Factors Impacting North American Freight Distribution in View of the Panama Canal Expansion

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Acknowledgments

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A. Introduction: Assessing the Impacts of the Panama Canal Expansion

The announcement made in 2006 by the Panama Canal Authority that the Panama Canal would be expanded by 2014 begs to question its potential impacts on maritime shipping and North American supply chains. There is a wide range of assessments, from a “game changing” event fundamentally impacting global freight distribution to limited or no perceptible impacts once the expanded canal is brought online. This divergence in opinion underlines that global freight distribution, the strategy of maritime shipping companies and terminal operators and supply chain management have become so complex and interrelated that it is unclear how the expansion will pan itself out. While what is known is fairly straightforward, such as the operational characteristics of the expanded canal, it is by far supplemented by what remain uncertain, namely shipping network configurations and their respective advantages.

The problem in assessing an issue which is relatively simple since it concerns only a capacity expansion project is that in reality the consequences are multidimensional and prone with feedback effects, some of which may even be unintended consequences. There are thus many unknowns in this equation, namely how the multiple actors will react and to what extent the variety of converging and diverging strategies will lead to shipping service reconfigurations. For instance, how the crucial Pacific Asia – North American trade segment is going to be serviced? How much more cargo is divertible from the West Coast to the East Coast? To what extent North American importers and exporters are going to be impacted by the availability, the cost and the reliability of transport services?

Answering these questions is a challenging exercise since the main actors of the freight distribution industry, from freight forwarders, rail operators, logistics service providers, terminal operators and maritime shipping companies are themselves uncertain. What is unmistakeable is that they will anticipate, react and adapt to changes brought by the expansion of the Panama Canal. This study identifies the factors that are most likely to have an impact and also try to assess what could be their respective extent. It must be seen as a speculative exercise, particularly because several of the factors been discussed are contradictory.

First, an overview of the role of function of the existing Panama Canal is presented, including what is the rationale behind its expansion and the expansion project itself. Then, the study will focus on three main classes of factors at play with the expansion. They include macroeconomic factors, particularly expected

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shifts in the structure of production, operational factors that the expansion may provide for the maritime shipping industry, and competitive factors related to other transport chains. Last, the study concludes about the expected changes the expansion of the Panama Canal will have on North American supply chains, with a focus on Western Canada. The observations are validated with a survey performed among stakeholders in Western Canada’s transport system.
B. The Panama Canal Expansion Project

The Historical and Contemporary Role of the Panama Canal

The Panama Canal joins the Atlantic and Pacific oceans across the Isthmus of Panama (Figure 1). Running from Cristobal on Limon Bay, an arm of the Caribbean Sea, to Balboa, on the Gulf of Panama, the canal is slightly more than 64 km long. Its operational characteristics limit vessels to the following characteristics: a depth of 12.5 meters (39.5 feet), a width of 32 meters (106 feet) and a length of 294 meters (965 feet). Its construction ranks as one of the greatest engineering works of all time as it prevents a long detour around South America, thus supporting the maritime flows of world trade. The Panama Canal is of strategic importance to the United States as it enables to link the East and the West coast more quickly, saving about 13,000 km (from 21,000 km to 8,000 km) for a maritime journey. It is composed of three main elements, the Gatun Locks (Atlantic Ocean access) the Gaillard Cut (continental divide) and the Miraflores / Pedro Miguel Locks (Pacific Ocean access). It is synonymous of a standard in maritime transport related to capacity, the Panamax standard, which equals to 65,000 deadweight tons, a draft of 12 meters and a capacity of 4,800 TEUs.
In its 93 years of existence (as of 2007), more than 957,000 vessels transited the canal, carrying 8.1 billion tons of cargo. About 13,000 ships transit the canal every year, with an average of 35 ships per day. However, the canal has the capacity to handle 50 ships per day with an average transit time of about 16.5 hours if the passage has been reserved in advance and about 35 hours if no reservations have been made, for an average crossing time of 23 hours. Containers, grains and petroleum account for the dominant share of the cargo transited. The introduction of super-tankers at the beginning of the 1950s forced the reconsideration of its strategic importance as economies of scale in petroleum shipping are limited by the size of the canal. This was exacerbated by the mid-1990s when new generations of containerships well above the design capacity of 4,500 TEU became available.

The canal handles about 5% of the global seaborne trade and about 12% of the American international seaborne trade. Under the control of the United States until 1979, its administration was entrusted to the State of Panama by the Panama Canal Treaty of 1977. In December 1999, the canal was reverted to Panama under the jurisdiction of the Panama Canal Authority. The authority generates revenue by collecting tolls on all ships crossing the canal. A loaded ship pays about $2.57 per net ton and the average toll is about $45,000. For container ships the toll is $72 per TEU of capacity on laden containers and
$57.60 per TEU of capacity on ships with empty containers. In 2008, $1.32 billion in tolls were collected, of which 54% were generated by container shipping.

**At the Juncture of the Maritime Systems of the Americas**

Through its history the Panama Canal has been a juncture for transoceanic trade and between the North American East and West Coasts. This role will be expanded in the future with a growing role of the South American trade and with higher levels of economic integration, notably free trade agreements beyond NAFTA. The maritime system of the Americas is composed of three major sub-systems (Figure 2):

- **North America.** This sub-system has three coasts (Pacific, Atlantic and Gulf) but they integrated with long distance rail corridors (landbridges). While hinterland access is dependent on port proximity, the efficiency and capacity of rail transportation makes the Panama Canal an option subject to comparative cost and reliability features. With the setting of NAFTA and the integration of its rail system, Mexico is increasingly considered as an extension of the Pacific and Gulf Coasts.

- **South America.** This sub-system has two coasts that are not integrated because of the difficulties to service the hinterland. Inland rail connections tend to be poor or non-existent and when they are present they are simply penetration lines linking linearly a gateway and a few inland load centers. Each coast is a completely different market and more than often each port is able to assert dominance over its hinterland since competition tends to be limited. In this setting the Panama Canal is fundamental since there are limited options to link both coasts.

- **Central America / Caribbean.** This sub-system has small hinterlands, implying limited growth potential due to endemic economic factors, with a few exceptions (e.g. Cuba and Columbia). The main growth driver is transshipment with the Panama Canal a fundamental element of this business.
As the amount of containerized trade in South America increases, there will be a corresponding growth in the usage of the Panama Canal to support internal South American trade, as well as its interactions with overseas trade partners (e.g. West Coast of South America and Europe or East Coast of South America and Asia).

**Rationale for the Expansion**

The requirements of container shipping have become an important consideration in the operations of the Panama Canal and a significant rationale behind its expansion (Table 1). In spite of being close to a century old, the Panama Canal remains a critical facilitator in global trade. The continuous growth of global trade since the 1990s has placed additional pressures on the Panama Canal to handle a growing number of ships in a timely and predictable manner. By the late 1990s concerns were raised that the existing canal could reach capacity by the second decade of the 21st century. Because of these capacity limits, many shipping companies have changed the configuration of their routes. This became increasingly apparent as a growing share of the global containership fleet reached a size beyond the capacity of the Panama Canal, which came to be known as “post-panamax” containerships. Through economies of scale, they offer significant operational costs advantages that cannot be exploited by the existing canal. Thus, if the canal would not have been expanded, serious
capacity issues would have taken place sooner or later, imposing shipping lines to adjust their network configuration and impacting trade patterns.

The increasing usage of post-panamax containerships along the Pacific Asia / Suez Canal / Mediterranean routes as well as the development of the North American rail landbridge have created a substantial competition to the canal as an intermediate location in global maritime shipping. Yet, concerns about the reliability of the landbridge connection incited the setting of “all-water routes” linking directly Pacific Asia and the American East Coast, particularly in light of the booming China-United States trade relation. The Panama Canal expansion remains a project designed to help alleviate congestion at West Coast ports and offer options for North American shipping.

Table 1: Main Criteria behind the Expansion of the Panama Canal

<table>
<thead>
<tr>
<th>Rationale</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Growth of Transpacific trade</td>
<td>High</td>
</tr>
<tr>
<td>Capacity constraints on the existing canal</td>
<td>High</td>
</tr>
<tr>
<td>Economies of scale in maritime shipping</td>
<td>High</td>
</tr>
<tr>
<td>Alleviate congestion at West Coast ports</td>
<td>Average</td>
</tr>
<tr>
<td>Revenue generation for Panama</td>
<td>Average</td>
</tr>
<tr>
<td>Uncertainty of the American landbridge</td>
<td>Average</td>
</tr>
<tr>
<td>Economic growth in Latin America</td>
<td>Average</td>
</tr>
<tr>
<td>Compete with the Suez Canal</td>
<td>Low</td>
</tr>
</tbody>
</table>

Characteristics of the Expansion Project

A decision to expand the Panama Canal was reached in 2006 by the Panamanian government. The expansion is a 5.25 billion US dollars project that involves building a new set of locks on both the Atlantic and Pacific sides of the canal to support a depth of 60 feet, a width of 190 feet and a length of 1,400 feet, which would accommodate ships up to 12,000 TEU depending on their load configuration (Table 2). The dredging of access channels as well as the widening of several sections of the existing canal will also be required. This would allow Aframax and Suezmax vessels to pass through the canal, thus permitting new opportunities for container services such as the re-emergence of round-the-world services. It is expected that the new infrastructures will become online by 2014 or 2015.
Table 2: Comparative Characteristics of the Panama Canal Expansion

<table>
<thead>
<tr>
<th></th>
<th>Panamax (1914-)</th>
<th>New Panamax (2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beam</td>
<td>32 m (106 feet)</td>
<td>49 m (160 feet)</td>
</tr>
<tr>
<td>Length</td>
<td>294 m (965 feet)</td>
<td>366 m (1,200 feet)</td>
</tr>
<tr>
<td>Draft</td>
<td>12 m (40 feet)</td>
<td>15.2 m (50 feet)</td>
</tr>
<tr>
<td>Container Vessel Capacity</td>
<td>4,500 TEU²</td>
<td>12,000 TEU</td>
</tr>
<tr>
<td>Bulk Carrier Capacity</td>
<td>52,000 DWT³</td>
<td>119,000 DWT</td>
</tr>
<tr>
<td>Locks</td>
<td>Miter gates</td>
<td>Rolling gates</td>
</tr>
<tr>
<td></td>
<td>Three lock systems:</td>
<td>Two lock systems:</td>
</tr>
<tr>
<td></td>
<td>Gatun Locks (3 stages; 85 feet)</td>
<td>Atlantic Locks (3 stages)</td>
</tr>
<tr>
<td></td>
<td>Pedro Miguel Lock (1 stage; 31 feet)</td>
<td>Pacific Locks (3 stages)</td>
</tr>
<tr>
<td></td>
<td>Miraflores Locks (2 stages; 54 feet)</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>$387 million</td>
<td>$5.25 billion (estimated)</td>
</tr>
<tr>
<td>Annual Capacity (# of ships)</td>
<td>13,500-14,000</td>
<td>16,000</td>
</tr>
</tbody>
</table>

The expansion project has four main dimensions:

- **New locks.** Two complete new lock systems will be built in parallel to the existing locks. They will employ the rolling gate principle and use side basins to minimize water consumption. This means that once the Panama Canal is expanded, both the old and new lock systems will be operational.

- **Deepening of canal entrances.** Both the Atlantic and Pacific access to the canal will be dredged to accommodate larger vessel drafts.

- **Deepening of the Culebra (Gaillard) Cut.** Expanding the continental divide cut and the navigation channels between the Pacific Locks and Gatun Lake so that they can accommodate deeper drafts and vessels circulating in both directions. The width current Culebra Cut can only handle ships heading in one direction at a time.

- **Gatun Lake expansion.** Concerns the deepening of the Gatun Lake navigation channel as well as raising the water level of the lake from 26.7 meters above sea level to 27.1 meters. This will increase the water supply available to the lock systems.

² Twenty foot Equivalent Unit. A standard measure of capacity in containerized maritime shipping.
³ Dead Weight Tons.
Although the annual capacity will increase by about 2,000 additional ships able to transit the canal, it is through economies of scale that the impacts of the expansion will be the most significant. Capacity in terms of TEU will almost triple while bulk capacity in deadweight tons will more than double.

The Global Maritime System in a Post Panama Expansion Era

The considerations behind the expansion of the Panama Canal must be pondered by long term tendencies in the configuration of global shipping networks (Figure 3).

Figure 3: Emerging Global Maritime Freight Transport System

Four major overlapping and complementary routing systems can be noted:

- **Circum Equatorial Route.** With the expansion of the Panama Canal a relative capacity parity will exist for the first time between the Panama and Suez canals. Maritime shipping companies may elect to establish circum equatorial routes in both directions with the usage of high capacity (8,000 to 12,000 TEU) containerships. This high frequency "conveyor belt" could support a significant share of global east-west freight movements in a cost effective way. This does not imply a homogeneous service as several different configurations of ports of call are possible along this route, particularly if a 300 nautical miles deviation is

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considered. Several circum equatorial network configurations are possible depending on the markets serviced by respective carriers.

- **North-South Pendulum Connectors.** These connectors reflect existing commercial relations, namely for raw materials (oil, minerals, agricultural goods), such as South America / North America, Africa / Europe or Australia / Asia. For container shipping, they are mostly based on the rationale that there is not enough volume to support transoceanic pendulum services, so cargo is collected along a latitudinal sequence of ports. This conventional network will be expanded with transshipment opportunities with the circum equatorial route.

- **Transoceanic Pendulum Connectors.** Connect through pendulum services selected ports of the facades of large oceanic masses. The three main transoceanic connectors are transpacific, Asia-Europe (through the Indian Ocean) and transatlantic. The industrialization of Asia (China in particular) has made the Asia - Europe and the transpacific connectors particularly important. Growth within the “BRIC” countries (Brazil, India and China) favors the emergence of a new connector in the Southern Hemisphere between the east coast of South America, the Cape of Good Hope and to Southeast Asia.

- **Transshipment Markets.** They connect regional port systems to transoceanic and circum equatorial routes, mainly through hub-and-spoke services. The relay function between long distance shipping services performed by those markets is also significant. The most important are Southeast Asia, the Mediterranean and the Caribbean. They are referred as markets because the transshipment function can be substituted to another port. Therefore, a group of ports in a transshipment market are "bidding" for port calls as this type of traffic is difficult to anchor. The development of circum equatorial routes is thus likely to expand the opportunities of transshipment, including interlining between these routes.
C. Macroeconomic Factors: Changes in Derived Demand

Macroeconomic factors are outside the control of ports and other actors involved in freight distribution as they are associated with the economic structure of consumption and production. Since freight transportation is a derived demand from the level but also the locational structure of economic activities, those factors must be considered even if they are highly general and conjectural. The financial crisis that unfolded after 2008 was an important reminder of the close relationships the port and maritime industries have with international trade dynamics.

Aggregate Demand Changes

There are several complex factors at play that influence the consumption level of the North American economy and which are prone to a fairly high level of uncertainty. One revolves around demand saturation. For instance, it has become clear post-ante that the American housing bubble of 2001-2007 was associated with a staggering level of debt-based consumption; once the bubble collapsed, so did its associated artificial level of consumption. Economic opportunities in North America, particularly on the short and medium terms, appear to be more limited and would thus imply lower growth levels they were previously anticipated in port development plans. This is compounded by long term demographic trends such as aging, where a growing share of the population will be involved in wealth consumption (retirement) as opposed to wealth creation. As the examples of Japan and Europe show, a significant level of social resources, such as healthcare, are consumed and thus diverted from the productive economy as the population ages. This would involve changes in the level and composition of the cargo carried by maritime shipping.

Alternatively, expectations about future growth in aggregate demand have shifted to locations that are dissimilar to the patterns that have prevailed in the last two decades. One such change is well anticipated and concerns China. The export-oriented paradigm that characterized China, which is a form of neo-mercantilism, cannot endure indefinitely. Private consumption in China stands at around 36% of GDP, compared with 71% for the United States. In light of these figures, there are expectations that the growth of endogenous consumption in China is likely to be associated with a growth of imports of finished goods, intermediate goods and commodities. Since the expected changes in aggregate demand involve lower growth levels in markets that previously were the dominant drivers (e.g. United States and Western Europe) and higher growth levels in markets that were
previously more marginal (e.g. South America, South Asia), this will have a notable impact on the structure of trade flows.

**Changes in the Structure of Production**

Globalization is not a static process, particularly since comparative advantages are constantly shifting. While East Asia has been a driver for global economic growth for decades (Japan, South Korea, Taiwan and Hong Kong), it is the Chinese economy that has the most deeply impacted the global structure of production. For several manufacturing sectors the exploitation of comparative advantages within the North American Free Trade Agreement (NAFTA) were essentially by-passed by the “China effect”. This was accompanied with a surge in transpacific trade and cargo handled by West Coast ports to the point that the US-China trade relation was considered the most fundamental growth driver. For a variety of reasons, the comparative advantages of China are being eroded, particularly for labor intensive activities, which imply a redistribution of elements of the manufacturing base to other locations, namely Southeast Asia and South Asia (Figure 4). Although the interior provinces of China could represent development opportunities, accessibility and reliability issues in freight distribution make this alternative prone to risks.

![Figure 4: Main Export-Oriented Regions and Shipping Routes Servicing North America](image)
A salient example of shifting comparative advantages concerns the apparel industry, which over the last few years has relocated several assets in Southeast Asia, notably Vietnam and Indonesia. This implies that the associated containerized cargo flows are much more likely to transship through Singapore, which represents the point of indifference between the transpacific and the westbound Suez Canal route. The growth of the export-oriented manufacturing base in South Asia, as well as endogenous consumption, would also be associated with a growing share of the Suez Canal (westbound) route. The point is when the supply chain managers in a specific sector start to change their sourcing strategies, the industry tends to react as a whole with competitors adopting a similar strategy. This implies that once a shift begins, it can take place relatively quickly and accordingly change the nature and composition of international trade.

Changes in the structure of production are not just an issue concerning Asia, since potential offshoring destinations tend to be located far from North American consumption markets. Transport costs, including inventory carrying costs, were accommodated because the comparative advantages gained in many manufacturing sectors exceeded the drawbacks in supply chain management (e.g. more inventory in transit, higher transport costs, more complex organization and relations with suppliers). Additionally, massive transport infrastructures were put in place by Asian exporters to support and expand this trade pattern, as reflected in the maritime shipping industry; the majority of maritime shipping and terminal operator interests are controlled by Asia. One likely scenario, labeled regionalization, involves a higher share of manufacturing done regionally within NAFTA and with Latin America. A similar assumption can be made in the case of Europe where European integration processes has made it more convenient to tap production resources in Eastern Europe, North Africa and the Middle East (e.g. Turkey). Thus, the expansion of the Panama Canal takes place in a phase where many drivers behind the contemporary growth of transpacific trade are being reassessed.
D. Operational Factors in Freight Distribution

Freight distribution involves several operational considerations that are related to the organization of flows along the various transport chains, such as maritime shipping. They also concern the dynamics of supply chains that are responsive to issues of total cost, time and reliability. These factors have a direct impact on the configuration of maritime shipping services, the ports of call and the inland routing options.

Supply Chains: Diversification and Differentiation

Diversification aims to avoid disruption through the usage of several routing options, or at least having other routing options available in case of disruptions on the preferred route. This is common in supply chain management where several suppliers can be used. Although this strategy can be more costly, it mitigates potential disruptions such as a supplier unable to deliver because of an unforeseen event (e.g. a strike). Just-in-time practices and particularly tight supply chain management (inventory in transit) have made managers highly sensitive and intolerant to supply chain disruptions. The West Coast ports’ strike of 2005 remains a disruptive factor that supply chain managers have considered in the positioning of their warehousing assets to service the North American economy with a greater emphasis on the East and Gulf coasts as part of a mitigation strategy. Savannah has particularly benefited from these changes, being able to gather business from these changes, being able to gather business from these changes, and particularly the transatlantic routes.

Servicing the North American economy from Pacific Asia involves at start two major options, one being the intermodal route and the other being the all-water route (Figure 4 and Figure 5). For Pacific Asian cargo bound for the East Coast, the current share of the respective routes is about 55% for intermodal and 45% for all-water routes. In both cases, there are additional options; the intermodal route can use an array of gateways along the West Coast, from Canadian ports (Prince Rupert and Vancouver) to new gateways in Mexico (mostly Lazaro Cardenas) while the all water route can transit through the Panama or the Suez canals.
At an aggregate level the transpacific route between Asia and the American West Coast accounted for about 75% of American imports from Asia in 2006. This includes a transpacific crossing time of about 13 days and 6 days of intermodal transit. The all-water route through the Panama Canal accounted for 19% of American imports from Asia with an average transit time of about 22 days. The least important is the Suez Canal all-water route accounting for 6% of imports and having an average transit time of about 21 days. Looking more specifically at the Northeast Asia / American East Coast trade, the closest and the most suitable to substitution to the all-water route, significant changes took place in recent years. While the intermodal option was conventionally dominant, the diversification of routing options between Northeast Asia and the American East Coast has been remarkable over the last decade (Figure 6). While in 2000 intermodal (landbridge) accounted for 82% of TEUs between Northeast Asia and the East Coast, this share went down to 55% in 2007. In view of this shift that took place before the expansion of the Panama Canal, it is uncertain to what extent it could endure. Even if for any reason the all water route was to lose most of its advantages, freight forwarders are likely to keep using it to diversify their routing options.


Figure 5: Routing Options between Pacific Asia and the American East Coast
In addition to the diversification of routing options, **differentiation** is also an emerging paradigm in global supply chains. It concerns the routing of freight according to criteria preferences:

- **Cost.** A standard criteria where the cheapest routing option is sought, as long as the cost structure remains stable as supply chains are unlikely to be modified if a cost advantage is only temporary. The concept of cost is relative since its importance is in relation to the value of the cargo being carried. Cost considerations tend to concern more containerized goods that have a low value, such as commodities (e.g. paper). If cost is the dominant factor, it is likely that the all-water route will be preferred for cargo bound to the East Coast. The expansion of the Panama Canal will likely modify this factor by making the routing option cheaper.

- **Time.** A criteria that is increasingly being considered since it strongly influence inventory carrying costs and inventory cycle time in supply chain management. So, for cargo that has a higher value (clothing) or is perishable (reefers) the routing option that is the fastest and/or shortest will be preferred. In this case, the intermodal option would be preferred with Prince Rupert filling a specific niche. The expansion of the Panama Canal will have limited impact on this criteria, except at an aggregate level as the expansion will reduce congestion and the associated delays.

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6 Source: Panama Canal Authority.
Factors Impacting North American Freight Distribution in View of the Panama Canal Expansion

- **Reliability.** Relates to criteria that is mitigated by contemporary supply chain management practices. For several supply chains, time can be a secondary factor as long as shipments arrive at the distribution center within an expected time frame. If shipments are regular and that this reliability remains consistent, it is possible to organize supply chains accordingly. Reliability can also involve a consistency in costs, implying that a more costly routing option could be preferred as long as it costs remain more consistent in regard to other routing options (e.g. seasonality). The expansion of the Panama Canal is expected to slightly increase the reliability of the all-water route, mostly because its additional capacity will be associated with less congestion and transit delays.

Some of those preferences tend to be mutually exclusive, namely time and cost. A survey of one thousand of the world largest shippers\(^7\) revealed that among their priorities, freight rates accounted for 38% of the respondents, transit time accounted to 12% while schedule reliability accounted for 43%. These figures underline the niche that each gateway can take as a cargo routing option for discretionary cargo as long as they are considered reliable.

**Economies of Scale**

An important rationale behind the expansion of the Panama Canal relates to the improvement of economies of scale in maritime shipping. A growing share of the world containerized fleet is unable to use the Panama Canal, imposing new configurations in maritime services. For instance, while in 1990 only 5 out of 1,355 containerships were beyond the panamax limitations (accounting for 1.3% of the global capacity in TEU), by 2006 this figure quickly grew to 1,387 out of a global container fleet of 3,547 (36% of the global capacity in TEU) and by 2010 1,447 containerships out of a fleet of 4,848 vessels were beyond panamax (40.5% of the capacity; Figure 7). By 2014 post-Panamax vessels are expected to account for 48% of the global container fleet. Still, maritime shipping companies also expanded substantially ship designs fitting the panamax specifications. This underlines the importance of the standard, not only because of its capability to use the Panama Canal, but also since many ports around the world have a draft and crane equipment designed with such specifications. Switching away from standards is always a costly and risky endeavor.

From a current capacity of about 4,500 TEUs, the expansion project places the capacity at around 12,000 TEUs. Depending on the port pairs serviced, this implies a drop in shipping costs per container in the range of 40%. Shipping companies are likely to respond by changes in capacity deployment and network configuration to take advantage of the potential cost savings that the additional capacity of the Panama Canal will confer. Post-Panamax vessels are effective for trade flows over long distances and between large ports, thus creating multiplying effects with economies of scale at modes and at terminals. In this context the expansion of the Panama Canal could incite additional deployments of post-panamax ships since greater routing options become available.

The emergence of global circum-equatorial services between major transshipment markets remain a distinct possibility for a better utilization of Post-Panamax ship assets. However, many East Coast ports are ill-able to accommodate such ships since their depth is limited, even after significant dredging projects, to 50 feet. New York, Baltimore, and Hampton Roads are major East Coast ports above the 45 feet threshold having a market base large enough to justify direct calls by Post-Panamax vessels with Savannah at 42 feet and able to accommodate ships of about 5,500 TEU. An important consequence of the Panama Canal expansion is likely to be a growth in transshipment activities around the Caribbean, and this for the following reasons:

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8 Source: Clarkson Research and Alphaliner.
A better utilization of post-panamax ship assets along the circum-equatorial route since that route is likely to provide both volume and frequency.

The difficulties of reconciling the multiplicity of cargo destinations. The larger the ship, more likely its cargo is bound to numerous destinations, which requires additional transshipment.

Economies of scale along feeder services able to use panama class ships instead of smaller vessels usually used for such services.

Feeder services to East Coast ports would thus increase, which would help mitigate the port depth issue. This would also represent a challenge for Caribbean transshipment hubs since Post-Panamax vessels would likely call only at a few large hubs (e.g. Freeport, Kingston), undermining the expectation of many ports to become large transshipment hubs unless clearly supported by a global terminal operator (e.g. Caucedo in the Dominican Republic, a terminal with a design capacity of 1 million TEU managed by DPW).

**Cost Structure**

Several cost factors have an impact on routing options. First, there are capital costs related to the acquisition of the ship. New ships above 6,000 TEU have costs above 100 million USD, while a ship of 10,000 TEU is well above 140 million USD. Second, there are operating costs. Maritime shipping is highly sensitive to bunker fuel costs as they represent between 45 and 50% of operating costs with limited opportunities to mitigate outside slow steaming (see next section). Still, from a comparative perspective maritime shipping has less fuel price sensitivity than trucking and rail, implying that higher energy prices are likely to trigger the consideration of routing options that have a port call the closest possible to the destination of the shipments; maximizing the maritime segment and minimizing the inland segment.

A standard Panamax containership has operational costs of about $9 million per year (Figure 8). The most significant expenses are related to fuel (46%) and port charges (21%), which are variable costs. This is transcribed in annual operating costs of about $2,314 per TEU. Not shown here are the significant amortization costs related to the ship purchase (principal and interest). The incentive to use larger containerships is quite clear from the perspective of maritime shippers, which led to a new generation of 10,000 TEU containerships being introduced in 2007. In this case, fuel and port charges account respectively for 50% and 21% of their annual operating costs, while manning costs remains constant. However, annual operating costs per TEU drop by more than one half to $1,449. So, on one side the expansion of the Panama Canal will enable shipping companies to improve their all-water costs.
The cost structure of the transport chain will be an important determinant in the comparative advantages of respective routing options, including the landbridge, the usage of the Suez Canal, or the all-water route through the Panama Canal (Figure 9). The pattern for inbound traffic is straightforward and a function of shipping distance; the lowest among the sample being Vancouver and the highest being Montreal at the opposite end of the all-water route (compounded by a significant detour through the St. Lawrence).

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**Figure 8: Annual Operating Costs of Panamax and Post-panamax Containerships (in USD)**

The cost structure of the transport chain will be an important determinant in the comparative advantages of respective routing options, including the landbridge, the usage of the Suez Canal, or the all-water route through the Panama Canal (Figure 9). The pattern for inbound traffic is straightforward and a function of shipping distance; the lowest among the sample being Vancouver and the highest being Montreal at the opposite end of the all-water route (compounded by a significant detour through the St. Lawrence).

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9 Source: Drewry Shipping Consultants.
The container shipping rates for outbound traffic differ with shipping distance playing a much less evident role. They are more reflective of trade patterns, particularly of export opportunities in the port’s hinterland. Where inbound flows are significant and where return cargo is proportionally scarcer outbound rates are much lower as shipping companies try to attract backhaul cargo by

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10 Source: Drewry Container Benchmarks. Note: The rate benchmarks are for full container loads and include the base ocean rate, the terminal handling charge both at origin and at destination, the fuel surcharge and all other surcharges; they do not include inland transport costs. Source for equivalence lines: WorleyParsons and Princeton Consultants, Inc.
discounting. The greatest paradox concerns New York and Vancouver, both at the opposite end of the all-water route from Asia. While, as expected, the inbound rate per TEU is 60% higher for New York than Vancouver, the outbound rate is 15% cheaper for New York. The availability of empty containers along the East Coast, as exemplified by New York, could expand export opportunities with the Panama Canal expansion. A significant change could involve a shift in the maritime ranges that are using import-related supply chains that are less time sensitive.

The usage of the all-water route can be perceived as an exercise between lower transport costs at the expense of more time spent in transit than for the intermodal option. In the current context, the all-water route to the East Coast is about $500 per TEU cheaper than the intermodal option, but imply on average 7 or 8 more days of transit time. This means that the cost differential in terms of dollars per TEU per day saved in the range of $70-75, which corresponds to a current market share of the all-water route for Asian imports of about 28% (Figure 10). Importers are thus paying this premium ($75 per day) to save 7 or 8 days through the intermodal option. Conversely, traffic that is less time sensitive or where supply chain management has been organized to mitigate time through frequency of service is getting a $75 per day discount for using the all-water route.
The expansion of the Panama Canal is expected to further expand this cost differential through better economies of scale and could thus result in a higher share of the all-water route for American imports from Asia. The cost differential could increase in the range of $25 to $50 per TEU per day. This would lead to extrapolate that the market share of the all-water route could grow from 28-30% to figures in the range of 40-50%, resulting in a substantial increase in traffic for East Coast ports (Figure 10). The expected lower transportation costs of the all-water route are likely to have an impact on the cost equivalence line, which represents the point of indifference between using the landbridge or the all-water route. Under a specific set of parameters related to bunker prices, the usage of panamax ships and canal toll rates, the cost equivalence line is an axis roughly between Houston and Detroit (see Figure 9Figure 1). This accounts for about 46% of the American population. By keeping these parameters constant but benefiting from the economies of scale of post-panamax ships the cost equivalence line shifts further inland along the Chicago – Nuevo Laredo axis, which accounts for 63% of the American population.

These highly optimistic figures must be pondered by several important caveats, notably tolls. In light of all of the above there are indications that the remarkable shift towards the all-water route that took place since 2000, as exemplified by

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Figure 10: Potential Diversion between Intermodal and All-Water Panama Routes for Asian Imports

Figure 6, maybe essentially completed and that the expansion of the Panama Canal would improve the market share of the all-water route only marginally.

The Toll Conundrum

The tolls related to the expansion of the Panama Canal will also play a significant role in the cost structure. Already, the PCA has substantially increased tolls; from $40 per TEU capacity of the ship in 2006 to $72 in 2009, an 80% hike. In 2011, tolls where slightly increased to $74 per TEU capacity. This means that toll increases have already captured about 40% of the potential cost savings of the expansion, which mitigates a substantial share of the expected gains. As a result, and due to other mounting cost pressures, namely bunker fuel, the cost differential gains could be even lower (+ $10-20 instead of +25-$50), resulting in a market share of the all-water route in the range of 35% after the expansion, which may still be an optimistic scenario.

The PCA is facing a conundrum between financial pressures for revenue generation and industry pressures to lower their cost structure. Container shipping already accounts for 54% of the toll revenue generated by the canal. The plan to pay off the full $5.25 billion cost of the expansion, including $2.3 billion in loans that were borrowed from international capital markets, was based on toll revenue projections over the next 20 years. They assume a continuous increase in global trade and the willingness of the maritime industry to pay indexed tolls, which is now being questioned following the financial crisis. Since then, the Panama Canal has received pressures from the shipping industry to freeze or lower its tolls. Additionally, there is a possibility that the expansion project could have cost overruns as it is common with large infrastructure projects. If the overrun is significant, tolls would bear the brunt of the pressure. This brings the question about how high must tolls rise to recover the costs of expansion and will the higher tolls offset the shipping lines’ cost savings obtained through the economies of scale of larger ships. Like all major investment projects, there is an opportunity cost linked with the potential returns of if the capital investments would have been allocated to something else. Therefore, the strategy of the PCA appears to lean more on revenue maximization than on the maximization traffic transiting the canal. In addition, the cost structure does not consider the unfolding impacts of slow steaming.

The toll structure used by the Panama Canal does not reflect well pricing mechanisms in a situation where supply is fixed while demand is flexible. The airline industry is facing such a situation and for years yield management strategies have been established to maximize revenue. While blocs of seats are sold in advance at a relatively fixed price, as the capacity of the plane gets filled seat prices are increased to reflect their growing scarcity. If within a pre-specified

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12 Dredging Today (2010) “East Coast ports are set for a sea change, but the new Panama Canal locks may not open trade floodgates”, February.
time period of a flight’s scheduled departure there are too many seats left unsold, then prices are discounted to attract opportunistic customers (e.g. tourists). If the flight is almost full, then the remaining seat prices are substantially increased so that customers with the most urgent needs will be able to afford them (e.g. last minute important business meetings). For security reasons and to prevent a speculative market, airline seats cannot be resold to a third party. For the Panama Canal, yield management would mostly imply the following:

- Long term utilization contracts with large customers, mainly shipping companies, where the number of slots, their schedule and the toll can be negotiated in advance. Shipping lines can negotiate individually or as a group with the agreement that slots can be reallocated within the group.
- A spot market where slots are sold using a bidding process. It represents slots that are available on a short period of time (24 hours to a week). This represents the segment where the Panama Canal transit tolls reflect current demand.
- An absolute minimum price essentially representing the operational costs of a transit below which it is not profitable to accommodate such a transit.

**Slow Steaming**

For decades, the cruising speed of containerships has been relatively constant, enabling to maintain a level of schedule integrity along pendulum routes. Figure 11 illustrates standard shipping times between Shanghai and several North American ports. The all water transit time ranges from 12 days to Prince Rupert to 26 days to New York. Rising bunker fuel prices and excess shipping capacity caused by the financial crisis of 2008-2010 induced several maritime shipping companies to lower the operational speed of their ships. While the standard sailing speed of a containership is in the range of 20 to 25 knots, “normal” slow steaming involves speeds between 19 and 20 knots. To this, the practice of “extra” slow steaming is emerging with speeds between 17 and 19 knots. For long distance shipping services (transpacific or Asia-Europe), this can add between 3 to 7 days in transit times and require the addition of 2 or 3 ships to the pendulum service to maintain the frequency of port calls. For instance, a standard Far East – West Coast loop that requires 6 to 8 ships to maintain with normal cruising speeds, requires 9 to 10 ships with a slow steaming service.

Slow steaming is more than just a cost issue since it also involves transit time and frequency adjustments that have a direct impact on supply chain management. It also remains to be seen the impacts slow steaming may have of maritime capital costs since ships will have lower port call frequencies and thus lower returns on investments. Contrary to what could be expected, slow steaming has not improved schedule reliability of liner services\(^\text{13}\). Even if there are more opportunities to adjust speed to meet port call schedules in case of a delay,

shipping companies have a preference in saving fuel and operating costs. Therefore, about half of all vessels still arrive late\textsuperscript{14}. While it was initially believed that slow steaming was just a temporary measure to cope with the excess capacity in container shipping, evidence underlines that it has become an enduring and prevailing practice in light of higher bunker fuel prices\textsuperscript{15}.

\textsuperscript{14} Arrival not on the scheduled arrival day of the pendulum service.
It is uncertain how supply chains that are more time dependent would react to this emerging operational reality that forces greater quantities of inventory in transit, and with little observed benefits of being more reliable time-wise. Additional inventory must be maintained to achieve a similar level of fulfillment since more cargo is caught in transit. In addition, this will put additional pressures on the performance of intermodal transport systems, both at the terminals and

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inland to insure time gains as well as to better guarantee the reliability of freight distribution. For the transpacific trade, the impacts of slow steaming are latitudinal as well as longitudinal.

- **Longitudinal.** Since most transoceanic shipping routes have an east-west orientation, the impacts of slow steaming in terms of additional time and schedule reliability increase proportionally with distance. The most impacted trade route will be the Asia-Europe segment, followed by the transpacific segment and then the transatlantic segment.

- **Latitudinal.** Because of the great circle distance the impacts of slow steaming will be felt more significantly in a latitudinal manner (north / south) in North America, Los Angeles / Long Beach being more impacted than Seattle and Vancouver. The port which will be the least impacted time-wise is Prince Rupert. On the East Coast, the impacts are the other way around, getting more acute heading north from the Panama Canal. With slow steaming, New York could see the transit time of its all-water route service to Pacific Asia increase by more than 5 days. This could easily negate all the cost benefits conferred by economies of scale due to the canal expansion.

Since the Panama Canal Route would involve proportionally longer shipping times with the slow steaming options, this could incite the usage of West Coast ports, particularly for supply chains that are more time-dependent. It may further promote supply chain differentiation. The impact slow steaming may have on the availability of containers inland remains uncertain, since more containerized assets are likely to be tied up in transit along maritime shipping routes. This may compound the problem of the availability of containers inland and incite supply chain management to rely to a greater extent on strategies based on transloading. It must also be considered that in light of the growing prevalence of slow steaming, some regular or faster (express) shipping services may be offered, particularly on a point-to-point basis, thus filling a niche for cargo which is more time sensitive.

**Transloading**

Transloading is an operation transferring cargo from one load unit to another, which is common in containerized transportation. It requires specialized equipment and a facility where it can be performed. There are several causes that may favor container transloading, which tends to take place in the vicinity of port terminals or inland (satellite) terminals (Table 3).
Table 3: Container Transloading

<table>
<thead>
<tr>
<th>Cause</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consolidation</td>
<td>Transferring the contents of smaller containers into larger containers (e.g. three maritime 40 foot containers into two 53 foot domestic containers). Cost savings (number of lifts). Time delays.</td>
</tr>
<tr>
<td>Weight compliance</td>
<td>Transferring the contents of heavy containers into loads meeting national or regional road weight limits.</td>
</tr>
<tr>
<td>Palletizing</td>
<td>Placing loose (floor loaded) containerized cargo unto pallets. Adapt to local load units (e.g. europallet).</td>
</tr>
<tr>
<td>Demurrage</td>
<td>Handing back containers to owner (maritime shipping or leasing company) by transferring its contents into another load unit (e.g. domestic container).</td>
</tr>
<tr>
<td>Equipment availability</td>
<td>Making maritime containers available for exports and domestic containers available for imports. Trade facilitation.</td>
</tr>
<tr>
<td>Supply chain management</td>
<td>Terminal and transloading facility as a buffer. Delay decision to route freight to better fulfill regional demands. Perform some added value activities (packaging, labeling, final assembly, etc.)</td>
</tr>
</tbody>
</table>

- **Consolidation.** In cases where this is a significant market for domestic containers and the domestic load unit is larger than the maritime load unit, shipments consolidation is often performed. In North America the largest domestic load unit is 53 foot, which represents the maximal legal size of a truck load on the highway. Thus, in distribution centers in the vicinity of several major port terminals the contents of three maritime containers are transferred into two domestic containers. This enables cost savings as shipment costs, including terminal costs, are established in terms of loads. A rail terminal charges by the number of lifts, which means it costs the same to handle a 40 foot or a 53 foot container. Under these circumstances, the transloading costs are compensated by savings on inland transport costs. Yet, transloading involves some risks such as damage and theft or additional delays to perform (about one day), which may not be suitable for several goods.

- **Weight compliance.** Simply involves shifting the contents of heavy containers into lighter loads such as domestic containers or twenty footers. This is particularly the case for the containerized movement of commodities. However, transloading heavy maritime containers into domestic containers is not a common practice.

- **Palletizing.** Very common for shipments of consumption goods. To gain shipment space in imbalanced flows many containers are "floor loaded" and once arriving near consumption markets, the shipments are broken down and assembled into pallets. This also gives the opportunity to adapt to local load units that involve different sizes, such as the difference
between North American and European pallets. Doing such a task at the point of origin would be logistically complex.

- **Demurrage.** Containers are commonly leased for a specific time period. The leasing contract may also specify that the maritime container cannot leave the vicinity of the port or cannot spend more than a specific amount of time inland. Transloading is thus performed to insure that the leased container is handed back to the maritime shipping or the leasing company without additional charge. This tends to reduce the repositioning of empty containers over long distances and promotes a higher level of asset utilization for the container lessor.

- **Equipment availability.** This often takes place in conjunction with demurrage. Transloading enables a more efficient use of both container assets (international and domestic) and can facilitate international trade by freeing transport capacity. For instance, moving maritime containers over long distances in the North American transport system can be considered a suboptimal usage of transport equipment. Conversely, the global maritime shipping industry is mainly designed to handle 40 foot containers and cannot accommodate domestic containers. However, a large amount of transloading for inbound shipments may reduce the availability of maritime containers available for export at inland locations. This is a salient problem for the export of containerized commodities.

- **Supply chain management.** A transloading facility can act as a buffer within a supply chain, enabling shippers some room to synchronize the delivery of goods with the real time needs of their customers. This is particularly the case for long distance trade where a shipment can be in transit for several weeks while the demand conditions at the destination may have meanwhile changed. Transloading enables to delay the decision about routing freight to the final destination by using the facility as an opportunity to do last minute adjustments in terms of which shipments should go to which markets. Another common supply chain practice concerns the assembly of loads for a specific market which transloading offer. More directly, transloading represents an opportunity to perform some added value activities (packaging, labeling, final assembly, etc.) before shipments arrive at final markets.

Already, as of mid-2010, container shortages are being felt within the global freight distribution system, which resulted in a surge in transloading activities. While a share of this shortage is related to a rebound in global trade that caught some freight forwarders with limited containerized assets to accommodate it, a part of it is due to the diffusion of slow steaming practices tying up greater quantities of containers in transit. Maritime shipping companies are highly supportive of transloading taking place near port terminals such as Vancouver, mostly because of better asset utilization. It means getting their containers back sooner rather than having a dwell time consisting of a combination of port time
and transportation transport time across the Canadian hinterland with an ultimate empty return of the container. If the container is de-stuffed in Vancouver it can be put back on the ship and returned to Asia for re-stuffing and re-delivery to North America within approximately, the same time for which the container would remain in Canada in the port/hinterland transport chain. This means two trips per container across the Pacific, implying a higher level of asset utilization.
E. Competitive Factors: A Variety of Feedbacks

It is expected that actors within supply chains, from ports to railway companies, that will be impacted by the expansion of the Panama Canal, either positively or negatively, are likely to respond with their own mitigation strategies. The point is that the expansion of the Panama Canal will be linked with numerous feedback effects, many of which are difficult to predict and assess.

East Coast Ports: Trying to Capture New Opportunities

East and Gulf coast ports see the expansion of the Panama Canal as an opportunity to increase cargo volumes and gather a greater share of the transpacific trade, which was the dominant growth factor in containerized transportation. An exemplification of this opportunity has been since 2003 the signing of several memorandums of understanding (MOU) between the Panama Canal Authority (PCA) and port authorities along the East and the Gulf coasts (Table 4). This initiative is mainly the outcome of a report commissioned by the PCA that recommended forging alliances with East and Gulf Coast ports to offer an effective value proposition to compete with the North American intermodal system. An important emphasis was the coordination of Canal improvements with various port improvements projects as well as the need to follow closely trends in the maritime industry, including shippers, shipbuilders and terminal operators. As of August 2011, 22 such MOUs have been signed. They typically involve six dimensions that the partners may elect to abide to:

- **Joint marketing activities.** Insuring that the Panama Canal option is part of the marketing plan of the respective ports so that the potentially new businesses generated benefit both partners.
- **Data exchange.** Sharing information about trends in the shipping market and the trade handled, namely port calls, transit time, type of commodities, and cargo tonnage. It is expected that better forecast assumptions would result.
- **Market studies.** Confidentially share their respective market studies over issues of common interest. May also elect to undertake joint studies.
- **Modernization and improvements.** Sharing information about infrastructure development projects, particularly as they relate to all-water services and port capacity.
- **Training.** Sharing information concerning the development of managerial expertise, including joint sessions.

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18 See http://www.pancanal.com/eng/acp/acuerdos/
- Technological exchange. Sharing information technology capabilities and the related datasets.

Table 4: Selected Memorandum of Understanding between the Panama Canal Authority and Selected Ports

<table>
<thead>
<tr>
<th>Port Authority</th>
<th>Date</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antwerp Port Authority</td>
<td>September 2010</td>
<td>Share expertise in the handling of Post-Panamax vessels, including rolling gate locks and tug boats.</td>
</tr>
<tr>
<td>Mississippi State Port Authority at Gulfport</td>
<td>August 2010</td>
<td>None specific except as identified by the MOU.</td>
</tr>
<tr>
<td>Jacksonville Port Authority</td>
<td>April 2010</td>
<td>None specific except as identified by the MOU.</td>
</tr>
<tr>
<td>Alabama State Port Authority</td>
<td>April 2010</td>
<td>Port improvements to capture the anticipated traffic growth. ASPA completed in 2008 a US$300 million container terminal at Mobile in partnership with APM and CMA CGM.</td>
</tr>
<tr>
<td>Maryland Port Administration</td>
<td>June 2009</td>
<td>Fund a 500-foot berth at Seagirt Marine Terminal in operation when the Panama Canal expansion project is completed in 2014. The Port of Baltimore is currently one of only two US East Coast ports with a 50-foot draft.</td>
</tr>
<tr>
<td>Broward County's Port Everglades Department</td>
<td>August 2009</td>
<td>(Port Everglades). Increase its capacity to handle larger ships. Develop the cruising industry with a new terminal for large cruise ships (2009).</td>
</tr>
<tr>
<td>Port of Palm Beach</td>
<td>December 2009</td>
<td>Container and cruise segments. South Gate Complex. Another key project underway is the Inland Port Complex, (Charleston). None specific except as identified by the MOU.</td>
</tr>
<tr>
<td>South Carolina State Ports Authority</td>
<td>July 2006</td>
<td>None specific except as identified by the MOU.</td>
</tr>
<tr>
<td>Port Authority of New York and New Jersey</td>
<td>September 2003</td>
<td>Dredging projects to 50 feet. New on dock rail facilities. Bayonne Bridge clearance.</td>
</tr>
<tr>
<td>Georgia Port Authority</td>
<td>June 2003</td>
<td>Deepening of the Savannah River from 42 to 48 feet (completed by 2014).</td>
</tr>
<tr>
<td>Port of Houston</td>
<td>July 2003</td>
<td>None specific except as identified by the MOU.</td>
</tr>
</tbody>
</table>

Like all MOUs, those discussed here are fairly generic and are not legally binding. Still, their importance resides in the willingness of the concerned partners to acknowledge an existing interdependency and the potential of additional revenue generation by pursuing them further. There is an obvious concordance between the signing of these MOUs and the surge in the share of the all-water route, as underlined by Figure 6, but the trend appears to have
begun a few years beforehand. In this case the MOUs simply underlined an existing trend in the diversification of routing options for the Asia trade. An important aspect of these MOU is that they provide a rationale for port authorities to undertake investment projects by trying to synchronize them with the expected expansion of the Panama Canal. A post ante overview underlines that the MOUs, while appearing to be mostly operational endeavors, were actually a strategic move to help secure financing and support for their respective investment projects. It is interesting to note that the earliest MOUs signed in 2003 were with the largest ports (New York, Savannah, Hampton Roads, Miami and Houston). A second wave of MOUs was signed with small ports in 2009-2010 when the canal expansion project went underway and as the financial crisis incited many ports to carefully assess their market potential. There is an assumption that each port will fully capture the benefit while in many cases it could be mostly a zero-sum game. A unique MOU was signed with the Antwerp Port Authority in September 2010, involving for the first time a European port. This MOU will particularly focus on Antwerp’s experience in handling post-panamax containerships through its rolling gates locks.

It is interesting to note that no MOU involve a West Coast port, which is reflective of the prevailing view that the expansion is mostly perceived as a threat. Indeed, 57% of the traffic handled by the Panama Canal concerns the Asia / American East Coast trade so port activities along the West Coast are competing with the Canal as well. It is thus likely that West Coast and East Coast ports will be facing an increased level of competitiveness both at the intra-range (between ports of the same maritime façade) and inter-range levels (between ports of different maritime façades).
The pressure for Gulf and East coast ports is mostly on dredging and capacity expansion to accommodate the larger ships that are anticipated with the Panama Canal expansion. Only five ports along the East Coast have a depth in the range 50 feet and above which can accommodate a 8,000 TEU ship: Halifax, New York, Baltimore, Hampton Roads and Charleston (Figure 12). Ports at a more marginal draft perceive dredging as a strategically important option and are using the expansion of the Panama Canal as a rationale to justify substantial dredging projects. This is particularly the case for Savannah that stands at a draft of 42 feet\textsuperscript{19} and Miami at 45 feet. Still, the argument for dredging East Coast ports can be counterbalanced by the fact that most of the ships that would use the all-water route after the Panama Canal expansion would be in the 6,000 to 8,000 TEU range, thus requiring depths of about 48 feet after fuel consumption is factored\textsuperscript{20}.

Responses from West Coast Ports

West Coast ports tend to perceive the expansion of the Panama Canal as a threat to their hinterland market share, particularly for the Midwest. It is uncertain to what extent the cargo handled by the West Coast is divertible to other maritime ranges, with some putting this figure in the vicinity of 25% of the intermodal cargo\(^\text{21}\). Still, Pacific Asia remains the fundamental market of the West Coast. A response from major West Coast ports, particularly in light of the financial crisis, has been to extend existing terminal facilities, placing them in a situation of excess capacity. The pressure for West Coast ports is leaning more towards having effective long distance rail connections particularly since between 50% and 70% of the cargo they handle is considered as discretionary.

In the Fall of 2009, six major American West Coast ports (Seattle, Tacoma, Portland, Oakland, Long Beach and Los Angeles) along with the two western rail carriers, BNSF and UP, established a joint arrangement dubbed the “U.S. West Coast Collaboration”. The main objective is to try to rectify three issues that are perceived to be a disadvantage for West Coast ports:

1. **Marketing.** Identify and communicate the advantages of shipping through the U.S. West Coast with port users (ocean carriers and freight forwarders).
2. **Image.** Improve the some of the negative image that West Coast ports may have through accurate information. This particularly stems from the 2005 west coast port strike as well as various environmental schemes adopted by port authorities (e.g. Los Angeles / Long Beach).
3. **Lobbying.** Common advocacy at the Federal level for investment in West Coast gateway intermodal infrastructure and promoting a strong National Goods Movement Strategy.

In doing so, the emphasis of the collaboration is on the value proposition of shipping Asian cargo through West Coast ports, particularly over the all-water route:

- **Maritime Service.** Shortest transit times, most frequency and flexibility, deep water berths, low average dwell time.
- **Rail Network.** Several rail routes, daily train departures, on-dock/near dock rail, and a coverage of the entire United States.
- **Cost Efficiency.** Price competitive, fuel efficient, reduced carrying cost, supply chain predictability and flexibility.
- **Reliability.** Little to no variability in service, no congestion, consistent rail service and labor stability.

Responsibility. Environmental stewardship, partners in a green supply chain, supporting and increasing community benefits.

Several of these value proposition statements need to be comparatively assessed, particularly in light of the increased fees at Los Angeles / Long Beach and the labor issues most West Coast ports continue to face. In all cases, a greater emphasis will be placed on hinterland access regimes as a strategy to improve the cost, quality and reliability of the West Coast as well as to secure traffic outside their fundamental hinterlands.

Canada’s gateways and corridors initiative can be perceived as a strategy to improve the competitiveness of the Canadian West Coast (Vancouver and Prince Rupert) without impairing in a noticeable manner the market share of the East Coast. Canadian East Coast ports, Montreal and Halifax, are dominantly linked to the transatlantic market, with the all-water route through the Panama Canal offering limited growth opportunities. As cost, time and reliability factors vary significantly according to the concerned supply chains, many market niches remain based upon how individual ports will respond. Therefore, the North American lattice of transport chain is likely to become even more complex after the expansion of the Panama Canal.

Responses from Railways

A wide variety of responses is also to be expected from North American railways, depending on their respective market orientation. The dichotomy between the western and eastern rail systems is much less prevalent than for ports, with the Canadian operators in an ambivalent position (less so for Canadian Pacific that is more oriented towards western Canada). At start, the rail system of the West Coast is more oriented towards international trade and has been improved in such a fashion. All West Coast ports have on-dock and near-dock rail facilities that are designed to improve the inland movement of intermodal cargo, which are well suited to handle the expected growth in transloading.

The pacific trade is an important source of revenue for western railways (Burlington Northern Santa Fe, Union Pacific, Canadian National, Canadian Pacific) that were able to use the advantages of large double stacked unit trains to push rail economies of scale to levels unseen before and make intermodal a profit center. They thus have important stakes in the continuation and ongoing growth of this transport sequence and the business model it implies. The current trend, particularly the spectacular growth of the all-water route, underlines that this model is being challenged.

22 Labor issues are far from being absent for East Coast ports as the short strike that took place at the Port of Montreal in July 2010 can underline.
A substantial wave of investment took place in recent years over strategic segments of the American rail system with the goal of improving the capacity and efficiency of long distance corridors. The improvements are multiple, namely better grades, double (or triple) tracking where volume warrants, new and improved intermodal terminals, but also better signal and management systems. For instance, BNSF and UP have respectively upgraded their transcontinental corridors from the West Coast (called Transcon and Sunset corridors respectively; Figure 13). At the Port of Seattle, BNSF invested in its Seattle International Gateway near dock rail terminal with four wide-span gantry cranes that came online in 2008, a first North America (3 tracks and 4 container stacks each). It can handle high stack densities in a similar fashion than port terminals. Also of significance are the massive inland ports projects at the end of their transcontinental corridors, such as BNSF-Centerpoint and UP-Centerpoint in the vicinity of Chicago, and the new $200 million BSNF Memphis intermodal facility that opened in the Spring of 2010. The latter is using wide-span high clearance gantry cranes spreading over up to 8 rail tracks. To capitalize on the Prince Rupert rail corridor, CN is projecting to develop a logistics park adjacent to its Harvey intermodal terminal in Chicago (Calumet Logistics Park).
The eastern railways are pursuing two options to maintain their flexibility in light of some uncertainties concerning intermodal flows, which can be dubbed being “coastal neutral”. First, their role in the second leg of the North American landbridge remains a substantial source of income. As a result they will keep investing at building or improving facilities that would support this intermodalism. A salient example is the Memphis Intermodal Terminal, a joint venture between CN and CSX Transportation that opened in 2005. While for CN, Memphis is an intermediary terminal along their Chicago – New Orleans axis, for CSX it is the end hub of its Crescent corridor and a point of transfer between the Western and Eastern rail systems. Eastern railways are also pursuing strategies that are in many ways competing with the Pacific trade-oriented western railways; particularly towards servicing the Midwest. For instance, Norfolk Southern (NS) inaugurated in 2010 the Heartland Corridor that reinforces the access of Hampton Roads all the way to Chicago, but mostly to Columbus where NS is involved in the development of an inland port (Rickenbacker). NS is also capitalizing on the Crescent Corridor that runs along the East Coast from New Orleans to New York. Although this corridor is mainly aimed at capturing modal
shift opportunities along movements within the East Coast, its reach to the Gulf Coast can support inland services for all-water routes through the Panama Canal. Another corridor is being developed by CSX is called the National Corridor, which competes with the Heartland Corridor, and is scheduled to become fully operational in 2014. In a similar fashion than NS, CSX is opening or expanding intermodal rail facilities. For instance, Northwest Ohio Terminal, which is also using wide-span gantry cranes, became operational in early 2011. Both corridors are calling from Hampton Roads, the East Coast port poised to benefit the most from the Panama Canal expansion since it already have a minimum channel depth of 50 feet and several terminals able to handle 55 feet.

**New Gateways**

Two new port gateways have been established in recent years, both with the support of major rail operators. In Canada, Prince Rupert, an ice-free deep harbor, capitalizes on shorter transpacific distances (2 days closer to Shanghai than LA/LB) and a dedicated and uncongested rail corridor to Chicago owned by CN. It also confers a cost advantage of about $400 per forty foot container in comparison to Californian ports. About 80% of the traffic handled is related to the United States, a sharp contradiction with Vancouver where about 95% of the traffic is related to Canada. Although the business model advocated by Prince Rupert is a fast rail access to the North American hinterland, it has been increasingly competing with the Port of Vancouver as an export gateway, particularly since backhaul containers can be repositioned more rapidly across the Pacific. Still, for the Canadian West coast a gateway differentiation is notable with Vancouver focusing on the Canadian market and Prince Rupert exploiting its time advantage niche to service faster the American Midwest.

In Mexico, Lazaro Cardenas with a rail corridor operated by KCS up to Kansas City, offers another alternative. KSC has been a major proponent of this corridor by establishing a Mexican subsidiary (Kansas City Southern de Mexico; KCSM) with rail terminals at the deep water port of Lazaro Cardenas. KCS is also developing with Centerpoint a large inland port in Kansas City (CenterPoint-KCS Intermodal Center). In 2009, KCS opened the Rosenberg Cut, a new 90 miles (145 km) rail segment between Laredo and Houston, which shortens its transit time by about four hours. At the same time, the Rosenberg Intermodal Terminal was opened in colocation with the CenterPoint Intermodal Center – Houston Metro, which is under development and like Kansas City has received the status of a free trade zone. KCS is thus trying to capitalize on three trends. The first is an increase in NAFTA trade, likely to be reinforced in a higher energy price context, by offering a cross-border corridor that spans Mexico. The second is a mix of gateway and transshipment activities that could increase with the expansion of the Panama Canal. The third concerns increasing its market share within the Laredo – Kansas City corridor, particularly in Texas where truck transportation dominates. Although in these cases the concerned volume is still
relatively modest, they both involve ports that have substantial room for expansion.

Other gateway projects exist, but are based on highly speculative business models (such as the transshipment hub project in Canso Bay, Nova Scotia).

![Figure 14: The North-American Container Port System and its Multi-Port Gateway Regions](image)

The observed cargo concentration levels in the North American container port system are emanating from the increasing dominance of Long Beach/Los Angeles as the major gateways along the Pacific Coast, mainly catering for Asian import cargo (Figure 14). The Pacific Coast now accounts for 55% of the total container volume handled, up from 50% in 1990, placing intense pressures on its main gateways. The share of the Los Angeles / Long Beach port cluster of the total US container traffic grew from 32.4% in 1997 to 37.8% in 2006. During the same period, New York/New Jersey’s share increased slightly from 11.2% to

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13.2%\textsuperscript{24}. Essentially, traffic doubled every decade, an indication of a rapid growth of international trade as well as the diffusion of containerization as a privileged mode of transportation. However, the extent to which this trend will endure is highly questionable as evidenced by the economic slowdown that began in 2008.

The inland rail freight transport system of North America is unique in the world, not only because of its sheer size, but also because of the direct link made between two different coastlines. The major hinterland in North America changes, namely the decline of the industrial belt (which has been monitored for decades) and the industrialization of the “sun belt” are long term shifts that are reflected in the gradual reori- entation of the traffic. NAFTA also favors the setting of natural gateways and corridors, namely through Canada (in particular Vancouver and Montreal) and Mexico (Lazaro Cardenas) and a reorientation of traffic flows.

**Responses from Maritime Shipping Companies and Terminal Operators**

It is essentially maritime shipping companies that are making the decision in terms of the network configuration of their routes. An important goal for them is to maximize their revenue, mostly through operating cost reductions and by capturing as much long distance trade as possible within their networks. While they essentially respond to the demands of freight forwarders, they decide of the routing this cargo takes, as long as it is within the expected time frame of their customers. With the expansion of the Panama Canal there could be greater competition on some routes, particularly if there is a higher level of consolidation around large transshipment hubs. Each routing option has some advantages and drawbacks (Table 5).

\textsuperscript{24} Traffic data from the American Association of Port Authorities.
Table 5: Advantages and Drawbacks of the Maritime Routes Servicing the American East Coast

<table>
<thead>
<tr>
<th>Route</th>
<th>Port Infrastructure</th>
<th>Ship Configuration</th>
<th>Costs</th>
<th>Schedule Integrity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Asia to American West Coast</td>
<td>(-) Only 4 major gateways (LA/LB, SF, Seattle and Vancouver) (+) One new terminal (Prince Rupert) (-) Limited expansion projects (+) Deep draft (+) Good intermodal connectivity</td>
<td>(+) Minimum of 5 ships (5 to 7 the norm) (=) Minimum capacity of 2,000 TEU (+) Large containerships</td>
<td>(+) Fewer ships (+) Economies of scale (-) Congestion (-) Limited on-dock rail (-) Environmental impact mitigation</td>
<td>(+) Short ocean transit (11-13 days) (-) Port labor issues (-) Rail capacity and delays (6 days)</td>
</tr>
<tr>
<td>Pacific Asia to American East Coast via the Panama Canal</td>
<td>(+) New terminals (+) Dredging projects (-) Limited capacity to handle ships above 5,000 TEU (+) 7 major gateways (+) Several smaller ports</td>
<td>(=) Minimum of 8 ships (9 to 11 the norm) (-) Limited to 4,200 TEU</td>
<td>(-) Higher charter rates (-) Panama Canal Tolls (+) Good transit time</td>
<td>(-) Canal transit (22-25 days) (+) Avoid West Coast congestion and inland bottlenecks</td>
</tr>
<tr>
<td>Pacific Asia to American East Coast via the Suez Canal</td>
<td>(+) New terminals (+) Dredging projects (-) Limited capacity to handle ships above 5,000 TEU (+) 7 major gateways (+) Several smaller ports</td>
<td>(-) Minimum of 11 ships (=) Large containerships</td>
<td>(-) More ships required (=) Economies of scale (-) Longer transit time from Pacific Asia (+) Good transit time from South Asia and Middle East</td>
<td>(-) Longer transit means more delays (21 days) (+) Capacity available at Suez Canal (-) Piracy</td>
</tr>
</tbody>
</table>

Note: Positive (+), Neutral (=) and Negative (-)

In light of the above, a key issue remains how maritime shipping companies are going to configure their networks to service the North American economy:

- For the West Coast, few changes are expected in the structure of transpacific pendulum routes. As economies of scale are further applied, there could be an additional concentration of traffic among major gateways, particularly since many West Coast ports have invested in additional capacity and in improving their hinterland. Transshipment opportunities are limited since this activity takes place in Latin America.

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For the **East and Gulf coasts**, the situation is more fluid. Although the structure of transatlantic services, particularly for Northern Europe is expected not to change much, transshipment activities in the Mediterranean could have an impact (see below). However, the most problematic issue concerns the all-water route through the Panama Canal. Several configurations are possible, ranging from direct point to point calls from Pacific Asia to the usage of transshipment hubs in the Caribbean as intermediaries (Figure 15).
Figure 15 underlines four configurations, each possible in conjunction with the others:

- **Conventional.** A single pendulum service that covers the entire East Coast. The drawback of this configuration is a longer service time.

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• **Direct.** The East Coast can be serviced by three (or more) different direct services, each focusing on a specific sub range such as the North Atlantic, Central Atlantic or South Atlantic / Gulf Coast. This regional service specialization is slightly more time effective than the conventional service. These services can also be arranged in terms of containership capacity, with for instance 8,000 TEU ships calling East Coast ports having the capacity to handle them.

• **Transshipment.** Similar to the previous configuration, but with the insertion of a transshipment hub (or more), most likely within the “Caribbean transshipment triangle” where deviation from major shipping lanes is reduced. The regional services become feeder loops with smaller ship but higher frequencies.

• **Circum-equatorial.** Involves and additional hierarchy in the network structure with a global maritime shipping system with a circum-equatorial “conveyor belt” serviced by high capacity containerships (8,000 to 12,000 TEU). In this case the Caribbean transshipment hub acts as an interface between several major systems of circulation, namely the Asia-Caribbean-Mediterranean circum-equatorial route and north-south connectors to South America.

A salient example of the impacts of the configuration of shipping networks for Western Canada concerns the port of Prince Rupert. It is called by both Hanjin and COSCO\(^{27}\) with their PNWS (Pacific Northwest Service; South China/Northwest Coast) and CEN (China Express North East service) services. While Prince Rupert is the first port of call for the eastbound transpacific service, it is not called again for the westbound services, implying that export cargo from Prince Rupert is “delayed” since the containership will call other West Coast ports (Vancouver, Seattle, Oakland, Long Beach) sequentially after calling Prince Rupert. Only one loop, CEN, is calling Prince Rupert again as the last port of call for westbound services, but this call is often omitted. Such a network configuration is highly logical and reflects the trans-Pacific trade configurations well. Inbound cargo dominantly concerns consuming goods which are more time sensitive. With this in mind, calling Prince Rupert first makes sense since it enables to take full advantage of shorter transpacific crossing and hinterland access times. For the westbound flows, there is limited time advantage to exploit since the cargo tends to be more resource related. Therefore, the last port of call on the West Coast tends to be the one that has the most export cargo.

Container terminal operators have a tradition of “following the freight” by investing in ports that offer growth potential and where operations could be improved through technology and capital investment. In this regard, the East Coast is somewhat at a disadvantage, particularly because of labor and

\(^{27}\) Part of the CKYH Alliance; COSCO, "K" LINE, Yang Ming, and Hanjin Shipping.
regulatory issues. Similar terminal equipment located at east coast ports tends to be less productive than in other maritime ranges (Table 6).

Table 6: Port Terminal Productivity (TEUs/Acre/Year), Selected Ranges, 1999 and 2004

<table>
<thead>
<tr>
<th>Port Range</th>
<th>1999</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Asia</td>
<td>9,272</td>
<td>16,595</td>
</tr>
<tr>
<td>Western Europe</td>
<td>4,284</td>
<td>6,396</td>
</tr>
<tr>
<td>United States</td>
<td>2,894</td>
<td>4,028</td>
</tr>
<tr>
<td>American West Coast</td>
<td>3,543</td>
<td>4,944</td>
</tr>
<tr>
<td>American Gulf Coast</td>
<td>3,149</td>
<td>4,635</td>
</tr>
<tr>
<td>American East Coast</td>
<td>2,021</td>
<td>2,661</td>
</tr>
</tbody>
</table>

The productivity figures of Table 6 must be looked at with caution. Some of the variance is explained by the average terminal size, which is much larger in Asia and the West Coast, as opposed to the East Coast. Additionally, Pacific Asia terminals tend to have been built more recently and with the most modern terminal design and equipment. Dwell time is also at play. Export-oriented ports in Pacific Asia have the manufacturing facilities commonly in close proximity, implying that the container is brought to the terminal only when it is ready to be loaded into a ship; therefore each container yard slot has a higher turnover. The export-oriented dimension of Pacific Asian ports is conductive to a higher stacking density since export containers can be stacked higher without the need for re-handles as they are afterwards loaded sequentially onto the containerships.

On the American West Coast, a significant amount of transloading takes place, implying that containers are leaving terminal facilities when they are available. For East Coast ports, most of the ports’ customers are within drayage distance, so containers tend to stay longer at the terminal facility until they are brought up directly to distribution centers for final consumption. In spite of all these nuances, East Coast ports remain less productive than ports in other ranges, which play negatively in their selection to route discretionary cargo. Still, there have been remarkable improvements, particularly after 2007 with the completion of the APM Terminals Virginia in Hampton Roads, which is a highly automated facility with a capacity of 1.1 million TEU. The issue is that the terminal became online right at the beginning of a significant drop in traffic due to the global financial crisis of 2008-2009. Traffic expectations came short with traffic never exceeding 485,000 TEU, only 44% of the design capacity.

In July 2010, APM Terminals Virginia was leased to Virginia International Terminals (VIT), which is the terminal operating branch of the Virginia Port

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28 Source: Containerization International.
Authority. The agreement²⁹ will lead to a rationalization of the terminal facilities with the transfer of container activities from the Portsmouth Terminal to the two major facilities managed by VIT; Norfolk International Terminals and the newly acquired APM Terminals Virginia. The Portsmouth terminal will be converted to a break bulk, bulk and a ro/ro³⁰ facility. Another factor that could be speculated upon is that APM is no longer expecting containerships of about 8,000 TEUs and more to be calling East Coast ports, or at least in a significant manner. The assumption is that large containerships using the all-water route will call a transshipment hub in the Caribbean and that the East Coast will be serviced through feeder services (the transshipment or circum-equatorial options on Figure 15). In spite of this Hampton Roads, with a channel depth of 55 feet, would be one of the East Coast ports the best placed to capture the opportunities of the Panama Canal expansion if ships of more than 8,000 TEU call East Coast ports.

Maher Terminals (acquired by the German financial firm RREEF in 2007) are involved in a “bi-coastal” strategy. On the West Coast, they operate the Prince Rupert terminal (30 year lease), which has a design capacity of about 500,000 TEU and opened in the second half of 2007. In the summer of 2010, Maher announced its involvement as terminal operator for a $350 million project in Melford (Canso Bay) Nova Scotia, privately owned by Melford International Terminal (MIT). The plan is to build a 315 acre container terminal scheduled to open in 2013. There are also plans to have a 1,500-acre co-located logistics park. The terminal is expected to have on-dock rail facilities and linked to CN’s double-stacked rail network. In addition to deep drafts and being ice-free, labor costs are expected to be much lower since the port will be privately owned and not subject to the collective agreements of regular port authorities. The core business assumption is that sourcing from India will grow substantially and that a large portion of this trade will go through the Suez Canal. By having the closest transatlantic location, MIT expect to capture some of these flows. This remains a highly risky proposition because of poor hinterland access (distance to main markets) and since a lot of transshipment activity already takes place in the Mediterranean.

Another important role of terminal operators concern their inland access strategies, that is which type of agreements they establish with actors involved in inland freight distribution.

²⁹ APM will get a lease payment over the 20 years lease term and a fee for every TEU above 500,000 handled by the terminal. Another important aspect of the agreement is that Virginia Port Authority and the State of Virginia will invest in the second phase of the terminal development projects, as the first phase was financed entirely by APM. The second phase would provide an additional capacity of 1 million TEU, bringing the total capacity to 2.1 million TEU, which was the capacity initially envisioned by APM.

³⁰ Roll On / Roll Off; facilities mostly designed to accommodate ships carrying wheeled cargo.
Responses from the Caribbean Transshipment Hubs

It is important to underline that at the global level only 16% of the global commercial relations involve direct connections between ports, so transshipment is a fundamental aspect of maritime shipping networks. In recent years, an active transshipment market has emerged in the Caribbean, particularly within what has been dubbed as the “transshipment triangle” (Figure 15 and Figure 16). The growth in the Caribbean transshipment activities is linked to issues such as economic growth in Latin America, being at the crossroads of transatlantic and north-south trade flows and the need of shippers to reconcile these numerous inbound and outbound trade flows within their shipping networks. Transshipment activities are thus a mix of hub-and-spoke network configurations as well as interlining between long distance shipping routes. The advantages gained in terms of network inter-connectivity and better usage of ship assets outweigh the additional handling costs that transshipment entails.

Additionally, Caribbean transshipment hubs have two regulatory factors to their competitive advantage:

- The first is the Jones Act, which considerably hinders transshipment along the American East Coast since its provisions forbid a foreign carrier to move domestic traffic.
- The second is the “24 hours rule” where inbound cargo arriving at an American port must be filled to Homeland Security as least 24 hours before the ship is scheduled to arrive.

The expansion of the Panama Canal is opening a new phase for Caribbean transshipment. A likely response from several transshipment hubs would be the development of logistical activities to better anchor traffic. If this is coupled with agreements with the American customs office to pre-clear some of the cargo at the transshipment hub, the containers could be moved directly inland from an East or Gulf coast port. This could advantage ports such as Kingston, Caucedo and Freeport that are highly linked with the United States. Several ports are already anticipating this trend. For instance, in 2011 the Jamaican Port Authority announced plans to expand the Port of Kingston, doubling its capacity to about 4 million TEU and developing port-centric logistics zones.

Another important factor behind the usage of a transshipment hub is the availability of gateway-related traffic as it enables a more stable and diversified traffic. This could advantage ports such as Cartagena and even Callao on the west coast of South America. Transshipment traffic remains footloose since a shipping company can virtually switch hubs overnight if conditions are judged suitable. There is thus a potential convergence of the interests of maritime shipping companies and Caribbean transshipment hubs that could change the function of several East Coast ports towards being feeders. If this trend becomes

Factors Impacting North American Freight Distribution in View of the Panama Canal Expansion
prevalent, then import-based North American supply chains could be impacted by an additional offshoring of added-value activities.

Figure 16: The Caribbean Transshipment Market

There are indications that it is Panama that will gain the most from the growth of transshipment. The growth of maritime commerce through Panama, specifically of manufactured or semi-manufactured goods originating in East Asia, has been one of the main drivers of the expansion of the Panama Canal. In addition, it has
compelled both Panama’s Caribbean ports (MIT, Cristobal and CCT) and Balboa, on the Pacific, to continue adding capacity to guarantee the service level and terminal productivity these cargoes require to make their transit on Panamanian soil a feasible and valuable proposition to their supply chains.

While the global transshipment incidence was around 17% of port TEUs in 1990, it climbed to more than 28% in 2008. There are several factors that underline that transshipment in Panama represents a high value proposition. The first and most obvious is the central location of Panama within the trade system of the Americas and the convergence effect on trade flows that the canal has incited over a century of operations. The Panama Canal has the effect of a narrow strait, similar to Gibraltar or Singapore where axial east-west trade routes intersect with north-south connectors, making nearby ports ideal for the transshipment of cargoes.

Panama is thus well placed to be the anchor point of the Caribbean transshipment triangle and of the growing trade between the economies of the West Coast of South America and Asia. Its location permits the establishment, on both coasts, of hub-and-spoke services covering relatively short distances within the America’s coastal systems and allows for interlining between long distance shipping networks. The result is additional transshipment demand from north-south connectors linking with east-west deep sea routes and east-west routes relay.

The expansion of the Panama Canal also brings forward new risks for Caribbean transshipment in the form of the “curse of economies of scale”. As maritime shipping companies deploy post-panamax ships along routes through the Panama Canal there will be a tendency to use larger transshipment hubs able to accommodate the volumes brought by these ships. Economies of scale in shipping could therefore incite a concentration of traffic along the largest hubs, renegading smaller hubs to niche roles. This will also put pressure on existing terminals to improve their performance for fast ship turnaround and expand their real estate for temporary container storage, including the growing reefer business. The capital intensiveness of transshipment would therefore increase, placing smaller hubs at a disadvantage, unless large shipping companies or terminal operators are willing to invest for new or expanded terminal projects.

**Alternative Routes (Suez and Arctic)**

The usage of the Suez Canal as a routing option to service East Coast ports has increased in the last decade, particularly with the growth of transshipment activities around the Mediterranean basin. The Suez Canal route competes with the Panama Canal in the South and Southeast Asia–U.S. East Coast routes due to its shorter navigation time of 21 days and its capacity to handle Post-Panamax vessels. Mediterranean transshipment hubs offer additional opportunities to consolidate Asian and European cargo and employ larger ships. This would again reinforce Caribbean transshipment hubs as the largest ships would be
allocated along circum-equatorial routes that go through the Mediterranean. Thus, the expansion of the Panama Canal may be linked with a greater share of the Suez Canal in North American supply chains, particularly if the Suez Canal Authority responds with an aggressive toll strategy, but this is unlikely.

Additionally the Suez Canal routing option is having its own challenges. In 2008 and 2009 the canal experienced a substantial drop in revenue, in part because of the global economic slowdown and in part because several shipping companies were electing for the Cape Route in order to save on the toll and to absorb the excess containership capacity. The lingering issue of piracy along the coasts of Somalia and Yemen has been linked with rising insurance costs. Also, the idea of a “Suezmax” class of containership able to carry about 18,000 TEU has been considered for several years, but is unlikely to be deployed within the next decade. If this turned out to be the case, such ships will likely to be confined to the Pacific Asia – Mediterranean route.

Last, climate change concerns have raised the prospects of the usage of the Arctic Ocean as a new trade route between Asia, North America and Europe. This may offer new opportunities for international transportation networks where the Arctic could be used more reliably for navigation, at least during summer months. The Northwest Passage crossing Canada’s Arctic Ocean could, if trends continue, become usable on a regular basis by 2020, lessening maritime shipping distances substantially. The maritime journey between East Asia and Western Europe would take about 13,600 km using the Northwest Passage, while taking 24,000 km using the Panama Canal. The Northern Sea route passing through the Russian Arctic could also become a possibility. It would reduce a maritime journey between East Asia and Western Europe from 21,000 km using the Suez Canal to 12,800 km, cutting transit time by 10-15 days. The consideration of arctic routes for commercial navigation purposes remains a very speculative endeavor, mainly for two reasons:

- First, it is highly uncertain to what extent the receding perennial ice cover is a confirmed trend or simply part of a long term climatic cycle.
- Second, there is very limited economic activity around the Arctic Circle, implying that shipping services crossing the Arctic have almost no opportunity to drop and pick-up cargo as they pass through. Thus, unlike other long distance commercial shipping routes there is limited revenue generation potential for shipping lines along the Arctic route, which forbids the emergence of transshipment hubs.

There is also a project supported by Chinese interests to build a new rail line linking the Pacific and Atlantic coasts of Columbia, between the ports of Buenaventura and Cartagena. Although this project can be perceived as a competing alternative to the Panama Canal, its real purpose is a better accessibility of the Columbian resources and markets to international trade. The
most serious competitor to the Panama Canal expansion remains North American railways.
F. Conclusion: Perspectives for Western Canada

In light of the multiplicity of macroeconomic, operational and competitive trends impacting the maritime shipping sector discussed in this report, a series of seventeen observations can be made. Each of these observations was validated by a survey of stakeholders in Western Canadian transport sector, including port authorities, railways, manufacturers, governments and the mining and energy industry (see Appendix for detailed results). The main conclusions are:

1. **There is a great deal of uncertainty, even confusion, about the potential impacts of the expansion of the Panama Canal, implying that the transport industry has no clear expectations.** There was a strong divergence among respondents over this issue, some in complete agreement while others were in complete disagreement. This is indicative of the variety of conflicting opinions.

2. **In spite of the uncertainty it is agreed that if the expansion of the Panama Canal did not take place, the impacts on North American supply chains would have been negative in terms of costs, capacity and reliability.** Most respondents agree with the statement, while those in disagreement are likely to be in sectors or markets that are potentially little impacted by the expansion of the Panama Canal.

3. **The bulk of the shift of discretionary containerized traffic through the all-water route has already taken place since 2000 to reach about 45% of the East Asian traffic bound to the East Coast (American states bordering the Atlantic). The expansion of the Panama Canal is not expected to change this balance significantly.** There is again a strong divergence in the answers, but with the majority in agreement. Some expect significant changes while others tend to believe that the balance between the respective shares of the East and West coast will remain roughly similar.

4. **Supply chains for deliveries from origins to final destinations are increasingly being differentiated by cost, time and reliability considerations, implying the different types of freight may be routed differently depending on the criteria. While the expansion of the Panama Canal is expected to reduce costs, it will have marginal impacts on reliability and no impacts on time.** Respondents tend to disagree, implying that the expectation within the industry is that the expansion of the Panama Canal will improve the time performance as well as the reliability of the concerned supply chains. This is most likely related to the fact that additional transit capacity will reduce the risks of congestion.

5. **Because of the previous point it is expected that the expansion of the Panama Canal will not change in a significant manner the
configuration of supply chains in Western Canada. This issue shows an important divergence of opinion among respondents, underlining the uncertainty of the potential impacts of the Panama Canal expansion.

6. The costs of the Panama Canal expansion, in the range of 5.25 billion dollars and including 2.3 billion dollars in loans contracted on international capital markets, will cause significant pressures to increase tolls and adopt a revenue maximization strategy. It was estimated that toll increases have already captured 40% of the potential costs savings due to the expansion. This provides additional evidence that the expansion may have limited impacts. Although most respondents agree, there is a divergence of opinion. Part of this divergence can be attributed to the fact that the shipping costs benefits conferred by economies of scale are expected to overtake the additional toll costs. There is a high probability that the expansion project will have costs overruns. If this is the case, then there will be additional pressures to increase tolls, further impacting the costs advantages of respective shipping routes.

7. Canadian West Coast supply chains are facing a differentiation of the two West Coast gateways, Vancouver and Prince Rupert. While Vancouver services the Canadian hinterland, Prince Rupert has developed a niche towards the Midwest (Chicago). These gateways must be seen as complementary. Most agree, but a sizeable share disagrees, underlining that Vancouver and Prince Rupert may be increasingly competing ports.

8. Impacts on import-based freight distribution with destinations in Eastern Canada (Toronto and Montreal) are likely to be minimal since the great majority of imports transit through Vancouver; the Panama Canal offers no reasonable alternative to these flows. Strong divergence in opinion, underlining the uncertainty of the potential impacts on the routing of import flows.

9. East Coast ports are likely to be vulnerable to the expansion of the Panama Canal because it will make transshipment a more desirable option, which could result in additional feeder services from Caribbean transshipment hubs. Most disagree, implying that respondents tend to believe that East Coast ports are more likely to get direct port calls from ships passing through the Panama Canal. This reflects well the expectations of East Coast ports to become more competitive once the Panama Canal has been expanded.

10. The role of West Coast ports as gateways to North American freight distribution will not be compromised by the expansion of the Panama Canal. Most agree, but a notable share is also in strong disagreement since it remains to be fully assessed which freight flows are discretionary.
11. Even if the expansion of the Panama Canal may offer additional options for export-based distribution, they do not represent effective options for Western Canada’s exports that will continue to use its conventional gateways (Vancouver and Prince Rupert to a lesser extent). The great majority of respondents are in agreement.

12. Slow steaming is an issue independent from the Panama Canal expansion and will have a more profound impact since it influences time and schedule integrity issues to which a variety of supply chains are highly sensitive. Most respondents agree, but the impacts of slow steaming remain uncertain.

13. Slow steaming will incite more transloading in the vicinity of port terminals since maritime shipping companies, who own the majority of the global ISO container assets, will be pressured to keep containers within their service networks. Most respondents agree.

14. Slow steaming will likely less negatively impact Western Canadian supply chains because Vancouver and Prince Rupert have better cost and time advantages in relation to other North American and West Coast ports. Most respondents agree.

15. One of the most important and uncertain issues concerns the availability of maritime containers inland. The expansion of the Panama Canal is expected to have a limited impact on Canadian container availability. Small divergence in opinion among respondents with the majority agreeing. If the Panama Canal is able to gain a greater share of the discretionary traffic, then container availability may become even more problematic for inland destinations.

16. Providing an adequate pool of containers for backhaul movements (and thus exports) is a requirement if freight forwarders are to be engaged in promoting ocean export sales. In the Western Canadian context, the promotion of exports lies fast and high capacity rail corridors coupled with inland ports; efficient import-based distribution will reinforce the opportunities for exports. Strong agreement among respondents. This statement was the only one in the survey where there was a convergence with all respondents agreeing, implying that the availability of empty containers inland is an issue of high importance for Western Canadian freight distribution.

17. In the Western Canadian context, the promotion of exports lies fast and high capacity rail corridors coupled with inland ports; efficient import-based distribution will reinforce the opportunities for exports. The great majority of respondents agree.

An important observation derived from the survey was that there appears to be no clear consensus about the potential impacts of the Panama Canal expansion, with some key questions facing a significant divergence in opinion with a roughly equal number of respondents strongly agreeing and strongly disagreeing. The
answer pattern underlines quite clearly that most stakeholders are uncertain about what to expect and when there are expectations, they are diverging based upon who is the stakeholder. Therefore, the expansion of the Panama Canal is one factor among others that are impacting on the configuration of freight distribution in North America. Its specific impacts are difficult to consider individually and must be seen in conjunction with other factors. Table 8 provides a summary of those factors that were discussed in this study.

Table 7: Factors Impacting Western Canada Supply Chains in Light of the Expansion of the Panama Canal

<table>
<thead>
<tr>
<th>Factor</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Macroeconomic factors</strong></td>
<td></td>
</tr>
<tr>
<td>Aggregate demand changes</td>
<td>Level and composition of cargo.</td>
</tr>
<tr>
<td>Structure of production changes</td>
<td>Regionalization of production (NAFTA).</td>
</tr>
<tr>
<td></td>
<td>Production shifts within Asia (e.g. Vietnam and Indonesia).</td>
</tr>
<tr>
<td><strong>Operational factors</strong></td>
<td></td>
</tr>
<tr>
<td>Supply chain diversification and differentiation</td>
<td>Usage of various routing options to avoid potential disruptions.</td>
</tr>
<tr>
<td></td>
<td>Usage of various routing options because of different supply chain requirements in terms of costs, time and reliability.</td>
</tr>
<tr>
<td>Economies of scale in shipping</td>
<td>Incite shipping companies to order more post-panamax ships. Changes in the frequency of services, port calls and network configuration.</td>
</tr>
<tr>
<td>Shipping costs structure (e.g. tolls and fuel)</td>
<td>Comparative advantages of respective routing options (landbridge, Suez, all-water).</td>
</tr>
<tr>
<td>Slow steaming</td>
<td>Service length (latitudinal and longitudinal effects). Availability of containers for inland distribution.</td>
</tr>
<tr>
<td><strong>Competitive factors</strong></td>
<td></td>
</tr>
<tr>
<td>Response from East and West coast ports</td>
<td>Comparative advantages of port selection. New transshipment hubs.</td>
</tr>
<tr>
<td>Response from railways</td>
<td>Comparative advantages of inland routes.</td>
</tr>
<tr>
<td>Response from Suez Canal and transshipment hubs</td>
<td>Comparative advantages of routing options.</td>
</tr>
<tr>
<td>New gateways</td>
<td>Additional inland routing options (e.g. Prince Rupert and Lazaro Cardenas).</td>
</tr>
</tbody>
</table>
G. Appendix

In order to validate some of the conclusions of the investigation an online survey of Western Canadian stakeholders was conducted. They included port authorities, railways, energy and mining interests, manufacturers and governments. Respondents were offered a range of options, from strongly agreeing to strongly disagreeing as well as having no specific opinion. The sample of respondent is relatively small, so results have to be interpreted simply as indicative. The following tables summarize the answers provided.

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. There is a great deal of uncertainty about the potential impacts of the expansion of the Panama Canal, which implies that the transport industry has no clear expectations.</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>2. In spite of the uncertainty, it is agreed that if the Panama Canal was not expanded, the impacts on North American supply chains would have been negative in terms of costs, capacity and reliability.</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>3. The bulk of the shift of discretionary containerized traffic through the all-water route has already taken place since 2000 to reach about 45% of the East Asian traffic bound to the East Coast. The expansion of the Panama Canal is not expected to change this balance significantly.</td>
<td>1</td>
<td>4</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>4. Supply chains for deliveries from origins to final destinations are increasingly differentiated by cost, time and reliability considerations, implying that the different types of freight may be routed differently depending on the criteria. Although the expansion of the Panama Canal is expected to reduce costs, it will have marginal impacts on reliability and no impacts on time.</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>5. Because of the previous point, it is expected that the expansion of the Panama Canal will not change in a significant manner the configuration of supply chains in Western Canada.</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>6. The costs of the Panama Canal expansion, in the range of 5.25 billion dollars and including 2.3 billion dollars, will cause significant pressures to increase tolls and adopt a revenue maximization strategy. It was estimated that toll increases have already captured 40% of the potential costs savings due to the expansion. This provides additional evidence that the expansion may have limited impacts.</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>11</td>
</tr>
<tr>
<td>7. Canadian West Coast supply chains are facing a differentiation of the two West Coast gateways, Vancouver and Prince Rupert. Although Vancouver services the Canadian hinterland, Prince Rupert has developed a niche towards the Midwest (Chicago). These gateways must be seen as complementary.</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>
8. Impacts on import-based freight distribution with destinations in Eastern Canada (Toronto and Montreal) are likely to be minimal since the great majority of imports transit through Vancouver; the Panama Canal offers no reasonable alternative to these flows.

9. East Coast ports are likely to be vulnerable to the expansion of the Panama Canal because it will make transshipment a more desirable option, which could result in additional feeder services from Caribbean transshipment hubs.

10. The role of West Coast ports as gateways to North American freight distribution will not be compromised by the expansion of the Panama Canal.

11. Even if the expansion of the Panama Canal may offer additional options for export-based distribution, they do not represent effective options for Western Canada’s exports that will continue to use its conventional gateways (Vancouver and Prince Rupert to a lesser extent).

12. Slow steaming is an issue independent from the Panama Canal expansion and will have a more profound impact since it influences time and schedule integrity issues to which a variety of supply chains are highly sensitive.

13. Slow steaming will incite more transloading in the vicinity of port terminals since maritime shipping companies, who own the majority of the global ISO container assets, will be pressured to keep containers within their service networks.

14. Slow steaming will likely not impact Western Canadian supply chains because Vancouver and Prince Rupert have better cost and time advantages in relation to other North American and West Coast ports.

15. One of the most important and uncertain issues concerns the availability of maritime containers inland. The expansion of the Panama Canal is expected to have a limited impact on Canadian container availability.

16. Providing an adequate pool of containers for backhaul movements (and thus exports) is a fundamental requirement if Western Canadian freight forwarders are to be engaged in promoting ocean export sales.

17. In the Western Canadian context, the promotion of exports lies fast and high capacity rail corridors coupled with inland ports; efficient import-based distribution will reinforce the opportunities for exports.

Rank the following factors in terms of their priorities on the supply chains you are involved with. (1 = No Importance, 3= Minimal Importance 5 = Very Important or N/A= Do not know or not applicable)

<table>
<thead>
<tr>
<th>Answer Options</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>N/A</th>
<th>Rating Average</th>
<th>Response Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Importance of foreign markets (outside USA) for future growth</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>4.50</td>
<td>8</td>
</tr>
<tr>
<td>Factor</td>
<td>Count</td>
<td>Mean</td>
<td>SD</td>
<td>Median</td>
<td>Q1</td>
<td>Q3</td>
<td>Q4</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------------------------------------------</td>
<td>-------</td>
<td>------</td>
<td>----</td>
<td>--------</td>
<td>----</td>
<td>----</td>
<td>----</td>
<td></td>
</tr>
<tr>
<td>Importance of transport chain costs</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>4.57</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Importance of transport chain time performance</td>
<td>1</td>
<td>0</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>3.71</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Importance of transport chain reliability</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>4.29</td>
<td>8</td>
</tr>
<tr>
<td>Transloading at a gateway</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3.71</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Availability of domestic containers</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3.57</td>
<td>8</td>
</tr>
<tr>
<td>Availability of maritime containers</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3.83</td>
<td>7</td>
</tr>
<tr>
<td>Diversity in port of entry (exit) options</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>3.83</td>
<td>7</td>
</tr>
<tr>
<td>Proximity to an intermodal rail terminal</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>4.50</td>
<td>7</td>
</tr>
<tr>
<td>Diversity of supply chain partners (rail carriers, maritime shipping, trucking companies)</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>4.67</td>
<td>7</td>
</tr>
</tbody>
</table>
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