

Canadian Ports: Trends and Opportunities

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Abstract

This article offers an overview of the development of Canadian ports, with a particular focus on the impact of the container trade. The goal is to highlight the international context within which Canadian port development occurs and identify the attributes for port success in our dynamic global trade environment. The article begins with a discussion of the growth and extent of the container industry and the impact on trade corridors, as considered from the perspective of ports and intermodal systems. Opportunities for Canadian ports to serve the growing North American container trade are outlined, and the paper concludes with an overview of the key elements crucial for the success of Canadian ports.

Canada and the Global Economy²

Increasingly efficient international maritime transportation underlies the global economy's phenomenal growth. Reduced freight rates stemming from economies of scale in containerization and other forms of specialized maritime transport have enabled major companies to internationalize their activities. Economic globalization implies international firms can source raw materials and assemble components and finished products in various low cost locations throughout the world. The minimum cost of maritime transportation, primarily focused on containerization, coupled with reductions in national tariffs and trade barriers through international trade liberalization policies has fueled the growth of global economic activities (Levinson, 2006).

One economic forecaster suggests that Asia-North American trade growth is likely to slow during 2007-08 as China invests in its own public infrastructure and meeting growing domestic demand. In addition, the declining housing market in the US is dampening consumer

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confidence reducing the demand for imports (Pierce, 2006). Canada's Export Development Corporation is predicting a similar global economic slow down beginning in the US and spreading like "falling dominoes" throughout the rest of the world (Poloz, 2006). This should lead to a "normalization" of the global economy resulting in a more stable economic situation. This slowdown or "downgrade" of the world economy will lead to reduced commodity prices and increased difficulties for Canadian exporters. Added to exporters' woes will be the continued high value of the Canadian dollar as our currency is linked to higher oil prices. Canadian exports are expected to remain flat in 2007-08 due to the economic downturn in our main trading partner, the US (Poloz, 2007). However, despite these predictions of an economic slow down in the west, China's economy continues to surge forward. Its rapid growth is fueling fears of inflation in the Chinese economy (York, 2006).

As an indicator of how international trade underlies world economic output, the volume of world exports continued to expand in 2006. As shown in Table 1, for developed countries, North America led in export growth at 8.5 percent, followed by the EU at 7.5 percent. In developing countries, exports from Asia amounted to 13.5 percent in 2006 of which China recorded a remarkable 22 percent. China recorded high import growth levels at 16.5 percent (reflecting its growing demand for raw materials to supply their expanding export manufacturing activities).

Table 1: Annual Export and Import Growth of Volumes of Goods, 2004-2006 (percentage)

	Exports			Imports		
	2004	2005	2006	2004	2005	2006
World	8	6	8	n.a.	n.a.	n.a.
- North America	8	6	8.5	10.5	6.5	6.5
- European Union	7	4	7.5	6.5	3.5	6.5
Asia	15.5	11.5	13.5	14.5	8	8.5
- China	24	25	22	21.5	11.5	16.5

Source: UNCTAD, Review of Maritime Transport, 2007, Table 2, p. 4

Table 1 reflects strong world trade growth. However, the vast majority of Canadian exports and imports are continentally based in trading with the US. On a value basis, Canadian exports to the US increased in 2005 by 12.3 percent, to \$US 288 billion, representing 84 percent of total exports. Imports from the US rose by 11.3 percent to \$US 211 billion, representing 57 percent of total Canadian imports (AAPA, 2006).

Most of Canada's continental trade with the US is transported by surface rather than marine mode. In 2005, marine transportation carried \$19.7 billion worth of Canadian commodities to/from the US, with exports to the US comprising the major trade: \$17.7 billion, or less than 6% of the total. Marine trade with the US in 2005 amounted to only 15 percent of total Canadian marine imports and exports by value. However, on a tonnage basis, transborder trade with the US amounted to 39 percent of total marine trade, demonstrating that much of our trade with the US is low value bulk commodities (iron ore, potash, sulfur, oil and wood products) rather than higher value general cargo in containers (Transport Canada, 2006).

Thus, at least three conclusions can be highlighted: despite consistent growth in the global economy, Canada remains dependent on the American market; Canada's best options to

diversify are with Asia; and while there are opportunities to pursue greater trade with Asia, an economic slowdown may have an impact on this trade in the near future.

Global Seaborne Trade

Global international trade growth has been reflected in the expansion of the world's fleet of ships – both in terms of numbers and size. Table 2 outlines the development of international seaborne trade in terms of the tonnes of goods loaded over the past three decades. As shown in Table 2, total goods loaded have increased by more than 289 percent in this 36-year period.

Table 2 also shows the shift in goods being transported with dry goods (bulk, break-bulk and containerized general cargoes) increasing from less than half to almost two thirds of the total volume of international trade; reflecting the growth of world manufacturing output.

Table 2: International Seaborne Trade (goods loaded - million tonnes)

Year	Tanker Cargo		Dry Cargo		Total
	Tonnage	% of Total	Tonnage	% of Total	
1970	1,442	56	1,124	44	2,566
1980	1,871	51	1,833	49	3,704
1990	1,755	44	2,253	56	4,008
2000	2,163	35	3,821	64	5,983
2006	2,674	36	4,442	64	7,416

Source: UNCTAD, Review of Maritime Transport, 2007, Table 3, p. 4

Canadian maritime traffic includes domestic and international trade. Table 3 outlines Canada's marine traffic in 2000 and 2005. As shown, the total Canadian marine trade of 464 million tonnes in 2005 is about 6.5 percent of the world's total seaborne trade.

Table 3: Canada's Seaborne Trade (goods loaded and unloaded - million tonnes)

Year	Domestic	Tonnage		Total Tonnage
		Trans-border	Overseas	
1994	104	79	168	351
2000	109	109	185	403
2005	139	127.4	197.8	464

Source: Transport Canada, *Transportation in Canada 2006*, Table 8-16, p. 82

Global Maritime Fleet

As expected with continued world trade growth, the global maritime fleet has increased over the years as shown in Table 4. By 2007, the fleet size had increased by 58 percent in dead weight tonnage over a 17-year period. Table 4 also shows the decline in general cargo vessels (break-bulk commodities – decrease 2 percent) being offset with an increase in specialized cellular container ship tonnage – an increase of 392 over the past two decades. Table 4 outlines the significance of the liquid and dry bulk trades in terms of the world fleet. In 2007, bulk ships comprised about 72 percent of the global fleet.

The growth of the world fleet has been fueled by:

- Increases in energy and mineral cargoes (liquid and dry bulks) derived from a growing demand for these raw materials from North America, Europe, Japan and more recently, China.
- Economic globalization reflecting the international division of production and enhanced trade liberalization.
- Technical improvements in ship and marine terminals facilitating increased productivity and lower freight costs in moving goods (e.g. containerization).
- Economies of scale being achieved from larger ships enabling maritime transport to remain a low cost mode of moving goods.

Table 4: World Fleet by Principle Vessel Types (Thousands of dwt)

Year	Oil tankers	Dry bulk	General cargo	Container	Other	Total
1990	246	235	103	26	49	659
2000	285	265	100	75	74	799
2007	383	368	101	128	63	1043
% Change 1990 – 2007	55%	57%	-2%	392%	29%	58%

Source: UNCTAD, Review of Maritime Transport 2007, Table 5, pp. 24

The global marine fleet is comprised of a variety of specialized ships including:

- Bulk carriers are purpose built ships. These are designed to carry specific commodities. They can be classified into liquid bulk and dry bulk vessels. Bulk ships include the largest vessels afloat. The largest tankers, the Ultra large Crude Carriers (ULCC) are up to 500,000 deadweight tonnes (dwt). The more typical tanker size is between 250,000 to 350,000 dwt (VLCCs). The largest dry bulk

carriers are about 350,000 dwt with the more typical size being between 100,000 to 150,000 dwt.

- General cargo ships. These are designed to carry non-bulk cargoes. Traditional break-bulk general cargo ships were about 10,000 dwt due to slow loading and unloading times in handling such labour-intensive small package cargoes. Over the past three decades, general cargo ships have been replaced by purpose-built, cellular container vessels. Container ships load and unload their cargo quickly gaining efficiency by handling unitized commodities. The largest container ships are 100,000 dwt and larger. Normally container ship sizes are measured by their container carrying capacity in TEUs (twenty-foot equivalent units – a forty foot container is equivalent to two TEU). The largest container ship to date is Maersk's recently launched *Emma Maersk* with a reputed carrying capacity of more than 14,000 TEU.
- Roll on-Roll off (ro-ro) vessels. These are designed to allow cars, trucks and trailers to be driven directly on board. Originally used as ferries, larger ro-ro vessels now operate on deep-sea trade routes. The largest ro-ro vessels are car carriers that transport vehicles from assembly plants around the world to their main markets.
- Passenger and cruise ships. The former tend to be smaller vessels while the latter are usually large capacity ships, today exceeding 150,000+ gross registered tonnes.

Trade Corridors and Gateways

As a result of the earlier Free Trade Agreement (FTA) with the US and the subsequent North American Free Trade Agreement (NAFTA) that included Mexico, Canada's trade increasingly moved north-south rather than the more traditional east-west orientation. By the mid-1990s, north-south intermodal railway traffic surpassed east-west movements. CN Rail's US acquisitions in the 1990s reflected this shift in trade in obtaining rail access through the central parts of the US into northern Mexico (McMillan, 2006). The north-side trade shift led to the development of numerous trade corridor promotion organizations across the continent.

Trade corridors have been defined as "streams of products, services and information moving within and through communities in geographic patterns" (Van Pelt, 2003). Another approach considers "North American trade corridors as strategies developed by business and municipal (and sometimes state and even federal) government leaders to attract to particular regions some of the increased flow of materials generated by deepening North American economic integration" (Blank, 2006).

During the past decade, governments paid considerable attention to trade corridors with a view towards providing significant public investment in designated corridors to facilitate trade. Most of the proposed north-south trade corridors link US Interstate Highways with their Canadian counterparts. In 1991, the US envisioned an integrated system of superhighways supported by the Intermodal Surface Transportation Efficiency Act (ISTEA). The political process soon intervened with Congress quickly adding to the number of designated high priority corridors in subsequent legislation such that they now cross the country in a maze of routings. Other than

some improvements in selected border crossings, little has been achieved. A coherent, rational integrated North American highway system has yet to be developed (Blank, 2006).

Asia-Pacific Gateway and Corridor Initiative

In the Canadian context, the first successful gateway is the Asia-Pacific Gateway and Corridor Initiative focused on the British Columbia and Prairie hinterlands of lower BC mainland, Prince Rupert and the ports' hinterlands. The Asia-Pacific Gateway Initiative has received over \$860 million in federal funding supplementing provincial, municipal and private support to develop and enhance essential transportation infrastructure. Some \$2.3 billion has been provided for transportation infrastructure projects in BC, Alberta, Saskatchewan and Manitoba (Emerson, 2008). The aim of the Initiative is to reduce congestion and ease the flow of goods in and out of the major ports of Vancouver, Fraser River and Prince Rupert. On January 1, 2008, as part of the Asia-Pacific Gateway Initiative, the federal government enabled the three Vancouver area port authorities (Vancouver, Fraser River and North Fraser River) to amalgamate into one unit – the Vancouver Fraser Port Authority.

At a recent Association Canadian Port Authorities "Ports/Government Interface Conference", Transport Canada's Director-General of Strategic Policy, B. Bohunicky, pointed out "the next round of productivity will come through the greater integration of the transportation modes." Such Gateway integration requires private and public sector cooperation and coordination. To obtain federal government support for new Gateways, "they must offer a clear, coherent vision." The presentation outlined six key themes that the federal government is looking for in Gateway creation:

1. **International commerce and trade competitiveness:** Looking to the emerging superpowers such as China and their impact on the West Coast, gateways are not considered by the federal government to be overarching infrastructure models; rather gateways are expected to be targeted strategically to key opportunities.
2. **Global supply chains:** While efficient transportation systems are crucial to Canadian trade, other non-transportation issues along the supply chain must also be addressed. Gateways provide a framework for concerted strategic action.
3. **Policy integration:** The need to address interconnected issues to ensure coherence in dealing with interacting factors such as border crossings, security, land use, taxation policies, human resources and so forth.
4. **Multilevel partnerships:** The Asia-Pacific Gateway Initiative was driven by private sector leaders who championed an integrated approach (the public-private partnership model). Such a partnership is a precondition for establishing a gateway. This is seen as a horizontal policy challenge – developing clear collaboration across federal/provincial/municipal "silos."
5. **Productivity gain:** The need to address how the gateway will increase productivity

in the transportation sector. The next economic productivity gain will likely come from a greater integration across transportation modes.

6. **Communities and regions:** A convergence of geography, commerce and transportation in urban regions leads to the need to address urban transportation congestion and environmental concerns. In turn, this creates concerns about quality of life in urban areas, land use, and the impact of global economic dynamics on local areas (Bohunicky, 2006).

The Role of Ports

Seaports often have two distinct roles: serving as terminals and as nodes. As a terminal, cargoes arrive or depart the port as their final destination or initial origin. For example, crude oil shipments to the Irving Refinery involve the Port of Saint John in New Brunswick as a terminal as this imported raw material is refined locally and then shipped to other destinations by various modes. In its role as a node in the global logistics supply chain, ports provide the interface between transportation modes from deep-sea vessels to feeder ships or to landside transport (road and rail) for onward movement of goods to their final destination. The future movement of containers through the Port of Prince Rupert to the US Midwest underlies the port's key role as a node in the supply chain from Asia to North America.

Developing a modern comprehensive port requires it to focus on both roles. Ports need to secure bulk commodities to supply local industries encouraging economic activity while serving broader national and regional interests as a node for the transshipment of goods to/from inland destinations. As a terminal, Canadian ports support regional economic development, serving as an "engine of growth" as required in their federally legislated objectives. In their nodal role, ports interact with inland transport providers to complement and coordinate their efforts to move goods from the waterside to the landside as efficiently as possible.

Canada Port Authorities

The objectives of Canada's major ports have been outlined by the Association of Canadian Port Authorities:

Canada's major ports have a legal designation under the *Canada Marine Act* (CMA) as Canada Port Authorities (CPA) and consist of 19 Port Authorities known as the National Ports System. These Port Authorities were designated as being 'critical to domestic and international trade.' These 19 ports handle more than half of all Canadian marine cargo at approximately 240 million tonnes annually, valued at more than \$100 billion dollars.

The balance of Canadian marine cargo represents 200 million tonnes of cargo handled by an equally important regional ports system consisting of several hundred ports from Atlantic to the Pacific to the Arctic.

Canada Port Authorities were created by an Act of Parliament in 1998 under the

Canada Marine Act (CMA), providing an overall governance structure for the management of Port Authorities with important local governance and control.

The key elements of the new, autonomous structure include:

- requiring Port Authorities to be fully 'commercial' and completely 'self-sufficient' with no further funding from the Government of Canada,
- setting strict borrowing limits for Port Authorities with operations funded solely from the CPA's stream of revenues with no ability to pledge assets to borrow, and
- requiring Port Authorities to provide a portion of their gross revenues to the Government of Canada's general revenue fund (ACPA, 2008).

Canada Marine Act Reviewⁱ

During the 1990's, the federal government undertook a comprehensive port reform process resulting in the *Canada Marine Act 1998* (CMA). In establishing a National Port System (NPS) comprised of the 19 Canada Port Authorities (CPA), the CMA did not adequately address the need to make these major ports business-like in their competitive setting. The CMA retains considerable federal control in the regulation and governance of port authorities. The CMA reflects several elements of the federal government's earlier National Airport System (NAS). The NAS led to the long-term leasing of the government's 26 national airports to local non-profit Canadian airport authorities. However, a significant divergence between the airport model and the ports system lies in their governance systems. Locally appointed directors at Canadian airport authorities are independent and have full autonomy to manage their facilities. In the ports' case, almost all directors are appointed by federal Cabinet on the recommendation of the Minister of Transport (with user group representatives being selected from a list of proposed nominees, if the Minister chooses to do so). There are also restrictions in the CMA making various qualified individuals ineligible to serve as port directors.

Beyond these important port governance issues, the CMA restricts, to a degree, the CPAs' ability to diversify to take advantage of revenue generating opportunities in non-port related endeavors. From a financial perspective, the CMA precludes CPAs from using federal lands and assets as collateral for commercial loans. The CMA established CPAs as federal agents rather than their former status of Crown agencies. As federal agents, CPAs are not funded by government but rather are expected to borrow from commercial lenders. More recent legal interpretations suggest the Crown may be ultimately responsible for CPA borrowing obligations. Hence, to limit potential federal liabilities, restrictive borrowing ceiling caps have been placed on ports. These actions limit the CPAs' ability to raise capital for port investments. As federal agents, CPAs are exempt from various taxes, but they are required to make payments-in-lieu of taxes [PILT] to adjacent municipalities - a concern for former Harbour Commissions that were converted to CPAs as they had not paid grants-in-lieu of taxes in the past.

As commercial enterprises, major Canadian ports need to operate freely, unfettered by the constraints of federal reporting relationships and bureaucratic red-tape. They need to be able to devise innovative and creative responses to the many challenges facing them. Competitive flexibility and adaptability in the North American continental transportation system requires autonomous and independent commercial ports. The port reform reflected in the CMA sought to free CPAs from federal control and regulation, but this was only achieved to a limited degree.

The need to further untie major Canadian ports from the strictures of the federal government can be best exemplified by the restrictions to their commercial freedoms in the CMA. Restrictions on CPAs emerged from the actions of Transport Canada, Treasury Board, and the Department of Finance in their attempt to protect the federal interest. These restrictions and added regulations include CPA conformance to freedom of information legislation (this has created a privacy concern for commercially-oriented ports), environmental assessment, the *Official Languages Act*, and quarterly business plan reports to Treasury Board. These federal requirements were incorporated in the CMA despite the detrimental effects they might have on the CPAs commercial operations. Earlier, the Port of Montreal's CEO suggested, "the legislation [*Canada Marine Act*] needs clarification and improvement, because as it currently stands it is more restrictive than what we have already on operational and responsibility matters" (Taddeo, 1996).

But what is really needed for Canadian ports? In the face of continental and global competition, a more radical alternative is required. Canada Port Authorities must be unshackled from federal government strictures and allowed to operate freely in a competitive and business-like manner. This may sound radical in the current Canadian context, but it is important to reflect on port reform lessons from other countries. From a global perspective, port reform has led to a clear shift to the economic right. Many ports have moved from their former status as comprehensive agents - where the port as a public agency is provided with all services including dock labour – towards a landlord model, in which port lands are leased to private terminal operators. This landlord model is now used in most Canadian ports. Commercialization, corporatization and privatization are now the operational codes (Ircha, 1999).

The CMA reinforces the commercialized nature of the major ports. But is this enough? To be truly competitive with their US counter-parts, Canadian ports need to shift further to the economic right. Incorporating Canadian ports as "for-profit" companies would allow them to act independently and autonomously as a truly commercial business. Over time, as independent port corporations gain competitive experience and become financially viable, the next logical step would be to consider their privatization.

In June 2003, following a year of hearings across the country, the Canada Marine Act Review Panel recommended substantial changes to the CMA reflecting many of the major issues raised by the Association of Canadian Port Authorities (ACPA). The Review Panel's recommendations included many steps to further liberalize CPA operations and deal with their funding challenges. In the latter case, the Review Panel recommended that CPAs be able to access federal funding, increase their borrowing limits, establish financing alternatives for new port infrastructure such as tax-exempt bonds, changing the manner in which ports provide stipends to the federal government and so forth (Transport Canada, 2003). Despite their many strong

recommendations in favour of further liberalizing CPAs, the federal government has taken little action.

The ACPA has continued to lobby for federal adoption of five major CMA policy changes:

- allowing increased capital borrowing limits for ports,
- enabling CPAs to access federal funding in a manner similar to other commercial enterprises,
- improving the current lengthy process for transferring federal lands to CPAs,
- having the federal government undertake payments in lieu of taxes on behalf of CPAs for federal port lands, and
- switching the basis of annual stipends paid by CPAs from a percentage of gross revenue to net revenue.

Recently, the CMA was amended to adopt the first three of these policy initiatives. In addition, the federal government is enabling CPA mergers as discussed above, another Review Panel recommendation.

Container Trade Growth in West Coast Ports

Growing container traffic in the past several years has had an impact on Vancouver and other major US West Coast ports. Port congestion and subsequent delays in moving containers has been experienced in the intermodal road and rail connections from Vancouver's Deltaport and other container terminals in the Burrard Inlet, and 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 efficiently. In the US, considerable investment was made to improve intermodal movements through congested urban areas. One such project is the Alameda Corridor in California, an investment of more than \$2.4 billion to provide a container movement corridor for road and rail from the ports of Los Angeles and Long Beach to inland transfer stations. Despite this major infrastructure investment, Los Angeles and Long Beach still face serious port congestion and continuously seek innovative steps to enhance their overall productivity.

A recent forecast of US container port utilization shows that the ports of Los Angeles and Long Beach are operating at almost full capacity in 2006 (at 88 percent and 91 percent respectively) (MergeGlobal, 2007). It is expected that these ports will be unable to handle an anticipated increase of container throughputs in future years. Other US West Coast ports are also reaching their capacity limits. This means that without future investment in significant container terminal expansions, further congestion and the subsequent diversion of Asian containers to East Coast ports will be a certainty.

One method of addressing congestion is to reduce container dwell time in terminals. By limiting free container storage time, shippers have a financial incentive to remove their containers from the terminal more quickly. Reducing free storage increases container yard capacity thus 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 a step to reduce gate congestion and increase productivity, the ports of Los Angeles and Long Beach introduced a new "PierPass" program. In this program containers coming to and leaving terminals by road during peak hours are charged a \$40-per-TEU fee. Terminal operators are encouraged to open their gates for truck movements during off-peak hours, when no fee applies. This form of demand management creates an incentive to spread peak loads through the terminal gates.

The PierPass program has improved port container handling efficiency. As pointed out by the executive director of the Marine exchange of Southern California, M. Aschemeyer, "PierPass has been an unqualified success in moving trucks through the terminals day and night" (Johnson, 2006a). The port of Vancouver has initiated a truck licensing system to regulate container movement through its terminals, as well as to initiate a number of environmental and safety measures. While the port currently has an *ad hoc* system of extended terminal gate hours, they are seeking to introduce a 24/7 operation to coordinate all terminal movements (Kulisch, 2007a).

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 trade growth, and provides another alternative to port congestion. Various East Coast ports including Halifax and New York are actively marketing the Suez routing (the so-called 'Suez Express') for Asian trade to North America. It is this alternative container routing from India, Asia and China that is partly driving the Atlantic Gateway initiative, particularly for the port of Halifax and the proposed container terminal in the Canso Strait area.

However, the Suez container routing opportunity may be short lived due to the impending development of an enlarged Panama Canal. A recent Panamanian referendum supported the construction of a \$5.25 billion enlarged canal designed to serve the growing number of container ships that are too large for the existing Panama Canal. The new canal locks will be sized to serve ships as large as 12,000 TEU carrying capacity. The threat to Canada's East Coast ports is that, "the new canal will allow more cargo to be carried on big ships from the Far East to ports along the US East and Gulf coasts. That could help ease congestion on the US West Coast and still allow carriers and shippers to reap the benefits of the economies of scale big ships provide." (Dupin, 2006) Southern US ports are already gearing up to meet the challenge of additional container ship routing through an enlarged Panama Canal (Dow, 2007).

The anticipated growth in container shipments to North America continues to cause concern. As pointed out by D. Tilden, President of Marine Terminals, in order to handle the annual growth in North American container throughput, a port the size of New York – New Jersey would have to be added each year. He further indicated that port congestion in the future is likely to be sustained and systemic:

PierPass has brought in extra capacity, but there's limited potential for more diversions from L.A. and Long Beach, except for Oakland, which has capacity. And, frankly, other options like alternative gateways won't be online of '06. All the Greenfield sites in the U.S. and Mexico, if they were all available in the next three years, would barely be able to handle the growth of the next three years (Johnson, 2006b).

There is continued concern in the ports and logistics industry about the growing disparity between Chinese and North American port and inland infrastructure development. China's economy continues to grow rapidly with significant new ports and logistics infrastructure being built while North American ports, the destination of much of China's exports, are struggling to cope due to the lack of investment capital as well as the constraints posed by urban and environmental concerns.

Larger Container Ships

Over the years, the size of container ships has continued to increase as shipping companies sought economies of scale from bigger vessels in a highly competitive market. As container ships get larger, there are limits to the ports they can serve due to physical constraints of water depth, channel widths and size of turning basins as well as the capacity of the ports' cargo handling equipment and their productivity. In the future, due to these physical limitations, mega-sized container ships of 12,000+ TEU capacities will likely only serve a small number of designated ports in North America as the terminus to their eastern and western pendulum swings from Asia.

Container ships continue to grow larger. Post-Panamax sized 6,000+ TEU vessels are now commonplace in the major trade routes serving Asia. At present, the largest container ship afloat is the *Emma Maersk*, the first of a series of eight "PS-class" ships christened in September 2006. The *Emma Maersk*, at nearly 400 meters long, 56 meters wide and with a draft of 15.5 meters can carry 14,800 TEU, although Maersk Lines rates her as an 11,000 TEU vessel (Phillips, 2006). With a beam of 56 meters, the *Emma Maersk* and her PS-class counterparts are too wide for even the future enlarged Panama Canal.

Building larger ships is becoming commonplace. The summer of 2007 witnessed a whirlwind of orders for new mega-sized ships. The world's third largest container carrier, the French line CMA CGM, placed an order for eight 11,400 TEU vessels at a reported cost of \$1.2 billion. In August, COSCO ordered eight 13,100 TEU ships to be built for delivery in 2011. This was soon followed by Zim Lines' order for eight 12,600 TEU ships for delivery in 2012. There are 114 container ships of 10,000+ TEU on order including 52 of them of 12,000+ TEU. This rapid growth of mega-sized ships arises for the shipping lines continued quest for economies of scale. These large ships can save 10 to 15 percent of the sea part of the voyage, but such savings may be limited due to port inefficiencies causing the ships to remain too long in port and from higher feeder vessel costs (Heaney, 2007).

The global container fleet continues to expand; although some shipping lines are becoming concerned that projected capacity will outstrip the growth of container traffic. A recent estimate showed that the global containership fleet capacity is expected to grow by 76 percent from 2005 to 2010 compared to an anticipated container traffic growth of 41 percent (Clancy and Hoppin, 2006). In this same period, the percentage of the global containership fleet of 7,500 TEU+ is expected to expand from 5.3 percent in 2005 to 17 percent in 2010.

These increasingly larger container ships require:

- deeper and wider approach channels and berths,
- wider turning basins,
- bigger container terminals with significantly more land-side storage capacity to handle larger volumes of import and export containers,
- higher and longer out-reach, automated ship-to-shore gantry cranes, and
- a highly efficient labor force working 24/7 to ensure rapid ship turn-around.

The maximum size for container ships is predicted to be about 18,000 TEU, based on depth limits in the Malacca Strait (the main Asia-Europe shipping channel between Indonesia and Malaysia) (Blenkey, 2006). Such a ship would have a length of about 470 meters, a beam of 60 meters and a draft of about 18 meters.

It is anticipated that much of the mega-sized container fleet will be deployed on the Asia-Europe trade route rather than the trans-Pacific and trans-Atlantic trades. This is due mainly to higher port productivity in the Asia-Europe trade route and their ability to quickly turn-around these larger vessels. Thus it will be unlikely that North American ports will see many of these new builds in the near future. However, larger container ships “cascaded” from the Asia-Europe routes will continue to serve North American ports.

The key question is where will major North American container ports be located? An earlier study by Gustaaf de Monie suggested that a global fleet of 15,000 TEU vessels would likely need only four major hub ports to serve them – one in South-East 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 (1996). Feeder vessels and other intermodal systems would distribute containers to/from these four major transshipment hub ports. The study went further to propose an offshore island be built off the US East Coast as a major transshipment facility. Subsequently, the container terminal in Freeport in the Bahamas has positioned itself as the southern US “off shore island” container hub port by adding deep-water container ship handling capacity. Freeport’s container throughput increased from about 11,000 TEU in the mid-1990’s to over 1.1 million in 2005.

In response to de Monie’s off shore island proposal, another study suggests there are sufficient suitable deep-water ports in Canada to readily serve North American container movements (Ircha, 2001). These Canadian ports include: Vancouver and Prince Rupert on the West Coast and Halifax, Saint John, the Strait of Canso area and Sept Îles on the East Coast.

During the past two decades, the “hub and spoke” model container transshipment was the generally accepted approach. However, an analysis of ship routing suggests this model has not fully developed. Instead, ship routing has become increasingly complex. This analysis showed that from 1992-2002 there was an increase in the number of ports having direct calls from top-tier container lines. In this period, 22 new ports were added including 18 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 centers, 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 become the norm in the future. Locating such hubs outside of major urban areas may be prudent to enable container inspection to occur in secure areas. Hence the more remote, Canadian deep-water ports such as Prince Rupert may serve tomorrow’s North American need for new container hub ports.

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 use more than one hub port. 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 (Mottley, 2005).

In the future, we will likely see more rather than fewer major container terminals along both coasts of North America providing container security in non-urban, more isolated locations and offering port diversity to shipping lines to ensure delivery reliability. This trend offers a significant opportunity to existing and proposed Canadian ports.

Impacts on Ports

Major shifts in the container trade have impacted container terminals around the world. Some ports retained and expanded their hub port status, while others have been relegated to feeder port or niche port roles. Some of the key elements impacting Canadian container ports and impeding port expansion include: port congestion, security, urban development and environmental concerns.

Port Security

The growing demand 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 US have been heightened to the point where there is considerable fear of terrorist attack via containers. This concern led to several US container

related security programs. These include the Container Security Initiative (CSI) through which electronically submitted cargo manifests for all vessels inbound for the US or Canada must be filed 24 hours prior to loading containers at 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 US initiated Customs-Trade Partnership against Terrorism (C-TPAT) is 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 enhance their supply chain security using guidelines set by customs and trade community. By participating in C-TPAT such "trusted" partners may experience reduced US port inspections. Furthermore, most US and Canadian ports have been equipped with radiation detectors and gamma-ray inspection devices to allow customs officials to quickly check container contents against the filed manifest.

Recently, the US has been calling for changes in container security such that all boxes entering the US will have to be inspected prior to entry into the country (Kulisch, 2007b). This implies individual inspection at the port of origin. Alternatively, non-inspected containers could be off loaded in Canadian ports, inspected through the radiation and gamma ray portals installed in container terminals and then forwarded to the US. This proposed onerous US inspection might well provide a future opportunity for Canadian ports.

It is not beyond reason to expect that American 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 occurring in a densely populated area (the location of most major American and Canadian ports). In this case, establishing major container transshipment hubs in more isolated areas may make sense. Not only could such a facility serve mega-sized 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. Several Canadian deep-water ports on both coasts can meet these security criteria.

Urban and Environmental Constraints

A major trend impacting 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 citizen groups are exerting pressure to convert port lands to alternative, urban-oriented uses.

Today's post-industrial society is demanding the development of waterfront condominiums, walking trails, cafés and boutique shopping areas in place of under-used, industrial port lands (Ircha, 2002). Initially the proponents of such urban oriented waterfront development welcome the presence of busy terminals and an active harbour area, but often they soon tire of the ongoing noise (particularly in the evening and night time 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. This leads to pressure being mounted to constrain commercial terminals by limiting their hours of operation, reorienting dockside lighting, and restricting 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 (Ircha, 2000). 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 to its original marine terminal operators.

This post-industrial trend for the conversion of waterfront lands to urban oriented uses is occurring in many of the world's major ports. For example, there is pressure for the Port of Vancouver to curtail its terminal operations in the Burrard Inlet as the city's "cappuccino crowd" seeks 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 under-used port lands to public parks to provide community access to the waterfront.

To accommodate post-industrial society demands, many ports are incorporating sustainability as one of their key goals. In this context, sustainability refers to "balancing the financial, social and environmental needs... and integrating that balance into day-to-day business activities" (Nagle, 2007). Sustainability reflects the ports' recognition that their role goes beyond marine cargo handling to being good corporate citizens focusing on "people, planet and profits" (Scott, 2007/08). As an example, the Vancouver Fraser Port Authority is reinforcing its sustainability initiatives in environmental and community relations with the recent appointment of a Chief Sustainability Officer at a vice-presidential level.

From an environmental perspective, pressure is mounting on ships and ports from various sources, including the International Maritime Organization, to take steps to reduce their carbon footprint. Part of the current concern arises from a recent study on shipping by the UN Intergovernmental Panel on Climate Change which calculates that the annual air emissions from the world fleet has reached 1.12 billion tonnes of CO₂ or nearly 4.5 percent of the global amount. This is almost three times the previously estimated amount. The study further showed maritime CO₂ emissions could rise by 30 percent by 2020. As stated by the Chair of IPCC, "[t]his is a clear failure of the system. The shipping industry has so far escaped publicity. It has been left out of the climate change discussions. I hope [shipping emissions] will be included in the next UN agreement" (Vidal, 2008).

Increased attention from the environmental community will continue to pressure the shipping industry and ports to tackle rapid remedial actions to reduce their emissions and other polluting activities. Many steps are being taken such as: improving the fuel efficiency of ships, using lower sulfur content fuels, traveling at slower speeds, undertaking hull treatments to improve speed and efficiency, experimenting with supplementary propulsion such as the use of kites, and various port initiatives.

The Norwegian government has introduced a NO_x (nitrous oxides) tax on shipping. Today, ships entering Norwegian waters pay a tax of NOK15 (about \$2.70) per kg/NO_x emitted. Other Baltic states are considering the concept as a means of reducing NO_x emissions in sensitive environmental areas (Wheater, 2008). Given growing environmental concerns about shipping, such taxes on emissions could become a common feature in the future adding further to the costs of shipping. The US Environmental Protection Agency has proposed a regulation significantly limiting sulfur, nitrogen oxide and particulate matter emissions from ships in a two-

step process by 2012 and 2016 (Johnson, 2008). The State of California has introduced legislation to ensure ships burn clean fuel within 24 miles of the shoreline.

The alternative to taxation and outright prohibition is the provision of subsidies and incentives to encourage the use of lower sulfur (cleaner) fuels to reduce harmful emissions. Such steps were initially taken by the Port of Rotterdam in 1994 with its Green Award Program whereby certified “green” ships receive reductions in harbour fees. The Green Award concept has spread to other ports. In 2007, the Green Award Foundation entered into a Memorandum of Understanding with the Association of Canadian Port Authorities to work with Transport Canada to initiate the program in Canadian ports. The Vancouver Fraser Port Authority has already introduced a three-tier harbour dues program providing discounts to ships burning lower sulfur fuel.

In addition to using cleaner fuels, major container shipping lines are considering slower steaming schedules to reduce fuel consumption. Such slow steaming leads to substantial reductions in fuel consumption. Some estimates suggest that a 10 percent speed reduction can cut fuels and emission by 20 percent. However, such reduced speeds may lead shippers to deploy more ships on key routes to maintain service levels. As suggested by the Chair of the International Bunker Industry Association, “[s]low steaming sounds commercially attractive, but beware. Such is the level of demand for rapid cargo transportation that slower ships are likely to result in demand for still more ships, which in turn will actually increase fuel consumption” (Fredriksen, 2008).

Other steps being taken by shipping lines to reduce their carbon footprint include ensuring their hulls and propellers are clean to improve fuel and operating efficiency and using supplementary propulsion systems such as “sky sails” or kites to offset conventional fuel sources.

On the shore side, ports are taking steps to reduce air emissions from ships and cargo-handling equipment. In several major ports, provisions are being made to support “cold-ironing” or the provision of shore power for ships tied alongside. Shore power enables ships to shut down their generators leading to reduced emissions in the harbour area (however, there may still be emissions at the more remote power generating site). In 2004, the Port of Los Angeles opened the first container terminal using Alternative Maritime Power (AMP). Many shipping lines have committed to retrofitting their vessels with the onboard equipment required to hook up to AMP (Wheater, 2008). In addition, the port of Los Angeles is considering developing a 10-megawatt solar array to supplement traditional power sources in supplying its AMP system. (Nall, 2007).

Various ports have taken steps to retrofit or re-equip their onshore container handling equipment to reduce emissions through the use of alternative fuels such as liquefied natural gas. For example, the port of Long Beach has initiated a Clean Trucks Program for modernizing and replacing the ports’ truck fleet within four years. This program includes a \$1.6 billion subsidy program to finance the lease or purchase of clean trucks. It is expected that the program will replace 16,800 older drayage trucks in Long Beach by 2012.

Ports and shipping continually face new challenges. In recent years pressure has been mounting on the industry to convert waterfront lands to non-marine cargo handling activities and reducing the air emissions and other pollutants being created by the maritime industry. In the latter case, steps are being taken to reduce the industry’s carbon footprint, but such steps

inevitably come with added costs which will eventually be borne by consumers in the higher cost of goods transported by sea.

Canadian Port Opportunities

In 2006, Canadian container ports handled some 4.2 million TEU (AAPA, 2007). Canadian container throughput represents about 1 percent of the world's container traffic of 428.8 million TEU in 2006 (Degerlund, 2008). Assuming the forecast of a 75% increase in TEU throughput in North America over the next ten years is correct, there will be a requirement for Canadian ports to handle a minimum throughput of about 7 million TEU in 2015. The actual demand could be higher as some US ports may not be able to expand their container handling facilities to serve mega-sized container ships. In an earlier study, the possible location of major container transshipment hub ports on the Canadian West and East Coasts was reviewed. This study suggested that tomorrow's major hub transshipment facilities could be located at Prince Rupert and Vancouver on the West Coast and in Canso and Halifax on the East Coast. Steps are currently being taken in these two West Coast ports to address the issue of increasing container trade.

West Coast Ports

The Port of Vancouver is actively engaged in upgrading and expanding its container handling terminals to address both current capacity issues and meet the growing demands of tomorrow. In a recent presentation, the Vancouver Port Authority's President Captain Gordon Houston stated there are five separate container projects either underway or being planned in Vancouver. These include adding a third berth at the Deltaport Container Terminal, developing a new additional three berth terminal at Deltaport (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 TEU capacity to Vancouver.

Prince Rupert is now operating the first phase of its new 2 million TEU container handling facility. The Port of Prince Rupert is ideally located on deep water relatively close to the northern Pacific great-circle route from Asia to North America. Prince Rupert's location places it closer to Asian ports than any other North American facility. In addition, the port is served by a currently under-used rail system connecting Prince Rupert to the continent's industrial heartland. Prince Rupert's strategic location for the movement of containers on larger container ships was recognized early on. More recent major public and private investment in developing the port's first phase container terminal will ease some of the pressure on congested West Coast container ports in getting Asian and Chinese containers into North America. Further development of the Prince Rupert container terminal facilities will enhance trade and contribute to local economic development.

Conclusion

The growth of the global economy was underpinned by the lower freight rates generated from technological developments such as containerization in the seaborne trade. Remaining competitive by offering lower freight rates led to the development of ever-larger ships seeking economies of scale. This is particularly evident in the container trades with the recent launch of mega-sized container ships of 12,000+ TEU capacities.

NAFTA led to a focused interest by the public and private sector on developing north-south trade corridors. As corridor discussions matured, it became evident that major ports on or near these major trade corridors played a key role as gateways connecting North American markets to the global economy. The focus of trade corridors and gateways evolved into considering a fully integrated intermodal transport system as part of a comprehensive logistics chain. The Asia-Pacific Gateway Initiative provides Canada's first comprehensive and integrated transportation corridor and gateway strategy based on a full public-private partnership. This form of integrated transportation strategy (port and rail) led to the development of Prince Rupert's success in developing its initial container terminal.

The continued development of Canadian Port Authorities is constrained to a degree by the *Canada Marine Act 1998* and other federal legislation. CPAs are not able to respond quickly to emerging business opportunities as they are still tied to various federal regulations and requirements. The Canadian ports situation is considerably different than the business-like environment of their US competitors who typically have considerable freedom to take action to capture emerging opportunities. The liberalizing recommendations of the Canada Marine Act Review Panel need to be adopted by the federal government to enable CPAs to act as businesses rather than as mere federal agents. Recent CMA amendments are a major step in this direction.

There are opportunities for Canadian ports to serve North America as hub container ports on both coasts. Ongoing congestion and capacity constraints in major US ports could lead to the development of more remote Canadian alternatives – Prince Rupert's container terminal initiative offers a prime example of this approach. Other Canadian ports could serve continental container trade such as expansions at Vancouver, Halifax, Saint John and new container terminal developments in the Strait of Canso and Sept Îles.

There are several key elements required 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 and connected to effective trade corridors. 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 coast's port range.

Secondly, ports seeking to serve mega-sized container ships must be accessible to them. This means they must have water depths of 15 meters or more, appropriately sized turning basins and navigation channels to serve such ships.

Thirdly, container hub ports must have and maintain a reputation for continued high productivity in terms of ship turn-around time and truck/rail car turn-around 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 rapidly adopt new and changing technology to maintain high throughput levels. Flexibility also means 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.

Fourthly, 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, these key elements must be achieved economically such that the rates and tariffs charged for container moves through the port and terminal remain competitive. Achieving these key elements is not an easy task, but they are essential if Canadian container ports wish to remain key players in the continued development of the North American economy.

Endnotes

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- i Based on M.C. Ircha, "Public Policy for Ports: To Be or Not to Be Corporatised or Privatized?" a submission to the Canada Marine Act Review Panel, October 2002.

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