Think Piece
Assessment of port performance and port connectivity in Central America and the Dominican Republic

IDB Port Connectivity Project
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1. Executive Summary

There is general agreement that poor logistics performance is a major impediment to trade growth in most of Latin America. This study focuses on identifying the basic logistics capabilities in the countries of Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama. It was undertaken to examine the maritime infrastructure and transport sector with the goal of assessing capability and making recommendations to improve performance. The study addresses needs and capabilities within the region together with integration of value chains connected to international markets outside of the region.

While the study was initially focused on the ports and sea network, it became apparent during its execution that meaningful recommendations could not be reached without consideration of intermodal networks involving both land and sea components together with the major performance drivers of intermodal networks. These are:

- geography,
- infrastructure,
- network connectivity,
- transportation costs and time,
- trade / movement requirements,
- shipping dependability,
- transport and trade regulations.

Geography

The total population of this region is 52,776,788 people and the most populous country is Guatemala with 14 million people and the least populous is Belize with only 327,719 people. The total area of the region is 570, 546 km^2, about the same size as Madagascar. The largest country is Nicaragua and the smallest is El Salvador. About 65% of the population is concentrated in the sub region defined by Guatemala, El Salvador Honduras and Nicaragua and the distance from Guatemala City to Managua (Nicaragua) is about 750 km which is roughly the distance between Atlanta and Orlando in the US.

In the presence of good land connectivity in Central America, trade from Europe will tend to come in through ports on the Atlantic side to be distributed inland whereas trade from Asia will tend to come in through ports on the Pacific side to be distributed inland. This observation means that there should be a good East to West road network for land connectivity. Even though the terrain in Central America can be sometimes quite difficult, the region is relatively small and hence the internal geography is not an insurmountable barrier for any of the countries.

Infrastructure

Of the eighteen ports studied, five do not have any operational cranes and must therefore rely on geared ships. These are:

- The two ports in El Salvador: Acajutla and La Union;
- The only port in Nicaragua: Corinto
- Puerto Castilla in Honduras;
- Puerto Barrios is Guatemala

Four countries and five of the eighteen ports have ports that can receive Feeder type vessels requiring a depth of up to 10.7 m. They are:

- Belize: Port of Belize
- Guatemala: Puerto Santo Tomas de Castilla, Puerto Barrios;
- El Salvador: La Union;
- Dominican Republic: Rio Haina

Four countries and six of the eighteen ports could receive Panamax vessels strictly based on berth depth (between 10.7m and 12.5 m). These are:

- Costa Rica: Puerto Caldera and Puerto Limon-Moin;
- Guatemala: Puerto Quetzal;
- Honduras: Puerto Castilla and Cortes
- Nicaragua: Corinto.

Only two countries have ports that are equipped to handle New Panamax vessels. These are

- Panama: Balboa, CCT, Cristobal, Manzanillo and PSA;
- Dominican Republic: Caucedo.

The general recommendation for the ports in the study is to streamline their operations in order to be more efficient and to integrate their processes with customs and other government agencies to facilitate entry and exit of containers from their yards. The operating models vary from port to port and country to country. For instance, the port of Limon-Moin moves nearly 1M TEU with very limited equipment and yard space. Countries with ports that are saturated, i.e. operating at near capacity, should look to variants of these various models to see if any could be adapted to their needs, in addition to adding more space and equipment. Connection to hinterland must also be improved for most of the ports. Road infrastructure and port development have not been always planned in an integrated fashion and this should be remedied.

Network Connectivity

There are two disjoint sub networks of ports, a fairly well connected Pacific sub network of ports on the Pacific side and a sparsely connected Atlantic sub network of ports on the Atlantic side. All ports in the Pacific sub network must transship through ports in Panama to connect to ports in the Atlantic sub network and vice versa.

The network connectivity for ports in the study also shows that there are two main hubs: i) the ports in Panama which are pivotal to traffic from Asia, Europe, North America and the West Coast of Latin America; ii) Caucedo in Dominican Republic which is more involved in traffic between the North and South (East and West coasts of North America and Latin America).

Transportation costs and time

An important observation is that trucking should be considered between two points that are less than 1,100 km apart and sea shipment should be considered for shipments greater than 1,100 km by land. This observation allows the grouping of ports in five groups: the ports in Panama, the ports in Costa-Rica, the ports of Guatemala, El Salvador and Nicaragua on the Pacific side, the ports of Guatemala and Honduras on the Atlantic side and ports of Belize, Guatemala and Honduras, except Pueto Castilla, on the Atlantic side. Sea routes should be used only when shipping between ports located in two different groups and land transportation should be used within the immediate region of ports in the same group.

Trade / movement requirements

Availability of container liner services between ports is greatly dependent on trade between countries, price that shippers are willing to pay and cargo handling requirements. In 2010, an estimated total of 150,000 TEU was moved between the eight countries in this study. The largest traffic flows of ocean containers are between the Dominican Republic (DR) and Guatemala, El Salvador, Costa Rica and Panama.

The analysis indicates that a significant amount of trade is moved by land in Central America as the region is relatively small and does not have enough volume for a dense maritime network. It however lacks a good road infrastructure which increases transportation costs. The integration of an efficient maritime network and the improvement of land connectivity are imperative for the development of the region. The governments of the region should focus on reforms to reduce logistics costs by improving:

- Inefficient multimodal integration
- Bottlenecks at borders and crossings
- Customs-related inefficiencies
- Security of land transportation
- Quality of transportation networks
- Underinvestment and congestion
- Inadequate services (ports, maritime, air cargo)
- Maritime –hinterland interface

Shipping dependability

Disruptions on regional ports and intermodal systems have occurred in the past and have affected the reliability of the region's transportation network to support the cost efficient distribution of products. Such disruptions cause significant monetary losses, reduce confidence levels and ultimately deteriorate competitiveness on international markets. Even though some of these disruptions cannot be prevented (e.g. natural disasters), others can be minimized by taking preventive measures or establishing action plans in case of their occurrence (e.g. equipment failures, accidents or labor-management relations). Regional and local policy should aim to minimize the risk of disruptions on ports and intermodal systems and promote public-private collaboration that would ensure the resilience of the regional distribution network.

Transport and trade regulations

Restrictions on foreign carrier cabotage have been identified to have a significant on impact intermodal networks. Given the small size of the countries in the study, sea cabotage is not really a barrier for the development of a regional intermodal network.

Even though there has been efforts to establish fair trucking regulations in Central American Countries for domestic and foreign providers, anecdotal evidence indicate that this is not the case today. Gaps on the enforcement of regional agreements increase the cost of regional trucking services and hampers trade and distribution of goods between regional countries.

Since a well-integrated and regulated trucking industry in the region is necessary to improve intermodal transportation and reduce logistics costs, further analysis is required to determine the current state and challenges of the regional trucking services.

Impact of the Panama Canal

Nearly one hundred years ago, the opening of the Panama Canal revolutionized not only the maritime industry but also global trade routes by connecting the Atlantic and Pacific Oceans at the heart of the Americas saving almost 3,000 miles on traditional sea voyages. Today, in response to international trade growth and shipping lines investment in more Post-Panamax Vessels, the Panama Canal is betting on an USD 5.2 billion expansion project that will allow vessels with almost three times the current cargo carrying capacity to transit through this waterway[1]. The expansion is scheduled to be functional in 2015[2] and will modify transportation costs and capabilities between regions served by the Canal.

Post-panamax vessels consume more resources at ports (more time at berth, more stevedore gangs, pilots, tugs, etc) in addition to increased access channel, longer and deeper berth and additional equipment such as post-panamax cranes. Hence, in order to maintain the expected economies of scale, it is conjectured that these vessels will not follow the current configuration of most liner services that transit the current Panama Canal with multiple port calls along their rotation. As a result, a more pronounced hub-and-spoke transshipment and feeder line system will be necessary to support the deployment of post-panamax vessels through the Panama Canal.

Except for ports in Panama and Caucedo no other ports in this study whether in the Pacific or Atlantic can handle the larger vessels that will come through the expanded Canal. Furthermore, these ports are the only ones that have direct services to/from Asia. Hence, unless there are some major changes in the current strategies of the ports, the basic dynamics of the network of liner services for the other ports in the study will not change in the immediate future as they will continue to be served by Feeder lines. Ports such as Moin, Quetzal and Cortes are currently developing expansion plans and they may be able to serve Post-Panamax Vessels sometime in the future. The impact of the Canal for each port has been analyzed and is detailed in the country reports.

Conclusions and Recommendations

The result of this study points to the need of an integrated intermodal sea-land network to foster global trade and trade exchanges between the various countries. The recommendation for governments of the region is to better plan road infrastructure and connectivity between regions of production/consumptions and ports. Access roads should be developed to support container traffic and reduce delays in container pick-up and delivery.

Transportation in the mainland of Central America is complex as the region is too small and does not have enough volume for a dense maritime network but too big and lacking in road infrastructure to be adequately served by land. Development of land connectivity and integration to an efficient maritime system is essential for the development of the region. For Dominican Republic, trucking rates are the most expensive of the region and problems with

[1] The current Canal allows for vessels of up to 4,500 TEUs. When expanded, the maximum vessel size capable of transit the new locks would be 12,600 TEUs. These capacities vary according to vessel design. Source: Panama Canal Authority.

[2] The Panama Canal Expansion works are scheduled to be completed in 2014 and expected to be fully operational by 2015.

trucking unions exacerbates transportation problems contributing to higher logistics costs and hence more expensive products and services to the population.

There are a number of initiatives that if successfully undertaken would significantly improve the structure and performance of the regional intermodal network and facilitate greater trade:

1. Each country should develop a coordinating body to oversee both sea and land transport for the country. The intermodal network can only work effectively if the land and sea portions are integrated. The level of integration required is unlikely if critical decisions with regard to land and sea investment and regulations are under the jurisdiction of different government bodies.

2. There is a general need to significantly improve roads between origin/destination points within each country and the logical ports to serve these points. It is often said that the supply chain is only as good as its weakest link and the roads are often this link.

3. There should also be a focus on improving the land links between countries including improving the roads, eliminating delays at land border crossings and improving customs.

4. There should be a strong coordinating body to oversee both sea and land transport for the region, to provide enforcement for treaty agreements regarding truck inspections and backhauls and to improve security for trucks, particularly those from outside the country.

5. The expansion of the Panama Canal will very likely create one or more mega hubs on the Atlantic and it is crucial that countries work with the carriers to develop good connectivity with these hubs.

Lastly, the lack of transportation related data makes it very difficult and time consuming to perform the analytics necessary to facilitate a better intermodal transportation network. Hence there is a critical need for the countries to work together to support an observatory-like structure along the lines being proposed by IDB, to collect and maintain quality data and provide the analytics necessary for all of the stakeholders to make decisions that benefit themselves as well as the region.

2. Introduction

There is general agreement that poor logistics performance is a major impediment to trade growth in most of Latin America. This study focuses on basic logistics capabilities in the countries of Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua and Panama. The study was undertaken to examine the maritime infrastructure and transport sector with the goal of assessing capability and making recommendations to improve performance. The study addresses needs and capabilities within the region together with integration of value chains connected to international markets outside of the region.

Methodology: The fundamental approach for this study was to determine what relevant data was available regarding logistics capabilities related to these countries, determine the gaps in this data, develop mechanisms for filling these data gaps and then to base recommendations on results and insights gained from analyzing this data. This data includes information about ports shipments, transportation capabilities, transportation costs and times, and constraints on the transportation network.

Intermodal network: While the study was initially focused on the ports and sea network, it became apparent during the study that meaningful recommendations could not be reached with a "siloed" approach that did not take into consideration that ports networks are subsets of bigger "intermodal" networks (see Figure 1) that span multiple countries and multiple regions of the world. These intermodal networks involve both land and sea components (sometimes air), serve multiple customers and transport many different products with varying cost and service requirements. Each potential trade route in an intermodal network must compete based on its cost, transit time and dependability. Countries must base their policies and investments on a "supply chain" view of the network with a focus on assuring performance of all of the elements for facilitating trade and the competiveness of the overall chain for the specific needs of the shippers. All components of the supply chain must perform well in order for the chain to be competitive. Isolated investments into segments of the chain without understanding the entire supply chain and the trade value it provides is not likely to yield desired results.

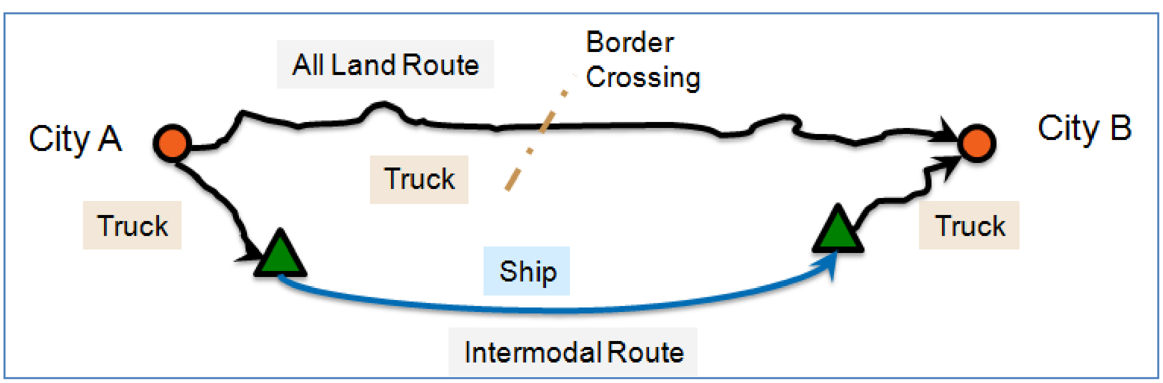

Figure 1: Intermodal Network

This report is organized around the major performance drivers for intermodal networks. They are: geography, infrastructure, network connectivity and time, transportation costs, movement requirements, shipping dependability and transport and trade regulations as they relate to the countries being studied. An assessment of the potential impact of the Panama Canal is also provided together with the impact this will have on port connectivity. The countries and seaports considered in this study are shown in Figure 2. The seaports considered are the main container ports of each country.

Figure 2: Countries and ports considered in this study

3. Geography

A country's internal and external geography is one of the most critical drivers of logistics performance. The external geography that impacts logistics is the positioning of a country with regards to other countries and the locations of its points of connectivity such a ports and border crossings. This impacts a country's logistics in two ways. First, there is a tendency for countries to trade more if they are close to each other (e.g., Canada and Mexico are the biggest trade partners of the US). Note that long distances do not necessarily prevent trade (e.g., China is the third biggest trading partner of the US). Long distances, however, must be offset by investment in an exceptionally good intermodal network as the one from China's manufacturing centers to it ports, from China ports to US ports and from US ports to its major points of consumption.

The internal geography that impacts logistics is the positioning of the points of generation and consumption of goods within a country relative to each other and to the country's points of connectivity with other countries. While having poor internal or external geography does not necessarily prevent trade, it generally means that more investment is required to enable a high performance intermodal network.

Table 1 gives for each country in the study, its population, GDP per capita and surface area. The total population of this region is 52,776,788 people and the most populous country is Guatemala with 14 million people and the least populous is Belize with only 327,719 people.

The total area of the region is 570, 546 km^2 with about the same size as Madagascar. The largest country is Nicaragua and the smallest is El Salvador.

Countries	Population	GDP per Capita (2011)	Area (km^2)
Belize	327,719	8,400	22,966
Costa-Rica	4,636,348	12,100	51,100
Dominican Republic	10,088,598	9,400	48,670
El Salvador	6,090,646	7,600	21,041
Guatemala	14,099,032	5,100	108,889
Honduras	8,296,693	4,400	112,090
Nicaragua	5,727,707	3,200	130,370
Panama	3,510,045	14,300	75,420
Total	52,776,788		570,546

Table 1: Population, GDP per Capita and Area of countries of study

For some countries (e.g., Panama and Singapore), their position relative to other countries provides the opportunity for them to be a transshipment point where freight is transferred from one ship to another. For other countries that have poor geography for being a transshipment hub, there is unfortunately not much that the country could do overcome this hurdle even with big investments. An exception is Panama where building the Canal tremendously increased Panama’s potential as a logistics hub.

Even though the terrain in Central America can be sometimes quite difficult, the countries in this study are all relatively small and hence the internal geography is not an insurmountable barrier for any of the countries. The location of major population centers for each country and their proximity to ports is addressed in the country reports.

The interaction between port locations and the internal geography of a country is important to understand. Each port has a natural “catchment” area where it is the natural port to serve the area. These catchment areas may vary based on distance, cost and natural boundaries. Trade efficiency and barriers also impact the region of influence of a port.

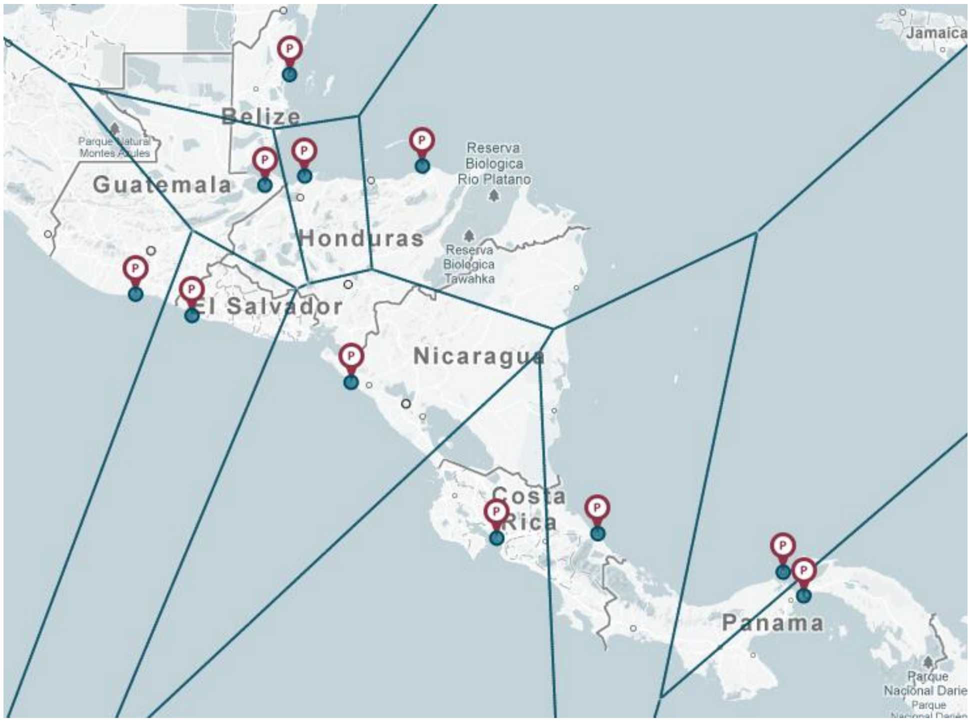

Figure 3: Natural catchment area or area of influence of a port based on distance for ports in study (except for DR)

Figure 3 shows the catchment area based on land distance from the ports where points on a line between two ports are equidistant from each port. The area inside each polygon can be thought of as the natural region to be served by the port in the polygon assuming that the cost from the port to the destination of the product is the same for all ports. As will be seen below, the dimensions of these polygons change when costs are assumed as different for different ports. In this drawing, ports that are close to one another have been regrouped together (e.g. Puerto Santo Tomas de Castilla and Puerto Barrios in Guatemala). Figure 3 clearly shows the struggles between the ports as they compete for market. First there is a clear struggle between ports on the Atlantic and ports on the Pacific. Second, the ports in Belize, Guatemala, El Salvador Honduras and Nicaragua are facing intense competition from one another. For instance the natural catchment area of Santo Tomas de Castilla on the Atlantic side of Guatemala includes part of Honduras and shippers in this area would be better off using Santo Tomas de Castilla if land connectivity was good and travel costs proportional to distance. On the other hand, Puerto Cortes (Honduras) can only push its boundary into Guatemala by being more efficient than Santo Tomas de Castilla and therefore less costly to use from the shipper's perspective. Note that the region defined by these 5 countries contains 65% of the population and the distance from Guatemala City to Managua (Nicaragua) is about 750 km which is roughly the distance between Atlanta and Orlando in the US.

A port that has its region fully defined by the equidistant lines means that it faces competition from all sides as is clearly the case with the ports of Santo Tomas de Castilla (Guatemala), Puerto Cortes (Honduras) and Corinto (Nicaragua) for example. Also, more edges in the polygon defining the region of a port means more ports with which that port must compete.

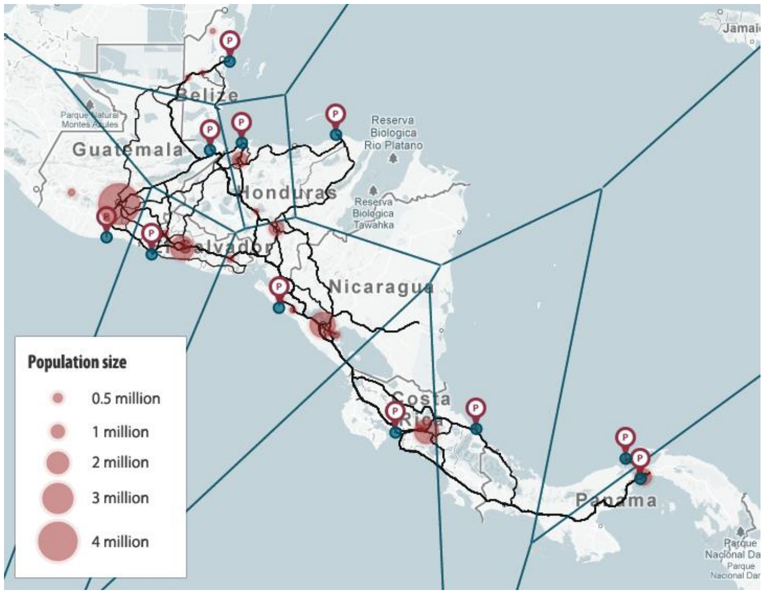

Figure 4: Natural catchment area for ports in study (except for DR) showing main roads and main areas of population concentration

Figure 4 shows the main land routes through the countries of study (except for Dominican Republic) and the main areas of population. It can now be observed that the catchment area of Santo Tomas de Castilla does not include any large city whereas the catchment area of Corinto just barely includes Tegucigalpa (Honduras) which gives Corinto a strategic advantage if it could exploit this trade route successfully. In this figure, the port of La Union is not included as currently no liner services call at this port. However, including La Union in the analysis significantly reduces the catchment area of Corinto as it gains the southern part of Honduras (including Tegucigalpa) as part of its catchment area. This indicates that the strategic decision of building a port at La Union might not have been a bad one (even though the port is currently not being used) as it could not only be used for import and export from its natural region of influence but also as a transshipment port on the west coast competing with Balboa in Panama.

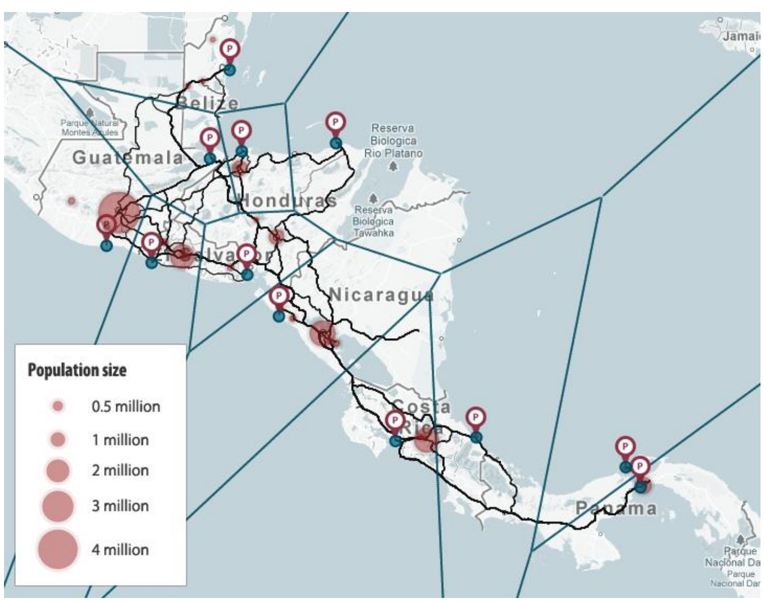

Figure 5: Natural catchment areas when La Union is included.

However, land and sea costs may vary significantly and the region of influence of a port will change based on the cost of shipping/receiving a container from a city or region to/from another city or region. Figure 6 shows how the catchment areas change when considering trade from Europe to the ports of study (excluding DR). Here it is assumed that ports on the east coast receive cargo directly whereas the vessel must go through the Canal and that sea rate is $0.27[3] per km and land rate is $1.60[4] per km. It can be seen that the catchment areas of the ports on the Atlantic side dominate the regions while the influence of the ports on the Pacific side is reduced to a very small area around the ports. For trade from Asia, with a sea rate of $0.33[5] per km and a land rate $1.60 per km, the picture is much clearer with an evident dominance of the ports on the Pacific side. Note that a similar result would have been obtained if the higher rate of $0.54 was used for trade from Europe: the dominance of the ports on the Atlantic side would have been complete[6].

This leads to the following observations:

Observation 1: In the presence of good land connectivity in Central America, trade from Europe will tend to come in through ports on the Atlantic side to be distributed inland whereas trade from Asia will tend to come in through ports on the Pacific side to be distributed inland.

Figure 6: Catchment area of ports for trade from Europe based on sea rate of $0.27 per km and land rate of $1.60 per km.

Figure 7: Catchment area of ports for trade from Asia based on sea rate of $0.33 per km and land rate of $1.60 per km.

[3] Sea rates derived from actual rates obtained from Maerskline.com between Rotterdam and the cities where service was available.

[4] Computed from sources such as: Georgia Tech Short Sea Shipping Capstone Project, IDB‘s Freight and Logistics Report and data from a local logistics service companies.

[5] Sea rates derived from actual rates obtained from Maerskline.com between Shanghai and the cities where service was available.

[6] A similar result would have been obtained by also using lower land rates.

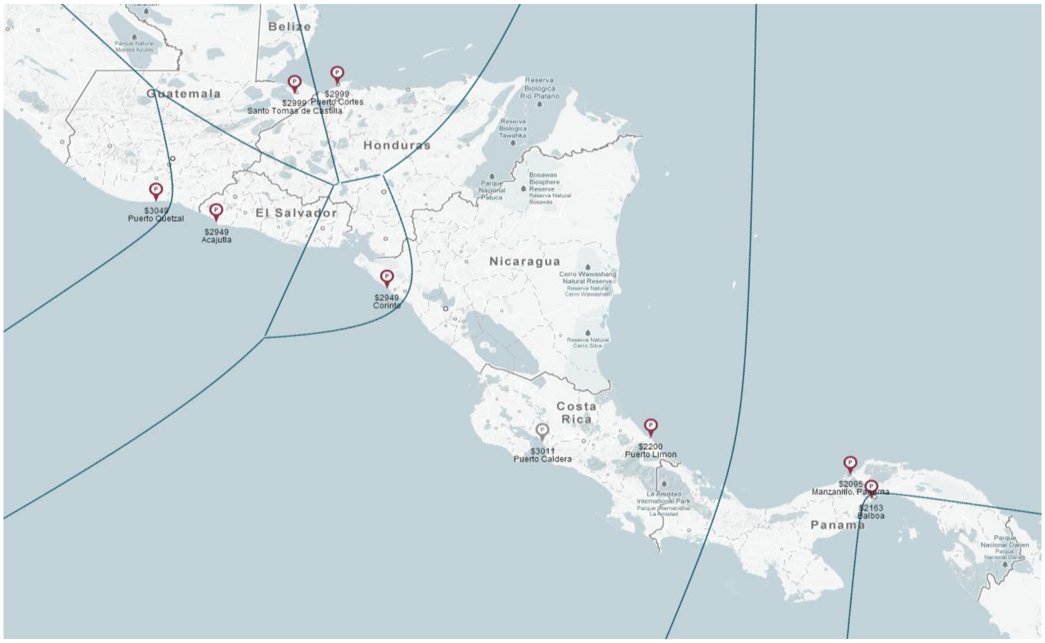

Figure 8: Catchment areas of ports for trade from Europe based on actual shipping cost from Maersk to ports and a land hauling rate of $1.60 per km

But shipping line pricing for containers does not tend to be always proportional to distance as prices to some ports or regions may be cheaper while others are more expensive. This depends on the services, the volumes transported, and the rates that shipping lines have negotiated with ports and or land transport. Figure 8 shows the catchment areas when the actual shipping costs of sending a TEU from Rotterdam to the various ports in the study are used. Land cost is assumed to be $1.60 per km. Here the costs of sending a TEU from Rotterdam to the ports in Guatemala, El Salvador, Honduras and Nicaragua are nearly the same (in the range of $2949 to $3049[7]) independent of whether the port is located on the Pacific or Atlantic side. Note that there are no direct services from Rotterdam to the ports on the West Coast of Central America and the container must be transshipped in Panama adding at least 3 to 5 days to the trip in the best cases which might deter some shippers. The average time from Rotterdam to ports on the Atlantic Coast is 26 days whereas the average time to ports on the Pacific Coast is 31 days. In reality, Puerto Santo Tomas de Castilla in Guatemala reported that 24% of containers received at that port are destined for El Salvador which confirms observation 1 above.

An important element of the external geography of a country is its position with respect to trade routes. Countries with good external geography are on or near trade routes and hence good candidates for transshipment. Figure 9 shows the worldwide services for container shipping lines[8]. It confirms Panama's external geography as a transshipment hub. After analyzing the main trade routes from various regions of the world , the only two countries in the study that have the external geography to make them obvious natural candidates for transshipment hubs are Panama and the Dominican Republic. However, there are plans for transshipment ports in

[7] These rates were obtained from Maerskline.com.
[8] Lines have been drawn by joining two points which does not necessarily reflect the vessel's routes.

Costa Rica, El Salvador, Guatemala and Honduras. This will be discussed further in the Infrastructure and Transportation Connectivity sections below.

Figure 9: Worldwide container shipping line services according to Compair Data

4. Infrastructure

The main infrastructure that makes up an intermodal sea network is seaports and roads. This project has focused on container seaports and the roads connecting them to the hinterland. It did not include a comprehensive documentation and analysis of the road system in the countries considered. Detailed data and analysis on each of the ports studied and their connecting roads are included in the individual country reports.

A ports network is made up of a set of ports, a set of routes or services that visit these ports and a set of ships assigned to each service. A key to the development of a ports network is that, for a given service, the infrastructure at each port visited has capability to serve all of the ships in the rotation. For example, in order to put an un-geared (i.e., ship without crane onboard) each port to be visited must have its own cranes to load and unload the ship. Similarly, all ports must have adequate depth to allow the ship to berth. Each port must also have at least enough storage space for the maximum daily arrival of containers multiplied by the average dwell time plus the space required to work the containers. A detailed questionnaire on ports infrastructure and throughput has been completed for each of the ports in the study and the results compiled in Table 10 in the Appendix.

Figure 10 shows the two main characteristics of a port (i.e. berth depth and the type of cranes) for each port in the study. Except for the ports in Panama, only one port on the Pacific Coast (Acajutla) and one port on the Atlantic Coast (Caucedo) can receive New Panamax vessels that require a depth of 13.5 m to 15 m. These vessels can carry up to 12,500 TEUs and are the largest vessels that will be able to go through the Panama Canal after expansion. Today, the countries that have ports that could potentially handle New Panamax size ships strictly based on berth depth[9] are:

- Panama: Balboa, CCT, Cristobal, Manzanillo and PSA;
- Dominican Republic: Caucedo;
- EL Salvador: Acajutla.

However, even though, Acajutla has the depth, this port does not have any cranes and it is very unlikely to have the infrastructure to handle New Panamax vessels in the near future.

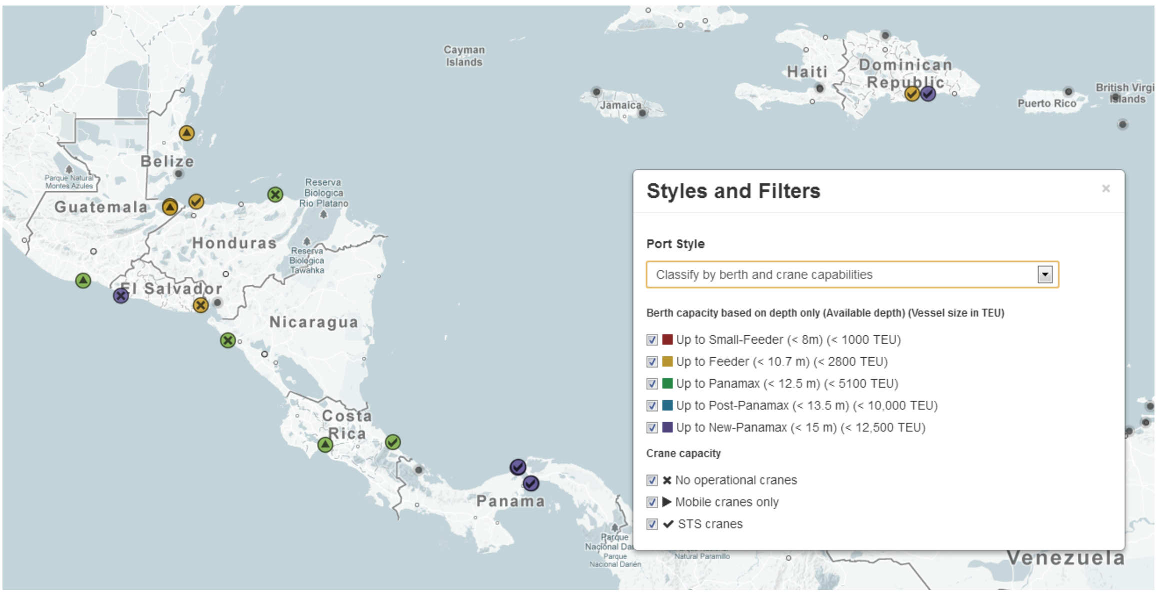

Figure 10: Berth and crane characteristics for ports studied.

The following ports could receive Panamax vessels strictly based on berth depth (between 10.7m and 12.5 m):

- Costa Rica: Puerto Caldera and Puerto Limon-Moin;
- Guatemala: Puerto Quetzal;
- Honduras: Puerto Castilla and Cortes
- Nicaragua: Corinto.

The remaining ports can receive Feeder type vessels requiring a depth of up to 10.7 m:

- Belize: Port of Belize
- Guatemala: Puerto Santo Tomas de Castilla, Puerto Barrios;
- El Salvador: La Union;
- Dominican Republic: Rio Haina

Furthermore, five out of the 18 ports studied do not have any operational cranes and must therefore rely on geared ships. These are:

- The two ports in El Salvador: Acajutla and La Union;
- The only port in Nicaragua: Corinto;
- Puerto Castilla in Honduras;

[9] This is considering only the depth of the berth and excludes all considerations as to the depth and width of the channel.

- Puerto Barrios in Guatemala;

Table 10 from the appendix shows that the current maximum vessel sizes that are handled by the ports in Panama vary from Panamax to Post Panamax and Caucedo can also handle Post Panamax ships. Hence bigger ships from Asia or Europe or North America can only call at these ports and from there the cargo must be transshipped to Feeder type vessels for the other ports in the study. For the ports that do not have cranes, the maximum vessel size handled is Feeder type vessels in the range of 2400 – 2600 TEU if we exclude La Union in El Salvador.

The infrastructure available at the ports vary from Super Post Panamax STS[10] cranes in ports such as Balboa, CCT, Caucedo and Manzanillo, to ports with no cranes as seen above. With the exception of La Union, the five ports in Panama and Caucedo have RTG[11]s and other full and empty container handler equipment for yard management. An interesting measure is the average vessel productivity rate which indicates the rate at which containers have effectively been loaded/unloaded based on 2011 throughput and the vessel's time at berth. This varies from a low of 10.8 TEU/hr for Corinto (Nicaragua) to a high of 72.15 TEU/hr for Manzanillo (Panama), the data for Balboa being unavailable. It is surprising to see a port with little infrastructure such as Limon-Moin having an average vessel productivity rate of 50 TEU/hr and a throughput of nearly 1M TEU (see Figure 11). This is explained by the operating model of Limon-Moin where the shipping lines bring their containers from external storage yards[12] straight to the vessel side, to be loaded directly on the vessel. The same is true for incoming containers: they are unloaded and driven straight to external container yards. The port of Caldera has a hybrid model where containers are managed from the yard and others from external container yards. Other ports have adopted variants of this model where only empty containers can go straight to an external container from a port. This model is interesting for those ports that have limited infrastructure and yard space. Variants of this model could be applied to Panama where some of the ports are operating at capacity. Its application does require changes in the legal framework and some pre-processing of the required paperwork.

[10] Ship-To-Shore cranes
[11] Rubber-Tired Gantry cranes
[12] Container storage areas outside of the fiscal port facility usually owned or rented by private operators

Figure 11: Port characteristics scaled by 2011 throughput

Other measures of productivity such as berth throughput (TEU per meter of berth), yard utilization (TEU per Ha) and average container well times are given in the table in the appendix. Ports should strive to have low dwell times as high dwell times will rapidly cause congestion and degradation in maximum attainable throughput. As an example, Balboa`s average dwell time of 7.2 days per container limits its maximum theoretical throughput at 2,756,643 TEUs instead of the 3,750,000 reported. It can only do the 2011 throughput of 3,232,265 TEUs by using additional storage that was not included in the maximum storage capacity of 54,000 TEUs. Ports operating at or above 80% of yard capacity are in danger of seeing a serious degradation in performance as containers get buried in stacks and a lot of unproductive moves are required for digging them up.

Each port must have truck access to the major business areas of the countries it serves. Table 2 gives an assessment of the land connectivity for each port in the study when compared between them. Out of the 18 ports in this study, 7 ports have limiting land connectivity, 4 have adequate land connectivity, 6 have good land connectivity and only one (Caucedo) has excellent land connectivity. It generally appears that, with the exception of some ports such as Caucedo, there has been insufficient coordination between the planning of port construction and the planning of road construction in the countries analyzed. One example is the road from San Jose to Limon-Moin in Costa Rica, a trip of up to 5 hours on a sinuous 2 lane road that can get very heavy in the rainy season. Another example, in Panama because of limiting road connectivity between Balboa on the Pacific and the Colon ports on the Atlantic, most transshipment involving east and west coast ports is transported by rail between the ports. This is a distance of approximately 80 km. In the US where there is very good road connectivity, any transport less than 900 km is more competitive to ship by truck than by rail. Having good road connectivity in Panama would dramatically change the transshipment dynamic.

The general recommendation for most the ports in the study is to streamline their operations in order to be more efficient and to integrate their processes with customs and other government agencies to facilitate entry and exit of containers from their yards. In particular they should:

I. Invest in securing their facility to prevent the theft and pilferage of containers and have proper security, 24 X 7 monitoring, and highly controlled access;
II. Train the local work force to handle cargo effectively and proficiently with proper container handling equipment and operating procedures needed to limit cargo damage;
III. Invest, upgrade and maintain the proper equipment for container loading and unloading;
IV. Invest, upgrade and maintain berthing facilities and equipment required to expand carrier usage, vessel turnaround, and facilitate new trade lane development;
V. investment in technology for port operations and management, and in the electronic tracking of the containers and real time status updates which is critical to support the global tracking systems of importers/shippers, carriers and forwarders[13];
VI. Improve and automate processes for container drop off and retrieval and gate accessibility.

The recommendation for governments of the region is to better plan road infrastructure and connectivity between regions of production/consumptions and ports. Access roads should be developed to support container traffic and reduce delays in container pick up and deliveries.

[13] Automation also helps with key element of C-TPAT and Custom compliance systems

Table 2: Land Connectivity Assessment

Land Connectivity Assessment																			
Category	Weight	Caldera	Limon-Moin	Rio Haina	Caucedo	Acajutla	La Union	Corinto	Castilla	Cortes	Santo Tomas de Castilla	Barrios	Quetzal	Belize City	PSA Panama	MIT	Colon (CCT)	Balboa	Cristobal
Number of lanes (at gate)	0.1	3	5	5	5	3	5	3	3	3	5	5	3	5	5	5	5	5	5
Distance/time/congestion/security to major cities	0.4	3	1	7	7	5	3	3	1	5	1	1	5	3	3	5	5	5	3
Distance/time/congestion/security to major highways	0.3	5	3	3	7	5	5	3	1	5	3	3	5	1	3	1	1	5	3
Surface type of road connecting to major highways	0.1	5	3	3	5	3	3	3	1	3	3	1	3	3	3	1	1	5	3
Surface type of major highways connecting to major cities	0.1	5	3	5	5	3	3	5	1	3	3	3	5	3	3	5	5	5	5
Total		21	15	23	29	19	19	17	7	19	15	13	21	15	17	17	17	25	19
Weighted average		4	2.4	5	6.4	4.4	3.8	3.2	1.2	4.4	2.4	2.2	4.6	2.6	3.2	3.4	3.4	5	3.4
Overall assessment		Good	Limiting	Good	Excellent	Good	Adequate	Adequate	Limiting	Good	Limiting	Limiting	Good	Limiting	Adequate	Adequate	Adequate	Good	Adequate

Category score	
Excellent	7
Good	5
Adequate	3
Limiting	1

Overall assessment	
Excellent	5.6 to 7
Good	4.0 to 5.5
Adequate	2.7 to 3.9
Limiting	1 to 2.6

5. Network connectivity

Sea transportation infrastructure, particularly ports, is necessary for an intermodal network but is does not assure that a network will actually evolve. For example La Union in El Salvador developed infrastructure to support container shipping but no shipping lines have chosen to use the infrastructure yet. In order for the infrastructure to provide value, shipping lines must actually use the infrastructure to provide transport services. The capability actually provided by shipping lines to move containers between a port and other ports in the world is what is referred to as the "connectivity" of the port. There are two fundamentally different ways a network can be connected, directly and via transshipment. If two ports are directly connected then services exist to move a container from one port to another without the container having to change ships. If two ports are connected only via transshipment then services exist to move a container between the ports but at some third port the container must be unloaded from one ship and loaded on to another.

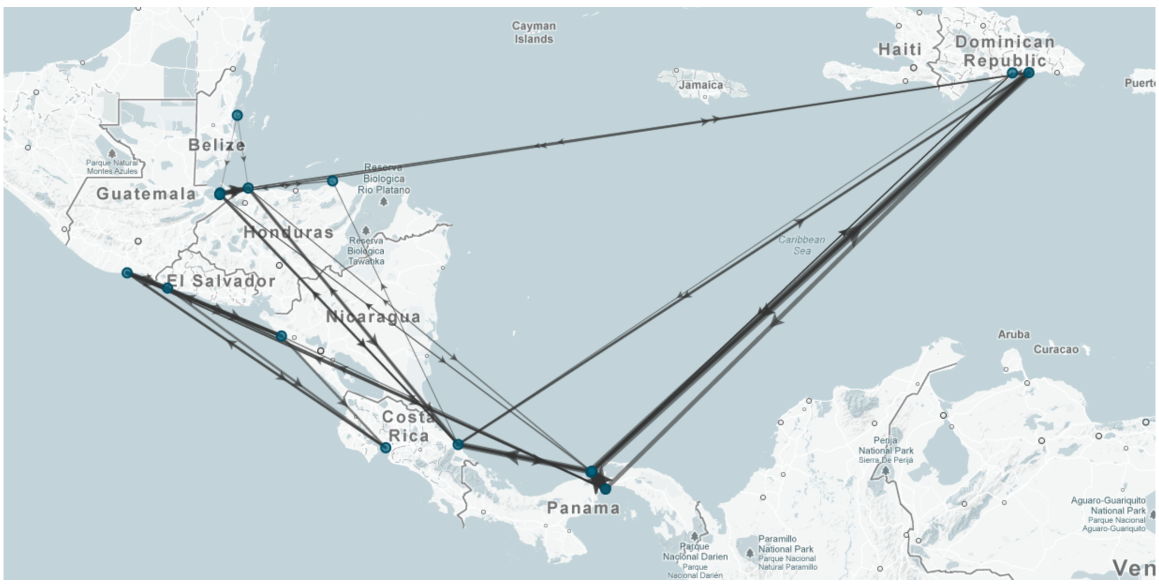

Figure 12: Connectivity network for ports in study

Figure 12 shows the connectivity network between the ports in the study. A link between any two ports in this figure means that there is a service between these two ports and therefore these two ports can be reached without transshipment. Figure 12 is derived from those liner services shown in Figure 13 that visit two or more ports among those in this study. The network in Figure 12 has a butterfly like structure, with two distinct sub networks, one for the ports on the Pacific side and another sub network for the ports on the Atlantic side. As can be seen, no port from one side is directly connected to ports on the other side except the ones in Panama and a link from Caucedo to Balboa. This means that transshipment is necessary going from any Pacific port north of Panama to any Atlantic port also north of Panama and this adds time and costs. In all cases, it involves going from the port of origin to Balboa, then transship to Manzanillo, and another transshipment from Manzanillo to the port of destination. Going from ports in the Atlantic to ports in the Pacific also require transshipments at Manzanillo and Balboa except for Caucedo that has a direct connection to Balboa.

Figure 13: Actual liner services that visit two or more ports among those in the study

We define a network to be connected if there is a path or connection between any two pairs of nodes in the network. Here the connection means that there is a liner service between any two ports in the network, meaning you can get from the first port to the second port without transshipment. Excluding the ports of PSA in Panama and La Union in El Salvador, there are five ports on the Pacific coast and eleven ports on the Atlantic side. The port sub network on the Pacific side is fairly connected with 15 possible connections out of a total of 20 connections between all five ports. The port of Caldera seems to be the most isolated from the Pacific sub network with no direct services to Acajutla, Balboa[14] and Corinto and no direct service from Balboa reported in Compair database. The network on the Atlantic side is sparsely connected with only 51 existing connections out of a total of 110 connections. The most isolated ports from the Atlantic sub network are the port of Belize and Puerto Castilla while the most connected ports are Puerto Limon, followed by Puerto Cortes and Caucedo.

Observation 2: There are two disjoint sub networks of ports, a fairly well connected Pacific sub network of ports on the Pacific side and a sparsely connected Atlantic sub network of ports on the Atlantic side. All ports in the Pacific sub network must transship through ports in Panama to connect to ports in the Atlantic sub network and vice versa.

Table 3 shows the vessel travel times between two ports for direct, no-transshipment connections. Notice how this matrix clearly reflects the fact that the port network consists of two sub networks (Observation 2) and that they are connected by the ports in Panama and Caucedo. The transit times vary from 0 days to a maximum of 10 days between Caucedo and Cortes.

Figure 14 shows the no-transshipment connections between the ports in the study and the rest of the ports in the world while Figure 15 shows the converse, the connections between the

[14] Actually there exists one feeder service between Balboa and Caldera but this was not reported on CompairData. In order to ensure the completeness of future studies, initiatives such as the Regional Observatory of Cargo and Transport should promote the collection and maintenance of such data in order to provide independence from external data providers that may not be familiar with the region.

ports of the rest of the world to the ports of study. An important observation is that except for the ports in Panama and the port of Caucedo, none of the ports in the study have a direct service from/to Asia and therefore they must all transship through the ports in Panama or Caucedo in Dominican Republic. For trade with Europe, 7 of the 11 ports on the Atlantic side have direct no-transshipment service from/to Europe. These are: CCT, Cristobal, Manzanillo (Panama), Limon-Moin (Costa-Rica), Puerto Cortes (Honduras), Santo Tomas de Castilla (Guatemala) and Caucedo (Dominican Republic). These figures also clearly show Panama and Dominican Republic as the two hubs for the region of study.

		Belize City (Belize)	Caucedo (Dominican Republic)	Colon (Panama)	Cristobal (Panama)	Manzanillo (Panama)	Puerto Barrios (Guatemala)	Puerto Castilla (Honduras)	Puerto Cortes (Honduras)	Puerto Limon (Costa Rica)	Rio Haina (Dominican Republic)	Santo Tomas de Castilla (Guatemala)	Acajutla (El Salvador)	Balboa (Panama)	Corinto (Nicaragua)	Puerto Caldera (Costa Rica)	Puerto Quetzal (Guatemala)
		E	E	E	E	E	E	E	E	E	E	E	W	W	W	W	W
Belize City (Belize)	E								2			1					
Caucedo (Dominican Republic)	E			9	4	5			10	5	0	9		4			
Colon (Panama)	E		3							9	4						
Cristobal (Panama)	E								7	1	4	8		0			
Manzanillo (Panama)	E		3	1						0	4	2		0			
Puerto Barrios (Guatemala)	E							2	1	1							
Puerto Castilla (Honduras)	E						5		6								
Puerto Cortes (Honduras)	E	1	4			6	1	1		1		1					
Puerto Limon (Costa Rica)	E		3	3	4	1	5	2	2			3					
Rio Haina (Dominican Republic)	E			8		5				5		7					
Santo Tomas de Castilla (Guatema	E	2	5			7			0	3							
Acajutla (El Salvador)	W													3	0	3	1
Balboa (Panama)	W				0	0							3		3		4
Corinto (Nicaragua)	W												2			1	3
Puerto Caldera (Costa Rica)	W																1
Puerto Quetzal (Guatemala)	W												1	4	3	4	
Max		2	5	9	4	7	5	2	10	9	4	9	3	4	3	4	4

Table 3: Port to port times

Observation 3: The network connectivity for ports in the study shows that there are two main hubs: i) the ports in Panama which are pivotal to traffic from Asia, Europe, North America and the West Coast of Latin America; ii) Caucedo in Dominican Republic which is more involved in traffic between the North and South (East and West coasts of North America and Latin America).

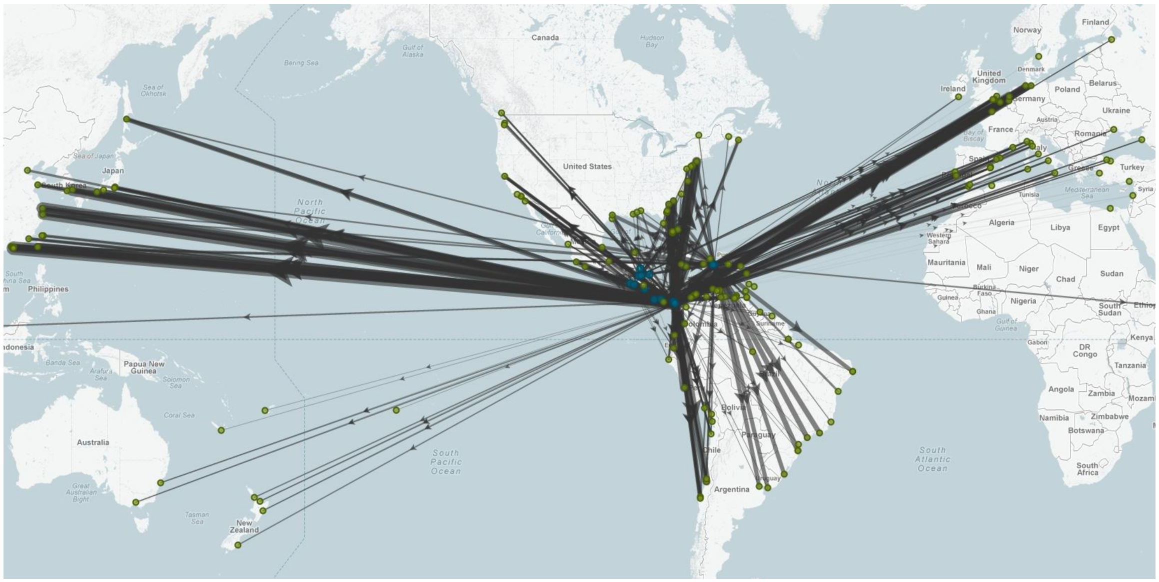

Figure 14: No-transshipment connections between ports of study to the rest of the world

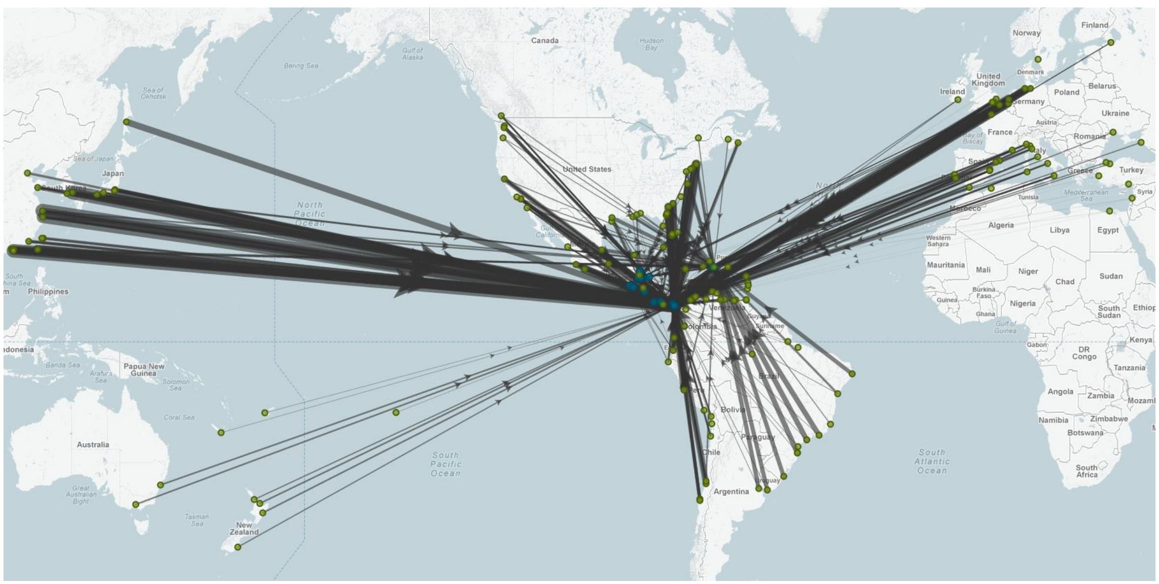

Figure 15: No-transshipment connections between the world and ports of study

Measures of Centrality and Connectivity

Informally speaking, a port is "central" to container shipping if it is located such that it is likely to play a role in the movement of freight. There are several ways to measure centrality, some appealing to geography and some to position with the network of scheduled container services.

It would be nice to be able to base centrality on actual volumes of trade between ports, but this level of information is not available. Consequently, we rely on a proxy, which is the movement of containers, without knowing what is within the containers or, indeed, whether they are empty. Thus our measures of centrality are based on capacity and not actual trade. Thus it is entirely possible that a port be well-located --- central to patterns of container flow --- but not actually handle many containers. This should be interpreted as an opportunity: such a disparity suggests potential for economic growth based on location, either geographic or within the network of container-ship movement.

One can think of two levels of connection within the global network of container-shipping. In the "no-transshipment" network, two ports are connected by a link if containers can be shipped from one to the other without transshipment (though there may be intermediate ports) as illustrated in Figure 14 and Figure 15. In the "direct shipment" network, two ports are connected by a link if there is a service traveling directly (without intermediate stops) from one to the other. In this network, two ports tend to be connected if there is a great deal of freight going from one to the other, or if geography makes this a natural ship movement. The following comments regard the "direct shipment" network.

One natural measure of centrality is "betweenness". A port has a high value of betweenness if it lies on the time-shortest paths between many pairs of ports. By this measure, the Panamanian ports of Manzanillo (PAMIT) and Balboa (PABLB) score exceptionally high, enough to put them amongst the top 25 in the world. It is natural to think that a port that is between many other pairs of ports is well-suited as a transshipment hub, and indeed there seems to be a strong correlation. No other ports in the IDB study have significant values of betweenness.

Another natural measure is "connectivity", which expresses how well integrated a port is into the larger trading community. A port that is well-connected can receive containers from many different ports and can ship to many different ports.

The most straightforward way of measuring connectivity is by the degree of the port, which is the number of distinct other ports that either ship directly to or else receive directly from the port in question. This measure is easy to compute but it fails to take into account the identities of the adjacent ports: are they important global hubs or small isolated outposts? The Port Connectivity Index (PCI) extends the idea of degree to account for, not just the fact of direct connection, but also the strength of the connection and the importance of the port connected to.

Port	Country	UNLOCODE	Betweenness time	Degree	In Degree	Out Degree	PCI inbound	PCI outbound	PCI
Belize City	Belize	BZBZE	26	4	2	2	0.036	0.015	0.051
Puerto Caldera		CRCAL	252	4	2	2	0.011	0.303	0.314
Puerto Limon	Costa Rica	CRLIO	6124	26	11	15	0.691	0.852	1.543
Caucedo	Dominican Republic	DOCAU	8960	29	14	15	4.3	4.595	8.895
Rio Haina		DOHAI	8359	17	9	8	0.302	0.1	0.402
Acajutla	El Salvador	SVAQJ	2347	7	3	4	0.232	0.269	0.501
Puerto Barrios		GTPBR	564	9	5	4	0.031	0.023	0.054
Puerto Quetzal	Guatemala	GTPRQ	2830	12	6	6	1.204	1.349	2.553
Santo Tomas de Castilla		GTSTC	670	17	11	6	0.271	0.084	0.355
Puerto Castilla		HNPCA	115	4	2	2	0.011	0.029	0.04
Puerto Cortes	Honduras	HNPCR	1856	18	8	10	0.054	0.146	0.2
Corinto	Nicaragua	NICIO	901	5	3	2	0.24	0.004	0.244
Almirante		PAPAM	671	5	1	4	0.016	0.005	0.021
Balboa		PABLB	27987	34	17	17	12.186	15.284	27.47
Colon	Panama	PAONX	2307	16	7	9	6.917	3.461	10.378
Cristobal		PACTB	3350	19	9	10	8.787	4.524	13.311
Manzanillo		PAMIT	36467	45	22	23	23.536	13.588	37.124
PSA Panama		PAPSA	0	2	1	1	1.612	0.108	1.72

Table 4: Measures of centrality and connectivity for ports in the study

This can be seen clearly for the port PSA Panama (PAPSA), which receives shipments directly from a single port and ships directly to a single port. But the PCI-inbound score is fifteen times higher than the PCI-outbound score, reflecting the fact that the upstream port is Manzanillo, MX, which is much better connected than the downstream port of Buenaventura, Colombia. An even more extreme example is provided by the port of Corinto, Nicaragua (NICIO), for which the PCI-inbound score is fully 60 times greater than its PCI-outbound score. Such imbalances identify ports that are the first stops after a container service departs from a big port that is an international shipping center.

It is similarly instructive to compare the connectivity of the ports of Colon, Panama (PAONX) and Santo Tomas de Castilla, Guatemala (GTSTC). Colon communicates directly with 16 other ports and Santo Tomas with 17 other ports, so they have about the same degree. Yet the PCI-inbound score of Colon is 25 times that of Santo Tomas and the PCI-outbound score of Colon is more than 40 times greater. Again, the difference is because Colon is connected to ports of much greater importance, including the great East Asian export ports.

Among this set of ports, the inbound connectivity is by far the greatest among the Panamanian ports of Manzanillo, Balboa, Cristobal, and Colon, reflecting their role as recipient of direct service from the great ports of East Asia and from North America. These ports also have the greatest values of outbound connectivity, but in general the ports in the study tend to have smaller values of outbound connectivity than inbound. This reflects their role of receiving freight from big international centers of production and distributing it to regional consumers. It is natural to send containers to Panama or Caucedo and distribute them from there throughout the region.

The potential for the ports in the study to be transshipment hubs is at least partially reflected by the graph in Figure 15. The betweenness score (a measure of the port's closeness to trade routes) is shown on the horizontal axis. Hence a port with a high score is more attractive. The PCI score (a measure of the importance of ports the port is connected to) is given on the vertical axis. The current connectivity of the port is reflected in the size of the sphere representing the port. Hence Singapore and Busan appear to have the most opportunity with Singapore better regarding its connectivity and Busan better regarding its closeness to trade routes. Regarding the ports in this study, Manzanillo has the most opportunity followed by Balboa. Of the others only Caucedo appears to have any significant potential and it is clearly dominated by both Manzanillo and Balboa.

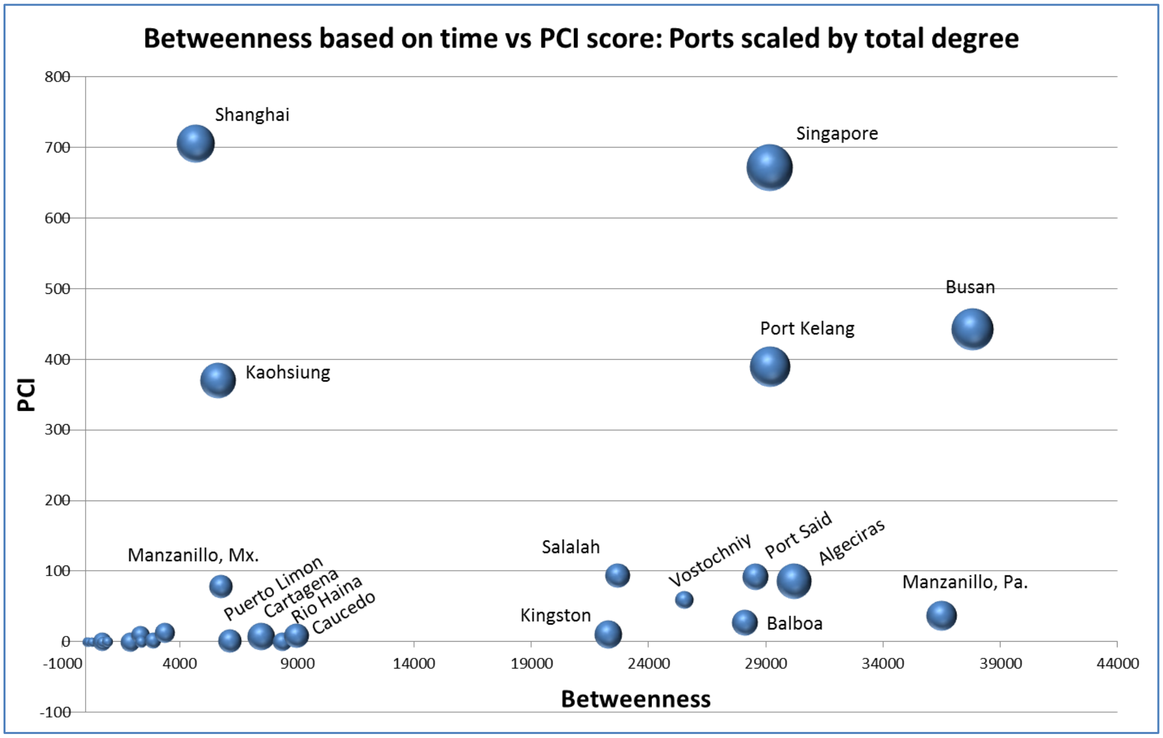

Figure 16: Graph of PCI score vs. Betweenness with ports scales by total degree for ports in the study together with the top 10 world ports with highest Betweenness

Land connectivity was discussed in the previous section. In general if there is an acceptable road between two geographic points then the points are connected in the sense that it is at least theoretically possible for a truck to haul freight between the two points. However, there are often local considerations that restrict a truck from picking up loads in certain locations such as duty free zones. Since most trucking services are provided "on demand" rather than as a scheduled service, it is difficult to say if two points are actually connected. As a result, no generally accepted measures of trucking connectivity have been developed.

6. Transportation costs

Critical elements impacting the competiveness and actual use of an intermodal network are the transportation costs and times. If both cost and time are better for one mode than another, then the latter may not actually exist simply because there is no demand for it. For example, in the US it is generally believed that the cost of moving containers on rail for distances less than 900 km is higher than moving them by truck over the same distance. As a result, there are only some very special rail services that provide connectivity between points separated by short distances. This same phenomenon should occur with sea shipping between ports in the study separated by short distances if it is feasible to transport by trucks. The question is where and when is it preferable to use an all land route vs. and intermodal short sea shipping route for the ports in the study. This requires the investigation of intermodal (land – sea – land) connection between two points vs. only land connection as illustrate in Figure 1 at the beginning of this document.

Transportation costs and times influence trading routes and for sea, the price may not be a linear function of distance especially on relatively short distances as between the ports in the study. This is readily apparent from the price matrix of sending a TEU (see Table 5[15]) which varies from a low of $2,027 (between Guatemala City to Panama City) to a high of $4,343 (between Guatemala City and Managua). These were obtained from Maerskline.com and may represent a premium price over market prices. Shippers having contracts and agents will pay an amount up to 20% to 30% lower depending on volumes.

	DESTINATION	Belize	Cost Rica	Dominican Republic	El Salvador	Guatemala	Honduras	Nicaragua	Panama
	ORIGIN	Belize City (ATL)	San Jose	Santo Domingo	San Salvador	Guatemala City	Tecugicalgpa	Managua	Panama City
Belize	Belize City (ATL)	X	X	X	X	X	X	X	X
Cost Rica	San Jose	X	X	X	2,519.94	3,112.47	3,382.47	2,424.94	2,184.19
Dominican Republic	Santo Domingo	X	X	X	X	X	X	X	X
El Salvador	San Salvador	X	2,868.58	X	X	3,188.00	3,983.00	2,658.00	2,177.25
Guatemala	Guatemala City	X	3,264.47	X	2,933.00	X	3,923.00	4,343.00	2,027.25
Honduras	Tecugicalgpa	X	3,524.47	X	3,248.00	3,913.00	X	3,483.00	3,002.25
Nicaragua	Managua	X	2,878.58	X	3,093.00	3,643.00	X	X	2,187.25
Panama	Panama City	X	2,545.83	X	2,495.25	2,410.25	3,455.25	2,400.25	X

Table 5: City to City prices for sending a TEU by intermodal route

All truck routes between the cities were computed using rates found from various sources including IDB's database. The results can be seen in Figure 17 where the prices per km for intermodal vs. all land routes are graphed using a 5% discount for the intermodal rates obtained by Maersk. The tradeoff between land and sea is 1,650 land km[16] when an average truck rate of $1.60 per km is used. Truck prices however vary greatly between providers of services in the region and it is not clear if the prices found included backhaul and all the taxes, insurances and other duties for border crossing. For these reasons, it is suspected that the actual land prices should be closer to $2 per km which then yields a tradeoff of 1,250 land km.

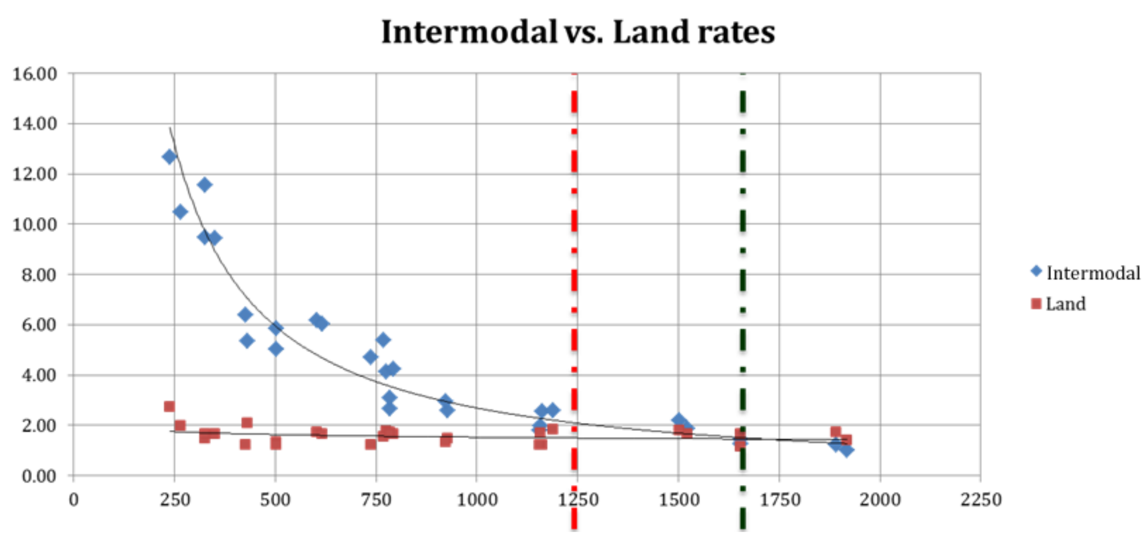

Figure 17: Intermodal vs. land cost for ports in the study

[15] No rates were found for cells in red on Maerskline.com.

[16] i.e. for land distances between two points that are shorter than 1650 kms, it is preferable to use trucks.

Online prices are premium prices and the intermodal cost in Figure 18 is discounted by 20%. The land vs. sea tradeoff now varies between 1,100 land km to 1,500 land km when using $2.00 per km and $1.60 per km respectively for trucking rates.

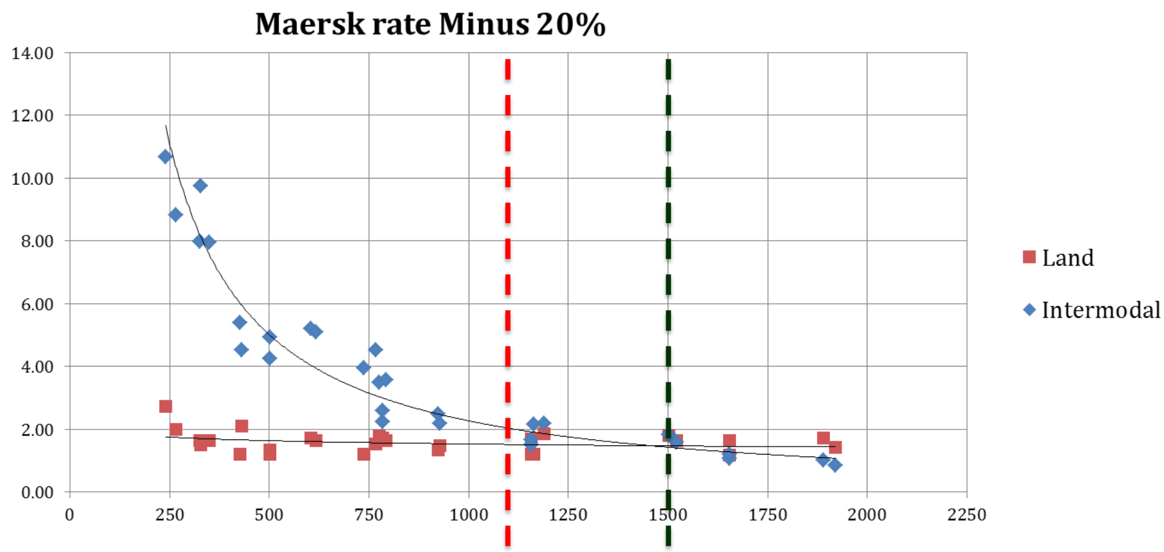

Figure 18: Intermodal vs. land cost for ports in the study discounted by 20%

Observation 4: Trucking should be considered between 2 points that are less than 1,100 km apart and sea shipment should be considered for shipments greater than 1,100 km by land.

Observation 4 allows the grouping of ports in five groups as illustrated in Figure 19 where one would not use an intermodal route that has both its outbound and inbound ports in the same port group unless there is a specific reason such as lower costs due to higher volumes or other special considerations. These intermodal routes would not be advantageous with respect to both cost and transit times. Land routes should be preferred to these intermodal routes.

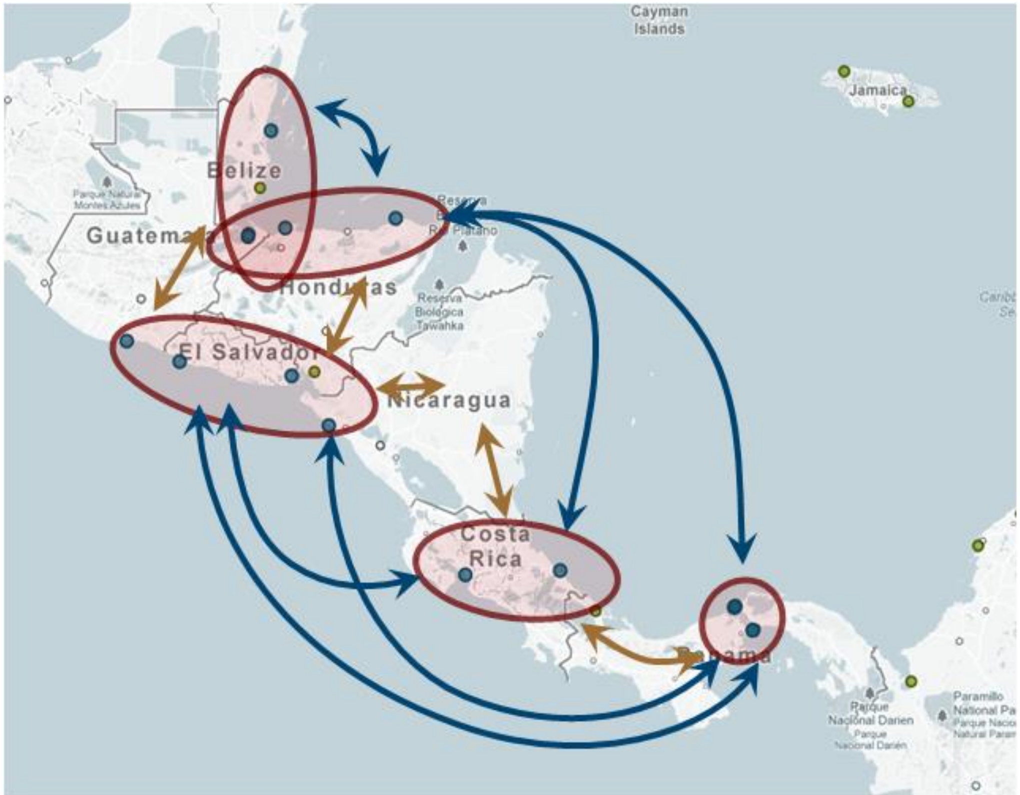

Figure 19: Grouping of ports where intermodal (land and sea) use of two ports in the same group is only preferred for high volume or special shipments. Blue lines are intermodal sea/land routes whereas brown lines are all land routes

In general, groups that are across each other, as the three groups at the top, should use land routes for exchanges of good between them except when such routes are too long, too costly or simply not available. It is also not advantageous to send cargo from the groups of ports on the Atlantic to the group of ports on the Pacific by sea through the Panama Canal. Land routes should be preferred. The main sea routes should be between the groups of ports as indicated in the figure and this is well reflected by the current design of liner services in place for the region.

7. Trade / movement requirements

The motivation for shipping lines to develop services between various points is very dependent on how much product needs to be moved between the points, the price that shippers are willing to pay for the movements (often related to the value of the product) and the handling requirements of the products (e.g., the requirement for refrigeration). Figure 20 shows the GDP per capita of countries in the study and the total trade between these countries.

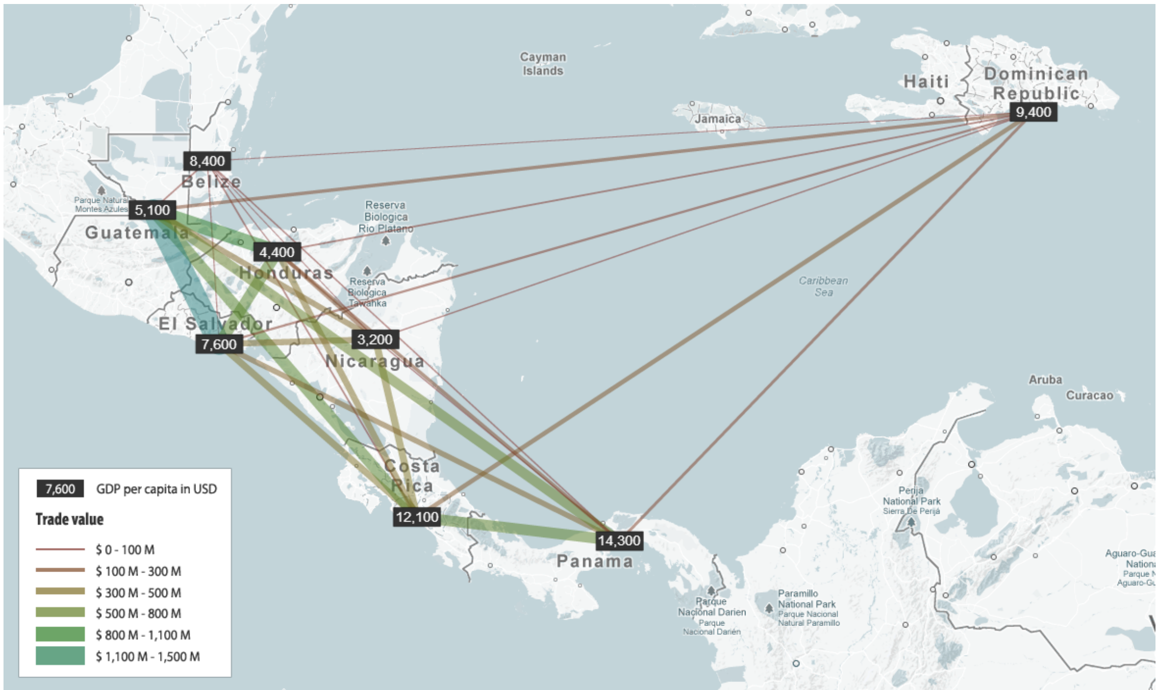

Figure 20: GDP per capita of countries in the study and total trade between these countries

These trade figures were converted to the amounts of TEUs that required to be moved by sea using the methodology explained in the Methodological Notes and the result shown in Table 6 and also in Figure 21. This figure shows that the largest exchanges of containers are between the Dominican Republic (DR) and Guatemala, El Salvador, Costa Rica and Panama. There are direct liner services between DR and Guatemala, DR - Costa Rica and DR - Panama. DR does not have any direct connection with ports on the Pacific Coast. It is possible that the trade from El Salvador goes to the port of Santo Tomas de Castilla or Cortes or through an intermodal route with transshipment through the Canal to DR.

Trade Matrix Between Mesoamerican Countries (Ocean TEU)									
Country	**Belize**	**Costa Rica**	**Dominican Republic**	**El Salvador**	**Guatemala**	**Honduras**	**Nicaragua**	**Panama**	**Total**
Belize		20	236	0	0	1	0	8	264
Costa Rica	11		15,175	4,352	5,192	5,774	8,924	3,035	36,689
Dominican Republic	13	2,863		175	7,280	747	152	4,863	15,345
El Salvador	0	2,123	18,110		0	0	2,599	1,729	24,561
Guatemala	0	5,977	18,464	0		7,117	3,818	5,184	33,444
Honduras	202	2,479	4,199	0	2,708		672	222	10,482
Nicaragua	1	3,425	684	3,090	1,257	1,859		168	8,626
Panama	712	1,429	11,100	1,226	2,926	1,015	204		17,597
Total	940	18,316	67,969	8,843	19,363	16,512	16,370	15,209	147,009

Table 6: Estimation of the number of TEUs that needed to be moved by sea in 2010 between countries in this study (except for Honduras which is based on 2009 data)

The sea container movement among the countries to be studied conforms to Observation 4.

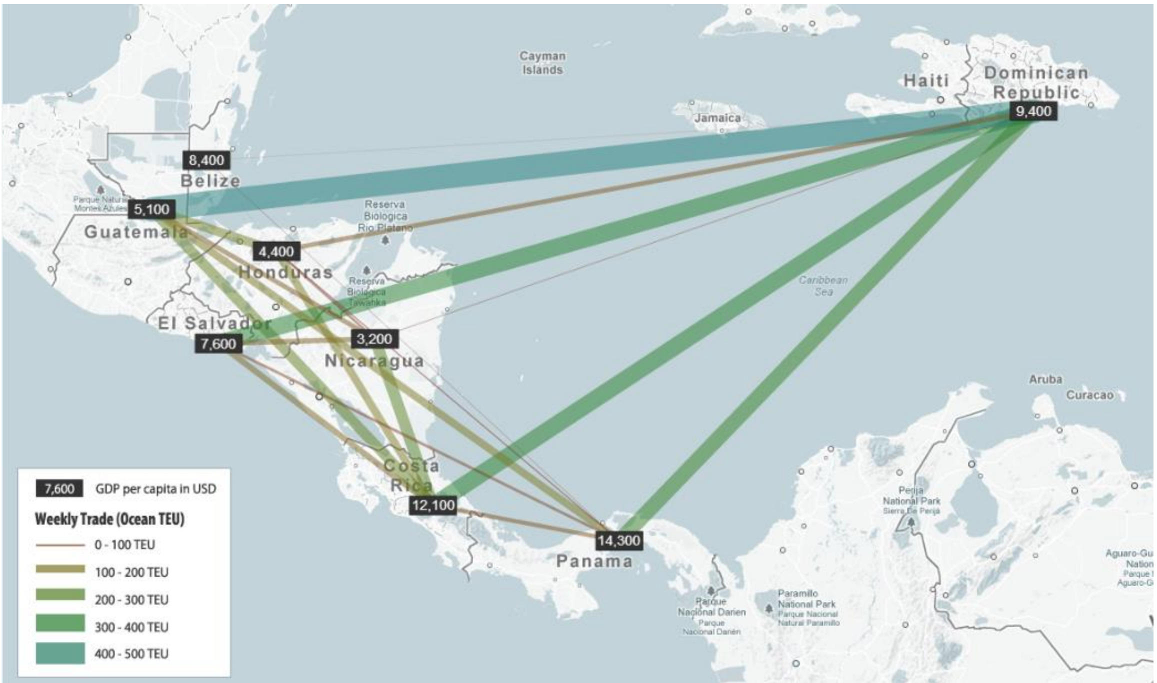

Figure 21: Graphical view of the number of TEUs that needed to be moved by sea in 2010 between countries in this study

Transportation in the mainland of Central America is complex as the region is too small and does not have enough volume for a dense maritime network but too big and lacking in road infrastructure to be adequately served by land. Development of land connectivity and integration to an efficient maritime system is essential for the development of the region. For Dominican Republic, trucking rates are the most expensive of the region and problems with trucking unions exacerbates transportation problems contributing to high logistics costs and hence more expensive products and services to the population.

Recommendation to Government: Focus reforms to reduce logistics costs by improving:

- Inefficient multimodal integration
- Bottlenecks at borders and crossings
- Customs-related inefficiencies
- Security of land transportation
- Quality of transportation networks
- Underinvestment and congestion
- Inadequate services (ports, maritime, air cargo)
- Maritime –hinterland interface

8. Shipping dependability

It is extremely important to most shippers that their transportation network provide both fast and dependable shipping times. Variability in transit times requires shippers to carry inventory to protect against running out of product. For example, suppose that a retailer in the US with predictable demand ships product from their manufacturer in China to their retail store in the US and the product is transshipped in Balboa. If the transit time always takes 30 days then the retailer always has 30 days of inventory in transit but the product always arrives just in time so the retailer does not have to maintain any safety stock. However, if the retailer knows that there can be disruptions in Balboa that might delay his shipment for as much as 10 days, before it is transshipped, then he must maintain an additional 10 days of inventory in the US to protect against running out of product. The problem becomes worse if the shipper must protect against a complete shutdown of the transshipment port where the delay time is not even predictable. If retailers believe that there is a reasonable likelihood of such a shut down they will generally avoid using the transshipment port at all.

Dependability of each node and link in the network is extremely important to shippers and carriers. Whenever there is a disruption in the network, the impact cascades out from the point of disruption. This is true anywhere in the network but is a particularly devastating problem when the disruption occurs at a transshipment port where the connections of many containers may be disrupted. For example, the Port of Balboa is the largest container port in Latin America with about 2 million containers (3.2 million TEUs) handled in 2011. About 93% of these containers are transshipped. This means that if Balboa is disrupted for a day, there are about 5,000 containers that will likely be delayed. In Panama, a disruption of this kind is likely to seriously affect ports on the Atlantic as well. This is because about 35% of the containers handled by Balboa use the rail to transit to and from the ports on the Atlantic. If Balboa is disrupted, the rail does not run and containers that come in to the Atlantic ports destined to leave Panama from Balboa pile up in the Atlantic ports. This in turn causes these ports to become congested and if the disruption lasts long enough, it will eventually cause the Atlantic ports to shut down as well.

The port of Balboa shut down for a few days in April 2012 due to labor problems which caused huge problems for shipping lines and shippers. On the worst day resulting from this disruption, one carrier had more than 80,000 containers that had to be repositioned. Many of the containers had to be diverted to other ports causing both serious delays to the shippers and significant cost to the shipping lines. In addition, such diversion of cargo also affected neighboring ports which became congested due to the surge on cargo volumes resulting from the shipping lines trying to find alternatives to re-configure their port calls. If this happens again, it will be catastrophic for Panama's desire to be a logistics hub since shipping lines and shippers cannot depend on good service with minimal delays.

All ports in the world are exposed to disruptions. Even though some of these disruptions cannot be prevented (e.g. natural disasters) others can be minimized by taking preventive measures or establishing action plans in case of their occurrence (e.g. equipment failures, accidents or labor-management relations). In order for the regional port network to provide a platform that would promote the consolidation and redistribution of products in a cost efficient manner, it should be the aim of each individual country (particularly those with transshipment ports) to establish measures that would prevent disruptions and provide standard operational procedures that would ensure the resilience of the system. An example of a national policy could be to support the creation of buffer capacity at national ports and intermodal system in order to avoid congestion. Other measures could be the creation of customs protocols that would expedite the flow of cargo in case of local or regional disruption.

9. Transport and trade regulations

The transport and trade regulations that generally impact intermodal networks are the restrictions on a foreign carrier cabotage (i.e., transporting products between two points in the same country), restrictions on foreign carriers (particularly trucks) picking up loads in a country that is not home to the carrier and various fees involved, forms and inspections required of foreign carriers that are not required of domestic carriers. The small size of the countries in the study essentially eliminates sea cabotage for these countries so cabotage restrictions are not really relevant. Also, since the Dominican Republic is not connected by land to the other countries in the study, there are no truck restrictions related to the DR that seem to impact the network.

The Free Trade Agreement (signed between Panama, Costa Rica, Nicaragua, El Salvador, Honduras and Guatemala) contains specific language to insure that the truckers from any of the countries in the treaty are treated the same as domestic truckers with regard to fees, forms, inspections, etc. as well as the ability to pick up loads to "backhaul" to their home countries. While this study did not systematically consider the degree to which these treaties are enforced, there is anecdotal evidence to indicate that they are not enforced very well in many cases and that this probably adds significantly to the cost and delays associated with truck transportation between the countries. The biggest problem appears to be with regard to backhaul. Some of the countries appear to either prohibit altogether or charge high fees to allow trucks from another country to enter their special economic zones (e.g., free trade zones). This has reportedly caused other country to retaliate. The result is that in many cases there are only hauls in one direction between countries. This essentially doubles the cost of transport. It has also been reported that in some countries there are special municipal fees charged when a foreign truck crosses the border: fees charged for special documents, delays for security checks, "donations" for expediting inspections, etc. This is an area where further study is required to determine the magnitude and impact of these practices.

Recommendation to Governments: Since short sea shipping is only viable for longer distances (greater than 1000 km depending on the scenarios), it is important to develop a strong, well-integrated and regulated trucking industry for the region. This will significantly improve intermodal transportation and reduce logistics costs.

10. Impact of the Panama Canal

Except for ports in Panama and Caucedo no other ports in the Pacific or Atlantic can handle the larger vessels that will come through the expanded Canal. Furthermore, these ports are the only ones that have direct services to/from Asia. Hence, unless there are some major changes in the current strategies of the ports, the basic dynamics of the network of liner services for the other ports in the study will not change in the immediate future[17] as they will continue to be served by Feeder lines.

[17] Ports such as Moin, Quetzal and Cortes are currently developing expansion plans and they may be able to serve Post-Panamax Vessels sometime in the future.

With the expansion of the Canal, larger, new Panamax type, vessels will come through the Canal to the Atlantic side and these vessels will have to stop in one or two mega ports from which feeder lines will be used for distribution of goods. The question is which ports will these be? To answer this question we need to consider additional ports that are outside of the ports of study such as Cartagena (Colombia), Freeport (Bahamas) and Kingston (Jamaica) among others. To this list, we can potentially add the port of Limon-Moin because of the new investments being made at that port[18] and the fact that this port is very close to Panama.

	Extra distance when transshipping at...				
From Shanghai to US	Kingston	Caucedo	Limón	Bahamas	Cartagena
Houston	557	2,008	109	1,408	620
Miami	278	1,158	109	198	363
Jacksonville	241	976	144	102	328
Savannah	243	976	269	226	328
Charleston	243	976	282	239	328
Norfolk	243	806	502	387	328
New York	243	739	544	430	330

Table 7: Extra distance when using another port for transshipment of goods coming from Asia to East Coast of US when compared to ports in Panama. Distances are computed by using www.vesseldistance.com

	Extra cost in USD when transshipping at... (assuming 0.17 $/km-TEU)				
From Shanghai to US	**Kingston**	**Caucedo**	**Limón**	**Bahamas**	**Cartagena**
Houston	95	341	19	239	105
Miami	47	197	19	34	62
Jacksonville	41	166	25	17	56
Savannah	41	166	46	38	56
Charleston	41	166	48	41	56
Norfolk	41	137	85	66	56
New York	41	126	93	73	56
Average	*50*	*185*	*48*	*73*	*64*

Table 8: Extra cost when using another port for transshipment of goods coming from Asia to East Coast of US when compared to ports in Panama. Cost is assumed to be $0.17[19] per extra km by sea.

Table 7 gives the extra distance when using another Atlantic port for transshipment of goods coming from Asia to East Coast of US when compared to ports in Panama and Table 8 gives the associated cost. Surprisingly the port of Limon-Moin has the smallest average extra cost[20] followed by Kingston, Cartagena, Freeport (Bahamas) and Caucedo. The results would favor Caucedo for cargo coming in larger vessels from Europe to be distributed to Central America.

Belize

Due to its nature and the size of its operation, the widening of the Canal will have little impact on the Port of Belize. It will continue to use feeder systems to import and export containers to and from Europe and Asia and may develop additional direct connections with the US which is the major trading partner. Trade to Guatemala, El Salvador and Honduras will be cheaper by land if land connectivity and security increases. Consequently, the best strategy for the port of Belize is to focus on enhancing the port efficiency and the length of the berth.

[18] Although the APM concession will initially focus on import and export.
[19] Rates from Asia to US obtained from Korinek & al. (2009) Maritime Transport Costs and Their Impact on Trade, OECD working paper TAD/TC/WP(2009),7, www.etsg.org/ETSG2009/papers/korinek.pdf
[20] Based on distance only.

Costa Rica

The port of Caldera is connected to the global shipping network through feeder lines and that will not change with the widening of the Canal. The port does have plans to increase the depth of the berth to 13m which means it will be able to receive bigger ships. For Caldera, the best option is to continue increasing the efficiency of the port and take advantage of the good land connectivity to the interior of the country for distribution of goods from and to Asia, West Coast of North America and West Coast of Central and Latin America.

The port of Moin-Limon moves nearly 1M TEU to/from the East Coasts of North and South America and Europe. The region will undergo a serious transformation in the coming years with Moin dedicated to cargo and Limon to passenger lines. In addition, APM will also build a new dedicated container terminal (TCM) in Moin with a planned capacity of 2.7 million TEUs when fully built. The primary focus of this port is import/export. But Moin is well positioned as a transshipment hub for bigger vessels that will come through the Canal. It is relatively a short distance off the main maritime route to the North East and can serve all of Central America (both by sea and land if land connectivity is improved) and the Caribbean. But it will have to compete with Cartagena (Colombia), Caucedo (Dominican Republic), Kingston (Jamaica) and ports in Panama which are well established transshipment ports.

Dominican Republic

Caucedo stands to gain from the widening of the Panama Canal with potentially bigger vessels calling at the port both from Asia through the Canal and from Europe down through the Canal. How exactly they will benefit depends on the port discussions with liner services, the added logistics services to be provided and the cost of these services. For instance, consolidation, deconsolidation and other value added operations could be done in the logistics park that is planned next to the port. The port faces competition from Kingston (Jamaica), Freeport (Bahamas), Cartagena (Colombia) and the ports in Panama.

Rio Haina on the other hand has no intention of receiving bigger vessels and is more focused in developing feeder services to the region. A natural strategy would be for these ports to provide integrated service where Caucedo focuses on the global shipping and transshipment operation and Rio Haina focuses on local feeder lines to ports that are not directly reachable by Caucedo. For this service to work, good land connectivity is required for containers to be moved from one port to the other.

El Salvador

At the time of the writing of this report, La Union had lost its only liner service and the port is facing serious economic and structural challenges that make its future uncertain. The port of Acajutla is connected to the global shipping network through feeder lines and this will not change with the widening of the Canal. The port has plans to increase the depth of its berth to 15m and to acquire a Post Panamax crane but these have to be approved. For Acajutla, the best option is to continue increasing the efficiency of the port and take advantage of the good land connectivity to the interior of the region for distribution of goods from and to Asia, West Coast of North America and West Coast of Central and Latin America.

Guatemala

On the Pacific side, expansion at Quetzal, both on the current terminal and TCQ investment could allow Quetzal to become a major consolidation and distribution hub for cargo coming from Asia and the West Coast of North America. This could increase its regional presence on markets such as El Salvador. It would then compete with the port of Balboa.

On the Atlantic side, further improvements at Barrios would allow the port to continue serving the local import and export of specialized cargoes (e.g. bananas or other fruits). For Santo Tomas de Castilla, it could benefit from the possible development of regional transshipment hubs in the Caribbean or coastal areas of Central America as this would increase the frequency of feeder services. Hence the port should continue its effort to improve efficiency and cost. Inability to do this could result in cargo volumes shifting to neighboring competing ports such as Cortes.

Honduras

Currently, none of the ports in Honduras is equipped to handle the larger vessels that can come through the Canal after the expansion project. Puerto Cortes, the larger of the two ports, has Panamax type cranes and can handle fully loaded feeder type vessels of 2500 TEUs and not-fully loaded Panamax vessels. Puerto Castilla has a depth of 12m but does not have cranes and handles only smaller feeder type vessels. None of the ports will be able to handle the larger Post Panamax vessels after the Canal expansion.

Nevertheless, Puerto Cortes could develop to be a key regional player for distribution of cargo, either by land or by sea, coming and going to the East coast of North America and Europe and other Atlantic routes. It has the local sea connectivity but will require improvement in land connectivity, port efficiency and development of feeder systems to the key transshipment hubs (such as Panama or others) after the expansion. It competes with Puerto Santo Tomas de Castilla which has better land connectivity.

The project of a new terminal at Puerto Cortes would strengthen its position as a distribution hub for the region. But it is less likely that this new terminal would be suitable for transshipment of larger vessels coming from Asia as it would have to compete with the ports in Panama, Cartagena (Colombia), Caucedo (Dominican Republic), Kingston (Jamaica) and Freeport (Bahamas).

Nicaragua

The port of Corinto is connected to the global shipping network through feeder lines and this will not change with the expansion of the Canal. It is the only port in Nicaragua and hence for Corinto, the best strategy is to continue to focus on increasing the efficiency of the port so as to attract more trade and increase the number of liner services.

Panama

The ports in Panama have a very significant potential for change as a result of the Panama Canal expansion. The expanded Canal will allow ships to transit up to a capacity of about 12,000 TEUs whereas the current Canal only allows ships of up to about 4,500 TEUs. There is a high potential for big ships from Asia to transit the Canal and then transship via feeder ships to the Caribbean and east coasts of the US, Central America and South America. If only one port evolves as this "mega" hub for transshipment then the cluster of ports on the Atlantic is the most logical location since all the big ships from Asia must pass right by this Panama cluster. If a hub develops to serve only the US east coast then Colombia, Jamaica, Dominican Republic and Freeport, Bahamas are logical competitors to be the mega hub. In order for the Panama cluster to be the mega hub, Panama will need to make significant improvements in the road infrastructure connecting these ports so that they can effectively function as one port.

The Canal expansion could also impact the port of Balboa on the Pacific coast of Panama in a negative way. There are currently two 8000 TEU ships that transship in Balboa each week with a significant portion of their cargo transported by rail to the Atlantic coast for transshipment there. With the expanded Canal, some of this cargo could transit the Canal on big ships and either be transshipped on the Atlantic side or continue on to the east coast of the US without transshipment. At this point, it is not known how much of a decrease this will entail for Balboa and the railroad.

Other improvements for Panama:

- Improve access to Manzanillo, CCT and Colon free zone from freeway.
- Build new road from PSA to Puente Centenario to speed-up transportation to Colon and to Puerto Balboa.
- New legislation to remove monopolistic trucking practices from Panama to Colon.

11. Conclusions and Recommendations

This study examined the current state of the port and land connectivity for Mesoamerica (excluding Colombia and Mexico) and provided valuable insights on the fact that an integrated sea-land intermodal transportation network is crucial for future development of this region. Countries must base their policies and investments on a “supply chain” view of the network with a focus on assuring performance of the major drivers for facilitating trade and the competiveness of the overall chain for the specific needs of the shippers. The major performance drivers for intermodal networks are: geography, infrastructure, network connectivity, transportation costs, movement requirements, shipping dependability, transport and trade regulations. But governments and Shippers are not the only players in the supply chain and a well performing and efficient supply chain requires participation and collaboration of its actors. In addition to government and shippers, the main actors are Carrier, Terminal Operators and Service Providers.

Table 9 gives the impact of each actor on each of the performance drivers. Although government can moderately influence the geography, for example by investing in the Canal expansion as in Panama, it is key to providing the required infrastructure and the legal framework under which the other actors will operate. The shippers create demand and supply and it is the carriers and terminal operators that are really responsible for the efficiency, security and performance of the value chain.

Factor	Government	Carriers	Shippers	Terminal Operators	Service Providers
Geography	Moderate	Very low	Moderate	Moderate	Very low
Infrastructure	Very high	Moderate	Low	High	Very low
Transportation Connectivity	Moderate	Very high	Moderate	High	Moderate
Transportation Cost	High	Very high	Moderate	High	Moderate
Movement Requirements	Low	Moderate	Very high	Moderate	Moderate
Shipping Dependability	Moderate	Very high	Low	Very high	Moderate
Transport & Trade Regulations	Very high	Low	Low	Low	Low

Table 9: Impact of the various actors on the main drivers for intermodal transportation network

According to the 2013 Doing Business report, the average cost to export a container from Latin America and Central America when compared to OECD countries is $240 more and approximately $530 more per container to import. The government should work with the main actors of the supply chain to:

1. Develop policies to accentuate logistics performance reform;
2. Develop a holistic approach to sustainable infrastructure improvement;
3. Focus on reforms to reduce logistics costs;
4. Focus on transportation policy reform;
5. Focus on policy reforms for logistic service capacity development and ease of doing business.

There are a number of initiatives that if successfully undertaken would significantly improve the structure and performance of the regional intermodal network and facilitate greater trade:

6. Each country should develop a coordinating body to oversee both sea and land transport for the country. The intermodal network can only work effectively if the land and sea portions are integrated. The level of integration required is unlikely if critical decisions with regard to land and sea investment and regulations are under the jurisdiction of different government bodies.

7. There is a general need to significantly improve roads between origin/destination points within each country and the logical ports to serve these points. It is often said that the supply chain is only as good as its weakest link and the roads are often this link.

8. There should also be a focus on improving the land links between countries including improving the roads, eliminating delays at land border crossings and improving customs.

9. There should be a strong coordinating body to oversee both sea and land transport for the region, to provide enforcement for treaty agreements regarding truck inspections and backhauls and to improve security for trucks, particularly those from outside the country.

10. The expansion of the Panama Canal will very likely create one or more mega hubs on the Atlantic and it is crucial that countries work with the carriers to develop good connectivity with these hubs.

Lastly, the lack of transportation related data makes it very difficult and time consuming to perform the analytics necessary to facilitate a better intermodal transportation network. Hence there is a critical need for the countries to work together to support an observatory-like structure along the lines being proposed by IDB, to collect and maintain quality data and provide the analytics necessary for all of the stakeholders indicated in Table 9 above to make decisions that benefit themselves as well as the region.

Appendix

Table 10: Summary of port assessment Metrics

Port Statistics						
Description	Caldera	Limon-Moin	Rio Haina	Caucedo	Acajutla	La Union
Port type	Import/Export	Import/Export	Import/Export	Transshipment	Import/Export	Import/Export
Hours of operation	24/7	24/7	24/7	24/7	24/7	24/7
Max ship size (today - CompairData)	Feeder 2,664 TEU	Feeder 2,785 TEU	Feeder 2,122 TEU	Post-Panamax 6,750 TEU	Feeder 2,664 TEU	Feeder 1,900 TEU
Max depth at container berth (m)	11	11.5	10.2	13.5	14	12
Max crane type available	Mobile	Panamax STS	Panamax STS	Super Post Panamax STS	N/A	N/A
IT system	In-house system integrated with Customs (TICA)	In-house system integrated with Customs (TICA)	Navis Sparcs N4	Navis	In-House	In-House
Number of reefer plugs	24	272	150	552	120	96
Number of container liner services calling at port - CompairData	4	20	12	14	5	1
Theoretical max gross port throughput (TEU/year)	588,710	842,124	605,026	1,908,497	180,278	231,843
Reported annual capacity (TEU/year)	450,000	1,120,000	500,000	1,500,000	180,000	215,000
2011 Annual throughput (TEU)	168,039	901,330	318,855	960,000	160,069	3,996
Theoretical max annual liner service TEU capacity	633,741	2,835,146	1,017,755	5,161,322	938,921	156,000
Estimated liner service capacity utilization	27%	32%	31%	19%	17%	3%
Berth						
Length of berth available for container operations (m)	490	710	964	922	1243	580
Average berth utilization (%)	83	70	57	64	56	7
Annual throughput per meter of berth (TEUs/m)	343	1,269	330	1,041	128.78	6.89
Max crane productivity (moves/h)	25	25	25	30	N/A	N/A
Theoretical max crane capacity (TEU/year)	219,000	219,000	657,000	1,839,600	N/A	N/A
Yard						
Yard area (ha)	4.2	4.2	20.0	50.0	4.9	9.4
Total yard storage capacity (TEU)	4,000	3,530	12,500	40,000	4,218	4,116
Total yard space utilization (TEUs/ha)	952	840	625	800	859	438
Average dwell time of containers at port (days)	2.5	1.5	7.5	7.7	7.5	6.5
Loaded container stacking blocks (WxH)	8x5	4X3	6x3	6x5	1x3	6x5
Vessel times						
Average number of container vessel serviced per day	1.0	4.0	2.3	3.0	1.6	0.1
Average vessel size (TEUs)	1,200	1,250	1,200	3,500	1,806	1,500
Vessel turnaround time - total time at port (h)	28	25.9	16.4	27.7	32.9	21.1
Percentage productive time at berth (%)	43	48	82	66	78	46
Average time off the berth - e.g. at anchor (h)	14	8.8	0	8	7.4	2.1
Average Vessel productivity in 2011 (TEU/h)	38	50	21.7	48.35	39.4	N/A
Average truck turnaround time						
Pickup (min)	30	60	55	30	40	12
Drop-off (min)	30	60	15	62	40	12
Drop-off and pickup of a container (mins)	30	90	90	82	45	6.5
Accessibility						
Total number of trucks in and out of gate	216	1500	616	730	520	24
Connectivity to hinterland	Good	Limiting	Good	Excellent	Good	Adequate
Security and Governance						
Certifications	ISPS, ISO 9001, 14001, BASC	ISPS	ISPS, C-TPAT, BASC, ISO 9001	C-TPAT, BASC, ISO/PAS 28000	ISPS, IMDG, MARPOL, FAL65	ISPS

Port Statistics						
Description	Corinto	Castilla	Cortes	Santo Tomas de Castilla	Barrios	Quetzal
Port type	Import/Export	Import/Export	Import/Export	Import/Export	Import/Export	Import/Export
Hours of operation	24/7	24/7	24/7	24/7	24/7	24/7
Max ship size (today - CompairData)	Feeder 2,664 TEU	Feeder 2,046 TEU	Feeder 2,490 TEU	Feeder 2,456 TEU	Feeder 2,490 TEU	Feeder 2,758 TEU
Max depth at container berth (m)	11.5	12	11	9.8	9.5	11
Max crane type available	Panamax STS (non certified)	N/A	Panamax	Mobile	N/A	Mobile
IT system	In-House	In-house based on AS400	In-house based on AS400	In-house	In-house based on AS 400	In-house
Number of reefer plugs	28	300	160	782	589	60
Number of container liner services calling at port - CompairData	4	2	20	17	6	8
Theoretical max gross port throughput (TEU/year)	87,600	1,275,109	2,436,650	547,500	955,140	599,739
Reported annual capacity (TEU/year)	240,000	120,000	620,000	N/A	323,000	300,000
2011 Annual throughput (TEU)	80,119	85,892	576,752	510,952	314,288	363,684
Theoretical max annual liner service TEU capacity	782,886	305,344	2,383,390	1,801,694	841,481	1,410,323
Estimated liner service capacity utilization	10%	28%	24%	28%	37%	26%
Berth						
Length of berth available for container operations (m)	610	225	800	915	505.00	810
Average berth utilization (%)	54	50	60	53	56	N/A
Annual throughput per meter of berth (TEUs/m)	131	399	721	558	622.35	449
Max crane productivity (moves/h)	22	N/A	30	25	N/A	22
Theoretical max crane capacity (TEU/year)	192,720	N/A	1,024,920	1,095,000	N/A	963,600
Yard						
Yard area (ha)	2.3	3.8	19.8	22.0	4.7	4.8
Total yard storage capacity (TEU)	1,800	16,000	32,845	7,500	5,600	12,537
Total yard space utilization (TEUs/ha)	783	4,167	1,659	341	1,191	2,623
Average dwell time of containers at port (days)	7.5	4.6	4.9	5.0	2.1	7.6
Loaded container stacking blocks (WxH)	5x4	15x3	10x3	1x2	8x4	N/A
Vessel times						
Average number of container vessel serviced per day	0.4	0.5	3.6	3.0	2.0	1.1
Average vessel size (TEUs)	1,882	2,200	1,600	1,326	1,100	1,793
Vessel turnaround time - total time at port (h)	38	12.5	37	17	28.0	N/A
Percentage productive time at berth (%)	84	91	77	86	88	N/A
Average time off the berth - e.g. at anchor (h)	1.5	0.5	10	1	1.30	N/A
Average Vessel productivity in 2011 (TEU/h)	10.86	12.31	23.24	38.9	20.50	N/A
Average truck turnaround time						
Pickup (min)	25	20	60	11.5	30	25
Drop-off (min)	240	30	30	9.3	31	25
Drop-off and pickup of a container (mins)	300	30	60	21.2	41	N/A
Accessibility						
Total number of trucks in and out of gate	408	600	731	652	314	N/A
Connectivity to hinterland	Adequate	Limiting	Good	Limiting	Limiting	Good
Security and Governance						
Certifications	ISPS, FAL65, RSI	ISPS, CSI	ISPS, CSI	BASC, ISPS, ISO 28000	ISPS, OHSAS, C-TPAT	BASC, ISPS, OHSAS, IQNet, ISO 28000, ISO 14001, NFPA

Port Statistics						
Description	Belize City	PSA Panama (PPIT)	Manzanillo (MIT)	Colon (CCT)	Balboa	Cristobal
Port type	Import/Export	Transshipment	Transshipment	Transshipment	Transshipment	Transshipment
Hours of operation	24/7	24/7	24/7	24/7	24/7	24/7
Max ship size (today - CompairData)	Small feeder 660 TEU	Panamax 5,762 TEU	Panamax 5,100 TEU	Panamax 5,090 TEU	Post-Panamax 9,200 TEU	Panamax 5,301
Max depth at container berth (m)	9	14.5	14	15	17	15.85
Max crane type available	Mobile	Panamax STS	Super Post-Panamax STS	Super Post-Panamax STS	Super Post-Panamax STS	Post-Panamax STS
IT system	In-House	N/A	TIDEWORKS	N/A	In-House	In-House
Number of reefer plugs	22	360	1,523	984	2,184	722
Number of container liner services calling at port - CompairData	2	1	31	7	21	10
Theoretical max gross port throughput (TEU/year)	197,966	248,916	2,547,178	N/A	2,756,643	N/A
Reported annual capacity (TEU/year)	N/A	450,000	2,200,000	1,500,000	3,750,000	1,000,000
2011 Annual throughput (TEU)	34,960	53,460	1,899,999	491,069	3,232,265	980,738
Theoretical max annual liner service TEU capacity	125,151	579,375	8,308,143	1,738,152	9,700,347	3,127,002
Estimated liner service capacity utilization	28%	9%	23%	28%	33%	31%
Berth						
Length of berth available for container operations (m)	67	330	1,640	982	1714	1002
Average berth utilization (%)	25	15	60	N/A	60	30
Annual throughput per meter of berth (TEUs/m)	522	162	1,159	500	1,886	979
Max crane productivity (moves/h)	16	28	32	N/A	30	30
Theoretical max crane capacity (TEU/year)	280,320	735,840	4,765,440	N/A	5,396,160	2,242,560
Yard						
Yard area (ha)	1.5	10.0	52.0	27.8	30.0	16.0
Total yard storage capacity (TEU)	3,200	6,465	48,000	45,000	54,000	19,870
Total yard space utilization (TEUs/ha)	2,119	647	923	1,619	1,800	1,242
Average dwell time of containers at port (days)	5.9	9.5	6.9	N/A	7.2	N/A
Loaded container stacking blocks (WxH)	2x3	6x5	6x5	N/A	6x5	6x4
Vessel times						
Average number of container vessel serviced per day	0.6	0.1	6.1	1.0	5.0	3.0
Average vessel size (TEUs)	660	5,571	2,500	2,429	3,400	2,448
Vessel turnaround time - total time at port (h)	12	13.5	16.93	N/A	23.9	14.0
Percentage productive time at berth (%)	92	81	70	N/A	N/A	N/A
Average time off the berth - e.g. at anchor (h)	0	4	N/A	N/A	1.40	1.00
Average Vessel productivity in 2011 (TEU/h)	15.20	22.5	72.15	N/A	N/A	N/A
Average truck turnaround time						
Pickup (min)	30	10	26.7	N/A	20	35
Drop-off (min)	40	10	26.7	N/A	90	20
Drop-off and pickup of a container (mins)	55	15	N/A	N/A	110	45
Accessibility						
Total number of trucks in and out of gate	78	N/A	893	N/A	600	255
Connectivity to hinterland	Limiting	Adequate	Adequate	Adequate	Good	Adequate
Security and Governance						
Certifications	ISPS	ISPS	BASC, C-TPAT, ISPS, SCIA, CSI	BASC, ISPS, ISO 9001	ISPS, CSI, BASC, C-TPAT	ISPS, CSI, BASC, C-TPAT