CHARACTERISTICS OF TOMORROW'S SUCCESSFUL PORT

MICHAEL C. IRCHA

The AIMS Atlantica Papers #4

Brian Lee Crowley

Series Editor

January 2006

Atlantic Institute for Market Studies

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b) investigating and analyzing the full range of options for public and private sector responses to the issues identified and acting as a catalyst for informed debate on those options, with a particular focus on strategies for overcoming Atlantic Canada's economic challenges in terms of regional disparities;

c) communicating the conclusions of its research to a regional and national audience in a clear, non-partisan way; and

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Remarks to the
1st Biennial Congress of the
Canadian Marine Pilots' Association,
Quebec City, August 30–September 2, 2005

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ATLANTICA

For some time, the Atlantic Institute for Market Studies has been promoting discussion about a geographical concept dubbed "Atlantica". The region is broadly composed of the Atlantic provinces, eastern Quebec, the northern tier of New England states, and upstate New York. These territories share a number of common characteristics — similar demographics, diversity, and migration; a shared history, and interrelated transport issues. Perhaps most important, the residents of Atlantica have generally suffered from relative economic underdevelopment and growth compared to their respective national economies.

Atlantica may not merely be an accidental aggregation of like economies or even a region reflecting a confluence of similar external forces. The regional characteristics may exist precisely because the border passes through it. Conceptually, at least, it is not too hard to understand why this may be so. Geographically, the axis of Atlantic Canada's trade would seem to be naturally north-south — as historically it used to be until national policies imposed an east-west bias. The huge northward bulge of Maine represents a major obstacle between Atlantic Canada and the country's industrial heartland. Maine and the other upper New England states, on the other hand, are a peninsula encircled by the border. Whatever local opportunities for development that might exist are frequently stymied by that frontier and drawn off southward along the interstate transportation corridors — reinforcing the relative isolation and underdevelopment of the north.

The existence and placement of boundaries, whether national or international, do matter. Borders are not merely cartographic creations. They are the intersections of government policies. Where those policies are not carefully harmonized and the implications of differences clearly understood, economic consequences ensue.

This is the fourth in a series of Atlantica Papers about the International Northeast Economic Region.

About the Author

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Dr. Ircha is the 2004 recipient of the Lieutenant-Governor's Award for Excellence in Public Administration. A frequent international lecturer, he was named "Distinguished Transportation Professor" by the International Intermodal Expo in Atlanta, and has received several research awards for his transportation publications. In recent years, he has offered UN port management courses to senior port officials in Yemen, Tanzania, Jamaica, Indonesia, France (IPER), and Britain, as well as at the Maine Maritime Academy and annually at the UN's World Maritime University in Sweden and the Shanghai Maritime University.

Dr. Ircha serves as Chair of the City of Fredericton's Planning Advisory Committee and as a director of the Greater Fredericton Airport Authority. He is past-president of the Canadian Society for Civil Engineering, and recently served as a director of the Association of Canadian Port Authorities.

EXECUTIVE SUMMARY

The growth of world container traffic and the increasing size of the ships that carry it present both challenges and opportunities for ports in the Atlantica region. World container trade is expected to nearly double over the next decade, largely due to increased trade with China and other Asian nations. A significant proportion of this increase is expected to flow through ports on both the east and west coasts of North America, which now face the opportunity of increased business but also the challenge of being able to handle the flow efficiently and without delay.

At the same time, specialized container ships continue to increase in size as shipping companies seek economies of scale in a highly competitive market. Vessels able to carry 5000 to 7000 TEUs (20-foot equivalent units — a 40-foot container is 2 TEUs) are now commonplace on the major Asian trade routes, and ships with double that capacity are on the drawing boards. Such large ships require deeper approach channels and berths, wider channels and turning basins, bigger terminals with significantly more storage capacity to handle higher volumes of containers, higher and longer outreach, automated ship-to-shore gantry cranes, and a highly efficient labour force working round the clock to ensure rapid ship turnaround.

Ports face other challenges as well. Citizens' groups demand a share of the harbour space, then subsequently exert pressure to move noisy cargo-handling operations elsewhere. And, in the post–9/11 world, with security now a high priority, there is increasing interest in siting major container transshipment ports in non-urban, more isolated areas, where containers can be offloaded and inspected in more secure settings.

Whether a container hub terminal is built at an existing port or a new, more isolated site, it must possess a number of key attributes to be successful:

- a considerable volume of captive traffic;
- a location central to main shipping routes and feeder ports;
- sufficient water depth and harbour space to accommodate the very large container ships under consideration;
- appropriate infrastructure and superstructure, including good intermodal linkages and appropriate container lift equipment;
- sufficient capacity to meet peak demand;
- high productivity;
- competitive rates and tariffs;
- a reliable and trouble-free labour force; and
- good security.

Meeting these standards will not be easy for North American container ports. In response to such challenges and to the growing congestion and subsequent delays in moving containers they already experience, Canadian west coast ports such as Vancouver and Prince Rupert are upgrading their facilities, building new container terminals, and improving their intermodal links, particularly rail.

On the east coast, where the growth of container traffic is not as significant as on the west coast, potential sites include the Strait of Canso, because of its deep water and relatively unpopulated location, and Halifax. The Port of Saint John has an underused container terminal and has the advantage of being closer than Halifax to the main markets of New England, New York, and central Canada, although its rail links are inadequate. Another possibility is to develop Sept-Îles as a major transshipment hub, serving the St. Lawrence and Great Lakes systems. However, although the port has deep water and an experienced labour force, winter conditions on the St. Lawrence will likely cause its container operations to be severely limited for three months of the year. Quebec and Montreal will continue to attract container traffic as well as feeder ports, although neither will be able to handle the larger container ships now coming into use and both face wintertime closures.

Canadian container ports that are able to build the necessary infrastructure and maintain competitive rates and tariffs to go along with the natural advantages of their location have an opportunity to be key players in the development of the North American economy.

THE GROWTH OF CONTAINER TRADE

In this paper, I describe the current and anticipated environment in which Canadian ports operate, and I outline appropriate attributes for success in our continually changing global economy. Space constraints led me to focus on just one trade dimension — containerization — rather than consider the wide range of commodities Canadian ports handle. Containerization is the most dynamic and lucrative trade for ports. It involves significant capital investment, it is highly competitive, and it is by its nature a risky proposition.

Container traffic continues to grow worldwide. The recent forecast of container trade growth, outlined in Table 1, shows that global containerization should almost double in the coming decade. Container throughput in North America is expected to increase by 75 percent in the next ten years from 41.1 million TEUs in 2004 to 72 million TEUs in 2015. (TEUs refer to 20-foot equivalent units — hence, a 40-foot container is 2 TEUs.) Much of the anticipated container throughput growth is due to increased trade with China and other Asian nations. Although a significant proportion of this increase will likely flow through west coast ports in Canada and the United States, there will also be growth in Asian traffic to and from eastern North America via the Suez Canal, as well as growth in North America-Europe trade. In 2004, some 22 percent of Asia-US traffic moved through east coast ports compared with 78 percent via the west coast. But over the same period, Asian trade to the east coast increased at almost twice the rate of the west coast due to delays in west coast ports (Damas 2004).

Increasing containerization growth has had an impact on Vancouver and other major US west coast ports. Growing port congestion and subsequent delays in moving containers is being experienced in the intermodal road and rail connections from Vancouver's Deltaport and other container terminals in the Burrard Inlet, and has almost reached crisis proportions in major US west coast ports. In the Vancouver area, intermodal congestion led CN and CP to take the unprecedented step of cooperating with each other in sharing regional rail line capacity to move containers and other freight more quickly and efficiently. In the United States, there has been considerable investment to improve intermodal movements through congested urban areas. One such project is the Alameda Corridor in Los Angeles and Long Beach — an investment of more than US$2.4 billion to provide a container transfer corridor for road and rail from the ports to inland transfer stations. Despite this major infrastructure investment, Los Angeles and Long Beach still face serious port congestion and are seeking innovative steps to enhance their overall productivity.

One method of addressing congestion is to reduce container dwell time in terminals. By limiting the time for free container storage, shippers have a financial incentive to remove their containers from

Table 1: ***World Container Throughput Forecast, 2004–15***

Region	2004	2010	2015	Increase
	(millions of 20-foot equivalent units)			*(percent)*
East Asia				
Northeast Asia	41.7	64	73	75
Chinese ports	68	97	117	71
Southeast Asia	49.1	80	112	128
Subtotal *(% of world)*	159.1 *(45%)*	241	302 *(47%)*	90
Americas				
North America	41.1	57	72	75
Other America	21.1	34	47	123
Subtotal *(% of world)*	62.2 *(19%)*	91	119 *(18%)*	91
Europe/Mediterranean				
North Europe	39.5	57	73	85
South Europe/Mediterranean	34.7	50	66	90
Subtotal *(% of world)*	74.2 *(22%)*	107	139 *(22%)*	87
Others				
Mideast/India	23.6	39	58	146
Sub-Saharan Africa	6.3	10	14	122
Australasia/Oceania	6.9	10	13	88
Subtotal *(% of world)*	36.8 *(11%)*	59	85 *(13%)*	131
World total	332.3	498	645	94

Source: Ocean Shipping Consultants Ltd., cited in *Canadian Sailings*, March 7, 2005, p. 15.

the terminal more quickly. Reducing free storage should increase container yard capacity supporting higher throughputs. Unlike many major ports around the world, not all US and Canadian ports operate on a 24/7 basis. The lack of round-the-clock operations, in particular through the gates, reduces container throughput efficiency and productivity. In another step to reduce gate congestion and increase productivity, the Ports of Los Angeles and Long Beach are introducing a new "PierPass" program. In this program, containers leaving terminals in the two ports by road during peak hours will be charged a fee of US$40 per TEU. Terminal operators are being encouraged to open their gates during off-peak hours, when no fee applies. Although this form of demand management provides incentives to spread peak loads in the terminals, truck drivers are complaining they will not receive extra pay for working overnight shifts, and are proposing a one-day work stoppage to reinforce their demand for added compensation (*Shippers' Newswire* 2005).

Much of the North American and European container trade growth comes from the rapid emergence of China as a major manufacturing and trading nation. The trans-Pacific pendulum trade from Asia to the west coast of North America is booming. The alternative pendulum routing from Asia via the Suez Canal and the Mediterranean to the east coast of North America is also experiencing significant trade growth. Various east coast ports, including Halifax and New York, are actively marketing the Suez routing for Asian trade to North America.

LARGE CONTAINER SHIPS

Over the years, specialized cellular container ships have continually increased in size as shipping companies seek economies of scale in a highly competitive market. In 2004, 50 percent of the new container ships on order were large enough to carry 5500 TEUs and more, and some 36 percent of all container ships scheduled to be built in the next few years will be larger than 7400 TEUs (Mottley 2005a). Such large vessels are now becoming commonplace in the major trade routes serving Asia. Recent new orders for ships by the China Shipping Container Lines are in the range of 8500 to 9600 TEUs. These new vessels will be 334 metres long and 42.8 metres wide and have anticipated drafts of 15 metres or more. Further increases in container ship size likely depend on improved engine propulsion systems. It is anticipated that the next increase in ship size will be to 12,000 TEUs and more, as current limitations on the size of slow-speed diesel systems mean that twin engines may be needed for vessels larger than 10,000 TEUs. South Korean shipbuilder Samsung Heavy Industries has completed performance tests for a 12,000 TEU vessel, and is designing a 14,000 TEU ship (*American Shipper* 2005). The maximum size for container ships is predicted to be about 18,000 TEUs, based on depth limits in the Malacca Strait, the main shipping channel between Indonesia and Malaysia (Gilman 1999).

Such larger container ships require deeper approach channels and berths, wider channels and turning basins, bigger container terminals with significantly more landside storage capacity to handle higher volumes of import and export containers, higher and longer outreach, automated ship-to-shore gantry cranes, and a highly efficient labour force working 24/7 to ensure rapid ship turnaround. The key question is, where will such major container ports be located?

Gustaaf de Monie (1996) suggests that a global fleet of 15,000 TEU vessels would likely need only four major hub ports to serve them: one in southeast Asia (likely Singapore or Malaysia for transshipment to the rest of Asia), one in the Mediterranean to transship to Europe, and one on each of the east and west coasts of North America. Feeder vessels and other intermodal systems would distribute containers to and from these four major transshipment hub ports. The author goes on to propose an offshore island be built off the US east coast as a major transshipment facility. Subsequently, the container terminal in Freeport, Bahamas, has sought to position itself as de Monie's "offshore island" by adding deepwater container handling capacity. Freeport's transshipment container throughput increased from about 11,000 TEUs in the mid-1990s to more than 1 million TEUs in 2004.

Since the 1990s, the general concept of "hub-and-spoke" container transshipment has been the model for the future. However, a more recent analysis of ship routing suggests the anticipated hub-and-spoke system has not fully developed and may not do so in the future. Instead, ship routing has become increasingly complex, with 22 new ports added to the top-tier container liner services from

1992 to 2002, 18 of which are located in Asia (Meyrick 2004). The complexity of ship routing and the addition of new ports rather than port consolidation arose from several factors, including operating costs, the need for cargo balance, container repositioning requirements, transit time demand, service frequency requirements between major centres, and the need to retain key customer accounts by providing them with frequent and high-level service.

In today's increasingly security-conscious world, the use of non-urban and more isolated major container transshipment ports may well become the norm in the future. Locating such hubs outside major urban areas may be prudent to enable container inspection to occur in secure areas.

Recent terminal congestion problems and other difficulties relating to labour relations and inland intermodal services in North American ports have led many shippers and shipping lines to diversify their port options in choosing to serve more than one hub port. Richard Larabee, New York's port commerce director, has stated:

> We now have 24 strings of all-water services calling in our port. That's happened because shippers are saying to ocean carriers, "I don't want all my cargo going through one place. I need to be much more comfortable as far as redundancy and reliability are concerned." This clearly is a trend no one can dispute. (Quoted in Mottley 2005b.)

Thus, in the future, we will likely see more rather than fewer major container terminals along both coasts of North America providing security in the form of non-urban, more isolated locations and offering port diversity to shipping lines to ensure delivery reliability.

EFFECTS OF INCREASED CONTAINER TRAFFIC ON PORTS

These major shifts in the container trade have affected container terminals around the world. Some ports have retained and expanded their hub port status, while others have been relegated to feeder port or niche port roles. Some of the key elements affecting Canadian container ports include port congestion and security, urban development and environmental concerns that constrain port expansion, and container hub port attributes.

Port Congestion and Security

As Canada's major west coast container port, Vancouver has experienced throughput congestion as imports from China and the rest of Asia led to double-digit growth in 2004, with continued anticipated growth in 2005 and beyond. The Port and its intermodal system found they did not have sufficient spare capacity to cope with this rapid increase in container traffic. To address this capacity shortfall, the Vancouver Port Authority is planning to develop a second container terminal at Deltaport. In addition, container terminals in the Burrard Inlet have acquired new equipment to increase throughput capacity, CN and CP have linked their services to speed containers through the Vancouver metropolitan region, and the Fraser River Port Authority has acquired new ship-to-shore gantry cranes to increase its ability to handle added container throughput.

The Prince Rupert Port Authority is developing a new 500,000 TEU container intermodal transshipment terminal on existing, underutilized port lands. In this case, the contracted terminal operator, New York's Maher Terminals, is investing $60 million in equipment, the federal and provincial governments are investing $30 million each, CN Rail is putting in $125 million for locomotives, railcars, and track upgrades to serve the new terminal, and the port is seeking $25 million from commercial banks for its share in the investment. This $170 million terminal is slated for completion in 2007 (York 2005). The Prince Rupert terminal will add needed capacity in a more isolated setting to handle the growing trans-Pacific container trade.

Container terminals have continually sought technological solutions to improve throughput. Today, many terminals are using automated processes, including Internet access for truckers and other intermodal operators to schedule arrivals to speed vehicle turnaround times in the container interchange areas. Other automated systems are being developed and tested in high-throughput container terminals, such as the fully automated ground vehicle systems and double rail-mounted gantry cranes in Hamburg's Container Terminal Altenwerder. At this terminal, human intervention occurs only at the ship-to-shore

gantry crane and the final moments of loading or unloading containers from trailers in the container yard. The latter operation is undertaken remotely through the use of live video and joystick control in the central control tower.

On the other hand, the impact of the increasing need for port security under the International Maritime Organization's International Ship and Port Facilities Security Code (ISPS) may reduce terminal productivity and efficiency. Security concerns in the United States were heightened by the events of September 11, 2001, to the point where there is fear of terrorist attack via containers. This concern has led to several US security programs, including the February 2003 Container Security Initiative (CSI), through which electronically submitted cargo manifests for all vessels inbound for the United States or Canada must be filed 24 hours prior to loading containers at the port of origin. US customs officials have been assigned to various international ports (on a reciprocal basis) to pre-check in-bound shipments. In addition, the United States has initiated the Customs-Trade Partnership Against Terrorism (C-TPAT) as a voluntary program in parallel with CSI. Under C-TPAT, importers and carriers (shipping lines, rail, and air) apply to participate in the program by agreeing to conduct a comprehensive self-assessment of their security and to enhance their supply chain security using guidelines set by the customs and trade community. By participating in C-TPAT, such partners might be able to reduce their number of US port inspections. Further, most US and Canadian ports have been equipped with radiation detectors and gamma-ray inspection devices to allow customs officials to check container contents quickly against the filed manifest.

It is not beyond reason to expect that US, and likely Canadian, security agencies would prefer to have containers offloaded and inspected in a non-urban setting to avoid the possibility of a terrorist act in a densely populated area (the location of most major US and Canadian ports). In this case, establishing major container transshipment hubs in more isolated areas makes sense. Not only could such a facility serve mega container ships for transshipment to inland and coastal ports, it would provide a relatively remote location for intensive security pre-clearance of containers prior to arriving at their final North American destinations.

Urban and Environmental Constraints

One major trend affecting port facilities located in urban areas is the public's growing demand to access and use waterfront lands for purposes other than commercial marine cargo handling. In ports around the world, politicians, municipal officials, and citizens' groups are exerting pressure to convert port lands to alternative, urban-oriented uses. Today's "cappuccino crowd" seek to develop waterfront condominiums, walking trails, cafés, boutique shopping areas, and so forth in place of underused industrial port lands. Initially, proponents of such urban-oriented waterfront development welcome the presence of busy terminals and an active harbour area, but they often soon tire of the ongoing noise (particularly in the evening and nighttime hours), dust, air emissions from port equipment and ships, light spillage from the terminal, truck and rail traffic and other detrimental aspects of major commercial cargo-handling operations. As a result, pressure usually mounts to constrain

commercial terminals by limiting their hours of operation, reorienting dockside lighting, and limiting truck traffic. In the extreme, marine terminals are forced to shut down and move their operations to more remote locations. This phenomenon can be seen in Sydney, Australia, where, over the years, various port operations have been curtailed and relocated to nearby Botany Bay. The result is that Sydney Harbour has become known worldwide as an attractive tourist and recreational facility. But this tourism development came at a cost for its marine terminal operators. This same trend for the conversion of waterfront land to urban-oriented uses is occurring in many of the world's major ports.

There is pressure on the Port of Vancouver to curtail terminal operations in the Burrard Inlet as Vancouver's "cappuccino crowd" seek additional waterfront lands for alternative urban uses. In part, the Port has responded to these pressures by developing its major container terminal expansions at Deltaport, on Roberts Bank, far from the city centre. Vancouver, like other major Canadian ports, has converted some of its underused port lands to parks to provide public access to the waterfront.

Another example of expanding container operations at a remote site is Shanghai, where the Port is developing a new major container transshipment terminal at Yangshan, some 50 kilometres south of the city. The Yangshan facility is being built as landfill on existing offshore islands to ensure deep water for tomorrow's mega container ships. A new four-lane bridge, 32 kilometres long, has been built at a cost of almost US$2 billion to connect the islands to the mainland. The first phase of this massive project, a five-berth terminal capable of handling 2.2 million TEUs, opened at the end of November 2005. The entire project will take 15 years to complete and will provide terminal capacity for 25 million TEUs (*Canadian Sailings* 2005). The Chinese approach of developing massive container terminals to handle their projected traffic may be a portent of things to come in North America. There is clearly a need to respond quickly to the rapid growth of the container trade by building new terminals and adding capacity to existing terminals.

Attributes of Container Hub Terminals

The development of a container hub terminal means achieving a number of key attributes, one of which is having a considerable volume of captive traffic. In the past, this attribute meant such hub terminals were usually located in major metropolitan areas. However, today's security concerns might mean future hub terminals could be located in more remote areas. Other key attributes of container hub terminals include

- being centrally located to main shipping routes and feeder ports (both in time and distance);
- being accessible to larger ships — that is, having sufficient water depth and harbour space;
- offering appropriate infra- and superstructure, including good intermodal linkages and appropriate container lift equipment;
- having a reputation for continued high productivity (in terms of the number of container moves per ship per 24 hours);
- having competitive rates and tariffs; and
- being reliable and trouble free, particularly in terms of labour strife (IPP2 2005).

In addition, shipping lines exert other demands on major container terminals, such as

- ensuring that guaranteed berth windows are available;
- providing spare capacity (equipment and labour) to meet peak demands (such as the seasonal variation in traffic from China and Asia to meet the Christmas season);
- providing good security; and
- offering competitive prices.

North American ports need to be able to meet most of these key attributes and demands if they wish to achieve hub port status in their current and future configurations. The 2005 truckers' strike in Vancouver and the proposed one-day truckers' walkout in Los Angeles and Long Beach do not convey a sense of port reliability to shipping lines.

Today, many existing container hub terminals reflect the following characteristics:

- container-stacking density of 1000–1200 TEUs per hectare;
- sustained ship-to-shore gantry crane productivity of at least 30 container moves per hour;
- six days or less of dwell time in the container yard;
- truck turnaround time for import and export containers of 60 minutes or less;
- rail access in the port area; and
- water depths of 12 to 15 metres.

However, with the advent of increasingly larger container ships, it is anticipated that, in the near future, hub terminals will have to achieve higher productivity levels, including

- container-stacking densities of 2000–4000 TEUs per hectare;
- sustained ship-to-shore gantry crane productivity of 50 moves per hour;
- three-day dwell times;
- 30-minute truck turnaround times;
- on-dock rail service; and
- water depths at the berth of 15 metres and more (IPP2 2005).

The key question is whether existing and proposed North American container terminals can meet these anticipated hub terminal productivity levels. The evidence to date shows that the task will not be easy. North American container terminal productivity tends to be less than that achieved in Asian ports. As one major shipping line's managing director has pointed out:

> A simple formula is that a berth equipped with four gantry cranes in Hong Kong can normally handle 800,000 TEUs in a year but in Europe, it's only 400,000. Asian terminals are still able to manage the increase in volumes. In Europe, terminals are struggling. In the United States, in California, things are not in a better shape — terminals there are also struggling. (T. Wang, Managing Director of OOCL [Europe] Ltd., cited in Damas 2004.)

An analysis of annual ship-to-shore gantry crane productivity in terms of TEUs per year per crane found that European and North American ports averaged 67,500 and 60,500 TEUs per year,

respectively, while the average productivity of Asian ports was 95,500 TEUs per year. The actual number of container moves per crane would be considerably less per year, as most of the containers moved are 40-foot boxes, or 2 TEUs. Thus, these productivity figures should be divided by 2 or less to reflect the actual number of moves per crane per year.

Good intermodal connections are essential to maintain efficient and high-level container throughput in hub terminals. Containers must move rapidly through the terminal supported by an efficient and responsive intermodal system that includes road, rail, and short sea shipping options. Part of the congestion problems afflicting west coast ports over the past year arose from the lack of rail stock to move peak container traffic. This peaking problem led to longer dwell times in the terminal and created congestion. Hub container terminals must work with their intermodal operators to ensure reliability of supply to meet unanticipated variations in demand.

In the road mode, considerable concerns are being raised about the lack of drivers for medium- and long-haul container moves. This growing labour shortage reflects a North American demographic reality. There are anticipated shortages in all labour-intensive industries as the full implications of the "baby-bust" period are reflected in the labour force. This demographic reality means the transportation industry needs to introduce more automation and other mechanistic solutions to alleviate labour shortages. In the container trade, this may mean a shift to less labour intensive rail and short sea shipping. The road option also faces other difficulties, such as increasing highway congestion, particularly in urban areas, growing public concerns about the environmental costs of trucking, and higher fuel costs. All of these concerns may mean that the use of trucks to transport containers to inland destinations may be limited in the future.

The rail mode offers a better alternative for long-haul container movement. Revolutionary steps have been taken by North American railways to meet growing container challenges. The most obvious of these is double-stacking containers in special deepwell flatcars. Double-stack service now crosses North America offering reliable and low-cost container movement. To meet increasing container traffic, further capital investments are needed in the rail mode to respond to peak demands. Such investment takes time to achieve results. However, as demonstrated in the new Prince Rupert container terminal option, Canadian railways are not averse to significant investment. In this case, CN is investing $125 million for rail stock and track upgrades to serve the new terminal.

Short Sea Shipping

The short sea shipping option has not been well developed in North America but has recently become more attractive due to growing urban congestion and environmental pollution concerns. Short sea shipping might play a larger role in transshipping containers to feeder ports in the future if more isolated container hub ports were developed for security reasons.

Short sea shipping options exist on both coasts and within the St. Lawrence and Great Lakes system. If the option entails container transshipment from Canadian to US ports, there would be a problem

with the current regulatory environment, in which both countries apply "cabotage" restrictions. Nation-states normally use cabotage to protect their domestic coastal trade for their own flag carriers. In the Canadian and US context, short sea shipping is restricted to the flag of the respective nation if more than one national port is being served. In other words, if container traffic is moved from one Canadian port to another, a Canadian-flagged vessel is required. However, flying a Canadian flag limits a feeder vessel to serving just one US port in its itinerary. For example, a Canadian-flagged vessel could transship containers from, say, Sept-Îles to Montreal and then onwards to other Canadian Great Lakes ports, but then to just one US port, such as Chicago. An international-flagged vessel on the same routing would be limited to serving one Canadian and one US port in its itinerary.

Flying a Canadian flag means considerably higher shipping costs. The Canadian ship must carry crews holding Canadian certificates, which are limited to Canadian citizens and permanent residents. Ships must be built in Canada or, if built offshore, be refitted to meet higher and more costly Canadian safety standards, as well as pay a 25 percent duty. Canadian vessel safety standards are unique and onerous, as they are superior to internationally accepted standards. If there are no suitable Canadian vessels available, a foreign-flagged and, if need be, foreign-crewed vessel may be chartered or purchased and brought into the Canadian registry with a 25 percent duty payable.

US cabotage restrictions under the *Merchant Marine Act of 1920* (more commonly known as the "Jones Act") are even more onerous than Canadian regulations. In the US case, vessels serving more than one US port must be built in the United States and be crewed and owned by US citizens — there is no provision for bringing in foreign-built or -crewed ships into the US domestic trade.

The North American Free Trade Agreement (NAFTA) and its predecessor, the Canada-US Free Trade Agreement, failed to include provisions for the elimination or relaxation of cabotage provisions. Under NAFTA, Canada and Mexico did agree to liberalize their cabotage rules with each other, but the United States chose to remain outside this arrangement. This means that any short sea shipping between Canada and Mexico would be limited to one US port of call. Although, in late June 2005, a major NAFTA initiative was announced to improve marine transportation security and economic elements, the primary focus remained on security rather than on easing cabotage restrictions (Binkley 2005).

These regulatory restrictions hamper the development of a short sea shipping regime in the Great Lakes and on the east and west coasts. It is unlikely that an international operator would mount a one-port-per-country shuttle service in the St. Lawrence and Great Lakes system competitively with existing overland intermodal services. Major changes are needed in Canadian and US domestic shipping regimes to enable the development of an effective and efficient short sea shipping system. Given a lengthy history of unsuccessful attempts to amend the Jones Act and liberalize coastal shipping, it is clear that such dramatic regulatory change will not likely occur in the United States in the near future.

Attracting shipping lines to serve a port is always problematic. In the case of an entirely new, remote hub port service served by short sea shipping vessels, the difficulties of attracting international

shipping lines is magnified. For example, major trans-Atlantic shipping lines have negotiated lucrative private contracts with intermodal rail and road operators for the rapid movement of containers to central Canadian and US midwest destinations. The preferred intermodal rates offered to shipping lines are based on annual volume commitments by the shipping lines on a year-round basis. Such shipping lines normally control the complete movement of containers from origin to destination with a through bill of lading. As such, they contract for service with other transportation partners. Given long-standing relationships and the generous rates being offered by the railways for intermodal carriage of containers, shipping lines would have to be convinced of the benefits of using short sea services on the St. Lawrence and Great Lakes routes and on the east coast (Tardiff 2003). In the past, proposed marine services that tried to compete with the railways tended to fail, as the railways generally lowered their rates to discourage such a modal switch (Taylor 2003).

Short sea shipping does exist in Canada, however. Oceanex's successful short sea service to Newfoundland from Montreal and Halifax has been in place for many years. Oceanex operates Canadian-flagged ships and provides transshipment services for domestic and international containers and trailers. The company currently has a fleet of four ice-class, roll-on, roll-off containerships: *Avalon* and *Cabot*, which operate between Montreal and St. John's, and *Sanderling* and *Cicero*, which operate from Halifax to St. John's and Corner Brook. In 2002, Oceanex handled 70,202 TEUs of cargo on both routes as well as 21,359 autos on the Halifax to St. John's route (Oceanex 2002 *Annual Report*, cited in Marinova and Brooks 2003). However, this Canadian short sea shipping is costly. As a Transport Canada study notes, "Reflecting the fact that it operates Canadian flag and Canadian crewed vessels, which are subject to 25 percent duty upon entry into Canadian service, Oceanex's rates tend to be quite high, especially in comparison to rates to ship overseas from Montreal or Halifax" (Marinova and Brooks 2003).

European short sea shipping has often been used as an example of a successful inland marine operation. However, some unique factors have led to European success. There are few cabotage restrictions preventing the free movement of marine cargo. The continent has had a lengthy history of active inland water trade, with many vessels serving shippers' needs. More recently, urban and highway congestion and concerns about increasing air pollution have generated enthusiasm for this mode of moving freight. The European Union is supporting the development of short sea shipping and inland water trade with a €75 million program over a five-year period (Wright 2003).

A critical study of European short sea shipping (Paixao and Marlow 2002) notes that it works well because 60 to 70 percent of the continent's industrial production capacity lies near the seacoasts or along inland river networks. Short sea shipping does not have to abide by the same hours of service regulations to which other modes of transport adhere. In turn, this leads to long hours for inland shipping operators and inevitable concerns about safety. Longer service hours allow for greater utilization of short sea shipping assets and higher productivity.

Severe road and rail congestion in Europe has led to road-pricing schemes and limits placed on access to the network, thus making a short sea shipping alternative attractive. Short sea shipping is

energy efficient, with lower levels of air pollution and lower accident and fatality rates than found in road transport.

However, short sea shipping might be disadvantageous from the shipper's point of view. It is a slow and complex means of transporting goods. It is often not well integrated with land modes at either end of the journey, adding to the shipper's complexity and costs of service. In Europe, shippers expect a 35 percent reduction in freight rates compared with those for land modes to offset the increased inventory costs created by the longer transit times involved in short sea shipping (Paixao and Marlow 2002). Thus, despite its lower costs, reduced pollution, and avoidance of urban and highway congestion, the short sea shipping option might have difficulties meeting the service (time) and price requirements of shippers, particularly with the added costs of a Canadian flag, tolls, and pilotage charges. Building the case for short sea shipping will be difficult. Paixao and Marlow (2002) quote the Port of Hamburg as saying that, to be viable, short sea shipping services need to be reliable and to provide high-service frequency and short transit times to gain the benefits of overcoming roadway congestion and pollution. This implies two critical conditions for a successful short sea shipping service: severe road congestion and environmental savings such that shippers are willing to pay for them. The question is: has this situation been reached in either the United States or Canada?

Currently, Canadians and Americans are not as likely to be as vocal as Europeans in seeking the short sea alternative as a means of solving urban congestion and pollution problems. This means that the North American investment community might not be as forthcoming in providing needed capital to develop major hub container terminals that are based primarily on short sea shipping transshipment.

CANADIAN PORT OPPORTUNITIES

In 2004, Canadian container ports handled some 3.6 million TEUs. Assuming a 75 percent increase in TEU throughput in North America over the next ten years, as forecast in Table 1, is correct, Canadian ports will need to handle a minimum throughput of about 6.3 million TEUs by 2015. The actual demand might be higher, as some US ports might not be able to expand their container-handling facilities to serve the coming generation of mega container ships. In an earlier study (Ircha 2001), I reviewed the possible location of major container transshipment hub ports on the Canadian west and east coasts, and suggested that tomorrow's major hub facilities could be located at Prince Rupert and Vancouver on the west coast and at Canso and Halifax on the east coast. Steps are currently being taken in the two west coast ports to address the issue of increasing container trade. Similar approaches could be considered in several east coast ports.

West Coast Ports

As most of the anticipated future growth in containerization is derived from China and the rest of Asia, much of the growth will be focused on west coast ports. Canadian west coast ports are planning and developing facilities to meet this growing demand. Current plans of the three major west coast ports will add container-handling capacity of between 3.4 and 4.9 million TEUs, well beyond the 2.7-million-TEU increase forecast for the next decade.

The Port of Vancouver is actively engaged in upgrading and expanding its container-handling capacity to address both current capacity issues and meet growing demand. In a recent presentation, the Vancouver Port Authority's president, Captain Gordon Houston, stated that five separate container projects were either under way or being planned in Vancouver. These included adding a third berth at the current Deltaport Container Terminal, developing a new three-berth terminal at Deltaport (currently under environmental review), and, in the Burrard Inlet, upgrading and enhancing Centerm and Vanterm by replacing container lift equipment to achieve higher densities and greater productivity, as well as the possible conversion of Lynnterm, a forest products terminal located on the north shore, into a container terminal. These upgrades and new terminals could add a further 2.5 million TEUs to Vancouver's capacity.

The Fraser River Port Authority handles some container traffic and is poised to do more in the future. The Port is currently acquiring equipment to expand its container operations to enable it to handle 415,000 TEUs.

Prince Rupert, the third major port on the west coast, is actively developing the first phase of its new container-handling facility. The plans call for a 500,000 TEU terminal to be operational by 2007. Subsequent phases could lead to a container terminal with a capacity of 2 million TEUs.

East Coast Ports

The growth of container traffic is not as significant on the east coast as on the west coast. However, capacity constraints in US and Canadian west coast ports have caused Asian shipping lines to redirect some of their trade through the Suez and Mediterranean to the east coast. This shift provides opportunities for Canadian east coast ports to capture some of the forecast growth in container trade.

The obvious choice for increased container throughput is Halifax, with its two container terminals, both operating at less-than-full capacity. Halifax was involved in an earlier bidding competition with New York and Baltimore to attract a Maersk-Sealand transshipment container terminal. At the time, the Port's plans called for a new 750,000 TEU container terminal to be located at Rockingham on the western side of the Bedford Basin. Although Halifax was unsuccessful in its bid to attract the Maersk-Sealand terminal, the Port's plans demonstrated the feasibility of the facility. Despite the attractiveness of the Rockingham site, however, it is located on the foreshore in front of some of the most exclusive residential areas in the city, which could well lead to considerable community and environmental opposition to an actual development proposal.

The Strait of Canso offers an attractive alternative to Halifax in terms of siting a major transshipment hub port. Canso provides deep water, a large harbour, and considerable amounts of undeveloped industrial lands that could be converted to a container terminal. The limitation in its use is the lack of a captive market (although Halifax is only about 240 kilometres away) and the private short-line railway serving the site. A major transshipment terminal would require track upgrades to handle added traffic. Such a step is not improbable, as CN is proposing to upgrade its track to Prince Rupert in support of the new container terminal there.

Other potential east coast sites exist for developing a major transshipment hub terminal. For example, Saint John, New Brunswick, has an underused container terminal. Although the Port is located a short distance from the main shipping lines, thereby requiring a diversion, it is an attractive site as it is closer to the main markets of New England, New York, and central Canada than is Halifax. New container facilities could be readily developed in deeper water in the Port's outer harbour. Saint John's only major drawback is the lack of adequate railway facilities to service the Port, other than CN's return line to Moncton and then to central Canada. The Port is, however, served by a private short-line railway connected to US short-line services.

An interesting concept is the possible development of Sept-Îles as a major transshipment hub port — one that would primarily depend on short sea shipping to transfer containers from mega container ships down the St. Lawrence to Montreal or further, through the Great Lakes to Chicago and other

US midwest ports. In this case, Sept-Îles is a deepwater harbour with a labour force experienced in handling large bulk ships. It is also in an isolated location, one that might address a future need for security inspections in non-urban situations. However, as discussed above, developing a facility at Sept-Îles dependent on short sea shipping might be challenging under current cabotage regulations and considering the costs of pilotage and St. Lawrence Seaway tolls. To further exacerbate the financial impact of short sea shipping from that port, the St. Lawrence Seaway and the Welland Canal are closed for three months in the winter season, when shipping lines would be forced to find alternative means of transporting containers. The difficulties of finding alternative transport and the likely higher intermodal costs involved (due to the loss of volume and "loyalty" discounts by rail) would probably cause shipping lines to continue with their current, well-established intermodal contracts through Montreal, Halifax, or New York.

The Port of Quebec could serve as a hub port for the St. Lawrence and Great Lakes trade — it has deep water and can handle larger container ships up to 4800 TEUs (Tardiff 2003). In addition, Quebec is situated on main rail lines and thus could serve as an intermodal hub for containers destined inland. In the past, there has been discussion of a possible partnership between Quebec and Montreal whereby larger container ships could offload some of their containers in Quebec to reduce their draft and then continue to Montreal with the rest of their containers for discharge there. They would do the opposite on the outbound voyage by "topping up" with added containers in Quebec. However, bridge heights on the St. Lawrence River below Quebec City would restrict the passage of the very large container ships now contemplated.

Montreal will continue to serve a niche market, as it offers the longest water route and shortest overland route to the main US midwest markets. As long as the economies of the extended water route offset the diseconomies of using smaller container ships (up to 3500 TEUs, depending on water depth in the St. Lawrence), then Montreal will continue to attract increased trans-Atlantic container traffic.

There may well be other suitable sites for major transshipment container terminals on both the west and east coasts beyond the ports identified above. However, given current forecasts and predicted development of container facilities on the west coast and the spare capacity in east coast ports, there may not be a need for further container terminals in the immediate future (over the next decade) except to meet specific local and regional demand.

CONCLUSION

There are several key attributes for a port's success in the container trade. The first is geographic location. Ports seeking to grow to hub terminal status must be located on or near the main shipping routes. Few shipping lines can afford to divert their ships to serve isolated ports, unless these ports act as the terminus of the pendulum swing from Asia to North America (on either the west or east coasts). However, as the growing need for port reliability is causing shipping lines to diversify their ports of call, there will likely be more than a single hub terminal on either port range.

Second, ports seeking to serve mega container ships must be accessible to them. This means they must have adequate water depth, at 15 metres or more, appropriately sized turning basins, and navigation channels to serve such ships.

Third, container hub ports must have and maintain a reputation for continued high productivity in terms of ship turnaround time and truck/rail car turnaround time. Such productivity implies having spare capacity in terms of container yard storage and lifting equipment, including ship-to-shore gantry cranes and terminal equipment, along with a stable and reliable labour force working 24/7. Productivity also implies port flexibility — the ability to adopt new and changing technology rapidly to maintain high throughput levels. Flexibility also implies coping effectively with landside pressures to constrain terminal operations and to convert underused port lands to other urban-oriented uses. Dealing with the community and environmental consequences of a major container terminal requires tact and diplomacy on the part of the operators and port officials. Creative steps are needed to offset the community's constraining criticisms.

Fourth, container hub ports need efficient intermodal linkages (road, rail, and short sea shipping) to ensure containers are moved through the terminal quickly to reach their final inland destinations.

Finally, all of these attributes must be achieved economically such that the rates and tariffs charged for container moves through the port and the terminal remain competitive. All of this is not an easy task, but it is an essential one if Canadian container ports wish to remain key players in supporting the continued development of the North American economy.

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