, therefore, most estimates of the economic benefits to industry from transportation investments have been too low. The U.S. federal government study (1998) concluded that transportation would continue to play a key role in the economy, even as the economy shifts its focus from manufacturing to services. Furthermore, transportation may have a greater influence on the competitiveness of U.S. products in international markets than previously thought. For instance, Wells (1972) demonstrated that the amount of export shipments is positively correlated with the value per unit weight and that transportation costs are significant in determining the export volume of U. S. consumer goods.

Back in Canada, the 1997 Transport Canada Annual Report concluded that the transportation sector had improved its productivity and financial performance. In Canada, total employment in transportation has grown by 2.9% with an increase of 6.2% for water transport in 1997 compared to 1992 (Statistics Canada, Catalogue 72-002). At the same time, the average annual salary in transportation in 1997 reached \$37,239, about 17%

higher than the average in the economy as a whole. Furthermore, transportation is an important cost element. If presented as a percentage of export selling price, the distribution as of 1997 was as follows:

Table 2.1 – Transportation Cost as Percentage of Commodity Export Price

For Primary Goods		For Manufactured Goods	
Lumber	18%	Transportation equipment	2.9%
Grains	28%	Industrial goods	3.2%
Non-metal minerals	29%	Non-agricultural	4.3%
Forest products	30%	Publishing	6.6%
Coal	45%	Chemicals	16.1%

Source: "Introduction to Transportation", Transport Canada, 1999

(<http://www.tc.gc.ca/facts/Present/trnsport>)

Thus, analysis of the competitiveness of the transportation industry will help to evaluate an important element of the competitive positioning of a country.

2.2 TRANSPORTATION AND COMPETITION

Another recent study (Pisarski, 1998) has shown that America's future lies largely with improved competitive access between suppliers, manufacturers and consumers. The two dominant factors in competitive success are communications and transportation. The division of labour in society, permitting specialization, yields tremendous productivity. It also generates transportation, requiring products to be moved between dispersed sites. As the nation grows richer, it consumes more products and more tonnes per capita have to be moved. However, while the weight of goods is declining, the value is increasing dramatically. This translates into a requirement for higher speed and reliability in

transporting, utilizing such modes as airfreight and trucking. New competitive and cooperative arrangements, more and more defined by international agreements like NAFTA, intensify economic integration and competition in every area, including transportation.

Since the introduction of NAFTA, competition among the ports and between marine transportation and other modes has become fierce. A recent example of such competition is a bid offered by Sea-Land and Maersk shipping lines, inviting seven East Coast ports last May to submit proposals for a terminal with a mile of berth, rail access and 16 jumbo cranes to move 550,000 containers a year to and from some of the world's largest ships. In December, it was announced that only Baltimore, Halifax and the Port of New York remained in the running. According to James Devine, Sea-Land's northwest manager, if Halifax were 700 miles closer to the U.S. border, it would be a done deal (Knight-Ridder Tribune, February 2, 1999). While the decision was still pending, the three ports had already spent thousands of dollars on the bid, hoping to win and to enjoy great benefits in the future.

Thus, it was illustrated that transportation continues to play an important role in the country's economy. With the liberalization of trade, the demand for efficient transportation services should increase, stimulating competition among different modes of transportation and within the same modes, while generating jobs and contributing to the increase in country's GDP.

2.3 PORTS AND PORT MANAGEMENT

One of the definitions of a port states that a port is a location for the interaction of marine and surface transport functions/activities in support of trading activity and attended by subsidiary services and their facilities (MacDonald, 1996). Alternatively, a port is a geographical location developed purposefully to achieve the transportation, transfer and handling of cargo (MacDonald, 1996). Initially, ports developed at geographically advantageous sites to suit people. Later, they were developed to suit ships and the shipping industry.

David Ricardo in his Theory of Comparative Advantage suggested that “even a poor country has a comparative advantage in the production of those commodities in which it is relatively most efficient”. Today, in the so-called “global economy”, when the specialization of each country is developing further, ports play a crucial role in facilitating cost-efficient and swift transfer of goods. The technological advancements have transformed ports from labour-intensive enterprises with low productivity and high operating costs into automated and more productive ones. However, the port industry has no end product, but rather a multifaceted service for movements.

Any port provides the infrastructure for enabling cargo vessels to deliver or pick up goods. That requires a number of services and facilities that form the infrastructure of a port, such as wharves, berths, terminals, cranes, etc. The modern marine terminal was developed for the purpose of cargo interchange between the marine carrier and the

surface carrier. Therefore, a terminal requires facilities to provide cargo interchange, equipment to handle the cargo, management and labour to perform the required tasks. The terminal provides a full range of services a shipping line may require for vessel and cargo handling. These services include berthing of ships, stevedoring or loading/unloading, parking and storing for containers and chassis, maintaining inventory of containers by number, size, type and ownership, moving of containers within the terminal and through Customs, weighing containers and cargoes plus maintaining security within the terminal. Performance of these services is usually covered by long term contracts between the terminal operator and the shipping line.

There is a constant search for efficiencies and cost reduction since the cost of running the terminal can be almost as high as the total ship operating costs. In addition, there is a common misconception that cargo is lost or damaged mostly in transit, while it is in fact most vulnerable while at the terminal, requiring security and safety features that are present at any terminal.

Furthermore, speed is essential in all aspects of terminal operation because it can cost as much as \$ 1,500 per hour to keep a ship in commission. Since a ship can earn revenues only while actually moving cargo, a shorter port time can allow for more voyages per year, thus earning sufficient revenues. That is why many shipping lines have contracts with large stevedoring organizations under which the entire terminal operation is handled by the stevedores. In these circumstances, the ship owner has no responsibility for the work of the terminal but must assume full liability for cargo damage because, under

international law, stevedore workers are treated as agents of the shipping line.

In most countries, unionized port labour represents a continuous challenge for port and terminal management. In Canada, port labour is highly organized with most East Coast port workers represented by the International Longshoremen's Association (ILA), while on the West Coast, labour is organized by the International Longshoremen and Warehousemen's Union (ILWU). In the past, labour disruptions at Canadian ports have been significant and expensive. Work stoppages and service disruptions have resulted in cargo diversion to U.S. ports.

Port marketing is another important area of port activities. In carrying out a facilitator role, port marketing should be aware of seven distinct constituencies with whom it may interact. Those constituencies include shipping lines, ship owners, ship operators, ship agents, shippers/receivers, brokers/forwarders, and municipal authorities. Since each group of port customers has its specific interests, a port has to provide efficient and low transportation and handling costs, regular and convenient services along with sophisticated and modern facilities and equipment. Therefore, port marketing needs to have great customer awareness and to ensure customer's confidence in its services. The port's ability to successfully carry out all of its functions and tasks produces the ability to compete for customers and cargoes.

The management of a port is faced with a number of operational, financial and competitive problems. A well-defined strategic plan is often the best tool for providing

the management with means to solve those problems. Strategic port planning can be divided into five main elements, such as mission, goals, objectives, critical issues and strategies. Strategic planning requires ongoing data collection and analysis of the port's own performance and the performance of its competitors. A port's strategic plan should reflect the financial, economic, social, organizational, political and technological aspects of its activities. It should be forward looking with preparedness based on an understanding of new trends within the industry and the economy.

2.3.1 Ports in the United States

The port industry in the United States historically was decentralized, and the U.S. federal government had maintained a distant relationship with ports. U.S. ports typically come under the jurisdiction of state or local governments. Thus, U.S. ports are federally regulated but not federally owned. For example, Seattle /Tacoma comes under the jurisdiction of the local service district, while New York/New Jersey is under the bi-state authority. For a detailed profile on the U.S. port, please refer to Appendix 5. Most of the time, ports in the United States function as public enterprises. They are responsible for financing their own capital developments and generating revenues needed to cover operating costs, while earning adequate returns. The enterprise approach permits U.S. ports to compete with Canadian ports and with each other. In many cases, certain U.S. ports compete directly with certain Canadian ports and differences in the governing rules is of concern.

At the same time, as public enterprises, U.S. ports have financial advantages over private

ones. All U.S. public port authorities receive direct and indirect public subsidies, including direct funding from the local government, tax support as a property tax exemption, a right to levy taxes and others. As suggested by Don Welch (1993), "stripped of subsidy, most U.S. public ports would be utterly bankrupt". In a recent American Association of Port Authorities (AAPA) survey (1994), the percentage of financially self-sufficient ports has decreased from 45% to 37% in the period from 1988 to 1992. Almost all U.S. ports depend on federally funded dredging programs to ensure access to their facilities. This is one area in which U.S. federal government has established a role.

Another problem that challenges U.S. ports is their restricted landside access. Many U.S. ports are facing pressures from adjacent municipalities due to increasing traffic congestion, noise and pollution as port throughput increases. Most U.S. container terminals do not have on-dock rail traffic systems and thus are forced to "dray" (move containers on chassis) commodities to nearby rail transfer yards. This generates traffic and congestion on local streets near the port. However, since restricted landside access may restrict future growth, there is an ongoing debate on the landside issue and alternative solutions that can be satisfactory to all parties involved. Currently, all container ports on the West Coast are planning massive increases in container handling capacity, increases of about a total of 82 %. Concerns have been raised that some of these ports may be tempted to spend money on expansion without having their costs fully covered by future business.

Finally, there are labour issues that were complicating U.S. ports functioning. Following

decades of labour conflicts, there has been a surprising level of cooperation in recent contract negotiations. This can be partially attributed to the improved management approaches and awareness among employees that improved productivity is an essential ingredient in survival within a competitive environment. Besides, most public ports act as landlords and have no direct involvement with port labour issues and disputes. Nevertheless, avoiding port labour difficulties is crucial to the economic well being of ports in the U.S.A.

2.3.2 Ports in Canada

Historically, ports and harbours were a responsibility of the federal government of Canada, which included statutory reporting relationships to the Minister of Transport. At the same time, Canada's port system was far from homogeneous and financial regulations for each group of ports varied considerably (Ircha, 1997). As continental transportation became more complex in the 1970s with deregulation in the United States, concerns were raised about the rationalization of Canada's ports system. At that time, a certain degree of autonomy was provided to those ports of national and regional significance, which had achieved financial self-sufficiency. Among those ports were Montreal and Vancouver, classified as level I ports or commercial ports, providing gateway and terminal services for international and domestic shipments. (Please refer to the Appendix 4 for the port profile).

However, in spite of the trend towards commercialization, the legislation still prevented major ports from operating as true commercial enterprises. Delays in obtaining approvals

from Canada Ports Corporation (CPC) and Treasury Board for financial development and land transactions resulted in Canadian ports being unable to quickly tap emerging opportunities in contrast with their U.S. competitors (Ircha, 1997). A survey of the Canadian port industry conducted in 1993-1994 for the CPC was trying to determine the readiness of senior port managers to embrace commercialization. The survey consisted of a three-phased set of questionnaires. The selected expert panel of 90 plus participants was divided in four distinct groups such as Port Managers, Federal and Provincial Bureaucrats, Private Sector Managers and Industry Associates and Academics. The group responses were collated based on the mean of their responses to specific questions and issues. The results of the study suggested that all surveyed groups agreed on the negative impact of increased north-south trade to the detriment of Canadian ports' throughput.

However, the impact of continental port competition and intermodalism was shown as the primary concern for all survey participants. While both Port Managers and bureaucrats agreed that the ports' focus should be on generating profits rather than on regional development, Port Managers favoured the need for competition in a continental ports system. Both groups expressed a need for improving communication systems such as Electronic Data Exchange (EDI). Finally, Port Managers strongly believed that Canada's commercial ports should be financially autonomous.

During the past several years, the federal government has taken steps to commercialize Canada's transportation industry, including Canadian ports. Today, the process is still continuing. The new *Canada Marine Act* (1998) eliminated CPC (Canada Ports

Corporation), providing commercial ports with more autonomy. That new legislation intends to improve the effectiveness of major ports. Thus, new Montreal and Vancouver Port Authorities will enjoy greater management flexibility, including an increasing freedom to develop contracts and leases, set tariffs and fees, and borrow money from commercial lenders. Finally, the labour issues are complicating functioning of Canadian ports just like the U.S. ports. Similar to the American counterparts, Canadian ports act like landlords and do not have direct responsibility for labour issues, except for the staff of the Port Authority itself. However, shippers and other interested parties typically expect port managers to ensure a stable labour situation.

Another concern of Canadian ports is the greater range of financing means available to U.S. ports, including the collection of taxes. According to the MARAD's 1997 survey, the ports of Seattle/Tacoma/Portland collect a combined US \$50 million each year. Additionally, the use of revenue bonds accounted for more than 47% of all U.S. port revenues in 1997. In Canada, there are strong concerns that a comprehensive review of port taxation by federal, provincial and municipal governments is needed to ensure a level of taxation that does not threaten the viability and competitiveness of ports.

An overview of ports in general and specifically in Canada and the United States revealed certain similarities and differences in their respective positions. It appears that any international port has to provide convenient, reliable and expedient service to its customers to stay competitive. For that reason, ports are increasing their efficiency and capacity, investing in better security while closely cooperating with surface

transportation. Maintaining a balance between low cost of ports' services for competitive reasons and sufficient sources of financing of ports' operations remains a challenge. For both Canadian and American ports labour issues have been a source of concern since labour disputes directly affect the reliability of ports' service. At the same time, a number of factors contribute to the differences in the ports' positions, mainly attributable to differences in marine and port policy. Those differences are transposed into the level of independence and flexibility for ports, as well as their ability to obtain financial support and subsidies. Analysis of the similarities and differences in ports' competitive positions helped to identify several factors affecting ports' competitiveness. These factors, presented as determinants or independent variables, will be examined later in the discussion. Furthermore, introduction of the new marine legislation in Canada was particularly important for the present research since the port industry in the United States has been more deregulated. Closer similarities in commercial and corporate freedom of the ports from the legislative perspective would ensure a fair comparison between Canadian and American ports, as well as better generalizability of the research results.

In the following section, an overview of current media sources is presented for the purpose of providing a description of today's transportation environment. In addition to supplying some background information, it should help identify actual issues that face transportation industry overall and ports in particular. It should also link the theoretical framework of competition, as described above, with the realities of the transportation industry, substantiating theoretically identified determinants of ports' competitiveness.

2.4 CANADIAN TRANSPORTATION MEDIA SOURCES REVIEW

The Canadian transportation industry is a key player in Canada's export-driven economy. According to Mr. Paul M. Tellier, CEO and President of Canadian National Railway Co. (CN), there is a need for public policy changes to accelerate productivity gains in the railway industry, which are essential to the competitiveness of the Canadian economy. (Pacific Shipper, December 14, 1998). Mr. Tellier further added that rail productivity and competitiveness are vital to Canada's economy because freight exports account for close to 40% of Canada's domestic production and rail moves 40% of all Canadian export products, which is more than any other mode. (Canadian Sailings, January 11, 1999). For the last few years, Canadian National Railway Co. has described themselves as a continental, rather than just a Canadian freight carrier. This year, CN announced a \$2.4 billion takeover of U.S. Illinois Central of Chicago to form the fifth largest railway in North America with a rail network connecting Canada's East and West coasts, and stretching through the United States to its southern border. With the recent growth of north-south trade at a rate of about 10% annually, while east-west trade growth remains at around 3 to 4 %, this was a strategic move on the part on CN in strengthening its competitive position and gaining competitive advantage. As a result, shippers will get the goods to their destinations faster and with greater efficiency.

At the same time, the Vancouver Port Corporation is taking aim at the U.S. Midwest container market in a bid to increase traffic through the port, said VPC president and CEO Norman Stark. The Canadian market is only so big, but a low Canadian dollar

makes the port particularly competitive. Now that virtually all shipping lines are calling in Vancouver, and CN with CP have access to Chicago, the port can have a direct service to that area. Vancouver's container facilities and Canada's two transcontinental railways offer capacity and capability to challenge traditional intermodal routes from the West Coast to the U.S. Midwest and beyond.

According to a February 12, 1999 issue of the Journal of Commerce, the Port of Vancouver overcame the economic anguish along Canada's West Coast to post a record container volume of 840,098 TEU (20-foot container-equivalent units) in 1998, which is 16% higher than a year earlier. "This year's container numbers signal success in Vancouver's ability to compete with other ports in the Pacific Northwest. Vancouver had the greatest percentage increase in foreign laden containers among Pacific Northwest ports", said Carole Taylor, VPC Chair. Containerized import cargo through Vancouver leaped 27% and laden export container volumes rose an impressive 9% over last year's numbers. Several factors contributed to the growth, including strong consumer demand for Asian imports, highly competitive terminal and inland transportation services, and a low Canadian dollar. (Canada News Wire, February 4, 1999).

Meanwhile, container traffic reached a record high at the port of Montreal in 1998, approaching membership in the exclusive league of world ports handling one million TEU or more annually. Montreal's port handled a record 932,701 shipping containers. The facility earned \$13 million on annual operating revenues of \$57 million. However, "...maritime rate wars spurred by the Asian crisis are worrying the Port of Montreal

much more than future competition from jumbo container ships using East Coast deepwater terminals”, said the port’s chief executive Dominic Taddeo. (National Post, January 21, 1999). Container cargoes, the port’s backbone, offsetting a drastic 10-year decline in grain shipments, rose 5.8% to 8.7 million tones in 1998. “As more and more container transportation companies are muscling into the North Atlantic trade because of heavy over-capacity on other routes, everyone is fighting viciously over the same piece of pie”, he added. That means lower rates, yet they are already near record lows.

About 95% of Montreal’s container traffic is with Europe, but the port also serves Central Canada and the U.S. Midwest. While New York is the biggest East Coast container port, with about 25% of the North American market, the Port of Montreal has a similar share, Baltimore and Norfolk are declining, and Halifax’s container traffic is half Montreal’s volume (National Post, Jan.21, 1999). However, shipping lines, which have invested several million dollars in facilities at Montreal, know that the port has a clear cost advantage over New York and Halifax because of geography, service efficiency, service frequency and other factors. The super container vessels are already calling at Halifax and New York, “but we can prove that the cheapest way to move containers to and from Europe for the U.S. Midwest industrial heartland and Ontario with Quebec is via Montreal, and we don’t see a threat”, suggested Dominic Taddeo. Most container ships come to Montreal specifically to load and unload goods for distribution. Approximately 25% of the container traffic is originated from or destined to Quebec; another 25% is for and from Ontario, while the remainder is headed for or coming from the U.S (Port of Montreal, Annual Report, 1999). The U.S. Maritime Administration’s recent

transshipment study showed that U.S. trade moving via Canadian ports is increasing to record levels, perhaps as much as 770,000 TEU per year. (The Journal of Commerce, February 12, 1999).

In summary, the transportation industry has become a key player in Canada and the United States because its competitiveness directly affects the competitiveness of the national economy. Liberalization of trade stimulated a greater growth in North-South trading, changing traditional transportation patterns. There is an obvious increase in container volumes shipped along both East and West coasts. In addition to the factors influencing competitiveness, as summarized earlier, a more recent phenomenon was discovered, i.e. the emerging trend of significant trade destined to the U.S.A. and being shipped through Canadian ports. However, the factors that make Canadian ports more attractive should become more evident after the collection and analysis of the ports' data. In conclusion, it seems that the developments and trends in modern transportation, as revealed through the current media sources, support the theoretical framework of competition among the ports.

Following an overview of the background information, the literature review, arranged around the discussion of the past research in the field, will help to clarify key factors of success. A model of ports' competitive position and its assessment will be based on the existing literature, hypothesized factors of success and the theoretical framework as described earlier.

III. LITERATURE REVIEW

3.1 FREE TRADE AGREEMENT AND NORTH AMERICAN MARITIME TRADE

The Free Trade Agreement (FTA) implemented in 1988 by the United States and Canada was another step towards economic integration of the world's two largest trading partners. While the majority of cargo, roughly 85%, between U.S. and Canada was transported by surface, the volume and commodity composition of the maritime trade was also affected. The FTA, which removed trade and investment barriers between the two trading nations, also loosened restrictions on cross-border flows of capital and labour.

Warf and Cox (1992) examined the short-run effects of the FTA on water-borne shipments through U.S. ports. They argued that changes in the volume and commodity mix of trade flows trans-shipped through ports affect the demand for output in transportation services, financial institutions, business services and warehouses. Changes in the demand in all of these sectors, in turn, stimulate secondary effects in the demand for fuel, food and other inputs such as land and labour. For example, Warf and Cox (1989) found that ocean-borne cargo trans-shipped through the Port of New York in 1987, valued at \$50.3 billion, generated 251 000 jobs and \$6 billion in personal income. Although, it is difficult to measure all the direct and indirect impacts of FTA, it should be remembered that the consequences of such changes are quite substantial at the local and regional level.

The fact that the vast majority of trade volume between Canada and U.S. was transported overland reveals the close proximity and the degree of integration between the countries, particularly between southern Ontario and the American Midwest. For instance, in 1988, only 5.3% (\$2.9 billion) of exports to Canada and 7.6% (\$3.8 billion) of imports from Canada were shipped by water. However, for certain commodities water transportation is far more significant. Water-borne transportation is generally most important among commodities that are heavy, such as raw materials, mineral ores, wood products and petroleum. As the FTA relaxed tariffs on many commodities, the demand for those commodities increased, increasing in turn the demand for water transportation.

The distribution of water-borne trade is highly uneven among Canadian and U.S. ports. Such U.S. ports as Los Angeles (CA), Boston (MA), Detroit (MI), San Francisco (CA) and Seattle (WA) are prominent in importing goods from Canada. Water-borne exports to Canada leave primarily through Cleveland (OH) and Detroit (MI). The methodology, employed by Warf and Cox (1992), estimated the impact of FTA on water-borne commodity flows through a commodity-specific analysis of tariffs and the elasticity of demand between imports and domestic goods in the U.S. and Canada. While a considerable portion of U.S. - Canadian trade was already free of tariffs, on average, Canadian tariffs and non-tariff barriers (NTB) were slightly higher (averaging 4.8%) than those imposed by the U.S (averaging 4.1%). The degree to which the elimination of trade tariffs increases the demand for imports is a function of the elasticity of demand between imports and domestic goods. In general, the estimates of Canadian elasticity were higher than those for the U.S. (Letourneau and Lester, 1988).

The analysis by Warf and Cox (1992) was concluded with an estimate that total water-borne imports from Canada increased by 3.4% as a result of FTA, while showing an increase by 5.1% for U.S. exports. The study further concluded that FTA would accelerate trade and investment growth in North America. As market prices will decrease with increased competition and elimination of tariffs, the demand for goods will start to rise. As indicated earlier, although maritime transportation does not play a major role in Canada - U.S. trade, for certain types of cargo it will remain a preferred choice.

3.2 NORTH AMERICAN FREE TRADE AGREEMENT (NAFTA) AND PORTS

The work started by the FTA was continued by the NAFTA and the trends in trade in transportation continued as well. The North American Free Trade Agreement (NAFTA) which was signed by Canada, the U.S.A. and Mexico and came into effect on January 1, 1994, was a significant move towards further integration of the North American economies. The transportation sector was included under NAFTA and ports faced increased competition from surface-based modes of transportation. The 1994 NAFTA agreement extended the Canada-U.S. free trade agreement in several aspects, including transportation services, not to mention the fact that it included a third country - Mexico. However, for the purpose of this research, primary attention will be paid to the impact of the agreement on just Canada and the United States. The Conference Board of Canada (1993-1994) outlined key provisions of NAFTA in six areas: market access, trade rules, services, investment, intellectual property and dispute settlement. Under NAFTA, goods

traded between three countries are to be treated as if they were domestic products. While to-date tariffs on a number of goods have been eliminated, tariffs on the remaining items would be phased out over fifteen years. Following a study by the Conference Board of Canada, Heikkila (1995) examined the impact of NAFTA on integration within the North American transportation industries in more detail. Both studies predicted that NAFTA's impact on ports would be felt primarily through increasing trade.

An overview of trade profiles for Canada and the U.S. (Heikkila, 1995) indicated a trend in increased volumes of both imports and exports, revealing remarkable similarities between Canada and the U.S. For instance, trade within NAFTA has considerably strengthened since 1988. However, ports handled 17% of total Canadian exports and 18% of imports in 1993, compared to approximately 70% for road and rail combined. Although the total dollar volume of Canadian commodity imports (\$170 bill. in 1993) is comparable to the total commodity exports (\$177 bill.), export tonnage through Canadian ports easily exceeds those of corresponding imports, indicating the prominence of natural resources in Canadian exports. This statement can be illustrated by the volume of exports and imports data from the Canadian Maritime Database (Statistics Canada, 1993) for the ports of Vancouver and Montreal, for example. While about 6,000,000 metric tonnes of imports were shipped out through the port of Montreal and 4,500,000 through Vancouver, slightly over 50,000,000 metric tonnes were exported through Vancouver alone, with 5,000,000 metric tonnes exported through the port of Montreal. The significant amount of exports shipped through the port of Vancouver is a result of not only the influence of NAFTA but also the increasing trade with Asia at the time of the

report. However, it is possible to say that the trend in the trading patterns continues today. In addition, Canadian ports are quite specialized and distinctive from one another in terms of the products they handle. However, Montreal and Vancouver are much more diversified, handling a wide variety of products. On the whole, Canada imports a greater proportion of consumer goods than the U.S.A. and exports more minerals, fuel, raw and bulk materials native to their hinterland regions.

The most obvious and direct impact of NAFTA on Canadian ports is occurring through direct trade. As each country within the NAFTA agreement begins to specialize further in the context of integration of the North American economy, the flow of goods through each specific region begins to reflect those changes. The integration of the North American economy also pushes the integration of the continental or surface transportation system even further, having an impact on ports struggling to maintain a niche within an increasingly competitive environment. In light of the fact that the majority of Canadian trade is with the U.S.A. and that both countries are increasing imports from each other, an existing trend of trading certain categories of goods north and south is moving further (Cox and Harris, 1992). Whether Canadian ports are likely to benefit from those changes will depend on the competition from other surface-based modes of transportation.

The implication of the comparative advantage principle for ports is indirect but potentially profound. Instead of trading smaller quantities of many goods, the trade becomes more specialized. Since transportation itself is included under NAFTA but was

not in the FTA, a possibility of ports specializing to a greater extent also exists. The increasing volumes of north-south (versus east-west) trade flows can be attributed to economic restructuring, and will be compounded by consolidation of the transportation sector, particularly between Canada and the United States. As NAFTA increases trade between the three signatory countries, it may possibly come at the expense of trade with the rest of the world. In light of that proposition, Canadian ports will become more vulnerable to competition from inland transportation modes due to the close proximity of the markets. That is why ports will have to distinguish themselves in terms of other value-added activities. They may increasingly become specialized in handling commodities that are produced within their hinterlands, and will compete with other ports that are located within the same subregion (Heikkila, 1995). At the same time, competitive advantage or disadvantage for ports depends not only on purely economic reasons, but also on government policies. For instance, subsidies to maintain inefficient ports will become increasingly unattainable, be that in Canada or in the United States. Heikkila (1995) concluded that NAFTA might or might not offer important opportunities for Canadian ports to build on the specialization they have already developed, but in the final analysis, the deciding factors would be efficiency, convenience for shippers and inland links. He anticipated that ports would make strategic investments in their facilities to capture market share.

While NAFTA presents a challenge for ports, it constitutes a movement towards specialization within an integrated economy, presenting opportunities at the same time, and strategic planning within ports should consider this emerging reality. However, ports

cannot and should not succeed in isolation because, after all, ports are outlets for exports and receptacles for imports.

A brief review of the literature so far revealed that a relationship between the increase in trade and a growing demand for transportation was established. The introduction of NAFTA in 1994 stimulated trade between Canada and the United States, creating a shift in trading patterns and increasing trade volumes moving North-South. Thus, the post-NAFTA five-year period seems to be an appropriate time frame for the data collection and analysis.

That shift triggered particular changes in North American transportation networks and in the way goods were shipped. Elimination of many trade barriers provided greater access to the market for all parties, thus, intensifying competition among the ports, other transportation services and transportation networks. The presence of the competitive environment created favourable conditions for the search for lower prices to the benefit of ports' customers. However, while there are a number of factors affecting the cost of shipping goods, some of them are under the ports' control and others are not. For instance, differences in taxation policies between Canada and the United States seem to affect the cost of port services, making a port more or less competitive. Therefore, the relationship between the cost of shipping goods through the port, as a major criterion for customers, and the degree of taxation policies being favourable, should be explored in this research in addition to other factors noted earlier. Furthermore, previous research suggested that port competition should become more specialized based on the production

of goods within the ports' hinterland, leading to the competition among the ports within the same subregion. Thus, the choice of four ports, two of which are located within the same subregion on the East Coast and two - on the West Coast, would support or contradict that hypothesis. In addition, while port competition within the subregion is entirely possible, there is evidence that international ports such as Vancouver or New York compete with their counterparts even across the continent thanks to the integration of the economy and the development of the intermodal transportation networks. Perhaps, analysis of the data and information collected from all four ports would provide more information in that area.

3.3 OVERVIEW OF CANADIAN TRADE AND TRANSPORTATION

Since Canada is an actively exporting country, increases in trade flows should directly affect Canadian transportation networks and main ports. In addition, as noted earlier, overall economic growth generates greater demand for transportation services. According to an economic review produced by the Canadian Department of Foreign Affairs and International Trade (1998), Canada's economy continued to expand in the third quarter of 1998. The main source of growth during this period was the export of goods and services, which rose 2.3% from July to September over the second quarter of the year.

The key international development affecting Canada was the growth of 3.9% in the U.S. economy in 1998. The growth in Canadian exports came largely from trade with the United States, whereas exports to most other markets have declined in the recent years.

An overview of Canada's trade based on data provided by Statistics Canada (1997, 1998) showed that exports in the 3rd quarter of 1998 were at \$90.8 billion compared to \$86.3 in the 3rd quarter of 1997. At the same time, imports were at \$ 87.8 billion compared to \$83.2. With these developments, the quarterly surplus on trade in goods grew by \$1.6 billion, reaching \$5.3 billion in the third quarter, with the balance on trade in goods to U.S. of \$10.4 billion.

In 1998, the Asian economic and financial crisis continued to drive down Canadian exports to East Asia. Through the first nine months of 1998, exports to all of Canada's key markets in this region fell steeply compared to the same period the year before. The economic downturn in Japan, Canada's largest Asian trading partner, had a strong effect on Canada's trade performance with the Asia-Pacific region. Merchandise exports to Japan dropped 31.7 % in the first nine months of 1998 compared to the same period in 1997, while merchandise imports from Japan gained 16.4%. The most noticeable change in Canada's trade pattern in the 1990s has been the steady increase in the share of merchandise exports accounted for by machinery and equipment – from 19.0 % in 1990 to 22.6% in 1997. This trend became even more pronounced in the first three quarters of 1998, with growth of 24.8% in the export share of machinery and equipment, which is now Canada's largest sector. The strong performance of machinery and equipment exports is in large part due to solid demand from the United States, which absorbed 85.2% of Canadian machinery and equipment exports.

Overall, the direction of Canadian trade considering exports and imports for the first half

of 1998 looks as follows:

Table 3.1 – Canadian Trade Pattern

Major Export Markets	(% of Total)	Major Import Suppliers	(% of Total)
United States	85.6	United States	68.5
Japan	2.3	Japan	4.8
United Kingdom	1.5	Mexico	2.5
Asia (excl. Japan)	2.8	Asia (excl. Japan)	7.6
Latin America	1.8	Latin America (excl. Mexico)	1.7
Africa	0.5	Africa	0.7

Source: "Digest of International Economic Forecasts", February 8, 1999

Analysis of Canadian trade distribution, as illustrated in Table 3.1, suggests that the majority of goods to and from Canada are transported by the surface mode since most of the trade for Canada is with its closest neighbor – the United States. At the same time, since Canada is exporting a lot of natural resources, which are heavy commodities, it is possible that Canadian seaports are part of these transportation arrangements. In further analysis of cargo distribution for each one of the four ports under observation, a proportion of volume attributable to trade with the United States and with other countries could be explored.

3.4 OVERVIEW OF TRADE AND TRANSPORTATION IN THE UNITED STATES

In many cases, US ports compete directly with Canadian ports, while in other cases the competition is indirect. For instance, while the Canadian ports of Montreal and Halifax

have been alternative “gateway ports” for decades, they have lately become principal gateway between the United States and Northern Europe. Further, in 1994 the total U.S. trade transshipped through Canada was estimated at \$17.09 billion and 5,221,451 metric tons. Exports amounted to about \$ 7.0 billion and 2,380,894 estimated metric tons, and imports valued at \$10.28 billion and 2,840,557 estimated metric tons. In 1994, exports grew by 16.7% on a value basis and 13.8% on a weight basis compared to 1993, while imports were up 26.1% on a value basis and 28.4% on a weight basis. At the same time, the value of total U.S. cargo transshipped via Canada was 4.0% of U.S. liner cargo and 4.3% of the total on a weight basis.

The following table illustrates the steady growth in U.S. exports and imports via Canada for the period from 1976 to 1994 on a value basis.

Table 3.2 – U.S. Imports and Exports Via Canada

	EXPORTS (\$)		IMPORTS (\$)
1994	7,000,000		10,200,000
1993	6,000,000		8,100,000
1992	5,500,000		7,000,000
1991	6,100,000		6,250,000
1990	5,850,000		6,100,000
1989	4,950,000		6,100,000
1988	5,100,000		6,200,000
1987	4,000,000		5,300,000
1986	3,200,000		4,000,000
1985	2,900,000		3,900,000
1984	3,000,000		4,000,000
1983	2,005,000		3,000,000
1982	2,000,000		2,200,000
1981	2,300,000		2,500,000
1980	2,100,000		2,100,000
1979	1,300,000		2,050,000
1978	1,005,000		1,900,000
1977	1,100,000		1,000,000
1976	750,000		900,000

Source: Transport Canada, 1999 (<http://www.tc.gc.ca/facts>)

Data from Transport Canada, as presented in Table 3.2, is further supported by the U.S. Maritime Administration's (MARAD) recent study (1996-1997), showing an increase in U.S. trade moving via Canadian ports to record levels, perhaps to as much as 770,000 TEUs per year.

The reason for this shift is that traditionally, intermodal container operators were able to escape rate regulations imposed by the U.S. Federal Maritime Commission by shipping through Canadian gateways. More than 20 year ago, the Cast steamship line initiated all-inclusive point-to-point freight rates for U.S. traffic via Canadian ports to and from Europe. The shipper paid a single rate that included all costs, land and ocean, from origin to final destination. By the time the Shipping Act of 1984 allowed point-to-point freight rates in U.S. trade, Canadian ports had already proven their route to be a viable alternative. Consequently, the Montreal intermodal system had consistently offered intermodal services at lower costs than those available at competing U.S. ports.

The enactment of the U.S. Harbor Maintenance Tax in 1986 to pay for dredging was "a self-inflicted competitive wound" (Pauga, 1997). The report prepared by Alvis Pauga, a New Jersey-based international trade consultant for a joint project between the Port Commerce Department of the Port Authority of New York and New Jersey and the Department of Transportation's Maritime Administration (MARAD), assessed the tax at 0.125% of cargo value through U.S. ports. For example, a shipper with container cargo valued at \$800,000 would have paid \$1,000 in HMT via U.S. ports but not via Canada. Later, in 1998, the Supreme Court declared the tax unconstitutional for U.S. exports,

resulting in the recently implemented Ocean Shipping Reform Act (OSRA), which made freight rates at U.S. ports more competitive. However, the HMT is still being assessed for imports.

Meanwhile, Montreal's intermodal system has penetrated deeply into the U.S. markets to the benefit of U.S. shippers. Moreover, it is expected that Canadian port penetration would become even deeper with the completion of the Canadian National and the Illinois Central railway merger. Further, the North Atlantic trade may not be the whole story because, according to Pauga, China's trade with the United States has also grown considerably with large steamship lines using Vancouver in the same way they use Montreal to move goods into the United States by rail. Finally, U.S. – Europe carriers and those in the Canada – Europe trade are planning rate increases as of January 1, 2000, but those planned for U.S. – Europe trade are higher.

The insufficient depth of the New York port's harbour and the need for dredging to accommodate Maersk Lines' 6,000-plus TEUs jumbo container ships is another obstacle to the port's competitive position. In the meantime, some ships have to offload part of their cargo in Halifax to enable them to enter the Port of New York and New Jersey. Maersk and other carriers are often able to reduce their total costs by moving cargo via Canada. In fact, Maersk and SeaLand started a new direct service between Europe and Montreal in 1997. They have recognized Montreal as a principal port in North America for European cargo.

Figures in the recent Maritime Administration study, *"U.S. Exports and Imports Transshipped Via Canadian Ports in 1996-97"* show that total transshipments via Canada amounted to \$24.6 billion in 1997, up 9% from 1996, and 75.8% from 1993. By comparison, overall U.S. trade value increased only 49% during the same period. Average value per ton of transshipped cargo rose 22.9% since 1993. That is why Pauga (1997) suggested that perhaps, it was an indication that shippers were trying to avoid the harbour-maintenance tax by diverting their higher value cargo via Canada.

The transshipment figures in his study were not directly available from the Census Bureau, but were derived by commodity. The value per ton factor from corresponding waterborne movements was then used to calculate tonnage. Furthermore, perhaps U.S. ports deceived themselves by overstating their market share and ignoring Canadian ports' alternative routes in the context of changing trading patterns with Europe and Asia. The harbour-maintenance tax and the harbour depth problem incurred by larger container ships calling at Northwest ports were important factors in U.S. cargo movement via Canada. However, the cargo shift through Canadian ports has its roots in broader competitive aspects of intermodal systems offered by Montreal and other Canadian gateway ports.

Meanwhile, Canada remains the U.S. biggest trading partner, absorbing over 23% of its exports and providing a substantial volume of imported goods. Trade distribution and direction of the U.S. trade for the first half of 1998 is provided in the Table 3.3.

Table 3.3 – U.S. Trade Pattern

Major Export Markets	(% of Total)	Major Import Suppliers	(% of Total)
Canada	23.2	Canada	19.4
Mexico	11.4	Japan	13.5
Japan	8.6	Mexico	10.2
Asia (excl. Japan)	15.3	Asia (excl. Japan)	24.0
Latin America	20.7	Latin America (excl. Mexico)	16.1
Middle East	3.8	Middle East	2.3

Source: "Digest of International Economic Forecasts", February 8, 1999

Analysis of U.S. trade distribution, as illustrated in Table 3.3, suggests that since Canada is the biggest export market for the United States, the majority of goods to that market would be transported by surface modes, such as trucks and railways. However, a significant portion of export trade would be transported by water to Asian and Middle Eastern destinations. At the same time, the distribution of import trade suggests that larger trade volumes would be arriving into the United States by water. Perhaps, then, American ports would play a more significant role in international shipping than their counterparts in Canada.

While this may be true, it seems that Canadian ports have found a specific market niche for themselves by being a gateway between the United States and Europe on the East Coast and between the United States and Asia on the West Coast. Therefore, it is possible that ports in both Canada and the United States may approach their competitive

advantages and disadvantages from a slightly different angle, incorporating their present momentum into their strategic plans.

3.5 TRANSPORTATION COSTS RELATIVE TO COMMODITY PRICES

The cost of transporting goods to their destinations has always been an important element of the total cost of those goods, directly affecting the price charged to the consumers. Thus, it could be inferred that lower transportation cost makes the goods more competitive in the market by reducing their prices while increasing demand. The transportation cost of moving a commodity from producers to purchasers, relative to the value of the commodity, was the subject of investigation by Transport Canada in 1991. Although, the numbers would not be completely accurate today, the data revealing general trends would still be applicable. The analysis was performed at two levels of aggregation: one included 69 commodity groups, the other one - 522 groups. Transportation costs for domestic trades and exports were estimated separately. The total was calculated as an average of these two categories, weighted by value of commodities.

The study (1991) concluded that the majority of commodities had transportation costs at less than 5% of their value (at the producer's price). At the same time, 18% of export groups had their transportation ratios in the range of 5 to 10%, and for about 11% of export, transportation costs were in the range of 10 to 60%. These ratios were calculated based on the producers' and not the selling prices. Table 3.4 shows the transportation costs as a percentage of commodities price for 30 most popular commodities.

Transportation Cost Relative To Commodity Value as of 1991

Transportation/output ratio (%)

Table 3.4

		Total	Domestic	Export
1	Grains	26.50	11.9	39.3
2	Forestry products	3.90	3.8	10.5
3	Iron ores and concentrates	29.40	30.7	28.6
4	Other metal ores	2.70	2.4	3
5	Coal	41.80	27	57.2
6	Crude mineral oils	5.90	5	7.8
7	Natural gas	44.90	66.2	31.9
8	Non-metallic minerals	31.40	24.5	45.5
9	Feeds	4.70	4.3	8.3
10	Flour, wheat & other cereals	8.20	8.1	10
11	Sugar	3.30	3	9
12	Soft drinks	4.50	4.4	4.8
13	Alcoholic beverages	3.90	2.4	4.4
14	Tires and tubes	3.60	3.5	3.8
15	Lumber and timber	14.10	12.2	15.1
16	Other wood fabricated materials	8.00	8.4	5.6
17	Pulp	5.60	3.5	6
18	Newsprint & other paper stock	6.70	4.7	8.2
19	Printing and publishing	1.20	1.1	2.4
20	Agricultural machinery	2.60	3.3	2.2
21	Other industrial machinery	2.30	2.1	2.6
22	Motor vehicles	2.10	0.5	2.1
23	Motor vehicle parts	2.10	1.7	3.3
24	Cement and concrete	8.00	7.6	16.6
25	Gasoline and fuel oil	4.30	4.5	3.5
26	Industrial chemicals	5.60	5.2	6.7
27	Fertilizers	22.90	6.8	43.4
28	Pharmaceuticals	1.60	1.7	1.2
29	Other chemical products	4.30	4.4	3.8
30	Other manufactured products	2.30	2.5	1.9

As illustrated in Table 3.4, the highest transportation/output ratio is a factor for heavy bulk commodities, such as coal, ores, grain and fertilizer. Those are the specific types of goods that are primarily moved by water, allowing for a smaller transportation cost per unit of goods. Also, those are the commodity groups, which are prominent in Canadian

trade, making transportation cost an important element of the cost of Canadian exports, even though only the domestic leg of the journey was a subject of a study by Transport Canada.

At the same time, transportation cost as a percentage of the selling price was significant for major exports of natural resources or of the primary sector, ranging from 18% to 36% in the study sample with the overall average transportation cost ratio of about 15%. Even though transportation cost ratios were relatively low for some high value exports from the manufacturing sector, transportation cost remained vital because of the large share of these commodities in total export volume. For instance, while transportation cost represented about 2% of the selling price for motor vehicles group, exports for this group represented 19% of the total export volume in value terms.

Based on the Transport Canada study (1991), it can be concluded that the cost of transportation is an important factor for any major commodity group, having a significant impact on the price of goods. With the globalization of trade and increased competition, the cost of transportation may become even more important in sustaining the competitiveness of goods while impacting on the competitiveness of actively trading countries. Nowadays, many commodities in North America are being shipped through intermodal systems, involving a combination of several modes of transportation, such as water and surface. A number of other factors, such as taxation rules or labour issues, discussed in the following chapters, have an impact with a variable level of significance on the cost of transportation. Since the cost of transportation plays a key

role in the context of competition, it supports an earlier suggestion that such costs could play the role of a dependent variable in the model of ports' competitiveness. Hence, the factors that have an impact on the cost of transportation should be identified to serve as qualifiers or independent variables.

3.6 CONTAINERIZATION AND INTERMODAL SYSTEMS

The last twenty years of the twentieth century witnessed two major trends that changed the way goods were transported. Namely, it was the explosive growth of containerization that triggered the development of intermodal systems. Consequently, containerization and intermodalism transformed ports' operations, providing a new dimension to port competition. The material of this chapter was largely based on the final report prepared by the Container Competitiveness Committee of the Canada Ports Corporation (1991). The report concluded that the new free trade environment with its shift towards intensely north-south trade patterns, coupled with the new moves towards integration of ocean carriers and railroads, has redefined the competitive position of ports in North America. The study was concerned with such issues as containerization and intermodalism. The latter often means the movement of freight by more than one mode of transportation on a single bill of lading.

The containerization process, since its inception some forty years ago, has been dubbed "the container revolution" because it offered savings more significant than ever before in cost, labour and cargo damage. For instance, containerization or unification of packaged,

palletized or loose freight into steel containers increased the cargo protection from various types of damage, attracting goods traditionally shipped in bulk. Containerization provided such benefits as significant reduction in manual handling and improvements in speed and convenience of cargo delivery, increasing transportation efficiencies and triggering the development of the economies of scale in transportation.

In addition, containerization has changed the process of cargo handling, changing the equipment, mechanisms and information technology to conform to the new method. Finally, the development of containerization and creation of intermodal transportation services made it easy to transfer containers from ships to rail to trucks. However, there was yet another benefit to the containerization process, i.e. the development of a standard traffic measurement unit such as a TEU or a 20-foot container-equivalent unit. The dimensions of all marine containers were standardized in height and width, while the length was predominantly 20 or 40 feet. The new unit allowed not only the measurement of traffic moving through the ports but also the comparison of ports' throughput while providing effective pricing tool for shipping goods via any intermodal system.

As already mentioned, containerization and intermodalism provided favourable conditions for savings in cost of transportation. That is why within the past decade the ocean shipping lines increased their influence in the overall intermodal container movement. As their own carrying rates have been constrained by their competitive position, the shipping lines have moved towards the control of terminals, allowing them to control the time factors involved in door-to-door delivery. At the same time, the lines

also viewed the provision of supplementary "value-added" services, such as just-in-time inventory, as a potential source of additional revenues and as a means of product differentiation in a highly competitive market. The shipping lines, faced with the problem of low ocean rates, were pressured to rationalize their routings and improve turnaround times. The competitive factors facing North American ports, then, became partly a product of the economies of ocean carriage and the economies of inland carriage. The adoption of the intermodal door-to-door approach by the shipping lines impacted on the North American inter-port competition. Traditionally, a port occupied a position, representing termination of one handling activity and commencement of another in the movement of cargo. Today, ports represent a point on the intermodal continuum through which cargo moves with no change in the conveyance, that is of the container. Being an interface between land and sea carriage modes, the port prospers or suffers from the immediate effects of those modes.

With respect to the ocean carriers, the two most significant trends observed would include the increasing size of container vessels and the increasing involvement of ocean carriers in the inland movement of containers. Such major carriers as Maersk, SeaLand and COSCO are a few examples of liner carriers, exercising direct control over the complete range of transportation services offered to their customers. These trends also made a major impact on ports by concentrating cargo flows and establishing relatively few ports as load centres. Currently, the Port of Montreal in Canada and the Port of New York in the United States are recognized as load centres on the East Coast, while the Port of Vancouver and the Port of Seattle/Tacoma serve as load centres on the West Coast.

Through the development of intermodal transportation systems, all four ports, which are among the largest container ports in North America, find themselves in direct competition with each other. For instance, the share of U.S. West Coast ports in the container traffic rose by about 20% in the period between 1976 and 1989 because they were able to capture traffic previously shipped through the East Coast ports. That factor, among others, provided a reason for comparative analysis of the competitive position of the named ports within the current research project.

The continuing growth of containerization stimulated the growth in the carriers' fleet size and the size of individual ships. The, so called, fourth generation of ships had a capacity of about 3,000 TEUs and were approaching 'panamax' size, or ships that could pass through the Panama Canal, which is 40 feet deep and 110 feet wide. The fifth generation of ships was the "post-panamax" size with the capacity of 4,400 TEUs and the width of 129 feet. These ships were ordered by the American President Lines (APL), a predominantly Pacific carrier. APL chose to access its East Coast customers by shipping containerized goods to the West Coast ports and further with its own double-stack trains to the East Coast without passing through the Panama Canal. For a number of reasons, that way of shipping proved to be more efficient and less costly. Further, major improvements have been made with respect to the movement of containers inland. The Canada Ports Corporation report (1991) stated that the ability of a port to attract a shipping line is, in large part, related to the effectiveness of its inland transportation in terms of cost and services. The improvements in inland transportation affecting intermodal flows include the adoption of on-dock rail transfer facilities and the use of

double-stack rail cars, allowing for the growing use of intermodal rates. Meanwhile, container shipping lines were able to take full advantage of the increased flexibility of intermodal services, having a number of alternative routes over which to move the traffic at any particular moment depending on the current needs.

In 1990, containerization was still a growing industry, marked by the introduction of larger vessels. The total container throughput at world ports was expected to increase at a rate of about six percent per annum. That growth was expected to come partly from new trade opportunities and partly from containerization of cargoes previously handled as bulk or breakbulk. Further, since it was predicted that the move towards larger vessels would continue, some ports faced the need to invest significant capital in both dredging and handling facilities to accommodate larger vessels and higher volumes of container traffic. While the volumes of containerized cargo had been increasing steadily, these volumes in and out the U.S. were about nine times those of Canada^①. Naturally, the greater volumes served to reduce unit costs and have been largely responsible for the ability of ports to provide dedicated terminals. Besides the differences in magnitude of cargo volumes, Canadian export cargoes used to be heavier in weight and lower in value. This resulted in a greater demand for twenty-foot containers in Canada, in contrast to the industry trend in favour of forty-foot containers, which made Canadian rates for smaller containers more competitive. While the efficiencies and the flexibility of intermodal systems intensified competition for North American cargo among the liner carriers, they brought ports from different regions into more direct competition, as mentioned earlier.

^① Cargo International, December 1990

Moreover, the container traffic itself is becoming a subject of fierce competition among the ports because it provides great revenue potential. For example, containerized cargo volumes posted a strong 14 % increase in 1997 over 1996 level for the port of New York and New Jersey, while general cargo volumes increased by only 4.5 %. In addition, the share of the U.S. North Atlantic containerized cargo market rose from 53.3 % to 54.6 % on both the import and the export sides^②. Finally, the most commonly used type of vessel these days is, by far, a container ship, used in about 70% of cases and leaving 34% to dry bulk carriers, 21% to tankers and 15% to break bulk ships.

In summary, an overview of the containerization and the development of intermodal systems helps situate the current research project. Container traffic was described as a subject of competition among North America's major ports because it is predicted to increase even further, providing an important revenue source for ports. Thus, the assessment of ports' competitive position in terms of their containerized cargo should be most appropriate. At the same time, comparative analysis of ports' respective performances in terms of their capacity and pricing on the basis of container traffic is very convenient through the use of a standard measure such as the TEU. It was also demonstrated that the development of intermodalism led to a different way of shipping goods via intermodal systems and to the advantage of the ports with good intermodal links. The increased size of container vessels placed specific demands on the depth of the ports' harbours and on the equipment of container terminals.

^② The Port of New York/New Jersey home page, www.nynj.com

3.7 PORT'S LOCATION

Globalization or open global markets together with rapid transportation and high-speed communications should increase competition. In theory, the location of a business should no longer be a source of competitive advantage, but in practice, Porter (1990) demonstrated that location remains important to competition, at least today. In addition, Fleming (1997) argued that there are locational attributes that favour certain ports. Under the locational attributes he discussed the issue of harbour depth along with other micro and macro-geographic factors influencing the competitive position of a port.

There are also significant advantages for a port to be the first or the last port-of-call on a shipping line's itinerary, as pointed out in the Canada Ports Corporation study (1991). Being the first port of call inbound and the last outbound provides the shippers with the best transit time. In this, Montreal, for example, has the advantage of being the only port of call on its North American routes. Service factors also play an important role. In the selection of an ocean carrier, a shipper will consider the cost of service, the frequency of sailing, the reliability, the transit time and on-time pick up and delivery. In selecting a port of call, a shipping line will base its decision on which port will allow a service to meet shippers expectation as listed above.

Fleming (1997) put the 1995 ranking of top 25 container load centres in a geographical context. Site characteristics of container ports such as availability of flat waterfront land, expansion space and deep water alongside he classified as micro-geographic features.

Beyond the perimeter of site considerations, he outlined the macro-geography of ports, that is external relationships of the container ports and their relative locations with respect to traffic producing hinterlands and forelands. The macro and micro-geographic features of ports' location can create a competitive advantage or disadvantage for the port. For instance, the physical limitations in the channel depth leading to the port places some restrictions on the size of vessels that can easily use the port. For example, the port of Montreal can only accommodate vessels in the 2,000 to 2,500 TEUs maximum range with minor adjustments in the water management. Other constraints resulting from Montreal's location as a river port include the high cost of pilotage and the seasonal scheduling delays during winter operations.

In another study, Fleming and Hayuth (1997) suggested that there were two general location attributes that had strong bearing on container throughput at load centres: centrality and a strong traffic-generating local or immediate hinterland. The world top container ports, analyzed in the study, appeared to have both attributes in various proportions: they were central to something and en route to something else. For instance, the port of Seattle reported that about three-quarters of its inbound containers from Asia were destined for points in the central and eastern United States. At the same time, the Port of Montreal benefited from being on the shortest, most direct shipping route between Europe and North America's industrial heartland because it is located 1,600 km from the Atlantic Ocean. The inland location of the port allows ocean carriers to transport containers close to the great producing and consuming areas of the interior of North America. Thus, for competitive reasons, an aggressive port can groom and improve its

site or its geographic attributes to attract customers. It can also improve its competitive situation by cultivating hinterland connections. Therefore, while strategic commercial location starts with certain natural geographic attributes that are visible on a map, the hinterland connection would play an important role as well.

Furthermore, the metropolitan region of New York displayed a strong traffic-generating force emanating from its immediate hinterland, while on the West Coast, ports were striving to improve their intermodal role by improving the ship-to-rail transfers. The port of Montreal became a major factor in Canadian and American markets because it was a hub of a modern integrated system with key road and rail connections that link Montreal to the interior of the continent.

The survey of container load centres (March, 1996), framed geographically by Fleming and Hayuth (1997), suggested that there were aspects of site and qualities of situation that were quite relevant to traffic development. In conclusion, they defined a *strategic commercial location* as a combination of micro and macro-geographic features. Today, there is a lot of evidence that ports are looking for ways to improve their sites in macro and micro-geographic perspectives, considering that giant “megacarrier” multi-modal enterprises like Maersk and Sea-Land have the bargaining power to choose their load centres or ports.

Since it was demonstrated by Fleming and Hayuth (1997) that a port's strategic commercial location has an impact on the competitive position of the port, locational

factors should be incorporated as a determinant into the model of port competitiveness. In fact, there seem to be a number of variables that would represent strategic commercial location, such as centrality, strength of traffic producing hinterland, ability to accommodate megacarriers, ability to expand the port area, and the presence of convenient flat waterfront and approach to the port by water.

3.8 PORT SELECTION

With respect to port selection, Murphy et al (1993) looked into the selection of water ports for international shipments from the perspective of different parties, such as:

1. International water ports
2. International water carriers
3. International freight forwarders
4. Larger shippers
5. Smaller shippers.

The purpose of the study was to learn if there were differences in port selection factors across the five groups. The study concluded that generally, water ports were viewed as *providers of service*, that have multiple customer segments with ocean carriers and freight forwarders representing these customer segments. The study also concluded that ocean carriers were viewed by the ports as their primary customers. Therefore, the services provided by many ports have been designed to attract ocean carriers.

The methodology of the study by Murphy et al (1993) was such that the information

came from mail surveys. Five groups were surveyed over a three-year period. Where possible, the survey was addressed to top managers with international trade responsibilities in each group. The respondents' evaluation was based on 9 port selection factors:

1. Presence of loading/unloading facilities for large and odd-sized freight
2. Allows large volume shipments
3. Has low freight handling charges
4. Provides a low frequency of loss and damage
5. Has available equipment
6. Offers convenient delivery and pick-up time
7. Provides information concerning shipments
8. Offers assistance in claim handling
9. Flexible in meeting special handling requirements

Both univariate and multivariate techniques were used to learn whether port selection factors differ across the five groups. Results of the one-way ANOVA showed statistical significance at the 0.05 level for 5 out of 9 variables, including large and/or odd size freight, large volume shipments, shipment information, claims handling, and special handling, where large volume shipments received the strongest rating. Factor analysis of the aggregate data was used to determine if the 9 initial factors could be partitioned into fewer meaningful factors. Indeed, 9 variables loaded on 2 factors, which accounted for 68% of the total variance. Those 2 factors involved "Customer Service Issues" and "Freight Handling Capabilities".

In another study by Canada Port Corporation on Container Competitiveness (1991), the following factors were suggested as major reasons in selecting a port of call by a shipping line:

1. Port charges;
2. Terminal / Stevedoring costs;
3. Productivity;
4. Physical restrains / Advantages;
5. Inland cost and Infrastructure;
6. Transit time; and
7. Communication / Documentation flow.

The study noted that not all of the listed factors are under the direct control of the individual port. However, the above listed factors represent elements, which emerged from the industry consultations. The latter is important because it shows the industry concern with the various elements of shipping costs. This is consistent with the approach taken in the current project, which proposes the total cost of shipping as a major element and a dependent variable. The other remaining factors, including productivity, transit time and the inland infrastructure were taken into consideration within the current project to serve as determinants of the total cost. Unfortunately, it seems that the customer service issues were not fully addressed through the industry consultations because they are represented by only communication and document flow factor. Yet another study (International Competitiveness of Western Canadian Transportation, University of Manitoba, November 1994) also suggested that ports are trying to attract primarily ocean carriers because they are viewed as the ports' principal customers. That study recognized

the importance of customer service issues and that the ports are providers of services. However, specific characteristics of customer service were not singled out. Instead, the study focused on various elements of transportation costs represented by tariffs, and on the container competition in North America.

In summary, the conclusions of the University of Manitoba study (1994) support the selection of the dependent variable for the current project. Further, several sources suggest that the ocean carriers or ocean shipping lines should be viewed as the primary customers for the selected ports, and that the port performance indicators should reflect their point of view. In selecting port performance indicators, customer service, expressed as a number of options offered to the ocean carriers, should be included with other determinants. In addition, the model of port competitiveness should incorporate an independent variable representing "freight handling capability".

3.9 MEASURES OF PORT'S COMPETITIVENESS

The competitive position of a port is influenced by numerous factors that could be classified as factors over which the port has some control and factors over which it has little or no control. The examples of controllable factors are productivity, port charges and services, while such factors as local market size, global transportation environment and national transportation policies are clearly outside the ports' control. Thus, in assessing the competitive position of a port for the purpose of comparison with other ports, this project would consider only the controllable factors.

A port's competitiveness or its competitive position can be assessed through its performance evaluation. That was an argument that Talley (1993) proposed along with a methodology for evaluating a port's performance in economic terms as opposed to engineering terms. Traditionally, the performance of ports was evaluated by comparing their throughput with their optimum throughput for a specified period of time. When the actual throughput was approaching the optimum, port's performance was evaluated positively. The critical issue in such an approach was the determination of the optimum throughput, which was rather difficult. However, today a port is concerned not only with whether it can utilize its facilities to the full potential but also with whether it can compete for cargo. From the shipper's point of view, the costs incurred within the port for various services plus the cost of transportation by the inland carriers are the important factors in the port selection. A port can lower certain costs by being more efficient, by reducing a shipper's time in port, and by increasing the quality of the port's services. Further, Talley and Anderson (1988b) classified ports' operating objectives as either efficiency or effectiveness. The two authors identified effectiveness as being concerned with how well the firm provides service to its users, while efficiency was concerned with how well the firm utilizes available resources. Then, in order to be effective, a firm must be efficient. Hence, with efficiency being a necessary condition for effectiveness, it follows that the firm may be cost efficient without being effective.

Talley (1988b) concluded that if a competitive environment exists among ports, they should consider their actual and economic optimum performance together. However, he also suggested that the economic optimum could be different for different ports

depending on their ownership. For instance, if a port is privately owned, its objective might be to maximize the profits, while if a port is publicly owned, its overall economic objective might be to maximize the throughput subject to a zero profit.

Talley (1988a) compared two methodologies for selecting performance indicators from the public transit performance evaluation literature - the criteria specification methodology and the operating objective specification methodology. Performance indicators were considered as choice variables or independent variables, whose values were under managerial control for maximizing the firm's operating objectives.

In the sample selected for this research project, although all four ports are public enterprises, they are definitely interested in making a profit or in having their revenues exceed their costs. Furthermore, it seems that in the post-NAFTA era characterized by increased competition and subsidy reduction, all significant international ports would be interested in higher profits. In fact, the aim of generating profits is pushing the ports to compete for customers and cargo, particularly high revenue generating cargo, such as containers, while reducing costs. Since all four ports under observation have similar objectives, the comparison of their respective performance would be feasible and fair.

3.9.1 Performance Indicators Selection Criteria

In addition to performance indicator suggested by Talley (1993), Fielding et al. (1977) proposed criteria for selecting those performance indicators. The selection criteria were in evaluating proposed performance indicators for:

- consistency with the enterprise's main goals and objectives;
- conciseness or limited redundancy and overlap among selected indicators;
- data availability;
- expense and time commitment for data collection;
- measurability;
- minimization of uncontrollable factors;
- robustness, allowing the evaluation of performance under various scenarios.

The proposed criteria for selecting port performance indicators seem fully applicable to the current research. Thus, performance indicators, selected for the competitiveness model, will be assessed against the Fielding (1977) criteria.

3.10 PORT PERFORMANCE INDICATORS

In the past, several authors researched the subject of evaluating ports' performance and its relationship to competition. As mentioned earlier, with the globalization of trade, ports faced increased competition. Hence, it became more important to assess the performance of one port in relation to its competing counterparts. However, due to the differences in the ports' ownership, as well as different regulatory environment in Canada and in the United States, a number of different approaches and performance indicators were suggested in the transportation literature. Since previously the relationship between ports' performance and its competitiveness was established, an overview of such literature sources should provide a useful insight into the issue of port performance indicators for the purpose of the current project.

3.10.1 Port Productivity

The basic notion of productivity refers to the output/input comparison. Since partial productivity measures can be misleading, many economists advocate a comparison of total inputs to total outputs. At the same time, the analysis of individual productivity components provides an insight into the contribution of each component to the overall productivity.

The subject of port productivity as one of the widely used performance indicators was analyzed by Frankel (1991). He suggested that historically, ports were inward looking, considering performance as their internal measure. However, the interest in port productivity and quality of service expressed by the port users motivated ports to seriously consider their productivity and to adjust their management strategy to remain competitive. Traditionally, ports measured their performance in operational terms like tons per gang-hour or number of containers per hour, in other words, partial productivity measures. A study of International Competitiveness of Western Canadian Transportation prepared by the Transport Institute at the University of Manitoba (November, 1994) provided some data to illustrate such measures.

Table 3.5 – Measures of Port Productivity

Port	TEUs per Crane	TEUs per Terminal Acre	Return on Assets
Vancouver	54,300.00	2,400.00	8.10%
Seattle	33,400.00	2,900.00	4.20%
Tacoma	22,900.00	3,400.00	4.70%

Source: KPMG, *Study of Public Charges and Financial Assistance at Ports*, pp. 15, 16, 17, Economic Research Branch, Transport Canada, October 1993. Ekstrom Port Consultants Ltd., *Factors Affecting The Competitiveness of Canada's West Coast Ports*, January, 1992.

From the TEU-per-crane perspective, the port of Vancouver ranked as the most productive port. From the TEU-per-terminal-acre, Vancouver's performance appears less impressive. However, this might have occurred because Vancouver is a final port of call for most lines on the West Coast. For example, if a ship calls at Seattle, it may only get 70% of an export load, and will sail to Vancouver to top up. Tacoma, on the other hand, has new north/south intermodal yards, each of which can handle four trains simultaneously, which is very attractive to the port users. From the return on assets perspective, Vancouver's performance was better than that of other ports. Operationally, the figures suggested that Vancouver was competitive with its West Coast counterparts. Further, labour issues, as well as productivity, were also among important determinants of a port's competitiveness. In this regard, there was a concern that Vancouver's labour force was inflexible compared to its U.S. competitors.

While those measures provided ports with a relative measure of competitiveness and an insight into their performance, they were of little interest to port users. Port customers, such as ocean carriers, were rather concerned with ship turnaround time and total cost of their cargo throughput (Frankel, 1991), where the total cost included the cost of transiting the port, the cost of surface transportation within the port and the cost of inland links provided at the port.

The ship turnaround time was and still is an important factor for the port customers because a line operator, particularly in container trade, faces very high fixed costs as the ships and their container inventory are such a large investment. For example, fixed costs

in large container operations, including the cost of containers, often exceed 80% of the total cost. By comparison, for surface modes the fixed costs are only about 40-55%. To further illustrate the high level of fixed costs, Frankel (1991) showed that a typical container operator of a 3,000 TEU vessel has fixed costs of about US \$20,000 /day or US \$833/hour. As a result, container operators need to minimize turnaround time in order to achieve their own cost efficiency. Thus, a port that can satisfy the turnaround time criterion by its higher productivity can be more successful in competing for cargo.

Further on the issue of port productivity, Fleming and Baird (1998), concluded that improving productivity and reducing port costs is critical to ports' competitiveness. However, productivity can be affected by a number of factors, such as the level of sophistication of cargo handling equipment, information management system and technological advancement, as well as labour practices and the cost of labour. In other words, productivity expressed as turnaround time would depend on such elements as the equipment utilization rate and the productivity of labour. Thus, ports' productivity expressed as turnaround time should provide an overall measure or a total productivity measure. The two authors also noted that the globalization of trade resulted in some standardization of port labour and productivity across the board, making the comparison of productivity for the four ports under observation a fair exercise.

Port performance indicators have been an area of interest in several countries actively involved in shipping. For instance, a series of performance indicators have been selected to measure the productivity of resources utilization in Australia (WIRA, 1990). These indicators were selected from a stevedore's and shipping line perspective.

Stevedoring performance indicators measured equipment and labour resources utilization. From an equipment perspective, the indicators included the number of ships and cargo units handled, the cargo-handling rate, containers handled per crane, and cargo units per man-shift. The indicators from a labour perspective included the number of employees, average hours worked and the percentage of unproductive time. Shipping line performance indicators included average delays in time while ships are waiting for berths. Ports also measure their facility utilization rate and total throughput in TEU for containers or tonnage for bulk cargo.

The above listed indicators attempt to measure utilization of resources as productivity, and based on an earlier argument, they may be viewed as efficiency indicators or partial measures of productivity. However, since it is effectiveness that is connected with customer satisfaction, port performance evaluation should assess both efficiency and effectiveness if a port intends to compete for cargo and customers. An overview of various productivity measures suggests that efficiency measures, such as labour and equipment utilization, allow ports to assess their productivity for mostly internal purposes, while effectiveness measures, such as turnaround time, would allow the assessment of productivity for external purposes. Indeed, if shipping lines as ports' main customers are mostly concerned with the turnaround time of their costly assets, it should be a measure of ports' external productivity for competitive purposes and from the customers' point of view. The total turnaround time as time between ships' arrival and departure including the waiting time could be calculated on a per-ship or per-TEU basis.

The issue of port productivity is directly related to the issue of cost of port services because higher productivity reduces turnaround time, thus, reducing the cost of transiting the port for the user. Since it was established that lower cost of transiting the port attracts customers, it translates into a competitive advantage for a port that can satisfy such a requirement. Further, if the cost of transiting a port is a measure of relative competitiveness affected by the port productivity, the latter could serve as one of the qualifiers or an independent variable in the analysis.

During the data collection and analysis stage, it should become clearer whether port productivity expressed in terms of turnaround time should be the most appropriate measure of productivity for the purpose of assessing ports' competitiveness. Such a measure has the benefit of producing a total rather than a partial measure of productivity while expressing the interests of ports' main customers.

3.10.2 Port Pricing

In trying to estimate the total cost of transporting goods from an ocean carrier perspective, the issue of port pricing was discussed in the transportation literature. The concept of total transportation cost is closely related to the issue of port pricing because the cost of transiting the port remains a key element of that equation. Traditionally, the tariff rate has been an indication of port prices. However, if someone would assume that the rates published in the port's official tariff would be the prices applicable to all customers, that assumption would be incorrect.

A) The Tariff Rate

The tariff rate can serve as a benchmark price less usage revenues divided by the estimated throughput (Dowd and Fleming, 1994). The existing publicly available tariffs are often an approximation of the real charges paid by the shipper because shippers often negotiate a lower-than-tariff rate subject to long-term agreements with the ports. However, published tariff rates are an effective and flexible marketing tool. These rates are a starting point in negotiations and are used for analysis of the profit potential. Although, the actual price charged to each customer might be unknown in each specific case, tariff comparison for the selected ports would provide an understanding of the competitiveness of one of the key elements of the total cost.

Further, as noted in the performance indicators selection criteria section, the data also have to be available. The availability of data during the data collection stage would determine whether it would be possible to use tariff rates or other more precise information sources to assess the total price or total cost of transporting goods. While the *total cost* seems to be a logical measure of port competitiveness and, thus, can serve as a dependent variable, the *throughput per dollar profit* could also serve as an indicator of port competitive position. However, *throughput per dollar profit* may not reflect all of the elements that are of concern to the ocean carriers. Hence, it is possible that *throughput per dollar profit* could be used as the port-only or a partial measure of competitiveness, which could be clarified during the data collection stage.

B) The Port Pricing Strategy

The effect of port pricing and the pricing strategy associated with it on the model of port competitiveness is indirect but very important. Ports that develop an effective pricing strategy can use it as a tool in creating and sustaining their competitive advantage. The issue of port pricing strategy was addressed by Dowd and Fleming (1994), who suggested that if a port is a for-profit enterprise, then the difference between the port's price and the port's costs should be a positive number. In fact, a port would seek to maximize the margin. It can also try to maximize its throughput, thus increasing revenues while remaining a leader in the prices charged to the customers.

In formulating a pricing approach, Dowd and Fleming (1994) suggested that a combination of economic, financial and public enterprise approaches could be used. The authors' conclusion was that there is no single pricing approach that would apply uniformly to all ports because of the differences in their final objectives. In order to offer competitive pricing, ports may consider the negotiating tactics employed by carriers who shop for the best price especially since port competition in North America has become a fact of life. Over the years, a number of changes have affected port pricing. Currently, the cost of transiting a port itself represents a small portion of total voyage cost for most long-distance intermodal movements. If in the past wharfage, dockage and demurrage fees were major components of a port's tariffs, today, terminal rents and time/volume payments have replaced these (Dowd, Fleming, 1994).

Further, Dowd and Fleming (1994) defined the port pricing process phases as follows:

internal examination, external 'reality check' and determination.

C) Internal Examination

Internal examination provides a valid method of calculating the internal cost-based price or price range. The outcome is usually a benchmark price that would generate sufficient gross revenues to cover all direct and indirect costs associated with the delivery of a service or facility to the customer. The four elements of the benchmark price are: historical costs, imputed costs, return on investment, and sensitivity analysis.

- i) Historical costs include depreciation expenses on existing facilities and equipment; depreciation or amortization expenses on facilities and equipment to be constructed or acquired; facilities and equipment maintenance expenses; tax and insurance expenses; and direct and indirect terminal operating expenses.
- ii). Imputed costs are unreimbursed and unrecorded benefits provided by an outside entity (fire, police, other).
- iii). Return on investment (ROI) for both facilities and equipment should be based on market or replacement value rather than on book value.
- iv). The calculation of historical cost, imputed cost and ROI require certain assumptions about various cost elements. They take the form of estimates or educated guesses about the applicable percentages of certain costs. This can lead to the understatement or overstatement of costs. Thus, it is important to state the underlying assumptions. It is also important to test how sensitive each is to the calculation of the benchmark price.

Finally, the price per unit of cargo or the normal published tariff rate is that benchmark price that would incorporate historical cost, imputed cost, and return on investment. The benchmark price tempered by the sensitivity analysis, less any applicable usage revenue, such as dockage, wharfage, storage charges divided by the throughput volume is usually what makes up the tariff rate.

D) External examination

As described above, the benchmark price is supposed to ensure that the port would cover all direct and indirect expenses and earn a profit. Ideally, a port could charge the customer a benchmark price and prosper. However, in reality, the benchmark price is subjected to a number of tests that determine its applicability. External factors, such as strategic goals and objectives, inter-port competition, general business conditions and trends, will influence the preliminary pricing decision. A number of considerations will impact it further and finally negotiations will “close the deal”. That is why it is important for ports to negotiate the proposed pricing between the port’s representatives and a client, resulting in a reasonable intersection of interests.

In view of the analysis on port pricing by Dowd and Fleming (1994) considered together with the indicators selection criteria by Fielding (1977), it appears possible to use publicly available tariffs as a source of ports’ data. Since it was established that the ports are interested in deriving profits from their operational activities and based on the fact that the tariff rate is supposed to provide the excess of revenues over costs, ports’

tariffs should be a reasonable source of data for the costing comparative analysis.

3.10.3 Financial Performance Indicators

In addition to engineering, economic and locational indicators, some financial indicators for measuring port performance were proposed by Dowd (1992). The format of his analysis was designed to measure management effectiveness. In the opinion of the author, the Operating Margin was the most valid measure of the management effectiveness since the elements of it, such as Operating Revenue and Operating Expenses, were controlled, to some degree, by the port managers. This notion is also consistent with the Fielding et al. (1977) selection criteria.

Dowd (1992) suggested a structured approach in analyzing a port's financial information and its financial health. He collected information on the following indicators over a twelve-year period:

1. Operating Revenues – (OR)
2. Operating Expenses - (OE)
3. Operating Income before Depreciation (OI = OR – OE)
4. Non-operating Revenues - (nOR)
5. Non-Operating Expenses - (nOE)
6. Depreciation - (D)
7. Net Operating Income (Loss) - (NOI = OI + nOR – nOE-D)
8. Operating Ratio - (OE / OR*100%)
9. Operating Margin (NOI / OR*100%)

While the Operating Ratio was traditionally used to measure efficiency in transportation, Dowd (1992) argued that Operating Margin provided a more comprehensive measure of ports' financial performance. Information on the Operating Margin allowed the analysis and monitoring of a port's financial performance over any period of time, also allowing the comparison of financial performance from one port to another. While Dowd (1992) labeled the measure "Operating Margin", it was rather a Total Profit Margin, which incorporated the results of both operational and non-operational activities. The latter can serve as an overall measure of ports' financial position, however, it may not be suitable to measure the ports' overall competitiveness because it does not reflect locational and other factors discussed earlier.

Based on a previous argument, ports' competitiveness is concerned with their ability to compete for cargo and customers. Therefore, ports' financial performance as an important element of its competitiveness should become one of the determinants. However, for the purpose of the current project, only those revenues and expenses that are a direct result of ports' operations should be considered.

Thus, it follows that Dowd's (1992) Operating Margin, defined slightly differently in this paper as a ratio of Operating Income after Depreciation to the Operating Revenues, should provide a reasonable measure of ports' financial performance for the purpose of competitiveness. The financial performance determinant expressed as a ratio would facilitate a fair comparison while eliminating the scale of each ports' operations.

3.10.4 Business Indicators

Another set of indicators was developed through a study by Focus Management Consulting conducted for Canada Ports Corporation (1993). The study group derived the following methodology in selecting and assessing such business indicators as would assist in proactive management, involving the ability to anticipate and quickly respond to the opportunities and problems facing the port. The study's basic argument was that this ability proved to be a major factor differentiating successful businesses from the less successful in a competitive environment. Therefore, business indicators could act as barometers of the economic well being of a port. Also referred to as financial ratios or performance indicators, Business Indicators were intended to facilitate industry and historical comparisons. An effective use of analytical tools such as business indicators, as defined by Focus Management (1993), was supposed to assist management in recognizing problems at an early stage, allowing time for corrective action.

A business indicator was defined as a ratio relating financial or operational data. By being expressed as a ratio, the indicator was able to provide information about the firm's operation with the scale of that operation eliminated, thus facilitating the comparison.

Based on a study by Focus Management (1993), the following 10 indicators were selected:

1. Operating Profit Margin as a ratio of Operating Income to Operating Revenues.

This indicator shows how much a port has earned on each dollar of operating revenues.

2. Return on Operating Assets as a ratio of Operating Income to Assets minus

Investments.

3. Current Ratio as Current Assets divided by Current Liabilities, a measure of firm's liquidity or the ability to meet short-term financial obligations. For most financially healthy organizations, a current ratio of 1.3 to 1.5 is usually acceptable.

4. Leverage Ratio, as a ratio of Total Debt to the sum of Total Debt and Equity. It measures the amount of debt in the corporate capital structure. Therefore, the greater the level of business risk, the lower the acceptable level of financial risk or leverage.

5. Debt Coverage Ratio = (cash flow + interest) / (interest + principal payments). This ratio measures the ability to service the debt load. It is suggested in many cases that if a debt coverage ratio is less than 2.0, it may be necessary to monitor the debt situation.

6. Fixed Asset Turnover Time as a ratio of Operating Revenues to Net value of Fixed Assets. A low ratio may be a sign of underutilized assets or inadequate port charges relative to the value of facilities provided.

7. Revenue per Tonne = Port Operating Revenue / Tonnage. This provides information on the pricing of products and product mix. For example, a decline in this ratio means that more business comes from lower-valued products, such as dry bulk, than from high-value products, such as containers.

8. Port Capacity Utilization = Actual Tonnage / Maximum historical Tonnage, measuring the level of activity actually carried out versus the level a port is capable of achieving. To establish the "maximum capacity", an average of best

years for individual facilities can be calculated.

9. Facility Capacity Utilization = Facility Tonnage / Maximum Historical Annual Tonnage.

10. Return on Facility Assets = (Facility Revenue - Direct Expenses) / Facility Assets. That would provide the port with information on the relative performance of its major business areas. Since this indicator allows the comparison of facilities within the port, it is more useful for internal comparisons.

Analysis of business indicators for the purpose of comparison and performance evaluation usually requires historical data for each port. Focus Management (1993) suggested developing performance benchmarks based on the analysis outcome. Furthermore, similar data collected and analyzed for several ports would allow the comparison and evaluation of port's performance vis-à-vis its competition. However, the study group warned that certain limitations could arise from different accounting and reporting practices.

The study stressed that the development of performance benchmarks is important for ports because unlike some industries, where comparisons are made through established industry norms, such standards do not exist for ports. Instead, a number of different indicators have been used for internal and external monitoring. So far, no one indicator has provided sufficient information. In fact, it was suggested that indicators should be separated into different categories intended to measure different aspects of the business. As suggested by the Focus Management Consulting (1993), those categories could be

profitability, liquidity, debt coverage, operational and facility contribution indicators.

The selection criteria used by Focus Management Consulting (1993) were such that selected indicators should represent different aspects of port performance, they should be familiar to the user and easy to compute. The selected indicators should serve as a useful tool for early problem detection and allow comparisons. Thus, indicators for which readily available industry data existed were selected to avoid indicators for which differences in accounting practices could have distorted the validity of comparisons.

It was also recommended that analysts should avoid indicators that are subject to reporting bias or measurement error. The comparative analysis of business indicators proposed by Focus Management Consulting (1993) and of financial indicators suggested by Dowd (1992) showed certain similarities. For instance, Operating Margin and Operating Profit Margin are almost identical, although, Dowd's (1992) Operating Margin seems broader and more comprehensive.

Furthermore, the financial ratios by Focus Management (1993) seem to be more suitable for an internal examination and financial management evaluation than for the purpose of port competitiveness. In addition, if after all, the Net Operating Income for any port is higher than its Operating Revenues, the port should be assessed as financially healthy, which supports an earlier argument of using the slightly adjusted Operating Margin to measure the overall financial performance of a port for the purpose of its competitiveness. Finally, other measures proposed by Focus Management (1993) and

classified as port capacity utilization seem to rather be partial measures of port productivity, as discussed prior. In addition, since it was proven earlier that the best capacity utilization or facility utilization does not make a port competitive, these measures should not be included in the model under construction. However, that does not diminish the usefulness of these measures for internal monitoring, historic comparisons and development of port performance benchmarks.

3.11 SINGLE PERFORMANCE INDICATOR

Talley (1988a) had also addressed the question of whether a single performance indicator exists. He concluded that the shadow price or Lagrangean multiplier variable might be used as a single performance indicator. The measure of this shadow price for the public transit firm was the number of passengers per deficit dollar or *throughput per profit dollar* (Talley, 1993) for a port, where the ports' performance was with respect to the economic optimum throughput. The throughput per profit dollar could be a suitable measure of port competitiveness because it can incorporate the ability of a port to compete for cargo with its ability to maximize the profit margin by maximizing the revenue and minimizing the cost. Furthermore, such a measure would allow comparing ports' performance with respect to each other and over a period of time. However, throughput per profit dollar has its limitations. While it could reflect ports' locational attributes and efficiency as an ability to compete for cargo by maximizing throughput, it would not reflect other elements of the total price paid by the shipper, such as the inland carrier charges.

If a port wants to maximize its annual throughput, the annual demand for the port's services would be a function of the annual total price. For the purpose of the current project, that total price is what was referred to earlier as total cost of transiting a port. For containerized cargo, it should be cost per TEU or cost per tonne for bulk cargo, together with other charges and fees incurred by the shipper. As argued previously, the shipper would assess the total cost of shipping goods with port charges being a part of that total cost or total price.

However, some specific conditions included in the total price, like a Harbour Maintenance Tax in the United States, could make the shippers decide to divert their cargo to Canadian ports even if two ports' could offer equally competitive prices. Therefore, the total price, including all the charges paid by the shipper, perhaps, could serve as an overall comprehensive measure of port competitiveness. Unfortunately, such a measure also has serious limitations. For instance, in many cases various port and non-port charges are subject to confidential agreements between two private parties, such as a port and a shipper or a shipper and an inland carrier.

However, Talley's (1993) measure of throughput per profit dollar can be modeled as Throughput per dollar of Operating Margin. On the other hand, a ratio of the Operating Margin to the port Throughput over the same period could provide a measure of net profit per one unit of throughput or profit per TEU for a container port. As with the Operating Margin measure, all of the elements of such profit per TEU measure are under the control of port managers. Further, an additional benefit of such a measure is in the availability of

port data, allowing the calculation of net profit per TEU based on publicly available information. The ratio of net profit, expressed as an operating margin, to the total throughput could be utilized in a number of ways. For instance, it could be a measure of ports' financial success or ports' competitiveness. In this case, it could serve as a dependent variable. On the other hand, it could also be one of the determinants of competitiveness or an independent variable. At the present moment, it seems most practical to collect the data and compute the Net Profit per TEU or throughput in order to conduct comparative analysis of the results. Based on the outcome of the analysis, a better determination could be made.

3.12 PORT SERVICES

As briefly discussed earlier, port competitiveness is a function of not only cost but also the quality of service because shipping lines do not make port call decisions based only on cargo-handling price. A port's relationships with its customers has changed significantly since it is the carrier, not the shipper, who has become the port's direct customer. That change initiated long-term agreements between ports and carriers, replacing ship-by-ship arrangements and limiting the port's pricing options (Dowd and Fleming, 1994). That is why the two authors stressed the importance of proper port pricing strategy, aimed at a target market and consistent with the strategic framework of a port. Such pricing strategy could also serve as an effective customer service tool, attracting the desired customers to the port. However, for the purpose of the current project, the pricing issues would be taken into account through financial performance

indicators, as described earlier.

The quality of service issue was discussed by Talley and Anderson (1988b) who labeled it "effectiveness" since it is concerned with how well the firm provides service to its users in the context of competition. The importance of customer service for ports was also revealed through the "Customer Service Issues" factor identified in the Murphy et al (1993) study, which showed statistical significance at 0.05 level for such variables as large and/or odd size freight, large volume shipments, shipment information, claims handling, and special handling, where large volume shipments received the strongest rating. Factor analysis of the aggregate data further revealed 2 factors, accounting for 68% of the total variance: "Customer Service Issues" and "Freight Handling Capabilities". Since the *ability to handle large volume shipments* received the strongest rating, perhaps, it should represent a separate qualifier, i.e. "Freight Handling Capabilities". However, for the purpose of assessing ports' competitiveness with respect to customer service, it seems that such variables as claims handling, special handling and shipment information would have an impact on the evaluation of customer service.

But the quality of ports' services can hardly be limited to the ability of providing special handling and shipment information since such important factors as cargo safety or on-dock intermodal access would not be reflected. In view of the earlier discussion on the competitive environment among Canadian and U.S. ports, it was agreed that good intermodal links significantly improve ports' competitive position by decreasing delivery time and allowing the negotiation of lower point-to-point shipping rates. Further, it seems

that the latter issues should be among customer service factors rather than, for example, locational factors because it provides better market ports' services and offer more options to its customers.

Traditionally, the port's quality of service was measured in terms of a number of operating options offered to the customers. The latter is important since, as mentioned previously, differentiation of service is one of the possible ways to improve and maintain competitive position. Such factors as service reliability, service expediency and service frequency were used to assess the quality or level of ports' services. With respect to service expediency or frequency, these factors would be reflected through the productivity indicator represented by the total turnaround time. However, the issue of service reliability was not yet addressed. It was briefly mentioned earlier that cargo safety while transiting a port was one of the issues that ports actively deal with. Improvements in cargo safety reflect positively on the competitive position of a port. Therefore, to take cargo safety into account as part of the port service factor, an indicator of the level of *cargo loss and damage* should be computed and incorporated into the model.

While the issue of cargo safety was always an area of concern, the presence of strong intermodal links became more important lately, especially for competing Canadian and U.S. ports due to the close proximity of markets. In the discussion on port environment in the two countries, there were some examples of how Canadian ports that have intermodal links gain competitive advantage against their U.S. counterparts. In addition, several authors suggested that ports can cultivate those links plus have on-dock access to either

gain competitive advantage or to improve it. Thus, it would be important to incorporate the issue of *intermodal links* into the model. Further, it seems logical to include it with the customer service factor since the port customers, as noted above, would seriously consider such capability within the port. A port today needs to remember that unlike bulk commodities, container traffic can be delivered quickly to alternative routes and ports. With the development of intermodalism, the railways in both Canada and the US have introduced innovations that decreased the cost of labour, fuel and equipment, while improving the reliability of the transportation system which has had a positive affect on ports.

In addition, a port's competitiveness was linked to the cost of cargo delivery at the dockside. For example, the high cost of rail transportation to the port of Vancouver at one point was making the port less attractive to the shipping lines and, thus, less competitive. However, once the total cost of transporting goods is considered, the transportation cost to the port by surface modes becomes part of the total cost. Hence, it provides another argument in favour of considering the total cost of transportation for comparative purposes and in the context of competition.

Generally, ports also used to differentiate their services through a rate scale, such as ship berthing and unberthing rates, wharfage fees, ship loading and unloading rate, inland carrier entrance and departure service rate, and inland carrier loading-unloading service rate. However, since today it is the point-to-point rates that are most interesting to the port customers, the port fees rate scale becomes less relevant on its own. Rather, these

elements of the port fees would be included in the total cost of transiting the port.

The issue of port services was also discussed in a study of International Competitiveness of Western Canadian Transportation prepared by the Transport Institute at the University of Manitoba (November, 1994). The purpose of this study was to provide a reference document on the system of transporting western Canadian commodities to the West Coast and to determine the competitiveness of the western Canadian transportation industry.

The study concluded that Canadian ports compete with U.S. ports for a variety of traffic, with container traffic the most hotly contested. Analysis of the traffic patterns over the years lead the study group to the conclusion that *the competitiveness of ports was related to their ability to provide inexpensive, efficient and reliable service to the shippers*. A port that was unable to provide such service to its customers risked losing traffic to competing ports.

The impact of labour for Canadian West Coast ports was also analyzed. Labour issues, no doubt, have a significant impact on any port's operations. Labour productivity has served as an indicator of port competitiveness for some time now. However, in the discussion on productivity it was argued that labour productivity alone would not provide a full understanding of port productivity since it is only a partial measure of the utilization of port resources. Nevertheless, labour productivity expressed as throughput per employee (TEUs per gang per shift) is still very useful for internal purposes but not as a measure of competitiveness.

The cost of labour, on the other hand, would be reflected through financial performance measures such as operating margin, not to mention that such cost is certainly considered in the ports' tariffs. For example, in the 1993 report produced for Transport Canada, KPMG estimated labour rates as generally lower at Vancouver than at their U.S. counterparts. On estimates provided by the Port of Vancouver, the base rate per hour for longshoremen in mid-1994 was \$22.71 CAN in Vancouver and \$30.40 CAN in Seattle at a rate of exchange CAN\$1.34=US\$1.0.

Yet, there is another side of labour issues that is related to port services and more specifically, to the reliability of service. For instance, the port of Vancouver lost \$8 million from container diversions to Seattle and Tacoma during the strike of 1994. More recently in 1999, the lockout of 2,000 dock workers was costing the port an estimated \$89 million worth of trade per day. Although, in December of 1999 the port achieved its goal of shipping one million TEUs in one year, it was the customers' confidence that may have suffered and that may cost more in lost revenues in the long run. Therefore, it is important to assess the *reliability of labour in terms of the frequency of disruptions* as part of the customer service issues.

Further, it was suggested that to be competitive in the container shipping market, ports must be linked to major urban centres by rail links that can support double-stack trains. For example, the ports of Seattle and Tacoma prospered because of the presence of a double-stack rail link to Chicago. That conclusion is very similar to the one made by Fleming and Hayuth (1997) regarding links to the traffic-generating hinterland. It seems,

however, more logical to address that through the assessment of the ports' strategic location variable rather than to incorporate it with the customer service issues.

3.13 PORT SUBSIDIES AND TAXATION

The literature on differences in port taxation between Canada and the U.S. is less substantial than for the surface modes. Canadian and U.S. port authorities are generally exempt from income and capital taxes at both federal and provincial/state levels, except for the Washington ports, which are subject to a state Business and Occupation Tax. The only difference in the tax treatment between Canada and the U.S. relates to municipal taxes. Canadian ports (former Ports Canada ports) pay grants in lieu of taxes, while many U.S. ports are exempt from such payments. However, it should be noted that exemption from income and capital tax and the relatively low burden of taxes on goods and services is true of port authorities, but not of private terminal operators working in the port.

In the 1993 report for Transport Canada, KPMG estimated the net government support for a number of ports. The study was based on port financial and operational data from 1989 through 1991. A number of ports on the West Coast, such as Vancouver, Seattle, Tacoma, Los Angeles and Long Beach, and on the East Coast, such as Montreal, Halifax, New York/New Jersey and Georgia, were compared. The study found that government support or lack of it varied from major subsidies to heavy charges on port facilities. The government support, as classified by KPMG (1993), for the most part, consisted of fees, concessions and royalties, municipal tax revenues and government grants. Effectively, if

each port were to pay a rate of return to government on the book value of its investment, this would be 8% for Canadian ports and 6% for the U.S. ports (KPMG, 1993).

Further, the Canada Ports Corporation report on Container Competitiveness (1991), suggested a similar port financial support classification in the U.S., listing direct government grants, taxes levied by the ports, certain tax exceptions, and indirect subsidies in a form of non-cost-recovery services. The report also provided a classification of U.S. ports by the degree of their self-sufficiency, ranking the port of New York/New Jersey as self-financing, and the ports of Seattle/Tacoma as relying highly on public support.

The KPMG findings indicated substantial differences in the level of government support, with positive numbers indicating that the port was a recipient of funds, and negative figures indicating that the port was a net payer to the government. The ratios of government support calculated in the KPMG (1993) study revealed the most significant contrast between the port of Vancouver, paying the largest amount to the government, and the port of Seattle, receiving the most public assistance on the West Coast. Among container ports on the East Coast, the differences were less dramatic, with Montreal and New York/New Jersey receiving the least support, while Georgia received much higher amounts. Further, the study computed the amount that each port paid or received based on their respective cash flows. The result showed that Seattle received \$1.76 for each dollar of self-generated cash flow from operation, while Vancouver paid \$0.61 for each dollar of self-generated cash flow, Montreal paid \$0.71 and New York/New Jersey

neither paid nor received funds from the government. The results of that study suggest that if a port is a payer to the government, it should influence the amounts the port will charge to its customers. On the other hand, if a port is a receiver of government support, it should be able to offer lower charges to its customers. Therefore, the level of government support impacts on ports' competitiveness. *Thus, the level of government support, impacting on the cost of port services and on its competitiveness, should become one of the determinants or an independent variable in the model of port competitiveness.*

3.14 SUMMARY

Overall, the literature review provided comprehensive information on the issue of competition in general and for ports in particular. It was illustrated that competitiveness of transportation can influence the competitive position of other industries and even the national economy. That relationship was observed through the growth in demand for transportation services, triggered by the expansion in trade. Further steps towards globalization of trade through international agreements put more pressure on the transportation industry entities, which have to compete both domestically and internationally. Thus, it is important to assess the competitive position of the transportation enterprises, such as ports.

A number of literature sources, reviewed in this section, described various approaches to the assessment of the ports' competitive position. However, practically all sources indicated that there is no single measure readily available for use in the competitive

position assessment. A number of criteria reviewed suggested that port performance indicators, grouped in specific categories, could serve as measures of a port's financial and business health. Thus, through the assessment of such performance indicators, ports' competitive position or their ability to capitalize on their competitive advantage could be evaluated. However, only those performance indicators that can be controlled or influenced directly by the ports should be considered.

Through the literature review it became evident that several studies pointed to the cost of transportation as the most important criterion for port selection. This conclusion was based on the understanding that ports are in the business of providing services, and that the large ocean shipping lines are the ports' main customers. It was further noted that the cost of transportation should encompass the total cost, including the cost of transiting the port, the cost of transporting goods within the port, the cost of transportation outside the port to the final destination and additional costs, such as a Harbour Maintenance Tax or pilotage fees, where applicable. Thus, the Total Cost was suggested as a Dependent Variable for the purpose of port competitive assessment within this project.

Following the selection of the Dependent Variable, port performance indicators were reviewed in order to select determinants or Independent Variables. These determinants were proposed on the basis of their inferred influence on the Total Cost and from a port's customer point of view. It was concluded that the following factors could influence the ports' competitive position:

1. Port Location
2. Port Productivity
3. Port Financial Performance
4. Port Freight Handling Capability
5. Level of Port Services
6. Level of Government Support

These port performance indicators (Independent variables), together with the Dependent variable, as described above, will form a model of port competitiveness. The outline of such a model will permit data collection, followed by data analysis. The following section outlines the proposed methodology for constructing and evaluating the model of port competitiveness.

IV. RESEARCH METHODOLOGY

4.1 GENERAL OVERVIEW

The literature review suggested that the issue of port performance has been the subject of several research projects and papers. Such interest in assessing port performance can be explained by the need for quantitative information in support of managerial decision-making. Various management questions pertaining to port performance, port productivity, freight capacity, level of service and costs were linked to the question of overall port competitiveness and the competitiveness of intermodal transportation systems. Since the management question of assessing port competitiveness still stimulates the need for information and further analysis, it also triggers the current research process. As is often the case, the research question of constructing a model of port competitiveness led to a detailed exploration of that issue. The description of the exploration process was presented through the literature review. The current chapter will focus on such questions as research design and methodology, data collection, data analysis and interpretation.

In a research study, a number of general approaches in combination with some specific points are usually possible. Quite often, a research study may evolve as the research process progresses. For instance, the current project initially began as an exploratory study, which started shifting towards more formal study in the process of literature review. Currently, it could be classified as an exploratory-formalized study. On the issue of data collection, the study is mostly observational with an ex-post facto design.

However, the purpose of the study is to establish causal relationships among the variables whenever possible. In addition, the study will involve both cross-sectional and longitudinal dimensions because primary and secondary data will be collected from four different ports and for a specific period of time.

4.2 RESEARCH DESIGN

4.2.1 Observation Period

The proposed research design, as noted above, will include data collection from the selected ports. Initially, a five-year post-NAFTA time frame for the data collection was proposed because NAFTA encouraged more US-Canada trade with stronger North-South links and because a five-year period has often been used in transportation research in the past. However, annual data for five years will provide only 5 data points for each indicator (variable), which does not satisfy the data requirement for statistical analysis purpose. For that reason, it is proposed to collect data on each variable for a period of 10 years (1991 to 2000) instead of five in order to provide 10 data points for each variable without resorting to time series taken at close time intervals.

4.2.2 Study Sample

The four ports selected for the study include such major load centres as Montreal with New York on the East Coast and Vancouver with Seattle on the West Coast. Although these four ports will form a sample for the current study; it will not be a random sample in strictly statistical terms due to the specific nature of the subject matter. In the literature review section it was illustrated that there is a limited number of container ports with an

annual throughput of around 1 million TEUs in North America. However, it was also noted that those few ports find themselves more and more in direct competition with each other. That is why the current study will analyze data from the four major container ports in North America in order to reveal the factors that make ports successful, allowing them to compete for customers and cargoes.

4.2.3 Data Collection

This study intends to use primary and secondary data for the selected indicators of port performance. Since the issue of confidentiality of some of the financial information has to be taken into consideration, the study will attempt to use, for the most part, publicly available information pertaining to financial and operational reporting by the ports. Earlier, it was noted that publicly available tariffs could be used for price comparisons. Finally, information on the level of taxation that was computed in the KPMG (1993) study, with some modification and updating, could also be used for the current research. In such case, the data can be classified as secondary. However, it is anticipated that certain information would have to be obtained directly from the ports, in which case it would become primary data.

As mentioned above, primary and secondary data collected on an annual basis for a five-year period will not provide sufficient amount of data for each indicator (variable). The reason that the number of observations has to be discussed is that in statistical analysis it is important to have sufficient number of observations (N) relative to the number of variables (p) in order to obtain meaningful results. Usually, a ratio of $N / p = 15$ is

recommended. Another option of collecting quarterly data for each variable was considered. Although such option will provide 20 data points for each variable, the statistical tests most likely will be affected by the autocorrelations of the residuals, distorting the test results. Furthermore, previous experience indicates that in transportation, there is usually little difference in observations from one quarter to another. More specifically for ports and intermodal systems, the differences in performance indicators are more likely to be observed through annual data. For that reason, it is proposed to collect data for a period of 10 years instead of 5-years, acquiring 10 data points for each variable or 50 data points for each port's model containing 5 independent variables. Despite the fact that 1 to 10 ratio is short of the theoretically required 1 to 15 ratio, the results of statistical tests will provide an indication of statistical and practical significance. One final argument in favour of annual and not quarterly data is in the fact that ports as public enterprises publish their performance results every year in their annual reports, which are publicly available.

4.2.4 Variable Selection

Due to the data collection constraint, as discussed above, the issue of variable selection was given a careful consideration in this section. Through the literature review it became evident that ports' competitiveness is multidimensional. As noted above, a number of approaches to assess port competitiveness, expressed in financial, operational, locational and business terms, were reviewed in the previous chapters. However, the literature sources provided little or no evidence of an attempt to combine all of the performance indicators into one model. Thus, such an attempt may seem like a worthy task, which

may or may not be feasible depending on the port data and on the results of statistical testing.

Should the goal of this research project to derive a single complex measure of ports' competitiveness be achieved, the results would provide useful information to the port managers. However, a quantitative proof of the opposite, i.e. that there is no single measure of port competitiveness, could also be considered a positive outcome, allowing to continue port performance assessment through a combination of indicators.

A significant number of variables, proposed by previous authors, were carefully examined and the following list was compiled, ensuring no duplication among the variables, listed here in no particular order.

1. Revenue per Tonne
2. Number of Employees
3. Cost of Labour
4. Reliability of Labour
5. Cargo Safety Measure
6. Current Ratio
7. Leverage Ratio
8. Operating Revenues
9. Operating Expenses
10. Net Operating Income
11. Net Capital Assets

12. Operating Margin
13. Asset Utilization (Equipment, Land)
14. Total Cargo Throughput
15. Port Capacity Utilization
16. Average Waiting Time Per Vessel
17. Average Loading /Unloading Time Per Vessel
18. Port Taxation Level/Government Support
19. Marine Legislative Environment
20. Port Centrality/Location
21. Intermodal Links at the Port
22. Harbour Depth
23. Traffic Producing Hinterland
24. Ease of Access to Port
25. Overall Economic Conditions and International Trade Activities

This listing of variables, compiled from the literature sources, is not exhaustive but quite representative. Such a large number of variables would call for a significant amount of data or approximately 400 data points, which would be rather impossible to obtain due to a limited number of ports that are compatible in the magnitude of their operations.

Unfortunately, increasing the number of data points by including observations at closer time intervals would not resolve the problem but create an additional complication due to the autocorrelations of the residuals when data consist of time series. Therefore, all of the

earlier proposed variables were reexamined and assessed against the port performance selection criteria by Fielding et al. (1977).

The Fielding et al. (1977) selection criteria reviewed in section 3.9.1, called for the proposed performance indicators to be consistent with the enterprise's main goals, while avoiding redundancy among indicators. The data have to be available and the expense and time in data collection have to be considered. Finally, the selected indicators have to be measurable and robust with a minimum of uncontrollable factors affecting them. The assessment of the above listed variables against the selection criteria revealed that several variables were either non-measurable or outside of port management control. It became clear that the level of support provided by Marine Legislation, although very important, would be difficult to measure. Further, such indicator as the Current Economic and Trade Environment would be outside of control by port management. For these reasons, a number of listed variables were excluded from the model. In addition, financial performance measures, such as the Leverage Ratio or the Asset Utilization Ratio, were found to be more suitable for the internal assessment of port performance rather than for its competitiveness. (Please refer to section 3.10.4).

The many ways in which port performance can be assessed are also related to the purpose of such assessment. For instance, if port performance were assessed for internal purposes, it would imply indicators evaluating the utilization of port resources and the quality of managerial decisions. However, if port performance were assessed from the environmental point of view or against its contribution to the local economy, different

measures would be selected. Thus, in the second round of variable assessment, all of the variables were weighed against the goal of the current project to construct a model of port competitiveness and on the basis of conclusions drawn from the literature review. For example, an important conclusion that the selected ports nowadays are more and more in the business of providing services and that the large ocean shipping lines are the ports' main customers, further supported variable reduction. An indicator such as Port Capacity Utilization, for instance, was dropped because a port may be very successful in fully utilizing its capacity while being totally non-competitive. The variable "Number of Employees" was dropped for the same reason.

The issue of Port Productivity as a performance indicator and an independent variable was given a special consideration. As concluded in section 3.10.1, port productivity expressed in terms of turnaround time should be the most appropriate measure of productivity for the purpose of assessing ports' competitiveness. Such a measure has the benefit of producing a total rather than a partial measure of productivity while expressing the interests of ports' main customers. However, upon close examination and based on the discussions with port managers, it became evident that only a portion of the total turnaround time is under the ports' control. For instance, the time that containers spend in transit by ground transportation, from the time they are unloaded from the vessel to the time of delivery to its destination, is completely outside of ports' control. A good illustration of such situation can be found in recent truckers' strikes at the Port of Montreal and the Port of Vancouver. These strikes significantly increase the container delivery time or a total turnaround time. However, the shipping lines, well aware of the

fact that it was not the ports' fault, did not consider abandoning their port of call in favour of its competition.

Further, the efficiency of terminal operations, which has a direct impact on the turnaround time, is under the complete control of the terminal operators such as Cast or Maersk shipping lines. These shipping lines have long-term leases with the port authorities for the terminal facilities. Therefore, although the shipping community understands that overall efficient labour is a key factor in high productivity and low cost of shipping, most port authorities have no control over the terminal labour. In addition, port authorities have no control over the time it takes to navigate ships to the harbour by the pilots, the service provided by the Pilotage Authorities, which has a direct impact on the total turnaround time. For all of those reasons, it was concluded that since the turnaround time is mostly outside of the port authority's control, it can not serve as a determinant or an independent variable in the model of port competitiveness.

Finally, since the discussion about variable selection should be focused around selecting determinants on the basis of their inferred relationship with the Dependent Variable, the Dependent Variable itself had to be defined. The literature review did not provide much guidance for the selection of the Dependent Variable (DV). For the purpose of the current project, the DV selection was based on two conclusions, as noted prior, that the ports were providing services and that the large ocean shipping lines were the ports' main customers. Since several sources pointed out that the cost of transportation was a major concern for the ocean shipping lines, it was selected as a DV. Further, the cost of

transportation was interpreted as the total cost of transporting goods, including the cost of transiting the port, the cost of transporting goods within the port, the cost of intermodal connections and additional costs, such as a Harbour Maintenance Tax, where applicable. Thus, the DV for the four ports under observation will be computed according to the following formula:

DV: $TC = MC + PC + GC + AC,$ where

TC	is the total cost of transportation per TEU;
MC	is the marine (sailing) cost per TEU;
PC	is the cost of transiting the port per TEU;
GC	is the cost of ground transportation per TEU;
AC	is the additional cost per TEU, where applicable.

The definition of the Dependent Variable supported further analysis of the qualifiers or Independent Variables based on the hypothesized relationship between each qualifier and the DV, which led to the selection of the following indicators:

- IVs:**
1. Port Location
 2. Port Financial Performance
 3. Port Freight Handling Capability
 4. Level of Port Services
 5. Level of Government Support

Thus, the model of port competitiveness represented graphically would look as follows:

Figure 4.1 – The Model of Port Competitiveness

With five Independent Variables in the model, 75 data points are required to comply with the 1 to 15 ratio. However, it remains to be seen whether ten-year annual port data totaling in 50 data points or 10 data points per variable would provide meaningful results for the model with 5 qualifiers.

4.2.5 Data Collection Requirements

Another conclusion drawn from the literature review was pertaining to the fact that not only were the port performance measures multidimensional, but also that some performance indicators did not exist in a readily available format. Therefore, it became necessary to identify all of the components for each variable in order to understand data requirements, which, in turn, will support the data collection and variable computation.

For that purpose, Table 4.1, which follows, was compiled to illustrate variable components and data requirements, listing the types of data to be collected.

Table 4.1 – Variable Components and Data Collection Requirements

Variables		Variable Components	Data Collection Requirements
DV	Total Cost of Transportation (per TEU)	Cost of Transiting the Port per TEU	Port Tariffs
			Cost of transportation within Port
			Other Port Services
		Marine cost of the trip per TEU	Cost of a vessel during the trip, operating cost and cost of fuel.
		Cost of Intermodal transportation per TEU	Cost of Rail or Truck or both from port to destination on average
		Additional Costs per TEU	Harbour Maintenance Tax
		Pilotage Fees	
1. IV	Port Location	Strategic Commercial Location	Proximity to markets
		Strength of traffic producing hinterland	Size of consumer population base served by the port
		Ability to accommodate megacarriers	Harbour depth, total length of container berths
		Port Area	Total terminal area
			Number of container berths
2. IV	Port Financial Performance	Operating Margin (ratio of Operating Income after Depr. to Operating Revenues)	Operating Revenues
			Operating Expenses
			Depreciation
			Other income/loss
3. IV	Freight Handling Capacity	Large Volume Shipments	Container throughput per year (TEUs)
		Special Handling	Total Annual Tonnage
4. IV	Port Services	Port Labour Reliability	Frequency of service disruptions due to labour disputes in 11 years (1989-1999)
		Intermodal Connectivity	On-dock intermodal access, rail, truck
		Cargo and Navigation Safety	Availability of Storage / Warehousing and Temp. Control Storage
			Port Surveillance System
			Information Systems
		Ability to expand	Ability to expand terminal area
			Ability to expand land area
5. IV	Level of Government Support	Port Subsidies /Taxes Per Year	Availability of cargo pre-clearance
			Government Grants in lieu of Taxes
			Fees, Royalties
			Taxes levied by the Port
			Indirect Support / Services

4.2.6. Data Analysis

Once the required data (Table 4.1) have been collected, the data analysis process will commence. Through the data analysis and based on the proposed model (Figure 4.1), the relationships among the variables will be evaluated. In addition, the influence of individual determinants on the Dependent variable will be assessed. Analysis of the correlation between the qualifiers and the Dependent variable will allow the identification of more and less significant determinants within the model of port competitiveness. The resulting combination of determinants with the strongest impact on the Dependent variable will provide a measure of port competitiveness.

Since port performance indicator standards do not exist in a ready-to-use format, as mentioned earlier, the net effect of several indicators on the dependent variable will be obtained. The resulting measures for the period of 10 years under observation (from 1991 to 2000) and for each port will allow to compare ports' competitiveness. Year-over-year comparisons for the same port will provide an understanding of the fluctuations in port's competitiveness. This approach specifically addresses the problem of evaluating the net impact of several factors of port performance by combining values of selected explanatory variables. In other words, a single measure, such as the Total Cost, encompassing a net result of ports' respective performances could be obtained.

For the data analysis, at first, a multi-stage procedure using a combination of Factor Analysis and Descriptive Discriminant Analysis was proposed primarily because Factor Analysis allows dealing with an approximate data set instead of a random sample.

Following the factor analysis the discriminant analysis, used for describing major differences among the groups in MANOVA and classifying subjects into groups on the basis of a battery of measurements, was proposed. The Descriptive Discriminant Analysis (DDA) is used to break down the total association in MANOVA into additive pieces through the use of uncorrelated linear combinations of the original variables. The DDA helps to reveal which variables contribute to the significant discrimination, or which variables are most "important". It can also answer a question of whether the "discrimination dimension" can be interpreted in terms of meaningful underlying constructs, defined by the important variables.

However, given the types of proposed qualifiers and considering the relatively small sample size, both Factor and Discriminant Analysis were rejected because they may provide unstable results, overestimating or underestimating the significance of certain variables. Rigid assumptions in both types of analysis will have to be either violated or ignored. Therefore, after weighting the benefits and limitations of such design, it was decided to take a different approach.

Traditionally in transportation research, regression analysis has been used to reveal whether there was a causal relationship between one or several Independent variables and the Dependent variable. Therefore, a multiple regression procedure was selected to be applied to the data set.

However, since the data for the current project will be collected on an annual basis, the

data set will be represented by a time-series. Several literature sources described regression analysis performed on time series data. In applying regression to modeling time series, one has to test whether the residuals satisfy the regression assumptions: linearity, homoscedasticity, independence, and normality. Further, the results of significance tests could be incorrectly increased and a spurious (artificial) conclusion could be reached. By taking observations at closer intervals, series with higher autocorrelation are created (Ingram, 1998). In studying history to assess relationships between economic variables, often represented by longitudinal data, care has to be taken regarding the assumptions underlying the model. However, the benefit of such an approach would be in knowing up-front if any assumptions are violated. Also, with the careful treatment of the data, the effect of the assumption violation could be estimated better, providing for a more accurate result interpretation. In addition, certain steps, minimizing the assumption violation effect, could be taken. Since Time Series is a sequence of observations taken on a variable or multiple variables at successive points in time, the objectives of time series analysis are:

1. To understand the structure of the time series (how it depends on time, itself, and other time series variables), and
2. To forecast/predict future values of the time series.

In dealing with the time series, it is important to test for one-time unusual values and to either adjust the data or to incorporate an intervention variable to account for the identified anomaly (Ingram, 1998). Unusual values can often arise seasonally, thus one has to identify and incorporate Seasonal Intervention (Dummy) variables. Dummy

variables are very useful for capturing a variety of qualitative effects. They typically have the value 0 or 1 and can be included as explanatory variables in the regression equation, using the estimated coefficients and standard errors in hypothesis testing.

Seasonally adjusted time series are obtained by removing the seasonal component from the data through the use of dummy variables (Gaynor, 1994). A matrix of seasonal dummy variables can be created in SHAZAM, a statistical package designed to deal with time series, however, SPSS software also has the tools to deal with the same type of data.

It may also be interesting to test the seasonal effect for statistical significance with the null hypothesis stating that all seasonal effects are 0. The SHAZAM output, for instance, will provide an estimated regression equation with a separate t-ratio and an F-test statistic. However, testing a number of single hypotheses is not equivalent to a joint hypothesis test. A test of the joint hypothesis (F-test statistic) can be compared with a critical value from the F-distribution. Finally, it would be possible to estimate whether there is a significant effect of seasonality in the data.

In addition, time series analyzed through regression often suffer from autocorrelated residuals. In practice, positive autocorrelation seems to occur much more frequently than negative. Positively autocorrelated residuals make regression tests more significant than they should be and confidence intervals too narrow; while negatively autocorrelated residuals do the reverse.

In some time series regression models, autocorrelation could provide biased estimates. It is possible to first plot the data over time and study the plot for evidence of trend and seasonality. Seasonality can be dealt with by using seasonal indicators as predictors or by allowing specific auto-dependence or auto-projection such that the historical values ($Y(t-s)$) to be used in predicting $Y(t)$.

Autocorrelation can be dealt with by using lags (the amount of offset between the 2 series being compared) of the response variable Y as predictors. A lag of 0 means that positions 1..n of one series are being compared with the positions 1..n of the other. The comparison at lag 0 is always perfect and the autocorrelation value will be 1.0. A lag of 1 means that positions 1, 2, ...(n-1) will be compared with positions 2, 3, ...n. In theory, the model parameters should be invariant i.e. unchanging over time. If not, perhaps too much data was included in the first step and there was a need to determine at what points in time the model form or parameters change. In addition, before using a predictive equation, data can be filtered leading to the model refinement. The measure of goodness of fit is the autocorrelation value. The autocorrelation value at lag 0 will always equal 1.0, as the two comparing sequences are identical. Once the autocorrelation value has been obtained for every lag position, they can be plotted against the lag positions as an auto-correlogram. Autocorrelation may be regarded as a measure of correlation against distance (Ingram, 1998).

Testing for autocorrelation in the estimated residuals is possible using the Durbin-Watson (DW) test with the null hypothesis stating that there is no positive autocorrelation. The

Durbin-Watson test statistic is designed for detecting residuals that follow a first-order autoregressive process. For a calculated DW test statistic, the p-value is:

$$p\text{-value} = P(d < DW)$$

The Durbin-Watson test statistic is calculated from the estimated residuals $\hat{\epsilon}_t$ as:

$$d = \sum (\hat{\epsilon}_t - \hat{\epsilon}_{t-1})^2 / \sum \hat{\epsilon}_t^2$$

The d-statistic has values in the range [0,4]. Low values of d indicate positive autocorrelation, while values of d closer to 4 are in the region of negative autocorrelation. Therefore, for a one-tailed test against positive autocorrelation at a 5% significance level the null hypothesis is rejected if: $d < d_{cp}$, where d_{cp} is a critical value such that:

$$P(d < d_{cp}) = 0.05$$

For a one-tailed test against negative autocorrelation at a 5% level the null hypothesis is rejected if:

$$d > d_{cn}$$

where

$$P(d > d_{cn}) = 0.05 \quad \text{or} \quad P(d < d_{cn}) = 0.95$$

Considering the above, it is proposed to construct a separate model for each port with one dependent variable and five independent variables on the first stage. Following that, a stepwise regression procedure would be applied to each set separately. The regression coefficients from each of the estimated regression models for each port would be compared. To test for serial correlations, the regression (not stepwise) could be run again. Should the Durban-Watson test show no sign of autocorrelation in the residual, the analysis could proceed to the next stage. If the serial correlations show as significant, steps would be taken to reduce that effect like including a Seasonal Dummy variable.

Once a model for each port is constructed and tested, the importance of each of the variables can be determined. "Pratt's measure" (Thomas et al, 1998) assigns importance to a variable in proportion to the product of its standardized regression coefficient and its simple correlation with the response variable. That measure would allow assembling the most important variables by their contribution in an attempt to construct a single model for all the ports. Should that approach succeed, a single model of port competitiveness would be feasible, allowing for interesting conclusions to be drawn in terms of generality and specific contribution of various factors typical for any port. However, should that task be proven not feasible, another similarly important conclusion would be made that there is no general model for every port and that specific conditions exist in each separate case defining the competitiveness of each port. That conclusion would imply that there are significant differences in the competitive position of not only Canadian vs. U.S. ports, but that differences exist between the East Coast and the West Coast ports. At the same time, in assessing the significance of statistical tests, it would be important to remember the difference between statistical and practical significance.

Historically, in transportation research and analysis, data on various performance measures were collected and analyzed over a 5 or 10-year period. Further, in comparing results (dependent variable), the data can be normalized through price indices in order to bring those indicators to the level playing field, factoring in the level of inflation. In railway research, for example, specific price indices were used for that purpose. In other instances, such widely available and regularly published measure of inflation as the Consumer Price Index (CPI) was used. Thus, the CPI will be utilized in this project to

normalize financial port data. As well, other indices provided by Statistics Canada can be utilized to assess changes in fuel costs, for example.

Finally, to compare the results of the analysis for each individual port under observation, it is proposed to develop an INDEX of the port's competitive position. The INDEX would be computed as a ratio of the complex measure in the current year, expressed in terms of the base year, to the complex measure in the base year for either each port separately or for the unified model. Thus, a complex measure of competitiveness for each port in the current year for five years would be divided by the complex measure of competitiveness in the base year. That approach would develop an understanding of the competitive trends among the ports. Year-over-year percentage changes would provide information on the progress for each individual port within the ten-year time frame.

V. LIMITATIONS AND BENEFITS

5.1 LIMITATIONS

Several limitations in data collection and analysis have to be mentioned. The first limitation in the data collection pertains to the fact that certain business and financial information is often considered confidential or commercially sensitive by private businesses including ports. In other instances, port managers may be reluctant in releasing sensitive business information to any third party for competitive reasons. Therefore, it may be difficult or even impossible to fulfill all of the data requirements as outlined in Table 4.1. Although, the data collection requirements were compiled with the specific consideration given to the sensitivity of certain business information, there is a chance of acquiring limited data. Nonetheless, it is also anticipated that even non-confidential information from ports' annual reports and shareholders' reports should provide a reasonable set of data.

The second limitation in the data collection pertains to the time frame, i.e. how far back the port data may be available. As mentioned earlier, a certain amount of data is required for a meaningful statistical analysis. If, however, a limited set is collected, the proposed model will be re-examined based on the available data.

The data analysis limitation may become a factor due to the data collection limitation. Currently, the number of variables in the model in correspondence with the data

requirements should provide the basis for a meaningful analysis. Further, the proposed sample, although not random, should be representative in relation to the problem statement. However, a limited data set may limit the depth of the analysis, allowing for less significant inferences. Finally, the quality and reliability of data would depend on the response rate and the level of cooperation from the respective port representatives. Thus, as mentioned above, the model and particular types of analysis on the proposed model would have to be adjusted.

5.2 BENEFITS

The literature review revealed that there is no unified opinion on the selection of port indicators or on the assessment of port performance. The fact that close to forty indicators were found through the literature review attests to the lack of consensus. Furthermore, port performance indicators proposed by various authors were selected on the basis of understanding of port operations and researchers' expert opinion. Although these research papers provided an important understanding of port performance and factors influencing it, there was no attempt to combine various indicators into one model. Moreover, no evidence of port indicator assessment and selection through statistical tests was found so far. Finally, no literature source, which attempts to construct a model of port competitiveness through statistical means, has been found. Thus, the current study could provide some new understanding of port performance in the modern and highly competitive transportation environment within North America.

Should this research project succeed in ascertaining a model of port competitiveness through the assessment of port performance, the results could be quite useful for port professionals, who are trying to attract more business to their port by sometimes "stealing" it from the competitors. It could provide the major container ports in North America with the knowledge of the most critical factors with significant impact on the competitive position of a port. Furthermore, the proposed single model could provide industry executives with a helpful framework for competitive position assessment, which is extremely important in today's very competitive environment.

In addition, understanding of the factors of success could be of interest to various transportation industry analysts. Port policy makers can consider these factors in providing policy guidelines, conducive to the factors of ports' success, while strengthening ports' competitive position.

VI. DATA COLLECTION AND ANALYSIS

6.1 THE DEPENDENT VARIABLE – TOTAL COST OF TRANSPORTATION

The framework for the data collection and calculation of the dependent variable, defined as the Total Cost of Transportation, was modeled after a study produced by KPMG, Peat Marwick Stevenson & Kellogg and was based on their final report titled *“Evaluation of Competitive Advantages of the Port of Montreal in Container Transportation”*, 1993. The study was conducted in response to a request from the Port of Montreal and was largely based on the 1991-1992 data. At the time of the final report, the study concluded that the Total Cost, including port fees and other tariffs, paid by the ocean lines at the port of Montreal was less than at competing American ports including the Port of New York. However, a deterioration of such competitive advantage at the port of Montreal compared to the Port of New York. was also observed.

In summary, the study (1993) outlined the importance of the container traffic for the port of Montreal, which became evident in 1991, when it reached 33% of the total tonnage shipped through the port. For comparison, in 1980, container traffic accounted for only 12% of the total tonnage. In terms of revenue, container traffic was also important for the port because in 1991, it generated close to 40% of the total operating revenues. In addition, since the early nineties, intermodal traffic in North America was characterized by its mobility and flexibility. For instance, on the Atlantic Coast, ocean-shipping lines had the flexibility of dropping one port of call in favour of the other for the purpose of improved profitability due to the container terminal over-capacity and efficiency of

transportation services. In this type of a setting, a port became a link in the chain of an intermodal system and the ocean shipping lines gained direct control over the complete origin to destination transportation service offered to the clients, a service that includes shipping by water, through the port and by ground transportation to the point of destination. Therefore, the costs incurred by the ocean lines (cost of marine transportation, cost within the port and cost of ground transportation) played a primary role in the port selection.

That conclusion is very similar to the one outlined in the current research project in so far that the ocean shipping lines are the ports' main customers and that the ports compete with each other, trying to offer the most convenient service for the least amount of money. Further, since there is a clear trend of increased use of shipping in containers via intermodal systems, the costs incurred by the shipping lines are the total costs, as defined earlier (see Table 4.1), becoming the dependent variable in the model of port competitiveness.

6.1.1 Dependent Variable (Total Cost of Transportation) Components

Container traffic is very susceptible to competition with other ports because of the port-to-port tariffs within the intermodal system. This reduces the differences in cost of transportation between the origin and the destination. The international ocean shipping lines consider a number of factors in choosing their port-of-call with cost being a key factor.

Generally, the costs absorbed by the ocean lines, depending on the type of vessel and cargo, can be separated into three categories, such as Port Costs, Marine Costs and Ground Transportation Costs.

A) Port Costs

Port Costs are represented by the following sub-categories :

- Harbour Dues and costs of navigation (pilotage);
- Costs of wharfage / berthing, dockage and demurrage of ships;
- Cost of port labour and terminal fees;
- Other port-associated costs (handling of the lines, towing, taxes).

More specifically, the Port Costs can be divided into:

A-1). Harbour Dues or fees for passing through the port, usually paid to the port administration, including the right to enter and pass through the port, the right to berth and the right to moor. Harbour Dues are intended for recovery of the channel maintenance expense of the port. They depend on the gross weight of the vessel and its registry.

A-2). Berthage is a charge for occupying a berth at a port. The charge is based on the vessel's size and its length of stay. In many instances, various incentives are applicable to the basic berthage rate stated in the ports' tariffs.

A-3). Wharfage is a charge for moving cargo over a public wharf. The fee is based on the

cargo type with the rate per tonne or per cubic metre.

A-4). Mooring (docking) is also paid to the port administration. The calculation of that charge is based on the size of the vessel and the length of time required for the operation.

A-5). Storage – a charge for use of sheds or open terminal space occupied by the cargo. It depends on the volume of space occupied and the duration of use of the space.

A-6). Terminal fees, which are payable to the terminal operator. Ports have little or no control over those fees because once terminal operators sign long-term leases with the ports for the terminal space, they operate as private businesses, charging their customers different rates subject to confidential contracts.

A-7). Pilotage fees, payable to the pilotage authorities for the assistance of certified pilots, helping to navigate ships from the open waters through the harbour to the place of berthing. For the majority of large ports, pilots' services are required and in many cases, they are mandatory.

A-8). In addition, there are dues assessed against the cargo and payable into the employment security fund of the port labour, such as Contribution to the Maritime Employers Association.

A-9). "Container Royalty" is a fee paid in the United States ports.

A-10). Towing is a charge for the maneuvering of a ship with a tug-boat.

A-11). Handling of the lines is a charge for tying a vessel with ropes alongside a berth.

A-12). Various federal taxes.

The majority of such cost information can usually be found in the publicly available documents. However, terminal fee tariffs are often confidential, as noted above.

As seen from the list of port fees, most of the charges are based on the size of the vessel. The KPMG study (1993) produced costs for 20' and 40' containers and for the 4 different sizes of ships with the draught of 9.17 m, 10.08 m, 11.00 m and 12.02 m respectively. However, for the purpose of comparison within the current study, the costs will be calculated for one type of a ship with a capacity of 2,594 TEUs. This particular size was chosen because of a general trend in increased vessel capacity, while being the largest vessel that the Port of Montreal can currently accommodate for draught.

Typically, a vessel of such capacity is 240.52 m. long, 32.31 m. wide and 18.85 m. high, having a gross weight of 38,991 GRT, net weight of 13,039 NRT and a draught of 11 m. Although it can carry 2,594 containers of 20', the vessel capacity is not always utilized 100%. The KPMG study (1993) used an average capacity utilization of 75%. Further, since the ships are completely loaded and unloaded at the Port of Montreal, the calculation of various fees was based on the full 75% of the capacity of ships for the Port

of Montreal. In other words, for a vessel capable of carrying 2,594 twenty-foot containers, the calculation was based on 75% of the full capacity or 1,950 of twenty-foot containers and 975 of forty-foot containers.

At the same time, for the Port of New York, where vessels are loaded and unloaded at 50% of their capacity on average, the calculation was based on half of the amount of containers used for the Port of Montreal or 975 twenty-foot and 490 containers of forty-foot.

These assumptions that formed the basis for the KPMG study (1993) will be maintained within the current project while the fees will reflect actual charges as they changed over time.

It is important to note that the tariffs at the Port of Montreal have not been changed in 7 years from 1992 to 1999. The calculations of Port Costs for 1992 are summarized in Table 6.1-A, Appendix 1.

B) Marine Costs

In calculating marine costs, the KPMG study (1993) considered the cost of the marine leg between European ports and Montreal, Halifax, New York and Baltimore. The costs incurred at European ports were deemed not pertinent for the purpose of assessing port competition. For the period analyzed, all costs were expressed in Canadian dollars as of 1992. The following cost items were included in the Marine Cost category:

- the cost of the actual trip (fuel);
- the cost of capital recovery on vessels and containers;
- operating costs, such as cost of the crew wages, insurance, administration, etc.

In addition, it was necessary to assume that the ships were in operation for 350 days per year, however, it was also considered that the ships were utilized at 75% of their capacity, a standard capacity utilization ratio on the North Atlantic route.

B-1). Although the cost of the actual trip can vary depending on the exact route, other costs for the same type of a ship remain pretty much the same. The final report on the study (1993) noted that data for this calculation was collected from different sources and presented as the best estimate without accessing and revealing confidential information. The cost of a trip was calculated based on actual marine routes, such as the North Atlantic and the Mediterranean, typical for the East Coast ports. However, as mentioned earlier, only North Atlantic route and associated costs were considered within the framework of the current research project.

The fuel consumption, different depending on the size of the ship and its speed of sailing, was estimated by a special group of consultants. Since a ship typically requires two types of fuel, the cost of fuel was based on two separate price estimates for both heavy and regular diesel fuels. In addition, the fuel consumption was estimated for the ocean leg of the trip and for the maneuvering within the port. Further, average fuel consumption together with an average price of fuel within Europe and North America was used for the fuel cost estimate. The resulting costs per day were as follows: **\$7,200** for the heavy

diesel fuel during the ocean leg, \$454 for the regular diesel fuel for the ocean leg and \$681 for the regular diesel fuel for port maneuvering.

B-2). The replacement costs for the vessels and containers were used to assess the capital recovery. These costs were then averaged over a long-term. The cost estimates for various container ships were obtained from different sources in the course of the study (1993). For instance, some estimates reflected the cost of ships built in London, other estimates reflected the cost of ships built in Asia. The estimation of ship replacement cost was based on the depreciation rate of the daily ownership cost at 10% cost of capital rate over 20 years of ship's average service life. An additional 10% surcharge was added to the cost of capital for ships with reinforced nose, necessary for sailing on the Saint-Laurent during winter months. Thus, the cost of capital per day for a 2,594 TEU vessel with the reinforced nose came up to \$25,506.

The container replacement costs were estimated based on container ownership costs found in various specialized publications. The prices of new 20' and 40' containers manufactured in Korea were found to be about \$3,250 and \$4,950 respectively. The replacement costs were based on 10 years of service life. Thus, the cost of capital for containers per day came up to \$10,078.

B-3). The operating costs included salaries of the crew, the ship and container maintenance costs and the cost of insurance and supplies. The study (1993) estimated the average cost of compensation (salary with benefits) at \$150 per day for every crew

member. The total labour cost considered additional \$10 per day per person for food and other living expenses. Although, the number of crew members can vary depending on the size of a ship, it was estimated at 22 persons for a 2,594 TEU vessel for the purpose of the KPMG study (1993). Thus, the labour cost per day came up to **\$3,520**.

In addition, annual container maintenance costs were estimated at \$310 for a 20' and at \$480 for a 40'. It was further assumed that marine shipping lines need to have at their disposal the number of containers that is two times each container ship's capacity. Thus, container maintenance cost was assessed at **\$5,959** per day for a 2,594 TEU ship.

Further, the annual amount of insurance was assessed at 1% of the cost of the vessel, an acceptable industry standard. Thus, on a per-day basis, the cost of insurance came up to **\$2,171**.

The ship annual maintenance costs varied from \$400,000 to \$700,000 depending on the vessel's size. For a 2,594 TEU vessel, considering 350 operating days, the maintenance cost was assessed at **\$1,989** per day.

As for the cost of the supplies, 60% were allocated to the cost of lubricants, such as grease oils. Based on that assumption, the total cost of supplies was estimated at **\$765** per day for a 2,594 TEU vessel.

The cost of administration was estimated at 10% of the total operating cost for a total of

\$1,600 because the total operating cost, as a sum of operating cost elements listed in B-3, came up to \$16,004 per day.

The full listing of marine cost elements and the Marine Cost calculation for 1992 is summarized in Tables 6.1.5-B and 6.1.6-B, Appendix 1. With the Total cost per trip on the North Atlantic route of \$1,523,687, the Marine Cost per TEU for the selected vessel was \$391 for the Port of Montreal in 1992. However, since the distance from North European ports to the Port of New York is greater than to the Port of Montreal, the Marine Cost is also higher. For that reason, the KPMG study (1993) group added 6.2% to the Marine Cost per TEU for the Port of Montreal, thus assessing the Marine Cost for the Port of New York at \$415.

Upon completion of the marine cost calculations based on the vessel size, the study (1993) concluded that the economies of scale realized by very large ships were relatively modest compared to the base cost per TEU per day. The advantage was not proportional to the increase in the vessel capacity. For example, the total marine cost for a 2,594 TEU vessel was lower only by \$81 than for a 1,800 TEU vessel on the same route, declining from \$391 per TEU to \$311 per TEU. However, the study ignored the fact that large vessels allow the ocean shipping lines to serve bigger markets.

C) Ground Transportation Costs

As for the costs of ground transportation, the KPMG study (1993) used railway tariff and trucking tariff estimates between the ports on the East Coast and the reference points

(markets) in North America (Chicago, Detroit, Toronto and Boston). These tariffs were obtained from various sources and, because the actual ground transportation tariffs are mostly confidential, were based on estimates, which were summarized.

Further, the study (1993) noted that these costs reflected competitive situation in the ground transportation market in 1992 but did not necessarily reflect the costs of ground transportation companies. Also the ground transportation costs are usually different for "import" and "export" directions for ports in Canada and in the US. The calculation of the Ground Transportation cost, taken as an average of "import" and "export" cost estimates, produced the cost per TEU of \$535 from Montreal to Detroit and of \$755 from Montreal to Chicago. Similarly, the cost from New York to Detroit was \$642.50 and from New York to Chicago was \$635. The above cost estimates for New York included the cost of draying (\$50 US per container) and an incentive of \$20 US/container on import and \$40/container on export. The cost of ground transportation for Montreal included port railway charges since these charges are factored into the main railway (CN and CP) tariffs.

The KPMG study (1993) group concluded that the ground transportation costs for the Port of Montreal were lower than for ports in the United States for 20-foot containers and, in some cases, for 40-foot containers destined to Detroit. As for the Chicago market, it was concluded that Canadian tariffs were generally higher than similar tariffs in the United States. The calculations of Ground Transportation Costs for 1992 are summarized in Tables 6.1.5-C and 6.1.6-C, Appendix 1.

D) Total Cost of Transportation

Finally, to assess the competitive position of different ports, the KPMG study (1993) group combined all three components of transportation costs, described above in sections A, B and C to produce the Total Cost of Transportation. The Total Cost was computed in relation to two major North American markets, such as Detroit and Chicago, considering North Atlantic marine route and also for two types of containers, i.e. 20-foot and 40-foot. Although, these calculations assumed that 20-foot containers represented about 60% of the traffic for the Port of Montreal and about 40% of the traffic for the Port of New York, the total number of TEUs comes to about the same number for both ports, same size vessel on the same route. The calculations of Total Transportation Costs for 1992 are summarized in Table 6.1.D below.

Total Cost of Transportation for the Ports of Montreal and New York on the North Atlantic Route for a 2,594 TEU vessel (1992 \$ CA)

Table 6.1.D

Origin / Destination	Cost Category	Montreal	New York	% Difference
Detroit	Marine	391.00	415.00	
	Port	235.27	287.28	
	Ground	535.00	642.50	
	Total	\$1,161.27	\$1,344.78	- 13.65%
Chicago	Marine	391.00	415.00	
	Port	235.27	287.28	
	Ground	755.00	635.00	
	Total	\$1,381.27	\$1,337.28	3.29%

Source: KPMG study, Evaluation of Competitive Advantage for Port of Montreal in container traffic, May, 1993

As seen from the table above, the Port of Montreal had a competitive advantage over the Port of New York in the Detroit market, offering 13.6% lower transportation cost in 1992. At the same time, in the Chicago market, the Port of Montreal lost its competitive advantage to the Port of New York with the 3.29% higher total transportation cost.

6.1.2 Calculation of Port Costs for the Port of Montreal in 1992

a). Harbour Dues, as mentioned, depend on the gross registered weight of a vessel. As of 1992, the tariff per GRT is \$ 0.0493 and it hasn't been changed in 7 years, remaining the same until 1999. Thus, for a vessel of 38,991 GRT, the cost is \$1,922.26. Per 20' container, the cost is \$ 0.49 ($\$1,922.26 / 1,950 * 2$) and \$ 0.99 for a 40' container ($\$1,922.26 / 975 * 2$).

b). Berthage, like Harbour Dues, is based on the size of the vessel and the length of stay at the port. The KPMG study (1993) based their calculation on the average 72-hour cycle (6 periods of 12 hours) at the cost of \$ 0.0423/GRT for the first two periods and of \$ 0.0255/GRT for the remaining 4 periods. Thus, for a vessel of 38,991 GRT, the cost is \$7,275.72. Per Container, the cost is \$ 1.87 ($\$7,275.72 / 1,950 * 2$) and \$ 3.73 for a 40' container ($\$7,275.72 / 975 * 2$).

c). Wharfage is usually imposed on cargo at a rate of \$ 2.97 per tonne at the Port of Montreal. However, considering the incentives, as assessed by KPMG (1993), the rate is actually \$ 2.10 per tonne or \$ 26.04 for a 20' container (with an average of 12.4 tonnes of cargo) and \$ 43.26 for a 40' container (with an average of 20.6 tonnes of cargo).

d). Pilotage, the cost of pilotage on St. Laurence to the Port of Montreal is determined by the Laurentian Pilotage Authority. There are two obligatory zones, which are Quebec to Montreal (Zone 1) and Les Escoumins to Quebec (Zone 2). Also, the rules are different depending on the time of year. Considering both factors, the actual tariffs used in the KPMG study (1993) as of 1992 were:

Zone 1 - \$19.69 per 1 unit of pilotage plus \$9.74 for the time factor;

Zone 2 - \$12.50 per 1 unit of pilotage plus \$7.23 for the time factor;

In addition, there is cost of transferring 2 pilots from the boat to the vessel. Such cost at Les Escoumins was \$100, in Quebec it was \$115 and \$100 in Trois-Rivieres, for a total of \$315.

Further, since the cost of pilotage also depend on the sailing time, it was estimated that a container ship sailed for 8 hours in Zone 1 and for 12 hours in Zone 2.

For our vessel of 240.52 m long, 172 units of pilotage were required. Thus,

in Zone 1 @ \$19.69 per unit	the cost was \$3,386.64
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in Zone 2 @ 12.50 per unit	the cost was \$2,150.00
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Plus, the charges for the time factor:

in Zone 1: 8h * 11.00m = 88.0 @ \$9.74	the cost was \$ 857.12
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in Zone 2: 12h*11.00m =132.0 @ \$7.23	the cost was \$ 954.36
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Plus the cost of boats for the Pilots	\$ 315.00
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TOTAL	\$ 7,663.12
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Per Container, the cost is \$3.93 for a 20' and \$7.86 for a 40' container. In addition, it should be noted that for the winter period (from December 1st to April 1st), the number of pilots required at the Port of Montreal increases to six, which effectively doubles all components of the cost of pilotage for the 4 winter months except for the cost of boats for the pilots. The calculation of weighted average cost of pilotage throughout the year considering increases during 4 winter months results in a cost of \$ 5.19 for a 20' and \$ 10.37 for a 40' container.

e) Contribution (Dues) to the Maritime Employers Association - was \$ 4.0 per tonne or \$49.60 per 20' and \$ 82.40 per 40' container.

f) Towing, the charge for maneuvering the ship with a tugboat, was estimated based on two tugs per ship of any size, which is a standard practice at the Port of Montreal. As of 1992, the tariff at Racine terminal was \$1,425 per one tug, making a total cost of towing with two tugs at \$2,850.

Then, per container the cost is \$ 1.46 for a 20' and \$ 2.92 for a 40'.

g) Handling of the lines (tying up the vessel with ropes alongside berth), based on the tariff at Racine terminal as of 1992, was \$ 1,200 per operation. The costs per container then will be \$0.62 for a 20' and \$1.23 for a 40'.

h) Terminal Fees. In general, terminals are administered and operated by independent

companies, which are, quite often, closely affiliated with the shipping companies such as SeaLand and Maersk. The terminal fee usually covers all of the costs associated with the transfer of a container from the ship to the ground at the first point of entry. Beside the cost of physically transferring containers, there is also a cost associated with the removal of hatch panels and the cost of handling the cables. The cost of all such operations is a function of several factors such as the hourly wages for labour as per existing collective agreements, the accident insurance premiums, employee benefits, vacation time and other factors such as the cost of equipment and the productivity and efficiency of the work. The terminal fee includes the costs of different activities on the ground such as control of the containers from their arrival to the point of transfer to the railway or to the truck. In general, the ground services are affected by the same unions as terminal services.

For the purpose of the KPMG study (1993), the average amount of terminal fees was estimated by using different sources such as terminal operating companies and port administration. The authors of the KPMG study (1993) concluded that total terminal cost or an "all-in pick rate" can affect the competitiveness of not only one port over another but also of one terminal over another. Furthermore, it can have an impact on the competitiveness of one shipping line over another within the same terminal depending on the conditions of the contract.

The result of the terminal fee estimation was such that for the Port of Montreal the cost was estimated at 150.00 and for the Port of New York - 190.00 Canadian dollars for a 20' or a 40' container.

i) Total Port Cost per TEU for a selected ship type at the Port of Montreal in 1992 was computed by adding the various cost elements described above. Please also refer to Table 6.1-A, Appendix 1.

$$\begin{aligned}\text{Total Port Cost} &= \$ 0.49 + \$ 1.87 + \$ 26.04 + \$ 5.19 + \$ 49.60 + \$ 1.46 + \$ 0.62 + \$ 150.00 \\ &= \$ 235.27\end{aligned}$$

6.1.3 Calculation of Port Costs for the Port of New York in 1992

The Port of New York, administered by the Port Authority of New York/New Jersey (PANYNJ), leases its port facilities to the marine terminal operators and other users.

The structure of tariffs and services offered at the US ports is not the same as at Canadian ports. For example, in the US, there is no separate charge such as the Harbour dues. The introduction of COBRA (Consolidated Omnibus Budget Reduction Act) in 1985, added some fees that were meant to recover the costs of certain federal services such as customs, drayage and electronic data exchange. It should be noted that 95% of those fees were charged directly to the exporters/importers (shippers) and not to the shipping lines. These additional fees were somewhat abated by the Container Incentive Program introduced at the Port of New York in 1988. Within that program, a \$40 rebate on export containers and a \$20 rebate on import containers was offered in the 260 miles radius around the port. For the purpose of calculating the port fees within the KPMG study (1993), these fees were amalgamated and included in the category labeled "Federal

Charges”.

As far as other port fees, they remained more or less similar to those in Canada.

a). Dockage. The Dockage fees are usually charged only for docking at public quays and are based on the length of the vessel and the time spent in dock for each interval of 24 hours. If the Dockage fees are charged, they are paid directly by the ship to the Port Authority.

The tariff on Dockage at the Port of New York varied between \$4.25 and \$7.24 US per foot of length per day (per 24 hours) in 1992. The total cost for 72 hours (or three periods of 24 hours) and for a 2,594 TEU vessel was calculated by the KPMG study (1993) group as follows:

	Per Ship		Per Container*	
	\$ US	\$ CA	20'	40'
240.52 m of length = 789' @ \$5.75US*3	13,611	16,333	\$ 8.38	\$ 16.75

* The calculation of cost per container considered the 2,594 TEU vessel with capacity of 1,950 containers of 20' and 975 containers of 40' as mentioned earlier.

However, for the majority of container terminals operated by marine terminal operators at the Port of New York, there is no separate Dockage fee. Most of the time, that fee is included in the “combined pick-up rate” or factored into the terminal charges. For that reason, the Dockage fees, within the KPMG study (1993) were included in the category “Terminal Fees”.

b). Wharfage and Berthage (right to use the quay). Similar to the Dockage fee, the

Wharfage and Berthage are charged only at public terminals, thus, they are also included in the "combined pick-up rate" or factored in the supplementary tariff. The tariff on Wharfage and Berthage at the Port of New York was \$0.70 US per gross tonne or \$0.83 CA per metric tonne in 1992 or \$10.29 CA for 20' container and \$17.10 CA for 40' container. However, since the majority of container terminal operators at the Port of New York do not charge a separate Wharfage/Berthage fee, these fees within the KPMG study (1993) were included in the category "Terminal Fees".

c). Pilotage. As assessed by the KPMG study (1993), the pilotage fees charged by the Sandy Hook Pilots as of 1992 were based on a formula that considered a number of factors. However, the total amount of pilotage for the Port of New York and applicable to a 2,594 TEU vessel was assessed at 517 units of pilotage. At a cost of \$0.91 per unit and a lump sum of \$3,014 for the vessel, the total cost of pilotage was \$3,484.47 US or \$4,181.36 CAN. On a per container basis, it was \$4.30 CAN for a 20' and \$8.60 CAN for a 40'.

d). Fees to the New York Shipping Association (NYSA). These fees were intended to finance the longshoremen job security fund. In 1992, the rate was \$1.85 US or \$2.22 CAN per metric tonne of 2,240 pounds or per 40 cubic feet. It was up to the longshoremen themselves to select the assessment base in pounds or cubic feet. However, for the purpose of the KPMG study (1993), the calculation was based on information from the shipping lines considering an average weight of 15 tonnes per 20' container and 20 tonnes per 40' container. Thus, the cost per 20' container becomes \$33.30 CAN

(\$2.22 * 15) and \$44.40 CAN (\$2.22*20) per 40' container. There are other additional fees charged to the shipping lines that go into the job security fund. However, these are negotiated through a Master Contract Agreement and usually are included in the "combined pick-up rate".

e). Container Royalty is another type of fee negotiated under the Master Contract Agreement. There are two types of royalties:

- The royalty of \$3.00 US per metric tonne imposed by the Management Associations like NYSA. This type of royalty is charged according to 3 royalty agreements of 1960, 1971 and 1977; and
- A fee of \$0.70 US per metric tonne, \$0.40US of which goes into the fund of Carriers Container Council Inc. (CCC) and \$0.30 US goes into the International Longshoremen Association (ILA).

Based on these rates, the total of \$3.70 US (\$3.00 + \$0.70) or \$4.44 CA becomes an equivalent of \$55.06 CA for a 20' container and \$91.46 CA for a 40' container.

f). Federal Fees and Taxes. In the United States, the federal fees and taxes are charged to the vessel and to the shipping line. The federal fees to the vessel on a per container basis are so small that the amounts become negligible compared to other types of fees. The federal fees charged to the shipping lines were estimated by the KPMG study (1993) group at an average of \$180.00 CAN for a 20' container and of \$302.00 CAN for a 40' container. These amounts were applied to every type of vessel.

However, there were 3 types of federal taxes charged to the ships in addition to the federal fees. These were as follows:

f.1. Tax on the capacity of the ship. The Vessel Capacity Tax or Tonnage Tax was \$0.09 US or \$0.108 CA on the net capacity of the vessel in 1992. This tax was charged by the US Customs Service at the first port of entry for the first 5 trips between Northern Europe or Mediterranean and United States. The cost per ship of 2,594 TEU with 1950 containers of 20' and 980 containers of 40' was computed at \$1,408.21 CAN (KPMG, 1993). On a per container basis, it became \$0.72 for a 20' and \$1.44 for a 40' container.

f.2. Tax for Agriculture Inspection was paid to the Animal and Plant Inspection Service of the US Department of Agriculture. The inspection fee in 1992 was \$544 US or \$650 CA per every trip of the vessel. On a per container basis, this tax became \$0.33 ($\$650.00/1950$) per a 20' and \$0.66 ($\$650.00/980$) for a 40' container.

f.3. COBRA Tax. The COBRA User Fee was implemented as per Consolidated Omnibus Budget Reconciliation Act, 1985. That fee created a lot of controversy in the shipping community and the Act of 1985 was amended by the Tax Reform Act, 1986 and the Customs and Trade Act, 1990. The COBRA tax was meant to recover the costs of customs inspection services and Electronic Data Exchange (EDE) and was paid by the ocean shipping line that operated a ship. The KPMG

study (1993) group determined that the COBRA tax was \$397 US or \$475 CAN in 1992, making it \$0.24 per a 20' and \$0.48 per a 40' container.

These three taxes combined provide an amount of **\$1.29** ($0.72+0.33+0.24$) for every 20' container and an amount of **\$2.58** ($1.44+0.66+0.48$) for every 40' container.

In addition to the federal taxes imposed on a ship, there were 2 other types of taxes to be paid by a freight forwarder or a consignee.

f.4. Harbour Maintenance Tax was intended to cover the costs incurred by the US Army Corps of Engineers in improving the navigation channel at public ports. Before January 1, 1991, the tax was 0.04% to 0.125% of the value of exported or imported goods. Based on the average numbers published by the PANYNJ, the amount of the tax was assessed at \$4,395 CAN per metric tonne as of 1992. That amount was translated by the KPMG study (1993) group to an average of \$54,500 on the merchandise in a 20' container and \$90,500 on the merchandise in a 40' container or to an amount of \$68.13 per a 20' and \$113.13 per a 40' container. (Note: this tax was repealed by Supreme Court in 1998 on exports).

f.5. Customs Administration Tax. This tax was charged to the importer. Since October of 1990, American Customs imposed Merchandise Processing Fee of 0.17% on the value of the merchandise to a maximum of \$ 400 US. Based on an average value of goods in a 20' and a 40' containers, the tax was calculated

(KPMG, 1993) at \$110.00 CAN and \$185.00 CAN respectively.

The last two types of taxes would usually be included in the shipping charge and thus were not part of the total cost calculation for the Port of New York within the KPMG study (1993).

g). Towing is a fee that is usually based on the Net Registered Weight of a vessel and on a particular zone within the port. For the calculation provided by the KPMG study (1993) group, they used information from the Elizabeth Marine Terminal, which is considered Zone 11 within the Port of New York. The fee is paid for setting a ship alongside a berth and is standard according to the Moran Towing & Transportation Co. Inc. fee schedule. For a vessel of 2,594 TEU, the fee was assessed at \$2,704 US or \$3,245 CAN, making it \$3.33 per a 20' container and \$ 6.66 per a 40' container.

h). Handling of the Lines is an operation usually performed once the ship is at a quay and involves tying the vessel with ropes to the permanent installations alongside a berth. Though it is a separate operation, the cost is usually included with the cost of docking charged by the ports in the United States

i) Terminal Fees are charged at both Canadian and US port authorities. Since most of the container terminals in both countries are administered and operated by independent companies affiliated with international shipping lines such as SeaLand and Maersk, the conditions of the fee are quite similar. For the purpose of the KPMG study (1993), the

average amount of terminal fees, considering the “all-in pick up rate”, was estimated at \$190.00 CAN for the Port of New York for either a 20’ or a 40’ container.

j) Total Port Cost per TEU for a selected ship type at the Port of New York in 1992 was computed by adding the various cost elements described above. Please also refer to Table 6.1-B, Appendix 1:

$$\text{Total Port Cost} = \$ 4.30 + \$33.30 + \$55.06 + \$ 1.29 + \$3.33 + \$190.00 = \$ 287.28$$

6.1.4 Dependent Variable (Total Cost of Transportation) for 1991 to 2000

The calculation of the Total Cost of Transportation and its components for the ports of New York and Montreal, as described above, following the methodology developed by the KPMG study (1993) group, was produced for the year 1992. The same methodology was applied to calculating the Total Cost of Transportation and its components for the period of 10 years from 1991 to 2000. As a result, the current project produced a 10-year Total Cost of Transportation for the two competing ports (one Canadian and one American), located on the East Coast, for the purpose of longitudinal cost comparison. To produce these calculations, it was necessary to collect data on various cost components for the ten-year period. Please refer to the following sections for the detailed description of that process.

6.1.5 Total Cost of Transportation (1991 to 2000) for the Port of Montreal

A) Port Costs (Table 6.1.5 – A, Appendix 1)

A-1). Harbour Dues or fees for passing through the port for the 10-year period were obtained from the Montreal Port Corporation through the open tariff Schedule VIII, which confirmed that the rate per GRT for containerized cargo remained unchanged from 1992. Thus, the Harbour Dues per TEU of \$0.49, as computed in 6.1.2 (a) were included in Port Cost calculation for 1991 to 2000.

A-2). The Berthage (Dockage) rate, like Harbour Dues, which is based on the size of the vessel and the length of stay at the port, also remained the same (Montreal Port Corporation, Notice N-1, Schedule 1). Thus, per container cost of \$ 1.87 was included in Port Cost calculation for 1991 to 2000.

A-3). Wharfage charges, imposed on cargo at a specific rate per tonne, on containerized cargo at the Port of Montreal declined from \$2.10 per tonne in 92 to \$1.97 per tonne in 2000 due to the incentives provided to the shipping lines. (Source: 1999 Port of Montreal Annual Report and Montreal Port Corporation Notice N-2, Schedule I). It follows, that the wharfage charge decline of \$0.13 per tonne translated into a 0.8% decline per year over an eight-year period, allowing to calculate these charges for the specified ten-year period by reducing the 1992 amount by 0.8% in each consecutive year. In other words, the charge of \$ 26.04 in 1992 became \$26.56 in 1991 and \$24.42 in 2000.

A-4). Pilotage, the cost of pilotage on St. Laurence to the Port of Montreal, as determined by the Laurentian Pilotage Authority (LPA), remained unchanged from 1991 to 1996. However, it should be noted that the LPA tariff is subject to approval by the Canadian Transportation Agency (the Agency). In 1995, the LPA applied to the Agency for approval of the tariff increases. As per the Agency Decision No. 669-W-1995, the LPA tariff was allowed to increase by 5% plus the actual Consumer Price Index (CPI) component with a cap of 2% in 1996, and by 4% under similar conditions in 1997. Further, the Agency denied the tariff increase in 1998. Since that time, the LPA tariff stayed the same for 1998, 1999 and 2000, while the next increase was approved by the Agency as of January 1, 2001. As illustrated in Table 6.1.5-A, the Pilotage fee per TEU of \$5.19 remained the same from 1991 to 1995. In 1996, it increased by 5% plus 1.63% to \$5.53. In 1997, it increased by 4% plus 1.6% to \$5.84, after which point, it remained the same until 2000.

A-5). Contribution (Dues) to the Maritime Employers Association were \$ 4.0 per tonne or \$49.60 per TEU (for the selected vessel) in 1992. Although, no evidence of specific increases in that cost component was found, those types of contributions are usually indexed for inflation. Thus, the 1992 amount was indexed with the CPI (Statistics Canada, Cat. 62-001, Jan., 2001), which reflects the inflation level in any particular year.

A-7). Towing, the charge for maneuvering the ship with a tugboat, is subject to port tariff. Similar to other Port of Montreal tariffs, the towing fee did not change since 1992 and remained at \$1.46 per TEU for the entire ten-year period.

A-8). Handling of the lines, based on the tariff at Racine terminal, remained at \$0.62 for a 20' container as in 1992.

A-9). Container Royalty is a fee paid in the United States ports, and is not applicable to Canadian ports.

A-10). Terminal Fees. As mentioned earlier, terminals are usually administered and operated by independent companies, which keep the specific terminal fees confidential. However, general trend information can be found through special port reports. For instance, a QUONSET PORT report (July 31, 2000) indicated that in general, the Terminal Fees at the Port of Montreal remained the same, while increasing by 25% in 1999 at the Port of New York. Using that information, the Terminal Fee of \$150.00 from 1992 was indexed with the CPI (Statistics Canada, Cat. 62-001, Jan., 2001) to reflect the level of inflation from 1991 through 2000.

The Total Port Cost per TEU for the selected vessel type at the Port of Montreal was computed by adding the various port cost elements (A-1 through A-10), described above, for every year from 1991 to 2000. Please refer to Table 6.1.5-A for specific port cost values.

B) Marine Costs (Table 6.1.5 – B, Appendix 1)

As described in section 6.1.1-B, the following cost items were included in the Marine Cost category:

- the cost of the actual trip (fuel);
- the cost of capital recovery on vessels and containers;
- operating costs, such as cost of the crew wages, insurance, administration, etc.

B-1). The 1992 fuel costs per day of \$7,200 for the heavy diesel fuel, of \$454 for the regular diesel fuel during the ocean leg and of \$681 for the regular diesel fuel during port maneuvering translated into \$149,200, \$9,408 and \$3,866 respectively for a 26.4-day trip (See Table 6.1.B, Appendix 1). Fuel costs for years 1991 and 1993 through 2000 were produced by indexing the 1992 costs with the Industrial Product Price Indexes for Fuel oils and other fuel (Statistics Canada Cat.No.62-011, IPPI, Dec. 95; Statistics Canada Cat.No.62-011-XPB, IPPI, Dec. 97, Nov. 99, Nov. 00). Please refer to Table 6.1.5-B for specific fuel costs.

B-2). The replacement costs for the vessels and containers were used to assess the capital recovery. The 1992 cost of capital for a 2,594 TEU vessel with the reinforced nose was \$25,506 per day or \$673,007 per one trip. That same amount without indexing was applied to every year from 1991 to 2000 because the annual cost of capital remains the same over 20 years of the ship's service life. Please refer to Table 6.1.5-B for specific cost values.

The replacement cost of the containers was based on 10 years of service life. The 1992 cost of capital for containers per day came up to \$10,078 or \$265,915 per trip. Similar to the annual amounts of the cost of capital for ship, the cost of capital for containers remained the same at \$265,915 for every year from 1991 to 2000. Please refer to Table

6.1.5-B for specific cost values.

B-3). The operating costs, as described above, included salaries of the crew, the ship and container maintenance costs and the cost of insurance and supplies. The total operating cost, as a sum of operating cost elements, came up to \$16,004 per day or \$422,299 per trip in 1992. To produce amounts of the operating cost in years 1991 and 1993 to 2000, the 1992 cost was indexed with the Consumer Price Index (Statistics Canada, Cat. No. 62-001, Jan. 2001). The Consumer Price Index is often used in transportation research and analysis to produce labour-related costs. Please refer to Table 6.1.5-B for specific cost values.

The Total Marine cost of \$1,523,687 per trip on the North Atlantic route for 1992 was computed as a sum of various cost elements described above. In a similar fashion, the indexed Marine cost components in every year were summed to produce Total Marine cost for years 1991 through 2000. Further, the 1992 Marine Cost per TEU for the selected vessel at the Port of Montreal was calculated at \$391 [$\$1,523,687 / (1950 \times 2)$]. The same formula was utilized in calculating Marine costs per TEU in every year from 1991 through 2000, which produced an amount of \$392 for 1991 and \$393 in 1993, etc. Please refer to Table 6.1.5-B for specific cost values.

C) Ground Transportation Costs (Table 6.1.5 – C, Appendix 1)

The 1992 cost of ground transportation was estimated based on railway and trucking tariffs between the ports on the East Coast and the markets in Chicago and Detroit. Since

the ground transportation costs are usually different for “import” and “export” directions, the 1992 Ground transportation cost was calculated as an average of the two in each specific direction. That calculation produced the cost per TEU of \$535 from Montreal to Detroit and of \$755 from Montreal to Chicago (Table 6.1.C). The calculation of 2000 Ground transportation cost was based on the CNR open Freight Tariff No. 7589-AA. The charge between Detroit and Montreal for a loaded 20’ container in that tariff was stated at \$255 US, \$315 US and \$225 US, depending on various conditions, and on both import and export. To translate these amounts into Canadian dollars, an average rate of CAN-US dollar exchange (Bank of Canada, Banking and Financial Statistics, Exchange Rates, Jan.1, 2001) of 1.3820 (1992 to 2000) was applied. Following the transfer into Canadian funds, the three amounts were averaged and produced a cost of **\$366 CAN** applicable to the year 2000. If this cost is compared to \$535 in 1992, it shows a 46 % decline or a decline rate of 5% per year. That rate was applied to produce Ground transportation costs in every year from 1993 to 1999. For the year 1991, the 1992 cost was increased by 5%. Please refer to Table 6.1.5-C for specific cost values between Montreal and Detroit.

The calculation of 2000 Ground transportation cost between Chicago and Montreal was also based on the CNR open Freight Tariff No. 7589-AA. The charge for a loaded 20’ container in that tariff was stated at \$500 US, \$440 US and \$350 US, depending on various conditions, and on both import and export. The same average rate of exchange of 1.3820 was applied to these amounts to produce costs in Canadian dollars. Further, the three amounts were averaged and produced a ground transportation cost of **\$594 CAN** applicable to the year 2000. That cost compared to \$755 in 1992 showed a declined of

27% or 3% per year, which was applied to produce Ground transportation costs in every year from 1993 to 1999. For the year 1991, the 1992 cost was increased by 3%. Please refer to Table 6.1.5-C for specific cost values between Montreal and Chicago.

D) Total Cost of Transportation for the Port of Montreal for 1991-2000 (Table 6.1.5-D, Appendix 1)

The Total cost of transportation for the Port of Montreal and for every year from 1991 to 2000 was calculated by adding all three components of transportation costs, described above, such as Port costs, Marine costs and Ground transportation costs. The Total Cost was computed in relation to two major North American markets, such as Detroit and Chicago, considering North Atlantic marine route and also per TEU or per a 20-foot container. These calculations of the Total Cost are summarized in Table 6.1.5-D. It is interesting to note that the Total cost to both Detroit and Chicago from the Port of Montreal has declined due to a significant decline in ground transportation costs, while Port and Marine costs have slightly increased. The fact that the ground transportation cost declined, reflects the competitive situation in the North American railway industry, which benefits the shippers and supports the competitiveness of the Port of Montreal.

6.1.6 Total Cost of Transportation (1991 to 2000) for the Port of New York

A) Port Costs (Table 6.1.6 – A, Appendix 1)

A-1). As described in section 6.1.3, the structure of the tariffs in the US ports is somewhat different from that in Canadian ports, and Harbour Dues, for example, are not

imposed as a separate charge. Thus, the amount of Harbour Dues per TEU of \$0.00 was included in Port Cost calculation for 1991 to 2000.

A-2). The Dockage fee at the Port of New York is usually included in the terminal fee charged by the container terminal operating companies.

A-3). Wharfage/Berthage charges are similar to Dockage in a sense that they are factored in to the terminal fee.

A-4). In the KPMG study (1993), the Pilotage fees were based on the tariff of Sandy Hook Pilots, the company that provided pilotage for the Port of New York. In 1992, a vessel of 2,594 TEUs required 517 units of pilotage, which translated into \$4.30 CAN per a 20' container. After contacting the Sandy Hook Pilots, it was verified that they are still providing the service, however, they estimated that the same type of a ship would require 507.79 units of pilotage in 2000. Based on that estimate and the actual tariff, the pilotage fee for 2000 was computed as follows:

For 500 units of pilotage or more, the Basic tariff formula applies, i.e.

$$[(507.79-500.00)*0.85] + 3,195 = \$3,201.62$$

Then the Pension tariff formula also applies, i.e.

$$[(507.79-500.00)*0.23] + 1,060 = \$1,061.79$$

The total 2000 fee is a sum of two above, i.e. $\$3,201.62 + \$1,061.79 = \$4,263.41$ US

The total 1992 fee was \$ 3,484.47 US, meaning that the pilotage fees have increased over 8 years by 22.35% or at a rate of 2.8% per year.

Although, the calculation of the pilotage fees was based on the actual tariff and there was no need to index for inflation, it was important to reflect the difference in the rate of CAN – US currency exchange. For instance, that rate of exchange was 1.21 in 1992, increasing to 1.49 in 1999 and 2000. Thus, the rate of exchange index (Bank of Canada, Banking and Financial Statistics, Jan., 2001) was applied to the pilotage fee per TEU, initially calculated in US dollars. The pilotage fees calculations are presented in Table 6.1.6-A (supplementary).

A-5). Fees to the New York Shipping Association (NYSA), intended to finance the longshoremen job security fund are similar to the Contribution to the Maritime Employers Association. Although, no evidence of specific increases in that cost component was found, those types of contributions are usually indexed for inflation. Thus, the 1992 amount was indexed with the CPI (Statistics Canada, Cat. 62-001, Jan., 2001), which reflects the inflation level in any particular year. In 1992, the rate of \$1.85 US or \$2.22 CAN per metric tonne translated in to the cost per 20' container of \$33.30 CAN. Thus, the same rate in 1993 became \$33.90, in 1994 – 33.97, etc. Please refer to Table 6.1.6 –A (supplementary) for specific amounts.

A-7). Towing, the charge for maneuvering the ship with a tugboat, is subject to port tariff. Similar to the Port of Montreal, the towing fee at the Port of New York did not change since 1992 and remained at \$3.33 per TEU for the entire ten-year period.

A-8). Handling of the lines is a service of tying up a vessel at a berth. The cost of this

service in the US ports is usually included in the cost of the docking fee or terminal fee.

A-9). Container Royalty is a fee paid in the United States ports. Since no evidence of an increase in this port cost component was found, the 1992 cost of \$55.06 CAN per 20' container was indexed for inflation with the CPI (Statistics Canada, Cat. 62-001, Jan., 2001). Similarly to the NYSA fee, the Container Royalty of \$55.06 in 1992 became \$56.05 in 1993, etc. Please refer to Table 6.1.6 –A for specific amounts.

A-10). Terminal Fees. Since terminals are usually operated by independent companies, specific terminal fees are kept confidential. However, based on a QUONSET PORT report (July 31, 2000) the Terminal Fees at the Port of New York increased by 25% in 1999 or at a rate of 3.5% per year over 7 years from 1992 to 1999. In addition, the CAN – US rate of exchange index (Bank of Canada, Banking and Financial Statistics, Jan., 2001) fluctuation was factored in. Using that information, the Terminal Fee for every year was computed and the amount of \$190.00 in 1992 became \$212.38 in 1993, etc. Please refer to Table 6.1.6.-A (supplementary) for the Terminal Fees calculation. It is interesting to note that since Dockage and Berthage fees are included in the Terminal fees at the US ports, the amounts of Terminal fees are quite comparable with those at Canadian ports.

A-11). The last category of the port costs such as Federal Fees and Taxes is only applicable to the US ports. The calculation and description of that cost category for 1992 was given in section 6.1.3. It should be noted that in the process of updating information on that category for 2000, it became clear that US ports and federal authorities consider

these contributions as fees and not at all as taxes. The main source of information was the US Department of Customs (<http://www.customs.gov/>). The 3 types of federal fees charged to the ship were as follows:

f.1. Fee on the capacity of the ship or the Vessel Capacity Tax or Tonnage Tax, which remained unchanged since 1992 at \$0.72 CAN for a 20' container.

f.2. Fee for Agriculture Inspection in 1992 was \$544 US per every trip of the vessel. In 2000, it declined to \$465 US or by 14.52% over 8 years. Thus, the rate of decline per year of 1.82% was applied to the 1992 amount of \$0.33 per a container.

f.3. The COBRA User Fee, implemented in 1985 and amended in 1986 and 1990, did not change since 1992. The KPMG study (1993) group determined that the COBRA tax was \$397 US or \$0.24 per a 20' container in 1992.

Thus, the total of 3 fees combined declined since 1992 due to the decline in the Agricultural Inspection fee. However, since all fee amounts were initially quoted in US dollars and converted to Canadian dollars, the CAN-US rate of exchange (Bank of Canada, Banking and Financial Statistics, Jan., 2001) was applied in calculating the fee amounts for every year. For instance, the amount of \$1.29 ($0.72+0.33+0.24$) for a 20' container in 1992 became \$1.37 [$(0.72+0.32+0.24)*1.07$] in 1993. Please refer to Table 6.1.6.-A for the calculation and specific federal fees values.

Further, two federal taxes (Harbour Maintenance Tax and Customs Administration Tax), imposed on a ship and paid by a freight forwarder or a consignee, are usually included in the shipping charge and are not part of the port fees calculation. However, it should be noted that on March 31, 1998, the Supreme Court of the United States ruled that the collection of the Harbour Maintenance Tax (HMT) on exports was unconstitutional. The US Customs Service proceeded with refunding HMT claims for an estimated amount of \$600 million. Initially, the HMT was intended to recover a portion up to 40% of the cost of maintaining and operating federally funded navigation projects. The dredging of navigation channels was the primary maintenance activity. For 110 years, the dredging expenses were paid entirely out of General Treasury because it was considered vital to the American trade and US economic competitiveness. In 1990, Congress increased the tax to recover up to 100% of maintenance expenses. From that year through 1999, Customs collected approximately \$4.6 billion in HMT. The port of New York, as one of the major ports on the East Coast, benefited a great deal from that federal program, which allowed to pay for dredging of the port's channel to achieve the current depth of 40 feet. Thus, the Port of New York can currently accommodate Panamax and Post-Panamax vessels, making the port internationally competitive.

The Total Port Cost per TEU for the selected ship type at the Port of New York was computed by adding the various cost elements (A-1 through A-11), described above, for every year from 1991 to 2000. Please refer to Table 6.1.6-A for specific cost values.

B) Marine Costs (Table 6.1.6 – B, Appendix 1)

The Marine Cost for the Port of New York, as computed by the KPMG group for 1992, was 6.2% higher than that for the Port of Montreal due to a greater distance between North European ports and the Port of New York. Thus, the 1992 Total cost per trip on the North Atlantic route of \$1,523,687 and the Marine Cost per TEU for the selected vessel of \$391 for the Port of Montreal translated into \$415 (or 6.2% higher) for the Port of New York. Since the distance, as a major factor in Marine cost, did not change over the years, the same relationship between costs for Montreal and New York was maintained. Therefore, the Marine costs for 1991 to 2000 for the Port of Montreal were increased by 6.2% in every year to produce Marine costs for the Port of New York. Please refer to Table 6.1.6-B for specific Marine cost values.

C) Ground Transportation Costs (Table 6.1.6 – C, Appendix 1)

The 1992 cost of ground transportation was estimated based on railway and trucking tariffs between the ports on the East Coast and the markets in Chicago and Detroit. Further, the 1992 costs were calculated as an average of “export” and “import” costs in each specific direction. That calculation produced the cost per TEU of \$643 from New York to Detroit and of \$635 from New York to Chicago (Table 6.1.6-C).

The calculation of Ground transportation costs for 1991 through 2000 was based on information from the Surface Transportation Board report (December, 2000) on ground transportation. That report compared ground transportation costs in relation to the year 1984, which was considered a base year. Thus, the cost in 1984 was 100%, declining to

95% in 1991, 90% in 1992, etc. The ground transportation cost for 1999 was at 86.5% and for 2000 - at 85.6% of the 1984 cost. Considering that information, the earlier established 1992 costs, separate for each destination market, were "indexed" according to the percentage change from the Surface Transportation Board report (December, 2000) to produce costs for the ten-year period from 1991 to 2000. For example, the \$643 in 1992 from New York to Detroit became \$678 in 1991, and \$618 in 1999. Similarly, the \$635 in 1992 from New York to Chicago became \$670 in 1991, and \$610 in 1999. Please refer to Table 6.1.6-C for specific cost values.

It is interesting to note that the Ground transportation costs for both ports of New York and Montreal declined over the ten-year period. As mentioned earlier, that reflects the competitive situation in ground transportation in the North American market. However, the decline from the Port of Montreal to destination markets of 26.5% on average from 1992 to 2000 was much more dramatic than a similar decline of 4.9% for the Port of New York.

D) Total Cost of Transportation for the Port of New York for 1991-2000 (Table 6.1.6-D, Appendix 1)

The Total cost of transportation for the Port of New York and for every year from 1991 to 2000 was calculated by adding all three components of transportation costs, described above, such as Port costs, Marine costs and Ground transportation costs. The Total Cost was computed in relation to two major North American markets, such as Detroit and Chicago, considering North Atlantic marine route and also per TEU or per a 20-foot

container. These calculations of the Total Cost are summarized in Table 6.1.6-D.

It is interesting to note that contrary to the downwards trend in the Total cost to both Detroit and Chicago for the Port of Montreal, the Total Cost for the Port of New York to both markets has increased. The small decline in the Ground transportation cost was not enough to offset the increase in Port and Marine costs. Furthermore, the Total cost of transportation from Montreal to Chicago became much more competitive in 2000 from 1992. For instance, in 1992 it was higher than from New York to Chicago, whereas in 2000, it became lower by \$218, making the Port of Montreal a more attractive port of call on the East Coast.

At the same time, one should keep in mind that the above calculations will only apply to a specific "smaller" vessel, which is the most that the Port of Montreal can accommodate for draught. Unfortunately, if a shipping line mostly uses vessels larger than 2,594 TEU, the Port of Montreal becomes not an option, thus loses its competitive advantage.

6.2 THE WEIGHTED AVERAGE INDEX OF PORT COMPETITIVENESS

The calculation of the total Cost of Transportation for each port under observation, as described above, provided the necessary data for calculating the Index of Port Competitiveness. The general approach to deriving an index based on multi-year cost information was similar to that of calculating price or quantity indices. In the Cost-of-living index, for example, the price index measures the changing cost of a constant

standard of living, and the quantity index measures increases or decreases in the standard of living. The same interpretation may be given to the conventional fixed-weighted indexes, such as the Consumer Price Index (CPI), one of the most widely used indicators of price changes in Canada. In the fixed-weighted price index, one holds constant the collection of goods and services consumed in a specific year or a Base Year. That collection is referred to as *fixed basket*, for which weights are determined. The weight for each component within the fixed basket is represented as a proportion of the total expenditure for the Base Year. These proportions indicate the relative importance of the item within the fixed basket. The Base Year or the base period of an index is the period in which the index is given a value of 100. The standard practice, when quoting an index level, is to ensure that the base period is also quoted. The CPI, for instance, is obtained by comparing, through time, the cost of a *fixed basket* of commodities purchased by Canadian consumers in a particular year. For example, the CPI in 2000 was 113.5 (1992=100). Other examples of fixed-weighted price indices are the Industrial Product Price Index (IPPI), the Raw Materials Price Index, the Farm Product Price Index, etc. The year-over-year percentage changes in the price indices illustrate how prices have changed and in which direction. Statistics Canada recommends using the percentage change approach in analyzing price changes because percentage changes are independent of the level of index.

The price indices are often calculated using the price relative form of the base weighted formula, known as Laspeyres Index. The index formulae is:

$$\sum (P_{it} * Q_{it}) / \sum (P_{io} * Q_{io}) , \text{ where}$$

P_{it} – price of item i ($i=1, \dots, m$) in the period t

P_{io} – price of item i ($i=1, \dots, m$) in the base period

Q_{io} is the quantity of item I in the base period

The Laspeyres index measures changes in the cost of purchasing the same basket of goods in the current period as it was purchased in the specified base period. Thus, a comparison of costing data expressed as a Laspeyres type index provides an opportunity of comparing changes in the cost rather than comparing absolute cost values. Furthermore, for the benefit of the current project, the index will provide the basis for comparison of ports' competitiveness regardless of the ports' size and the magnitude of their operations.

6.2.1. The calculation of the Index of Port Competitiveness

The calculation of the Port Competitive Index or a Weighted Average Cost Competitive Index (WACCI) for Ports involved several steps. Since the Total Transportation Cost for each port was computed in relation to two destination markets, it was necessary to first derive an Average transportation cost. Such Average (Detroit and Chicago) transportation costs were computed as a simple average of each cost element in every year from 1991 to 2000, and summed. That process produced an Average transportation cost for the ports of Montreal and New York, different from their respective Total transportation costs. However, since the Marine and the Port costs in each year remained the same in relation to Detroit and Chicago with only Ground transportation costs being different, the Average transportation costs were different from the Total costs only due to the

differences in the Ground transportation costs.

To illustrate, the Total transportation cost for the Port of Montreal in 1992 for traffic destined to **Detroit** was:

Marine	\$391.00	Marine	\$391.00
Port	\$235.27	Port	\$235.27
<u>Ground</u>	<u>\$535.00</u>	<u>Ground</u>	<u>\$755.00</u>
Total	\$1,161.00	Total	\$1,381.00

Then, the Average cost in the same year for the **Port of Montreal** is $(\$1,161 + \$1,381) / 2 = \$1,271.00$. Please refer to Table 6.2.1. – A, Appendix 1 for Average transportation costs for the Port of Montreal from 1991 to 2000.

In a similar way, the Average transportation cost for the **Port of New York** is a simple average of Total 1992 costs to Detroit and to Chicago or $(\$1,345 + \$1,337) / 2 = \$1,341.00$. Please refer to Table 6.2.1. – B, Appendix 1 for Average transportation costs for the Port of New York from 1991 to 2000.

Further steps in deriving the WACCI followed the Laspeyres formulae. For the purpose of the current project, the year 1992 was assumed as a Base year. That assumption stemmed from the fact that the KPMG study (1993) produced comparative cost calculations for the same year and also because currently, a variety of price and cost indices are based on 1992.

Following the Laspeyres formula, Average transportation costs for 1992 were used to

calculate base year weights by dividing Marine, Port and Ground transportation cost elements by the Total cost.

The resulting weights for the Port of Montreal were as follows:

Marine - 0.3076; Port - 0.1851; and Ground - 0.5074. (See Table 6.2.1. – A).

Similarly, the weights for the Port of New York based on 1992 costs were:

Marine - 0.3094; Port - 0.2142; and Ground - 0.4763. (See Table 6.2.1. – B).

It is interesting to note that for both ports, Ground transportation costs received “heavy” weight, accounting for almost a half of the Total cost. However, Port costs were the least “heavy” element with about 20% of the Total cost. That observation leads to conclude that Ground transportation cost would be the most “influential” component in maintaining ports’ competitiveness, yet being outside of ports’ control. It seems that this phenomenon is a result of demographic and geographic peculiarity of the North American markets, and whether or not it is so, one thing is clear that today’s transportation is characterized by coordination of several modes, i.e. intermodal systems.

Once the 1992 weights were established, the Average transportation costs for each port and for every year from 1991 to 2000 were expressed in 1992 weights. These costs were produced by multiplying 1992 weight by the corresponding Average costs in every year as follows:

Port of New York	<u>1992 Weights</u>	<u>1999 Av. Cost</u>	<u>99 Av. Cost @ 92 weight</u>
Marine	0.3094	431.50	$431.50 * 0.3094 = 132.71$
Port	0.2142	425.93	$425.93 * 0.2142 = 78.83$
Ground	0.4763	613.91	$613.91 * 0.4763 = 311.48$
Total	1.0000		$\Sigma = 523.02$

The sum of Average costs, expressed in 1992 weights, produced the Weighted Average cost in every year for the 10-year period under observation and for each port. In other words, while the weights were held constant or fixed, the costs in each year were changing, providing the data for the numerator in the Laspeyres formula. At the same time, the Weighted Average 92 cost at 92 weights served as a denominator. Please refer to Tables 6.2.1 – A and 6.2.1. – B for port and year-specific values.

Finally, the port-specific index of Port Competitiveness, labeled the Weighted Average Cost Competitive Index (WACCI), was computed by dividing Weighted Average costs at 92 weights for every year by the 1992 Weighted Average costs at 92 weights and by multiplying the result by 100. Following that operation, the 1992 Weighted Average costs was divided by itself and multiplied by 100, producing a WACCI of 100.00 for the Base year. To illustrate, the WACCI for the **Port of Montreal** for 1999 was computed as follows:

$$425.1585 / 491.0504 * 100 = 86.58, \text{ where}$$

425.1585 was the W. Av. Cost 99 @ 92 weights, and

491.504 was the W. Av. Cost 92 @ 92 weights.

The WACI for the **Port of New York** for the same year was computed in a similar fashion:

$523.0180 / 494.1923 * 100 = 106.51$, where

523.0180 was the W. Av. Cost 99 @ 92 weights, and

494.1923 was the W. Av. Cost 92 @ 92 weights.

Please refer to Tables 6.2.1. – A and B, Appendix 1 for specific Index values.

The index values themselves provided an indication of general transportation cost trends. For instance, the WACCI for the Port of Montreal showed a decline from a value of 100.00 in 1992 to a value of 86.48 in 2000, while the WACCI for the Port of New York showed an increase from 100.00 to 108.16 for the same time period. However, the year-over-year percentage changes, as suggested by Statistics Canada, illustrated how transportation costs have changed independently of the index levels. The year-over-year percentage changes calculation showed that the WACCI for **Montreal was steadily declining** by about 2% per year from 1992 to 2000. Overall, the index declined by 13.52% in 2000 from its 1992 value. At the same time, the WACCI for **New York was increasing** by various amounts, showing an overall increase of 8.16% in 2000 from 1992.

An illustration of the dynamics of the Index is provided through Figure 6.2.1., which shows a steady decline in the Index value for the Port of Montreal with a similarly steady increase in the Port of New York Index. Such dynamics should be interpreted as showing a decline in the cost of transportation for the Port of Montreal, thus making the port more competitive and more attractive for the ocean shipping lines. In other words, the lower the Index, the more competitive the port is in terms of the total shipping costs.

Figure 6.2.1 – The WACCI for the Ports of New York and Montreal

6.3 INDEPENDENT VARIABLES

Initially (See section 4.2.4.), five Independent variables for the model of port competitiveness were proposed:

1. Port Location
2. Port Financial Performance
3. Port Freight Handling Capability
4. Level of Port Services
5. Level of Government Support.

However, data collection on all five indicators of port performance has proven impossible within the scope and the time frame of the current project. Nevertheless, specific data for

the two ports under observation was obtained for two performance indicators, i.e. Port Financial Performance and Port Freight Handling Capacity. For that reason, the model of port competitiveness was re-examined and adjusted as follows:

Figure 6.3 – The Adjusted Model of Port Competitiveness

6.3.1 Independent Variables – Financial Performance

The financial performance of each port under observation was assessed through the *Operating Margin*, as described earlier (See Section 4.1). The Operating Margin was computed as a ratio of Operating Income/Loss to Gross Operating Revenue. For the purpose of this exercise, data on Gross Operating Revenue, Operating Expense excluding Depreciation, Depreciation and Net Other Income was collected for the period of 10 years from 1991 to 2000 for both ports of Montreal and New York. Ports' Annual Reports were used as a main source of information. Please refer to Table 6.3.1, Appendix 2 for specific Operating Margin values.

6.3.1 - A Financial Performance – Port Of Montreal

As mentioned above, the Port of Montreal Annual Reports and Ports Canada Annual

Reports and summaries served as sources of information for calculating Montreal's Operating Margin. It was a straightforward exercise since information required to compute the Operating Margin was readily available, reflecting the port's financial reporting and operational structure. The calculated values in Table 6.3.1 demonstrated that since 1991, the Port of Montreal had Operating Income, which put the Operating Margin consistently on the positive side. The Operating Margin values varied from as low as 9.35% in 1992 to as high as 22.84% in 1998 with an average ten-year value of 18.13%.

6.3.1 - B Financial Performance – Port Of New York

Although the Port of New York Annual Reports also served as a source of information for calculating the Operating Margin, it was not a straightforward exercise. First, the Annual Reports are produced for the Port Authority of New York/New Jersey, which includes the Interstate Transportation Network, the Air Terminals, the Port Commerce and the World Trade Center. Further, the Interstate Transportation Network includes several major bridges and tunnels, while the Air Terminals include terminals at all three major airports in the New York/New Jersey area. Please refer to Appendix 5 for a detailed description of the New York/New Jersey Port Authority.

Therefore, a combination of Schedules E and D information from the Port Authority Annual Reports were used to extract data applicable only to Port Commerce. Analysis of these schedules led to an interesting observation that overall, the Port Authority reported Net Income on the combined operations. However, specific components of the Port

Authority did not perform equally well. For instance, while the Air Terminals were always in the “black”, the Port Commerce remained almost always in the “red”. Only in 1999 and 2000, the Port Commerce managed to report Operating Income instead of Operating Loss.

It should be noted that specific amounts of Gross Operating Revenue and Operating Expenses excluding Depreciation for the port operations only were not available for the period from 1991 to 1995. Instead, these amounts were calculated based on Total Port Authority Revenues and Expenses and an average percentage of revenues and expenses specific to the Port Commerce. For example, on the revenue side, Port Commerce contributed 5.42% on average to the Total Gross Operating Revenue of the Port Authority. Similarly, Port Commerce contributed 6.19% on average to the Total Operating Expenses excluding Depreciation of the Port Authority. As for Depreciation itself, amounts in connection with operating asset obligations from Schedule D of the Port Authority Annual Reports were used. Finally, Operating Expenses excluding Depreciation for the Port Commerce consisted of Operating & Maintenance Expenses and Allocated Expenses as reported in Schedule E of the Port Authority Annual Reports. Please refer to Table 6.3.1, Appendix 2 for specific values.

The calculated values in Table 6.3.1 demonstrated that from 1991 to 1998, the Port of New York had Operating Loss, which put the Operating Margin consistently on the negative side. However, the Operating Margin for 1999 and 2000 came out as a positive number. The Operating Margin values varied from as low as -13.5% in 1997 to as high

as 8.27% in 2000 with an average ten-year value at -7.5%.

6.3.2 Independent Variables – Freight Handling Capacity

The freight handling capacity of each port under observation was assessed through the ports' *Throughput*, expressed in the number of TEUs, as described earlier (See Section 4.1). Although, the Total Tonnage information was also collected (See Table 6.3.2, Appendix 2), it was not utilized as a performance indicator because, as demonstrated through the analysis of Total Cost of Transportation (the Dependent Variables), the main focus of the current study is on the Intermodal systems which transport containerized cargoes.

6.3.2 - A Freight Handling Capacity – Port Of Montreal

The Throughput data for the Port of Montreal was obtained from Ports Canada ten-year traffic reviews 1986-1995 and 1988-1997, the Montreal Port Authority Annual Reports 1998 and 1999, and the Port of Montreal Guide for 2000-2001. Since the vessels are usually fully unloaded at the Port of Montreal, a 100% offload was considered in assessing the port's Freight Handling Capacity. As such, the Throughput exhibited a steady growth over the ten-year period, increasing from about 500 thousand TEUs to over 1 million TEUs per year. Please refer to Table 6.3.2, Appendix 2 for specific values.

6.3.2 - B Freight Handling Capacity – Port Of New York

The Throughput data for the Port of New York was obtained from the home page of the American Association of Port Authorities (<http://www.aapa-ports.org>), detailing

container traffic in TEUs for the period from 1990 to 1999, and from the Port Authority of New York/New Jersey home page (<http://www.panynj.gov/commerce>) that provided data in metric tonnes and TEUs for the period from 1991 to 2000.

As seen from Table 6.3.2, the Throughput for the Port of New York has been steadily increasing over the ten-year period from about 1.8 million TEUs to an impressive 3 million TEUs. Such an increase can be attributed to not only a great location of the port with its proximity to the distribution markets and a strong hinterland but also to the port's ability to accommodate vessels of various sizes from medium to large and super-large. However, from the analysis of the Total Cost of Transportation (the Dependent variable), it became clear that the Port of New York attracted such a significant amount of traffic not due to lower transportation costs.

Further, since the vessels are usually unloaded at 50% of their carrying capacity at the Port of New York, a 50% offload throughput numbers were considered for the Independent variable labeled Freight Handling Capacity. In other words, the obtained throughput numbers were divided in half to represent the Freight Handling Capacity for the Port of New York within this research project.

6.4 STATISTICAL ANALYSIS

As mentioned in Section 4.2.4, a 1 to 15 ratio (or 15 observation per variable) is usually required in order to obtain meaningful results of statistical procedures. However, it

became impossible to obtain 15 observations especially on the Dependent variable. Instead, 10 observations became available on both the Dependent and two Independent variables. With that data deficiency in mind, statistical analysis was pursued carefully. The Dependent variable (DV) was expressed through the Average Transportation Cost (ATC). The first Independent variable (IV1) was Financial performance expressed thorough the Operating Margin. This variable was labeled IV1_FIN. The second Independent variable was Freight Handling Capacity, expressed through ports' Throughput, was labeled IV2_FR.

First, correlations between the DV and each of the Independent variables for each port were analyzed. As it turned out, the DV_ATC was strongly correlated with the Freight Handling Capacity (IV2_FR). However, such correlation with the IV1_FIN was much weaker. Furthermore, the correlation between the IV1_FIN and the DV was almost as strong as between two Independent variables. That prompted re-evaluation of the Independent variable number 1.

After reflecting on the nature of the Operating Margin, it became clear that for the purpose of statistical analysis, the Operating Income/Loss will better represent the ports' financial results as an Independent variable. However, it should be noted that the Operating Margin on its own appears to be a good measure of ports' financial performance. It provides a clear indication of the relationship between ports' revenues and expenses with a measure of positive or negative bottom-line results regardless of the size of ports' operation.

Thus, another Independent variable labeled IV3_FIN2 and represented by the Operating Income/Loss was introduced and correlated with the DV_ATC and the IV2_FR. Please note that the Operating Income/Loss was already computed in Table 6.3.1 for the ten-year period and for both ports under observation. The result of that exercise was better in that the correlation between the DV_ATC and the IV3_FIN2 was much stronger even though the IV3_FIN2 was also strongly correlated with the IV2_FR. That raised a concern about multicollinearity in the Independent variables. It will be very important to examine t-statistics on Independent variables to determine if both will be good predictors for the DV_ATC. Please refer to the correlation matrices for each port provided in Appendix 3.

The results of correlation analysis suggested that further statistical testing could be done because the relationship between the DV and the Independent variables was established. Therefore, a regression procedure, separate for each port, was run with the Average Transportation Cost as the DV and two Independent variables, one for the Freight Capacity (IV2_FR) and another one for the Financial performance (IV3_FIN).

As it is often the case in transportation costing analysis, the data on all three variables was represented by time series, meaning that the regression results will be carefully examined for autocorrelation of the residuals and for normality of the distribution of the error term.

6.4.1. Statistical Analysis – Port Of Montreal

The results of the Stepwise regression procedure produced a very high coefficient of determination ($R^2 = 0.92425$) and a highly significant F test of 97.6. Further, the Durbin-Watson test statistic of 1.8 suggested that there was no autocorrelation in the residuals, and a Kolmogorov-Smirnov goodness of fit test, applied to all three variables, showed Normal distribution of the errors on all three variables.

However, the t test came out significant for the Freight variable and NOT significant for the Financial variable. The Backward regression procedure produced exactly the same results as a Stepwise procedure.

Finally, the regression procedure with both Independent variables forced into the equation produced an even higher R^2 (0.92687) than in both Backward and Stepwise regressions. Even though the R^2 was high and the F test showed significance, establishing a significant relationship between the DV and the Independent variables, the Durbin-Watson test of 2.09 was inconclusive, suggesting the presence of autocorrelated residuals and making the F test no longer valid. Furthermore, the t test for the IV3_FIN also came out as insignificant, even though the VIFs for both Independent variables did not suggest the presence of multicollinearity. Please refer to Appendix C for the results of those statistical procedures.

6.4.2. Statistical Analysis – Port Of New York

Similar to the regression procedure results for the Port of Montreal, the results of the

Stepwise regression procedure for the Port of New York produced a very high coefficient of determination ($R^2 = 0.93689$) and a highly significant F test of 118.76. However, the Durbin-Watson test statistic of 3.03 did not allow concluding that there were no autocorrelated residuals. The Kolmogorov-Smirnov goodness of fit test, applied to all three variables, showed Normal distribution of the errors on all three variables.

Again, the t test came out significant for the Freight variable and NOT significant for the Financial variable. Further, the regression procedure with both Independent variables forced into the equation produced an even higher R^2 (0.93707) than in the Stepwise regression. Even though the R^2 was high and the F test showed significance, establishing a significant relationship between the DV and the Independent variables, the Durbin-Watson test was inconclusive, suggesting the presence of autocorrelated residuals and making the F test no longer valid. Finally, the fact that two Independent variables were strongly correlated with each other suggested the possible presence of multicollinearity, even though the VIFs values were relatively small. Furthermore, the t test for the IV3_FIN came out as insignificant. Please refer to Appendix 3 for the results of those statistical procedures.

Conclusion: The results of regression procedures for both ports, described above, suggested that the Financial Independent variable (Operating Income/Loss) was not a good predictor for the Average Cost of Transportation as a Dependent variable. However, based on the results of the Stepwise regression procedure for each port separately, it is possible to conclude that the port Throughput (IV2 FR) is a good predictor of the

Average Cost of Transportation, even on a limited set of data. These two variables are strongly correlated, there are no signs of violation of the basic assumptions in regression analysis, and there are no autocorrelations in the residuals. With only one predictor in the regression model, there is no basis for concern about the multicollinearity, which makes the significant F test results valid. Furthermore, the relationship between the Average Transportation Cost (DV) and the Throughput (IV) is such that the higher the Throughput, the lower the Average Transportation Cost. In other words, if a port wants to offer lower cost to the shipping lines, it has to ensure high cargo throughput.

6.4.3. Statistical Analysis – Port Transportation Cost as Dependent Variable

The conclusion that Throughput is a good predictor of Average Transportation Cost for both ports of New York and Montreal raised the following question: shouldn't Throughput predict even better the Ports' cost of transportation rather than the Average cost of transportation? As demonstrated prior, the Average Transportation Cost was a combination of Port, Marine and Ground transportation costs. Furthermore, the weight calculation based on 1992 costs revealed that Port costs contributed only about 20% to the Average cost, while the Ground transportation costs contributed 50%. In other words, cargo Throughput of the port, being more under the control of the port, should better predict Port costs, also under the control of port's management.

To test this hypothesis, another Stepwise regression procedure with Port Transportation Cost as a DV and two Independent variables (IV1_FR and IV2_FIN2) was executed on each port's model.

Indeed, the results of those procedures were quite interesting. For the Port of Montreal, the regression tests were stronger than for the model with Average Cost of Transportation as a DV. The R squared (0.93941) and the F test (124.04) were highly significant, the t test for the IV1_FR was also significant, and the Durbin-Watson statistic suggested no autocorrelations in the residuals. The t test for the other Independent variable IV2_FIN2 was insignificant, similarly to the results with the Average Transportation Cost as a DV.

For the Port of New York, the results were very similar. The Stepwise regression procedure rejected the IV2_FIN2, while suggesting very statistically significant results for the IV1_FR. The statistical tests suggested a strong relationship between the DV - Port Transportation Cost and the IV - Freight. Please refer to Attachment 1 for the results of those statistical procedures.

Given the fact that these statistical results were based on a limited data set, it was important to make sure that the regression results were strong and stable while the regression assumptions were not violated. The results of the regression procedures followed by statistical analysis allowed to conclude that the best model was the one with Port Transportation Cost as a Dependent variable and a Throughput as an Independent variable.

6.5 SUMMARY OF FINDINGS

- The ports' competitiveness was assessed through the Total Cost of Transportation,

comprised of the costs of Marine, Port and Ground Transportation. The Total Cost of Transportation was computed separately for the Port of Montreal and for the Port of New York, for a specific vessel-size with a capacity of 2,594 TEUs, on the North Atlantic route, and in relation to two major markets in Detroit and Chicago areas. The ten-year analysis of the Total Transportation Cost showed that since 1993, such cost for the Port of Montreal was lower than for the Port of New York. Thus, it was concluded that the Port of Montreal was more competitive for the smaller type container vessels. However, since the Port of Montreal can not accommodate larger ships due to the limited channel depth, the Port of New York attracts larger carriers without much competition.

- It was demonstrated that the Total Cost of Transportation can serve as a single measure of ports' competitiveness.
- For the purpose of developing an index of port competitiveness, weights for each cost component of the Average (Detroit, Chicago) Total Transportation Cost were computed. These weights were computed based on the 1992 costs and separately for the ports of New York and Montreal. In both cases, the weight of the Ground Transportation Cost alone was close to 50%, while the Port Cost was closer to 20% of the Total Cost of Transportation. Such weight distribution allowed concluding that Ground Transportation Cost plays the most important role in providing and sustaining the competitive advantage of ports as parts of intermodal transportation systems.
- The index of port competitiveness, labeled the Weighted Average Cost Competitive Index (WACCI), was computed using Laspeyres formulae and 1992 as a Base Year. That index for the Port of Montreal showed a steady decline since 1993, mostly

attributable to the decline in Ground Transportation Costs. For the Port of New York, the index showed a steady increase because a minor decline in the Ground Transportation Cost was not enough to offset the increase in Port Cost, which almost doubled in the period from 1991 to 2000. The index values provided an indication of general transportation cost trends. The year-over-year percentage changes illustrated how transportation costs have changed independently of the index levels or size of ports' operations. The dynamics of the WACCI should be interpreted such that the lower the Index, the more competitive the port is in terms of the total shipping costs.

- A model of port competitiveness was derived as a result of the regression procedures and statistical analysis. It was concluded that even on a limited data set, the Freight Handling Capacity of the port, expressed as Throughput, was a significant predictor (Independent Variable) for the Port Transportation Cost (Dependent Variable). At the same time, it was concluded that neither the Operating Margin nor the Operating Income/Loss was a significant predictor for the Port Transportation Cost. The relationship between the Throughput and the Port Cost was such that the higher the Throughput, the lower the Port Cost. Such relationship can be interpreted as follows: since it is important for the port to lower the costs in order to stay competitive, it is imperative to ensure significant throughput, which allows to lower the port costs.
- The outcome of statistical analysis for each port was very similar and allowed to conclude that ports' throughput is a significant predictor of ports' cost, thus a major factor of ports' competitive success. Furthermore, these results demonstrated that there is no difference in the competitive position of Canadian and U.S. ports on the East Coast of North America.

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APPENDIX 1

**Tables Containing Calculations of the Total Transportation Costs (the DV) for the
Ports of Montreal and New York, and the Total Transportation Cost Components
(Port Costs, Marine Costs and Ground Transportation Costs)**

Port Cost per TEU for Montreal

		Harb.Dues	Dockage	Berth/Wharf	Pilotage	Term.Fee	Emp.Sec.	Cont.Royalty	Fed. Taxes	Towing	Tying	TOTAL	Per TEU
<i>Montreal</i>	20'	\$0.49	\$1.87	\$26.04	\$5.19	\$150.00	\$49.60	\$0.00	\$0.00	\$1.46	\$0.62	\$235.27	\$235.27
	Ship 2594 TEU 40'	\$0.99	\$3.73	\$43.26	\$10.37	\$150.00	\$82.40	\$0.00	\$0.00	\$3.53	\$1.23	\$295.51	\$147.76

Port Cost per TEU for New York

		Harb.Dues	Dockage	Berth/Wharf	Pilotage	Term.Fee	Emp.Sec.	Cont.Royalty	Fed. Taxes	Towing	Tying	TOTAL	Per TEU
NYNJ	Ship 2594 TEU	\$0.00	incl	incl	\$4.30	\$190.00	\$33.30	\$55.06	\$1.29	\$3.33	incl	\$287.28	\$287.28
	40'	\$0.00	incl	incl	\$8.60	\$190.00	\$44.40	\$91.46	\$2.58	\$6.66	incl	\$343.70	\$171.85

Port Cost per TEU for Montreal from 1991 to 2000

Table 6.1.5.- A

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Harb.Dues	\$0.49	\$0.49	\$0.49	\$0.49	\$0.49	\$0.49	\$0.49	\$0.49	\$0.49	\$0.49
Dockage	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87	\$1.87
Berth/Wharf	\$26.56	\$26.04	\$25.83	\$25.63	\$25.42	\$25.22	\$25.01	\$24.81	\$24.62	\$24.42
Pilotage **	\$5.19	\$5.19	\$5.19	\$5.19	\$5.19	\$5.53	\$5.84	\$5.84	\$5.84	\$5.84
Term.Fee *	\$147.75	\$150.00	\$152.70	\$153.00	\$156.30	\$158.85	\$161.40	\$162.90	\$165.75	\$170.25
Emp.Sec.Dues *	\$48.86	\$49.60	\$50.49	\$50.59	\$51.68	\$52.53	\$53.37	\$53.87	\$54.81	\$56.30
Cont.Royalty	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Fed. Taxes	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Towing	\$1.46	\$1.46	\$1.46	\$1.46	\$1.46	\$1.46	\$1.46	\$1.46	\$1.46	\$1.46
Tying	\$0.62	\$0.62	\$0.62	\$0.62	\$0.62	\$0.62	\$0.62	\$0.62	\$0.62	\$0.62
TOTAL per TEU	\$232.80	\$235.27	\$238.65	\$238.85	\$243.03	\$246.57	\$250.07	\$251.86	\$255.46	\$261.25

* indexed with the CPI to reflect inflation, Stats Canada, Cat. 62-001, Jan. 2001 1992=100

As per QUONSET PORT report, July 31, 2000, Ground to Chicago for Montreal is \$798 and for N.Y. is 1,015

Also, Terminal Fees for Montreal stayed the same while increasing at N.Y. by 25% in 1999

** As per Canadian Transportation Agency Decision No. 669-W-1995, the LPA tariff was increased as follows:

1996 - by 5% plus a CPI component with a cap of 2%, actual - 1.63%

1997 - by 4% plus a CPI component with a cap of 2%, actual - 1.6%

1998 - no increase

1999 - no increase

2000 - no increase

Next increase in tariff was approved by the CTA in Decision No.94-W-2001 as of January 1, 2001

Port Cost per TEU for New York from 1991 to 2000

Table 6.1.6.- A

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Harb.Dues **	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00
Dockage **	incl	incl	incl	incl	incl	incl	incl	incl	incl	incl
Berth/Wharf **	incl	incl	incl	incl	incl	incl	incl	incl	incl	incl
Pilotage ***	\$3.93	\$4.30	\$4.77	\$5.25	\$5.45	\$5.66	\$5.94	\$6.71	\$6.97	\$7.24
Term.Fee *****	\$175.92	\$190.00	\$212.38	\$235.20	\$245.87	\$251.93	\$265.96	\$302.80	\$316.53	\$330.88
Emp.Sec.Dues *	\$32.80	\$33.30	\$33.90	\$33.97	\$34.70	\$35.26	\$35.83	\$36.16	\$36.80	\$37.80
Cont.Royalty *	\$54.23	\$55.06	\$56.05	\$56.16	\$57.37	\$58.31	\$59.24	\$59.80	\$60.84	\$62.49
Feder. Fees****	\$1.21	\$1.29	\$1.37	\$1.43	\$1.42	\$1.37	\$1.37	\$1.48	\$1.47	\$1.45
Towing	\$3.33	\$3.33	\$3.33	\$3.33	\$3.33	\$3.33	\$3.33	\$3.33	\$3.33	\$3.33
Tying	incl	incl	incl	incl	incl	incl	incl	incl	incl	incl
TOTAL per TEU	\$271.43	\$287.28	\$311.80	\$335.34	\$348.14	\$355.87	\$371.68	\$410.28	\$425.93	\$443.19

* indexed with the CPI (1992=100) to reflect inflation, (Stats Canada, Cat. 62-001, Jan. 2001). The basic rate did not change

** These port charges remained the same at the Port of New York since 1991.

*** Calculation of Pilotage Fees for 1992 to 2000

Table 6.1.6.- A (supplementary)

Source: Sandy Hook Pilots providing pilotage for the Port of New York/New Jersey
(Pilotage Fees rate of increase already reflects change in inflation.)

Ship 2594 TEU	Requires 507.79 units of pilotage in 2000			
For 500 units and up:	Basic Tariff	\$ [(507.79 - 500) * 0.85] + 3195 =		\$3,201.62
	Pension Tariff	\$ [(507.79 - 500) * 0.23] + 1060 =		\$1,061.79
	Total (USD)- 2000			\$4,263.41
	Total (USD)- 1992			\$3,484.47
	Percentage increase over 8 years			22.35%
	Rate of increase per year			2.8%

Change in \$US - \$CAN Exchange Rate (Bank of Canada, Banking and Financial Statistics, Jan., 2001)

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1.14		1.21	1.29	1.36	1.37	1.36	1.38	1.48	1.49	1.49

**** Calculation of Federal Fees for 1992 to 2000

Source: US Department of Customs, <http://www.customs.gov/>

1	COBRA (USD)	no change since 1992	\$397.00
	COBRA (CAN)		\$475.00
	COBRA (CAN) per 20' container		\$0.24
2	Agri Inspection	USD	1992 \$544.00
		USD	2000 \$465.00
	Percentage decrease over 8 years		-14.52%
	Rate of decrease per year		-1.82%
3	Tonnage Tax	CAN	no change since 1992
	Per 20' container		\$0.72

The total amount of Federal Fees declined by 1.82 % due to Agricultural Inspection Tax
In addition, the change in US-CAN exchange rate was applied

***** Terminal Fees increased by 3.5 % from 1993 to 2000 based on QUONSET PORT report (July, 2000)
Terminal Fees at New York increased by 25% in 1999 or at a rate of 3.5% per year over 7 years from 92 to 99
In addition, the change in US-CAN exchange rate was applied

Marine Cost per TEU

Source: KPMG study, 1993

Tables 6.1.5 and 6.1.6.- B (supplementary)

Fuel	1992=100									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Indexed with Fuel Price Indexes, Statistics Canada Cat.No.62-011, IPPI, Dec. 95										
Statistics Canada Cat.No.62-011-XPB, IPPI, Dec. 97, Nov. 99, Nov. 00										
	\$10,079	\$9,408	\$9,428	\$9,510	\$9,866	\$11,308	\$11,196	\$9,145	\$10,368	\$15,279
	\$159,846	\$149,200	\$149,523	\$150,813	\$156,458	\$179,338	\$177,548	\$145,022	\$164,418	\$242,301
	\$4,133	\$3,858	\$3,866	\$3,900	\$4,046	\$4,637	\$4,591	\$3,750	\$4,252	\$6,265

Labour	1992=100									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Indexed with Consumer Price Indexes, Statistics Canada Cat.No.62-001, IPPI, Jan. 2001										
	\$415,965	\$422,299	\$429,900	\$430,745	\$440,036	\$447,215	\$454,394	\$458,617	\$466,640	\$479,309

Cost of Capital for the ship	Not indexed since cost of capital remains the same over 20 years of the ship's service life									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	\$673,007	\$673,007	\$673,007	\$673,007	\$673,007	\$673,007	\$673,007	\$673,007	\$673,007	\$673,007

Cost of Capital for Containers	Not indexed since cost of capital remains the same over 10 years of the containers' service life									
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	\$265,915	\$265,915	\$265,915	\$265,915	\$265,915	\$265,915	\$265,915	\$265,915	\$265,915	\$265,915

Total Marine Cost per trip										
	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	\$1,528,945	\$1,523,687	\$1,531,640	\$1,533,889	\$1,549,327	\$1,581,421	\$1,586,650	\$1,555,456	\$1,584,600	\$1,682,076

Table 6.1.5.- B

Marine Cost per trip per TEU for Montreal										
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
\$392	\$391	\$393	\$393	\$397	\$405	\$407	\$399	\$406	\$431	

Table 6.1.6.- B

Marine Cost per trip per TEU for New York										
1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
\$416	\$415	\$417	\$418	\$422	\$431	\$432	\$424	\$431	\$458	

Tables 6.1.5.A (supplementary)

IPPI Indices		1992=100	
1986=100		1991	1992
		99.1	107.1
		92.5	100.0
		92.7	100.2
		93.5	101.1
		97.0	104.9
		Rebased	120.2
		107.1	119.0
		100.0	97.2
		100.2	110.2
		101.1	162.4
		104.9	

Statistics Canada Cat.No.62-011-XPB, IPPI, Dec. 97, Nov. 99, Nov. 00

Ground Transportation Cost per TEU for Montreal

Table 6.1.5.-C

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Detroit	\$557	\$535	\$516	\$493	\$469	\$447	\$425	\$405	\$385	\$366
Chicago	\$778	\$755	\$733	\$711	\$690	\$669	\$649	\$630	\$612	\$594

Note: Ground Transportation Cost from Montreal to Detroit and to Chicago for Export and Import was the same in 1992

Ground Transportation Cost per TEU for New York

Table 6.1.6.-C

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Detroit	\$678	\$643	\$643	\$614	\$635	\$628	\$621	\$621	\$618	\$611
Chicago	\$670	\$635	\$635	\$607	\$628	\$621	\$614	\$614	\$610	\$604

Note: Ground Transportation Cost from New York to Detroit and to Chicago was taken as average between Export and Import costs i

Calculation of Ground Transportation Cost, Montreal, 1991 - 2000

Table 6.1.5.-C (supplementary)

Rates between Chicago and Montreal

Per 20 ft IPEX Container	2001, CN open freight tariff
US \$	CAN \$ CNR 7589-AA
500	691
440	608
350	484
AVG:	\$594
2000over1992	27% or 3% per year

Source: CN Freight Tariff CNR 7589-AA

Rates between Detroit and Montreal

Per 20 ft IPEX Container	2001, CN open freight tariff
US \$	CAN \$ CNR 7589-AA
255	352
315	435
225	311
AVG:	\$366
2000over1992	46% or 5% per year

Source: CN Freight Tariff CNR 7589-AA

Calculation of Ground Transportation Cost, New York, 1991 - 2000

Table 6.1.6.-C (supplementary)

		Detroit	Chicago
1984	100%		
1991	95%	\$678	\$670
1992	90%	\$643	\$635
1993	90%	\$643	\$635
1994	86%	\$614	\$607
1995	89%	\$635	\$635
1996	88%	\$628	\$621
1997	87%	\$621	\$614
1998	87%	\$621	\$614
1999	86.5%	\$618	\$610
Est. 2000	85.6%	\$611	\$604

Source: Surface Transportation Board, Report from December 2000

Calculation of the Average Exchange Rate (US - CAN) between 1992 and 2000

Table 6.1.6.-C (supplementary)

1992	1.2083
1993	1.2898
1994	1.3659
1995	1.3726
1996	1.3636
1997	1.3844
1998	1.4831
1999	1.4848
2000	1.4852
AVG:	1.3820

Source: Bank of Canada, Banking & Financial Statistics, Exchange Rates, 11, Jan. 2001

Total Transportation Cost per TEU for Montreal

Table 6.1.5.-D

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Detroit										
Marine	392.04	391.00	392.73	393.30	397.26	405.49	406.83	398.83	406.31	431.30
Port	232.80	235.27	238.65	238.85	243.03	246.57	250.07	251.86	255.46	261.25
Ground	556.81	535.00	516.29	492.64	469.18	446.84	425.16	404.53	384.90	366.22
Total	\$1,182	\$1,161	\$1,148	\$1,125	\$1,109	\$1,099	\$1,082	\$1,055	\$1,047	\$1,059
Chicago										
Marine	392.04	391.00	392.73	393.30	397.26	405.49	406.83	398.83	406.31	431.30
Port	232.80	235.27	238.65	238.85	243.03	246.57	250.07	251.86	255.46	261.25
Ground	777.65	755.00	732.98	710.94	689.56	668.83	649.35	630.44	612.07	594.25
Total	\$1,402	\$1,381	\$1,364	\$1,343	\$1,330	\$1,321	\$1,306	\$1,281	\$1,274	\$1,287

Total Transportation Cost per TEU for New York

Table 6.1.6.-D

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Detroit										
Marine	416.34	414.91	417.08	417.69	421.89	430.63	432.06	423.56	431.50	458.04
Port	271.43	287.28	311.80	335.34	348.14	355.87	371.68	410.28	425.93	443.19
Ground	678.19	642.50	642.50	613.94	635.36	628.22	621.08	621.08	617.51	611.09
Total	\$1,366	\$1,345	\$1,371	\$1,367	\$1,405	\$1,415	\$1,425	\$1,455	\$1,475	\$1,512
Chicago										
Marine	416.34	414.91	417.08	417.69	421.89	430.63	432.06	423.56	431.50	458.04
Port	271.43	287.28	311.80	335.34	348.14	355.87	371.68	410.28	425.93	443.19
Ground	670.28	635.00	635.00	606.78	627.94	620.89	613.83	613.83	610.31	603.96
Total	\$1,358	\$1,337	\$1,364	\$1,360	\$1,398	\$1,407	\$1,418	\$1,448	\$1,468	\$1,505

Average Transportation Cost per TEU for Montreal

Table 6.2.1-A

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Marine	392.04	391.00	392.73	393.30	397.26	405.49	406.83	398.83	406.31	431.30
Port	232.80	235.27	238.65	238.85	243.03	246.57	250.07	251.86	255.46	261.25
Ground	667.23	645.00	624.63	601.79	579.37	557.84	537.25	517.48	498.49	480.23
Total	\$1,292	\$1,271	\$1,256	\$1,234	\$1,220	\$1,210	\$1,194	\$1,168	\$1,160	\$1,173
Weights_92										
Marine	120.58	120.26	120.79	120.97	122.18	124.72	125.13	122.67	124.97	132.65
Port	0.3076	43.54	44.17	44.20	44.98	45.63	46.28	46.61	47.28	48.35
Ground	0.1851	327.25	316.92	305.33	293.95	283.03	272.58	262.55	252.92	243.65
Total	1.0000	502.1905	481.8757	470.4990	461.1171	453.3745	443.9924	431.8330	425.1585	424.6569
W. Index	102.27	100.00	98.13	95.81	93.90	92.33	90.42	87.94	86.58	86.48
Year over Year Perct.		-2.22%	-1.87%	-2.36%	-1.99%	-1.68%	-2.07%	-2.74%	-1.55%	-0.12%
Year/1992 Perct.		0.00%	-1.87%	-4.19%	-6.10%	-7.67%	-9.58%	-12.06%	-13.42%	-13.52%

Average Transportation Cost per TEU for New York

Table 6.2.1-B

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Marine	416.34	414.91	417.08	417.69	421.89	430.63	432.06	423.56	431.50	458.04
Port	271.43	287.28	311.80	335.34	348.14	355.87	371.68	410.28	425.93	443.19
Ground	674.24	638.75	638.75	610.36	631.65	624.56	617.46	617.46	613.91	607.52
Total	\$1,362	\$1,341	\$1,368	\$1,363	\$1,402	\$1,411	\$1,421	\$1,451	\$1,471	\$1,509
Weights_92										
Marine	128.82	128.38	128.28	128.47	129.76	132.45	132.89	130.27	132.71	140.88
Port	0.3094	61.55	57.70	62.06	64.43	65.86	68.79	75.93	78.83	82.02
Ground	0.2142	304.26	324.08	309.68	320.48	316.88	313.28	313.28	311.48	308.24
Total	1.0000	508.1426	494.1923	510.0637	514.6691	515.1865	514.9493	519.4808	523.0180	531.1349
W. Index	102.82	100.00	103.87	101.86	104.81	104.92	104.87	105.79	106.51	108.16
Year over Year Perct.		-2.75%	3.87%	-1.93%	2.89%	0.10%	-0.05%	0.88%	0.68%	1.55%
Year/1992 Perct.		0.00%	3.87%	1.86%	4.81%	4.92%	4.87%	5.79%	6.51%	8.16%

APPENDIX 2

Tables Containing Calculations of the Independent Variables for the Ports of Montreal and New (Financial Performance Indicators and Freight Handling Capacity)

Financial Performance Indicator (\$'000), 1991-2000

Table 6.3.1

Independent Variable Financial 1 - Operating Margin Independent Variable Financial 2 - Operating Income/Loss

		2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
Montreal	Gr.Op. Rev.	60,965	58,872	57,113	56,620	56,174	54,584	56,906	52,395	53,291	53,601
	Op.Exp.exc.Dep	46,540	44,923	39,662	39,126	38,973	40,176	41,131	39,912	42,187	41,732
	Depreciation	9,959	10,170	10,740	10,698	11,141	10,903	10,310	10,762	10,254	10,648
	Net Other Income	5,841	6,435	6,335	5,630	5,762	5,803	4,630	9,721	4,131	6,920
	Op.Income/Loss	10,307	10,214	13,046	12,426	11,822	9,308	10,095	11,442	4,981	8,141
	Op. Margin	16.91%	17.35%	22.84%	21.95%	21.05%	17.05%	17.74%	21.84%	9.35%	15.19%
NYNJ Marine only	Gr.Op. Rev.	114,290	111,581	110,927	182,439	195,666	112,800	107,224	104,041	104,723	100,574
	Op.Exp.exc.Dep	71,002	73,272	84,871	160,608	160,524	91,037	87,201	83,010	83,513	82,832
	Depreciation *	33,841	35,235	32,831	46,453	58,089	32,254	32,103	32,774	31,745	30,669
	Net Other Income	0	0	0	0	0	0	0	0	0	0
	Op.Income/Loss	9,447	3,074	-6,775	-24,622	-22,947	-10,491	-12,080	-11,744	-10,534	-12,928
	Op. Margin	8.27%	2.75%	-6.11%	-13.50%	-11.73%	-9.30%	-11.27%	-11.29%	-10.06%	-12.85%

Sources:

Ports Canada, Summaries, 1998 Capital Budgets and 1998-2002 Corporate Plans, February, 1998

Ports Canada, Annual Report 1997

Port of Montreal, Annual Report 1999, 1996, 1998, 1993, 1994

MARAD 2000 Report "1999 Public Port Finance Survey"

Port Authority of New York/New Jersey, Annual Reports 2000-1996, 1988, Statistical and Financial Data, Sch. Also: www.panynj.gov web site

* Depreciation estimated for years 1995 to 1991

Freight Handling Capability

Independent Variable Freight (Throughput)

Table 6.3.2

		2000	1999	1998	1997	1996	1995	1994	1993	1992	1991
<i>Montreal*</i> 100% offload	Total Tonnage	21,530,000	20,600,000	21,000,000	20,700,000	19,900,000	19,224,000	20,083,000	16,500,000	17,471,000	17,470,000
	TEUs	1,038,192	993,486	932,701	870,368	852,530	726,435	726,799	598,120	537,256	575,554
<i>NY/NJ</i>	Total Tonnage	64,817,260	58,135,801	56,028,805	50,357,527	51,276,518	44,892,317	46,551,961	41,352,080	38,023,739	42,042,710
	TEUs	3,050,746	2,828,878	2,465,993	2,456,886	2,269,145	2,262,792	2,033,879	1,972,692	2,014,052	1,865,471
50% offload	Tonnage - 50%	32,408,630	29,067,901	28,014,403	25,178,764	25,638,259	22,446,159	23,275,981	20,676,040	19,011,870	21,021,355
	TEUs - 50%	1,525,373	1,414,439	1,232,997	1,228,443	1,134,573	1,131,396	1,016,940	986,346	1,007,026	932,736

Sources:

Ports Canada, Ten-Year Traffic Review, 1986-1995 and 1988-1997

Montreal Port Authority Annual Reports 1998, 1999

Port of Montreal Guide 2000-2001

Port Authority of New York/New Jersey, Annual Reports 97-2000, Statistical and Financial Data

See also www.panynj.gov web site Press Releases: March 15, 2000

The estimated by Ports Canada Tonnage for the Port of Montreal grew in 2000 by 4.5% over 1999

The same growth rate was applied to TEUs

* - Source: Canadian Sailings, October 23, 2000

Ports Canada, Ten-Year Traffic Review (1986-1995), April, 1996

Ports Canada, Ten-Year Traffic Review (1988-1997), March, 1998

APPENDIX 3**Statistical Analysis Results**

**Statistical Data Input for the Regression Procedure for the Port of Montreal
with the Average Transportation Cost as a Dependent Variable**

	Dv_ATC_M	IV1_FIN	IV2_FR	IV3_FIN2
1	\$1,292	15.19	575554	8141
2	\$1,271	9.35	537256	4981
3	\$1,256	21.84	598120	11442
4	\$1,234	17.74	728799	10095
5	\$1,220	17.05	726435	9308
6	\$1,210	21.05	852530	11822
7	\$1,194	21.95	870368	12426
8	\$1,168	22.84	932701	13046
9	\$1,160	17.35	993486	10214
10	\$1,173	16.91	1038192	10307

**Statistical Data Input for the Regression Procedure for the Port of Montreal
with the Port Transportation Cost as a Dependent Variable**

	Dv_PTC_M	IV1_FR	IV2_FIN2
1	232.80	575554.0	8141.0
2	235.27	537256.0	4981.0
3	238.65	598120.0	11442.0
4	238.85	728799.0	10095.0
5	243.03	726435.0	9308.0
6	246.57	852530.0	11822.0
7	250.07	870368.0	12426.0
8	251.86	932701.0	13046.0
9	255.46	993486.0	10214.0
10	261.25	1038192.0	10307.0

**Statistical Data Output for the Regression Procedure for the Port of Montreal
with the Average Transportation Cost as a Dependent Variable**

	N	Mean	Std Dev	Minimum	Maximum
DV_ATC_M	10	1217.800	45.360	1160	1292
IV2_FR	10	785344.125	178883.031	537256	1038192
IV3_FIN2	10	10178.200	2345.664	4981	13046

Kolmogorov - Smirnov Goodness of Fit Test

DV_ATC_M AvTransCost_Montreal

Test distribution - Normal Mean: 1217.80

Standard Deviation: 45.36 Cases: 10

Most extreme differences

Absolute	Positive	Negative	K-S Z	2-Tailed P
.13834	.13834	-.10129	.4375	.9909

IV2_FR Freight Throughput

Test distribution - Normal Mean: 785344.13

Standard Deviation: 178883.03 Cases: 10

Most extreme differences

Absolute	Positive	Negative	K-S Z	2-Tailed P
.15236	.15236	-.14639	.4818	.9744

IV3_FIN2 OperIncom/Loss

Test distribution - Normal Mean: 10178.20

Standard Deviation: 2345.66 Cases: 10

Most extreme differences

Absolute	Positive	Negative	K-S Z	2-Tailed P
.18585	.11074	-.18585	.5877	.8801

Correlation Coefficients for the Port of Montreal Variables

	DV_ATC_M	IV1_FIN	IV2_FR	IV3_FIN2
DV_ATC_M	1.0000 (10) P= .	-.4833 (10) P= .157	-.9614 (10) P= .000	-.6262 (10) P= .053
IV1_FIN	-.4833 (10) P= .157	1.0000 (10) P= .	.4485 (10) P= .194	.9804 (10) P= .000
IV2_FR	-.9614 (10) P= .000	.4485 (10) P= .194	1.0000 (10) P= .	.6091 (10) P= .062
IV3_FIN2	-.6262 (10) P= .053	.9804 (10) P= .000	.6091 (10) P= .062	1.0000 (10) P= .

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable.. DV_ATC_M AvTransCost_Montreal

Block Number 1. Method: Stepwise Criteria PIN .0500 POUT .1000

IV3_FIN2 IV2_FR

Step	MultR	Rsq	F(Eqn)	SigF	Variable	BetaIn
1	.9614	.9242	97.609	.000	In: IV2_FR	-.9614

Variable(s) Entered on Step Number 1.. IV2_FR Freight Throughput

Multiple R	.96138	Adjusted R Square	.91478
R Square	.92425	Standard Error	13.24164

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	17114.87089	17114.87089
Residual	8	1402.72911	175.34114
F =	97.60899	Signif F =	.0000

----- Variables in the Equation -----

Variable	B	SE B	95% Confdnce	Intrvl B	Beta
IV2_FR	-2.43779E-04	2.4675E-05	-3.00679E-04	-1.86879E-04	-.961379
(Constant)	1409.250449	19.825372	1363.533106	1454.967793	

Variable	Tolerance	VIF	T	Sig T
IV2_FR	1.000000	1.000	-9.880	.0000
(Constant)			71.083	.0000

----- Variables not in the Equation -----

Variable	Beta In	Partial Tolerance	VIF	Min Toler	T	Sig T
IV3_FIN2	-.064510	-.185889	.628977	1.590	.628977	-.501
						.6320

Collinearity Diagnostics

Number	Eigenval	Cond	Variance Proportions
		Index	Constant IV2_FR
1	1.97744	1.000	.01128 .01128
2	.02256	9.362	.98872 .98872

Durbin-Watson Test = 1.80375

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable.. DV_ATC_M AvTransCost_Montreal

Block Number 2. Method: Backward Criterion POUT .1000

IV3_FIN2 IV2_FR

Variable(s) Removed on Step Number 3.. IV3_FIN2 OperIncom/Loss

Multiple R .96138 Adjusted R Square .91478

R Square .92425 Standard Error 13.24164

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	17114.87089	17114.87089
Residual	8	1402.72911	175.34114
F =	97.60899	Signif F = .0000	

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T
IV2_FR	-2.43779E-04	2.4675E-05	-.961379	-9.880	.0000
(Constant)	1409.250449	19.825372		71.083	.0000

----- Variables not in the Equation -----

Variable	Beta In	Partial	Toler	T	Sig T
IV3_FIN2	-.064510	-.185889	.628977	-.501	.6320

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable.. DV_ATC_M AvTransCost_Montreal

Block Number 1. Method: Enter

Variable(s) Entered on Step Number

1.. IV2_FR Freight Throughput 2.. IV3_FIN2 OperIncom/Loss

Multiple R .96274 Adjusted R Square .90597

R Square .92687 Standard Error 13.90919

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	17163.34165	8581.67082
Residual	7	1354.25835	193.46548

F = 44.35763 Signif F = .0001

----- Variables in the Equation -----

Variable	B	SE B	Beta	T	Sig T	VIF
IV3_FIN2	-.001247	.002492	-.064510	-.501	.6320	1.590
IV2_FR	-2.33815E-04	3.2681E-05	-.922084	-7.154	.0002	1.590
(Constant)	1414.122454	22.987262		61.518	.0000	

Durbin-Watson Test = 2.09748

**Statistical Data Output for the Regression Procedure for the Port of Montreal
with the Port Transportation Cost as a Dependent Variable**

MULTIPLE REGRESSION

	Mean	Std Deviat	Label
PTC_M	245.381	9.266	PORT TRANSPORTATION COST MONTREAL
IV1_FR	785344.100	178883.035	FREIGHT THROUGHPUT
IV2_FIN2	10178.200	2345.664	OPERATING INCOME/LOSS

N of Cases = 10

Correlation, 1-tailed Sig:

	PTC_M	IV1_FR	IV2_FIN2
PTC_M	1.000	.969	.541
IV1_FR		1.000	.609
IV2_FIN2			1.000
	.000	.000	.031
	.053	.031	.

Equation Number 1 Dependent Variable: PTC_M PORT TRANSPORTATION COST
MONTREAL Block Number 1. Method: Enter IV1_FR IV2_FIN2

Variable(s) Entered on Step Number

- 1.. IV2_FIN2 OPERATING INCOME/LOSS
- 2.. IV1_FR FREIGHT THROUGHPUT

Multiple R	.97127	Adjusted R Square	.92718
R Square	.94336	Standard Error	2.50056

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	729.02126	364.51063
Residual	7	43.76943	6.25278
F =	58.29581	Signif F =	.0000

----- Variables in the Equation -----

Variable	B	SE B	95% Confdnce	Intrvl B	Beta
IV1_FR	5.27077E-05	5.8753E-06	3.88149E-05	6.66005E-05	1.017498
IV2_FIN2	-3.13023E-04	4.4806E-04	-.001373	7.46458E-04	-.079238
(Constant)	207.173319	4.132586	197.401327	216.945311	

Variable	Tolerance	VIF	T	Sig T
IV1_FR	.628977	1.590	8.971	.0000
IV2_FIN2	.628977	1.590	-.699	.5073
(Constant)			50.132	.0000

Total Cases = 10

Durbin-Watson Test = 2.53453

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable: PTC_M PORT TRANSPORTATION COST
 MONTREAL Block Number 1. Method: Stepwise Criteria PIN .0500 POUT
 .1000 IV1_FR IV2_FIN2

Variable(s) Entered on Step Number

1.. IV1_FR FREIGHT THROUGHPUT

Multiple R .96923 Adjusted R Square .93184
 R Square .93941 Standard Error 2.41923

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	725.96943	725.96943
Residual	8	46.82126	5.85266

F = 124.04098 Signif F = .0000

----- Variables in the Equation -----

Variable	Tolerance	VIF	T	Sig T
IV1_FR	1.000000	1.000	11.137	.0000
(Constant)			56.860	.0000

----- Variables not in the Equation -----

Variable	Beta In	Partial Tolerance	VIF	Min Toler	T	Sig T
IV2_FIN2	-.079238	-.255305	.628977	1.590	.628977	-.699 .5073

Total Cases = 10

Durbin-Watson Test = 2.29770

**Statistical Data Input for the Regression Procedure for the Port of New York
with the Average Transportation Cost as a Dependent Variable**

	DV_ATC_NY	DV_PTC_NY	IV1_FR	IV2_FIN2
1	1362	271.43	1865471	-12928.0
2	1341	287.28	2014052	-10534.0
3	1368	311.80	1972692	-11744.0
4	1363	335.34	2033879	-12080.0
5	1402	348.14	2262792	-10491.0
6	1411	355.87	2269145	-22947.0
7	1421	371.68	2456886	-24622.0
8	1451	410.28	2465993	-6775.0
9	1471	425.93	2828878	3074.0
10	1509	443.19	3050746	9447.0

**Statistical Data Output for the Regression Procedure for the Port of New York
with the Average Transportation Cost as a Dependent Variable**

	N	Mean	Std Dev	Minimum	Maximum
DV_ATCNY	10	1409.9000	54.1878	1341.0	1509.0
IV1_FR	10	2322053.5000	386077.7188	1865471.0	3050746.0
IV2_FIN2	10	-9960.0000	10313.9336	-24622.0	9447.0

Kolmogorov - Smirnov Goodness of Fit Test**DV_ATC_NY AVERAGE TRANSPORTATION COST NEW YORK**

Test distribution - Normal Mean: 1409.90

Standard Deviation: 54.19 Cases: 10

Most extreme differences

Absolute	Positive	Negative	K-S Z	2-Tailed P
.18031	.18031	-.10177	.5702	.9011

IV1_FR FREIGHT THROUGHPUT

Test distribution - Normal Mean: 2322053.500

Standard Deviation: 386077.719 Cases: 10

Most extreme differences

Absolute	Positive	Negative	K-S Z	2-Tailed P
.17229	.17229	-.11848	.5448	.9279

IV2_FIN2 OPERATING INCOME/LOSS

Test distribution - Normal Mean: -9960.000

Standard Deviation: 10313.934 Cases: 10

Most extreme differences

Absolute	Positive	Negative	K-S Z	2-Tailed P
.22053	.22053	-.18676	.6974	.7156

Correlation Coefficients for the Port of New York Variables

	DV_ATC_NY	IV1_FR	IV2_FIN2
DV_ATC_NY	1.000	.968	.603
	.	.000	.032
IV1_FR	.968	1.000	.634
	.000	.	.025
IV2_FIN2	.603	.634	1.000
	.032	.025	.

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable: DV_ATC_NY AVERAGE
TRANSPORTATION COST NEW YORK

Block Number 1. Method: Enter IV1_FR IV2_FIN2

Variable(s) Entered on Step Number

1.. IV2_FIN2 OPERATING INCOME/LOSS

2.. IV1_FR FREIGHT THROUGHPUT

Multiple R .96802 Adjusted R Square .91909

R Square .93707 Standard Error 15.41368

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	24763.82830	12381.91415
Residual	7	1663.07170	237.58167

F = 52.11645 Signif F = .0001

----- Variables in the Equation -----

Variable	B	SE B	9 5% Confdnce Intrvl	B	Beta
IV1_FR	1.37397E-04	1.7205E-05	9.67137E-05 1.78080E-04		.978924
IV2_FIN2	-9.11306E-05	6.4402E-04	-.001614 .001432		-.017345
(Constant)	1089.950075	44.562187	984.577482 1195.322667		

Variable	Tolerance	VIF	T	Sig T
IV1_FR	.598300	1.671	7.986	.0001
IV2_FIN2	.598300	1.671	-.142	.8915
(Constant)			24.459	.0000

Total Cases = 10

Durbin-Watson Test = 3.08348

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable: DV_ATC_NY AVERAGE
TRANSPORTATION COST NEW YORK

Block Number 1. Method: Stepwise Criteria PIN .0500 POUT .1000

IV1_FR IV2_FIN2

Variable(s) Entered on Step Number

1.. IV1_FR FREIGHT THROUGHPUT

Multiple R .96793 Adjusted R Square .92900

R Square .93689 Standard Error 14.43879

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	24759.07124	24759.07124
Residual	8	1667.82876	208.47860

F = 118.76074 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	95% Confdnce Intrvl	B	Beta
IV1_FR	1.35854E-04	1.2466E-05	1.07106E-04 1.64601E-04	1.35854E-04	.967930
(Constant)	1094.440654	29.305115	1026.863006 1162.018302	1094.440654	

Variable	Tolerance	VIF	T	Sig T
IV1_FR	1.000000	1.000	10.898	.0000
(Constant)			37.346	.0000

----- Variables not in the Equation -----

Variable	Beta In	Partial Tolerance	VIF	Min Toler	T	Sig T
IV2_FIN2	-.017345	-.053406	.598300	1.671	.598300	-.142 .8915

Total Cases = 10

Durbin-Watson Test = 3.03028

**Statistical Data Output for the Regression Procedure for the Port of New York
with the Port Transportation Cost as a Dependent Variable**

Correlation, 1-tailed Sig:

	DV_PTCNY	IV1_FR	IV2_FIN2
DV_PTCNY	1.000	.950	.553
IV1_FR	.950	1.000	.634
IV2_FIN2	.553	.634	1.000
		.000	.049
		.000	.025
		.049	.025

M U L T I P L E R E G R E S S I O N

Equation Number 1 Dependent Variable: DV_PTC_NY PORT TRANSPORTATION
COST NEW YORK

Block Number 1. Method: Enter IV1_FR IV2_FIN2

Variable(s) Entered on Step Number

- 1.. IV2_FIN2 OPERATING INCOME/LOSS
- 2.. IV1_FR FREIGHT THROUGHPUT

Multiple R .95191 Adjusted R Square .87932
R Square .90614 Standard Error 20.05674

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	2	27185.27940	13592.63970
Residual	7	2815.90944	402.27278

F = 33.78961 Signif F = .0003

----- Variables in the Equation -----

Variable	B	SE B	95% Confdnce Intrvl	B	Beta
IV1_FR	1.49753E-04	2.2387E-05	9.68157E-05	2.02691E-04	1.001391

IV2_FIN2 -4.55383E-04 8.3802E-04 -.002437 .001526 -.081349
 (Constant) 3.822862 57.985626 -133.291050 140.936774

Variable	Tolerance	VIF	T	Sig T
IV1_FR	.598300	1.671	6.689	.0003
IV2_FIN2	.598300	1.671	-.543	.6037
(Constant)			.066	.9493

Collinearity Diagnostics

Number	Eigenval	Cond	Variance	Proportions
Index	Constant	IV1_FR	IV2_FIN2	
1	2.56825	1.000	.00174	.00201 .03092
2	.42521	2.458	.00230	.00680 .49702
3	.00653	19.829	.99595	.99120 .47206

Total Cases = 10

Durbin-Watson Test = 1.82600

MULTIPLE REGRESSION

Equation Number 1 Dependent Variable: DV_PTC_NY PORT TRANSPORTATION
 COST NEW YORK

Block Number 1. Method: Stepwise Criteria PIN .0500 POUT .1000

IV1_FR IV2_FIN2

Variable(s) Entered on Step Number

1.. IV1_FR FREIGHT THROUGHPUT

Multiple R	.94983	Adjusted R Square	.88995
R Square	.90218	Standard Error	19.15299

Analysis of Variance

	DF	Sum of Squares	Mean Square
Regression	1	27066.49396	27066.49396

Residual 8 2934.69488 366.83686

F = 73.78346 Signif F = .0000

----- Variables in the Equation -----

Variable	B	SE B	95% Confdnce Intrvl	B	Beta
IV1_FR	1.42043E-04	1.6536E-05	1.03910E-04	1.80176E-04	.949832
(Constant)	26.262427	38.873101	-63.379012	115.903866	

Variable	Tolerance	VIF	T	Sig T
IV1_FR	1.000000	1.000	8.590	.0000
(Constant)			.676	.5183

----- Variables not in the Equation -----

Variable	Beta In	Partial Tolerance	VIF	Min Toler	T	Sig T
IV2_FIN2	-.081349	-.201187	.598300	1.671	.598300	-.543 .6037

Total Cases = 10

Durbin-Watson Test = 1.57038

Appendix 4**The Port of Montreal****Montreal Port Authority**

Under the *Canada Marine Act* (1998), the Montreal Port Corporation changed its name and status and became the Montreal Port Authority on March 1, 1999. This transformation was fairly easy because the port already operated in an efficient and profitable manner and according to the laws of the marketplace since 1983. In 1999, the Montreal Port Authority reported net earnings for the 20th consecutive year.

The mandate of the Montreal Port Authority is to facilitate domestic and international trade and contribute to the achievement of local, regional and national socioeconomic objectives. The port is committed to providing highly efficient facilities and services for its clients and to increasing and promoting the competitive advantages of the Port of Montreal.

The Port of Montreal builds and maintains infrastructure, which it leases to private stevedoring companies. The port operates its own railway network and grain and passenger terminals. In addition, the port has a computerized dispatching system that guarantees the precise number of longshoremen with the exact skills required for every ship. The labour force offered at the port is flexible, professional and highly efficient. In addition, shipping lines benefit from pre-clearance of cargo, allowing for faster delivery times to final destinations.

In 1998, port's traffic reached 21 million tonnes, an increase of 1.2 % over the previous year. Containerized traffic, representing 8.7 million tonnes or 42 % of the total traffic in 1998, increased by 5.8 % over 1997. Of the record 8.7 million tonnes of container cargo handled at the port in 1998, 7.8 million tonnes or about 90 % represented traffic on the North Atlantic route. The remaining 10% of the traffic were on the Mediterranean route. On both these routes, the major ports of call are: Antwerp and Zeebrugge in Belgium; Liverpool and London Thamesport in the U.K.; Rotterdam in the Netherlands; Hamburg and Bremerhaven in Germany; Le Havre and Marseilles/Fos in France; Cadiz and Valencia in Spain; Genoa, Livorno and Naples in Italy; Lisbon in Portugal; and St. Petersburg in Russia.

The Port of Montreal continues to invest in capital projects to improve and expand the total port area and specifically the container terminal area. For instance, in the period from 1988 to 1997, the port invested \$31.4 mill. in container terminal expansion in addition to \$134.2 mill. invested in land acquisition. The port's financial forecast for 1998-2002 shows further capital expenditure of \$133 million, while maintaining positive net earnings of about \$73 million.

Freight Handling

Montreal is a multifunctional port that has facilities for handling all types of cargo. Its highly diversified cargo includes containerized and non-containerized general cargo, grain and other dry bulk plus petroleum products and other liquid bulk. Commodities moving through the port include lumber, pulp and paper, chemical products, iron ore,

coal, gypsum, fertilizers, petroleum products, fruits and vegetables, etc. In 1996, the Port of Montreal had the biggest market share for containerized cargo on the North Atlantic route for U.S. Midwest and Northeast markets.

Port	Containerized Cargo		1996 (metric tonnes)*	
	Import	Export	Total	Market Share
Montreal	3,147,256	3,376,702	6,523,958	38.2 %
New York	3,666,669	1,274,726	4,941,395	28.9 %
Hampton Roads	700,527	828,824	1,529,351	9.0 %
Halifax	609,000	634,000	1,243,000	7.3 %
Baltimore	240,211	463,535	703,746	4.1 %
Boston	297,337	63,570	360,907	2.1 %
Philadelphia	119,127	100,175	219,302	1.3 %
Other ports	70,582	100,815	171,397	1.0 %
Total	9,381,001	7,692,197	17,073,198	100.0%

* Mercer Management Consulting, "Logistics and Distribution Hub Strategy", 16/07/99

Safety

The Port of Montreal is among the safest ports in the world. The entire port perimeter and individual terminals are enclosed and entrances are always under surveillance. Security guards and fire prevention inspectors protect people and goods throughout the port 24 hours a day, seven days a week. To ensure safe navigation, the port works closely with the Laurentian Pilotage Authority and the Canadian Coast Guard. In addition, The Maritime Employee Association (MEA) and the longshoremen's union in the Port of

Montreal have teamed up to develop a safer and more productive method to secure containers aboard vessels.

Port Facilities

The Port of Montreal is a final stop for ocean-going vessels, meaning that the ships are completely unloaded and loaded at the port's more than 100 berths. Stretched out over 25 km of waterfront, it has four modern container terminals covering an area of more than 70 hectares with over 30 berths, 20 transit sheds including a temperature-controlled warehouse and open spaces for non-containerized general cargo. Container terminals feature 15 computerized dockside gantry cranes with lifting capacities ranging from 30 to 50 tonnes. Mobile cranes can also load and unload containers at several berths. Overall, the port has 18 container berths representing more than 3,000 metres (10,000 feet) in total length.

Size and Activity

The Port of Montreal, one of the busiest inland ports in the world, is one of Canada's major container ports. Shippers take advantage of its inland location by unloading the entire cargo of a vessel in Montreal. Even for a vessel of a medium size (1800 to 2400 TEUs), this option has proven cheaper than having a larger vessel unload only 50 or 60% of its containers. For that reason, the Port of Montreal competes successfully against the Port of New York. For instance, on the same North Atlantic route, shippers use larger vessels going to New York than those coming into Montreal. However, these larger ships are offloaded only partially because New York is used mostly to drop off imports to satisfy consumer goods demand of its huge population base. At the same time, shipping

lines use the Port of Norfolk to drop off the remaining cargo but mainly to pick up exports destined back to Northern Europe. As mentioned above, such routing, although necessary, means higher per container marine shipping costs than having a smaller ship offload its entire cargo at the Port of Montreal. This factor is considered by the management at the Port of Montreal, enabling it to offer lower, thus competitive tariffs. Coupled with some extra services, such as an on-dock port railway, the Port of Montreal manages to sustain its competitive advantage.

Location

Located 1,600 km (1,000 miles) inland, the port is a key transfer point for transatlantic cargo. Strategically situated on the doorstep of North America's industrial heartland, Montreal serves as a gateway to the great producing and consuming areas of Central Canada and the U.S. Midwest and Northeast. It is on the shortest, most direct route between these fast growing markets and the markets of Northern Europe and the Mediterranean. The St. Lawrence Seaway, which provides access to the Great Lakes, begins upstream from the port.

While Montreal's location has contributed to the unique shipping services, its river location imposes certain physical limitations, which impact on the trade. The first such limitation is the limited channel depth leading to the port. The port can usually accommodate vessels in the 2000 to 2500 TEUs range and with minor adjustments up to 2800 TEUs. However, an increase in the ship sizes for up to 4000+ TEUs means that larger ships sailing to Montreal can carry only 60 to 70 per cent of their capacity, leading to higher per unit costs. At the same time, as mentioned above, shippers successfully use

smaller vessels, which are offloaded 100% at the port, allowing to reduce per unit costs. Other constraints resulting from Montreal's location as a river port include high cost of pilotage and seasonal complications from winter operations.

Intermodal Connections

The Port of Montreal has excellent road and rail links leading to all parts of North America. The port operates its own railway network with more than 100 km of track serving the entire waterfront. This railway connects with Canadian Pacific (CP) and Canadian National (CN), which provide services to all major points in Canada and the United States. The port's railway network has a switching capacity of 1000 container railcars to and from berths. The cost of the port's railway service is a cost absorbed by the shipping line, thus, it is factored into the shipping tariffs charged to the shipper. Waterborne coastal services are maintained 12 months a year to the Gulf of St. Laurence and Atlantic provinces. For 8 months of the year, the service also extends to Great Lakes ports. Truck transport links Montreal with the rest of Canada and the U.S. Over 50 trucking companies operate within the Port of Montreal, carrying about 40 % of containerized cargo in regular and refrigerated containers to and from major North American markets. The presence of various intermodal links used on its own or in combination provides valuable choices to the port customers.

Navigation

The St. Lawrence River is one of the world's largest navigable waterways with no locks to slow down the traffic. The channel, open year-round, was dredged to a depth of 11.3

metres (37 feet). Various types of ships can sail to the Port of Montreal including vessels of up to 2800 TEUs. Montreal is a non-tidal port and river currents are usually indicated on the port's marine charts. The average speed of the current along the berths is estimated at 2 knots. In addition, vessels approaching from the Atlantic benefit from a well-developed radio communications system that distributes up-to-date information on navigation conditions in the St. Lawrence River. Finally, highly skilled pilots and the Canadian Coast Guard together ensure safe navigation on the river.

Usually, the pilotage is compulsory in approaching the Port of Montreal. Pilots board inbound vessels at Anse-aux-Basques to bring ships as far as the Port of Quebec, where they are replaced for the trip to Trois-Rivières, and replaced again before proceeding to Montreal. A computerized information system helps to maximize the loading of deep draught vessels by electronically communicating water levels at all times. Ships also benefit from the technology of satellite navigation and electronic chart display and information systems.

In the berthing operation, river pilots dock and undock vessels on arrival and departure. Harbour pilots perform any subsequent moves within the harbour limits.

Port Services

The Port of Montreal offers highly skilled labour force through local stevedoring firms. Most importantly, the port is known to the shipping community as a port with a reliable labour. For instance, in the past 5 years, there were only two strikes affecting the port. The last one was a strike by the truckers, who are not part of the port labour. Today, the

entire shipping community, including ports and shipping lines, understands that efficient labour is a key factor in high productivity and low cost of shipping. However, most port authorities have control over only a small portion of the labour force involved in shipping services, while having no control over the terminal labour, the intermodal labour, the pilotage labour and so on. Since the shippers are well aware of these conditions, the Port of Montreal maintains its labour-reliable reputation, which adds to its competitive advantage.

Further, the port provides fresh water services at most berths in the harbour as well as most types of fuel and diesel oil for bunkering. In addition, mariners may receive treatment at several hospitals in the Montreal area and the repair services are accessible for various types of ships.

In addition, the port can provide tug services when and if needed. The need for tugs to handle vessels in the harbour depends on the dimension of the vessel, the location of the berth, the velocity of the current, and any other prevailing conditions in the immediate berthing area. Usually, the tending of the mooring lines for docking and undocking, another type of service, is performed by labour from the terminals. Boatmen are not normally required for tending lines but their services are available if necessary.

The shipping lines calling Montreal continue to invest in improving their services and fleets, thereby reinforcing Montreal's role as a major gateway in North America. For instance, Cast, that has its own terminal at the port, invested in state-of-the-art equipment

and facilities. The terminal also established excellent partnerships with road and rail companies to and from the port so that the inland connections are fast and efficient. For three years in a row, Cast has been named the best international ocean carrier by *Logistics Management and Distribution Report*, based on a survey of 3300 shippers. In the marine shipping world, the Cast line is known for its speed and service. For instance, Cast pioneered the concept of door-to-door intermodalism in the early 1970s, offering rail and road links on the both sides of the Atlantic.

Port Dues

Port dues absorbed by the shipper are payable to the Port Authority. They include Harbour dues, Berthage charges, Wharfage charges, Railway charges, Water services, Electricity, Wharf rental and some others. These charges are developed by the port and are publicly available. However, the Port of Montreal offers incentive rate programs since 1985, providing lower rates for volume and by the target market. In addition, the rates can differ based on the time slots allocation. Therefore, public port tariffs serve as a basis for port-shipper contract negotiations, while the real rates that include incentives and other specific factors become part of confidential contracts. In addition, the Port of Montreal takes advantage of the competition that exists among the shipping alliances for particular time slots. The shipping alliances' competition provides a greater flexibility for the port in setting its rates. Finally, several factors balance each other such that the Port of Montreal was able to freeze its tariffs for seven years from 1992 to 1999. Further, there are other charges to the vessel which are payable to other authorities. These will include Terminal fees payable to the terminal operator, Pilotage fees payable to the Pilotage

Authority, ground transportation charges payable to the railway or trucking company, as well as Linesmen, Boatmen, Towage, Sick mariners' dues and garbage removal.

Economic Impact

The Port of Montreal's container cargo traffic generates significant economic spin-offs. Its containerized cargo comprises a wide variety of products reflecting the industrial mix of Central Canada and the U.S. Midwest and Northeast. A 1997 study on the economic impact of the Port of Montreal on the Canadian and Quebec economies by the Canada Ports Corporation indicated that port activity in Montreal generated business revenues of \$1.7 billion annually and created some 17,600 jobs, with about 9,450 in direct employment. The port is of vital importance to the Montreal region, the Province of Quebec and the entire country. It provides fast, efficient, safe and highly competitive handling of all types of raw materials and finished products destined for local industries and businesses. As a trading and commercial centre, Montreal has a strong industrial base with manufacturing centres and skilled labour force in its hinterland.

Approximately one half of the port's containerized cargo traffic originates from or is destined to Canadian markets, mainly Quebec and Ontario. The other half comes from or goes to the United States, mainly to the Midwest (Illinois, Michigan, Minnesota, Wisconsin and Ohio) and the Northeast (New England and New York State). The predominance of Montreal in U.S. markets dates back to the early 1980s and, consequently, one may argue that the Port of Montreal was a precursor to the Canada-U.S. Free Trade Agreement.

The Montreal Port Authority is committed to further improving and expanding its facilities, adapting them to its clients' needs. In its five-year corporate plan, the port authority forecasted capital expenditure of more than \$120 million, with the lion's share going to container terminals. The port was prepared to make such a commitment because it is expected for the containerized cargo traffic to reach new heights despite some excess capacity on the North Atlantic route.

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Appendix 5

The Port of New York / New Jersey

New York/New Jersey Port Authority

The port is located in the New York-New Jersey metropolitan region, consisting of five New York City boroughs, four suburban New York counties and eight northern New Jersey counties. The Port Authority is a financially self-supporting public agency that receives no tax revenues from any state or local jurisdiction and has no power to collect taxes. It relies almost entirely on revenues generated by facility user, tolls, fees, and rents. It should be noted that the New York/New Jersey Port Authority operates the Interstate Transportation Network that includes bridges, bus terminals and tunnels, plus the Air Terminals at all three major airports in the area. In addition, the Port Authority is in charge of the port commerce, operating about 12 marine terminals, and the Economic Development corporation. The 1999 Financial and Statistical data produced by the Port Authority (Schedules D and E) showed that the Air Terminals operations and Economic Development created a Net Income, while the Port Commerce and the Interstate Transportation Network reported a Net Loss.

The Port Authority was established on April 30, 1921, as the first of its kind in the Western Hemisphere and the first interstate agency created under a clause of the Constitution permitting compacts between states. A governmental model for port management was found in the Port of London, the only public authority in the world at the time. The Port Authority struggled financially until 1930, when the states gave the agency control of the newly opened Holland Tunnel. In the 1970s and 1980s, the Port

Authority helped advance the region's interests through port and trade promotion and construction of the World Trade Center.

Today, the Port Authority employs 7,620 people. Its 1999 Budget was at \$3.6 Billion. The Port Authority's Mission Statement identifies the need to meet the critical transportation infrastructure demands while providing quality efficient transportation, services, port facilities, and access to the world in order to strengthen the economic competitiveness of the New York-New Jersey region.

Governance

The Governor of each state appoints six members to the Board of Commissioners, subject to state senate approval. Board Members serve as public officials without pay for overlapping six-year terms. The Governors retain the right to veto the actions of Commissioners from his or her own state. The Port Authority may proceed with only those projects that both states authorize.

Location

The port is located in the largest regional market in the United States with the same-day access to 18 million customers. The port features 750 miles of waterfront in the New York-New Jersey region with 12 intermodal terminals and more than 10,000 trucking companies, serving the port. Over 75 steamship lines call the port, totaling more than 4,600 ship calls every year with large containerships carrying an average of 2,000 forty-foot containers.

Size and Activity

The Port Authority of New York and New Jersey (PANYNJ) is the premier port on the eastern seaboard and a vital component of the economic life of the region. The Port Authority's primary roles in the harbor are as a landlord-developer and a promoter of maritime commerce. More than 200 tenants lease property at the Port Authority marine terminal properties. These tenants operate the businesses, which move maritime cargo in and out of the region.

The PANYNJ leases the land and port facilities to the marine terminal operators and other port users with an exception of Global, the owner of the land for its facilities within the port. With the introduction of Container Incentive Program in 1988, the Port of New York offered rebates of \$40 for an export container and of \$20 for an import container in the 260 miles radius around the port. Further, new container stacking services by Conrail reduced the costs of transportation in the interior by about 20%. The port has 10 container terminals, 2 of which are directly controlled by the shipping lines themselves. The big complex of Port Elizabeth/Port Newark has 6 container terminals including the new handling centre Expressrail (1 terminal), 2 Maher terminals, Universal Maritime Services Corp.(1 terminal), as well as terminal owned by Maersk and Sea-Land (2 terminals). The other 4 terminals consisting of Howland Hook on Staten Island, Global of New Jersey and Red Hook in Southern Brooklyn located on the East Side of the New York Bay.

The trade analysis performed by the Port Authority forecasted strong growth in the volume of goods shipped in containers. The current volume of about 2.5 million TEUs

was forecasted to double by 2010. Forecasts show similar growth for bulk and breakbulk cargoes. The same study also predicted a shift of at least 2.5 million TEUs of China and Southeast Asian cargo from West Coast ports by 2020 through an aggressive investment program. The Suez Canal route, actively marketed by the Port Authority, gives the Port of New York and New Jersey an important cost advantage over the West Coast competitors.

Recently, the Port Authority entered into an unprecedented marketing alliance with the Egyptian Suez Canal Authority to capture a larger share of Asian trade for the Port of New York and New Jersey by luring more direct shipments from Asian ports to New York Harbor via the Suez Canal. Under the agreement, the two authorities will work together to promote the increasingly popular "all-water route" from Asia to New York. Currently, most Asian cargoes destined for New York are shipped across the Pacific Ocean to West Coast ports and then by rail to the East Coast.

The Port Authority has predicted that maritime trade volumes will double over the next 10 to 15 years, with Asian trade being a key growth area. For instance, in 1997, trade with Asia increased by 8%, while trade with China – by 22 %, Indonesia - 40 % and Malaysia - 30 %. In addition, the largest container ship ever to call at a North American port will sail into New York Harbor in July of 1999. The Regina Maersk, long enough to carry the Eiffel Tower laid on its side, is the first of a new generation of giant container ships to call on North American ports. Its 47.5-foot draft underscores the importance of the channel dredging and deepening program begun by the Port Authority.

New labour-management agreements allowing lower labour costs together with investments in port facilities and dredging in the context of healthy economy expanded cargo trade in the Port of New York and New Jersey in 1997. In fact, containerized cargo posted a strong 14 % increase in 1997 over 1996 levels, while general cargo volumes increased 4.5 %. Values for general cargo increased by 3.5 percent to some \$60.2 billion. The share of the U.S. North Atlantic containerized cargo market rose from 53.3 percent to 54.6 percent on both the import and the export sides. The public-private sectors cooperation, especially between management and labor, has made the port more competitive.

Intermodal Connections

At the same time, ExpressRail, the Port Authority's recently expanded intermodal rail facility at the Elizabeth Port Authority Marine Terminal in New Jersey, continued to draw customers at a record-breaking pace. Nearly 128,000 containers moved through ExpressRail in 1997, an increase of 24 % over 1996. Cargo bound for the Midwest through ExpressRail increased by 27 % and Canadian volumes increased by 12 %.

Another recent announcement included an agreement with Norfolk Southern Corporation and CSX Corporation to satisfy agency's concerns about rail freight service to the Port of New York and New Jersey. This agreement creates a framework for competitive rail operations. There is also a potential for improvements in transportation services and pricing that will boost the economies of New York and New Jersey. The Port Authority wants to ensure that rail facilities can provide smooth service, and that capacity can be

expanded to accommodate future growth.

The on-dock rail service provides highly specialized straddle carriers, reach stackers and other equipment that allows fast, efficient transfer of cargo from ship to rail. It has strengthened the Port's position as a hub for cargo headed to or from Canada, New England and the Midwest. Further, the purchase of Delaware and Hudson Bay Railway by CP Rail gave better access to the port for the Canadian shippers.

Out of all container terminals, only Expressrail and Howland Hook offer on-dock rail service. The other terminals rely on trucking intermodal drayage service.

Freight Handling

Containerized cargo, moving through the port, increased significantly, growing from 2.0 million TEUs in 1992 to 2.8 million TEUs in 1999. Containerized imports showed a 12.4 % increase while containerized exports grew by 16 %. The Port Import-Export Reporting Service (PIERS) of the Journal of Commerce supplied the figures for containerized cargo to the Port Authority. Total general cargo volumes, including containerized cargo and breakbulk cargo, increased from 38 million tonnes in 1992 to 58 million tonnes in 1999, a 50 % increase.

However, as a result of the Asian economic crisis, the Port saw an increase in overall imports and a decline in exports to the Far East. Nevertheless, trade with China was especially strong. Of the Port's Asian trading partners, China provided the largest volume

in 1997, some 129,000 TEUs. The surge in China trade offset the decline in Asian trade markets occasioned by the economic crisis in that region. Overall trade with Asia increased 8 %.

Trade with Latin America and Europe, traditionally strong trading regions for New York-New Jersey, also showed strong growth. Latin American trade increased by 20.4 % while European trade increases indicated nearly 17 %. Top imports by category included alcoholic beverages, road motor vehicles and organic chemicals. Top exports were wastepaper, lumber and plastic materials.

Navigation

Significant progress has been made in dredging. Disposal sites and methods have been identified, a number of berths have been deepened from 40 to 45 feet to accommodate deep-draft ships, and the deepening of channels in the Kill Van Kull and Newark Bay is scheduled to begin this fall. Channel deepening is a vital part of port's strategy for attracting new business because modern ships require water depths beyond the current 40 feet and up to 50 feet and more. The Port Authority will contribute \$217 million to the \$621 million federal project under a cost-sharing formula established by the federal government.

Economic Impact

Current activities of the Port Authority and facility operations support more than 400,000 direct and indirect jobs throughout the region. Through a \$12 billion investment in the regional infrastructure over the 75 years and another \$4 billion over the next several

years, the port generated more than \$8 billion in sales, over \$3 billion in wages and \$250 million in state and local taxes. The port is moving forward with projects to modernize regional airport system and to make significant improvements to the marine facilities while upgrading the interstate transportation network and advancing waterfront development. To achieve those goals, the New York and New Jersey Port Authority requires an investment of about \$5 billion to handle increases in cargo volume forecast over the next 40 years. Construction of new marine terminals and distribution facilities will create 233,000 jobs and generate an additional \$30 billion a year in economic activity in the Port of New York and New Jersey. The investments will allow to capture a significant share of future North Atlantic maritime cargo growth, making the Port of New York and New Jersey a dominant port of the East Coast, and helping in winning business sought by other East and West Coast ports.

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