Asia-Pacific
Economic Cooperation

Promotion of Regional Economic Integration by Developing APEC Gateway Port Connectivity

Transportation Working Group

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Glossary

2M	A shipping alliance, comprising Maersk and MSC
3PL	A company that provides third party logistics
ASEAN	Association of Southeast Asian Nations. Member states include: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Viet Nam
BCO	Beneficial Cargo Owner - the party to whom goods are shipped and delivered (also called “consignee”)
CAGR	Compound Annual Growth Rate
EBITDA	Earnings Before Interest, Taxes, Depreciation and Amortization
HPH	Hutchison Port Holdings. An international terminal operator.
ICTSI	International Container Terminal Services Inc. An international terminal operator.
IE	Import/export cargo, also known as direct cargo
ITT	Inter-terminal transfer
KPI	Key performance indicator
NGCP	Next Generation Container port, located at Tuas in Singapore
O3	Ocean Three. A shipping alliance comprising CMA CGM, China Shipping, and UASC.
OD	Origin-Destination (cargo), sometimes also known as direct cargo, or import/export (IE) cargo
PRD	Pearl River Delta
TEU	Twenty-foot Equivalent Unit. A common measure of number of standard 20-foot-long containers
TS	Transshipment
UNCTAD	United Nations Conference on Trade and Development
YRD	Yangtze River Delta

APEC Member Economies Abbreviations

AUS	Australia
BD	Brunei Darussalam
CDA	Canada
CHL	Chile
PRC	People’s Republic of China
HKC	Hong Kong, China
INA	Indonesia
JPN	Japan
ROK	Republic of Korea
MAS	Malaysia

MEX	Mexico
NZ	New Zealand
PNG	Papua New Guinea
PE	Peru
PHL	The Republic of the Philippines
SGP	Singapore
CT	Chinese Taipei
THA	Thailand
USA	United States
VN	Viet Nam

Executive Summary

This Final Report for the study on the Promotion of Regional Economic Integration by Developing APEC Gateway Port Connectivity ("The Study") was prepared by ICF Consulting Services Limited Hong Kong (ICF, 'the Consultants') for the Asia Pacific Economic Cooperation (APEC) Transportation Working Group (TPT-WG).

Maritime transport is the most important transportation mode in supporting global trade, especially since the rise and expansion of containerization. According to the International Chamber of Shipping, over 90% of global trade by weight is carried by maritime transport. Given their proximity to major shipping lanes, urban population centers and major manufacturing centers, ports in the Asia-Pacific region are well connected and some of the biggest port terminals are in the Asia-Pacific Region. The performance of APEC's ports and terminals is therefore a direct driver of the competitiveness of the APEC economies.

This Study provides information on the underlying drivers of gateway port functions, and how such functions of a port can facilitate trade and promote economic growth. The best practices and development trends of gateway ports are reviewed, and their success factors and challenges are identified. Tools and indices to measure gateway port performance are discussed, and this discussion contributes to the recommendations of technical and political recommendations of developing gateway port functions.

Key Findings

The Study's key findings are based on analysis from desktop and literature research on 10 selected ports within the APEC region, consultations with industry stakeholders (port authorities and regulators, container terminal operators, beneficial cargo owners, freight forwarders / 3PLs, and researchers), and a stakeholder workshop held in Kuala Lumpur, Malaysia in September 2016.

Table ES1.1 Ports Selected for Review

Economy	Port	2015 TEU ('000)
North America		
Canada	Prince Rupert	776
Canada	Vancouver	3,054
USA	Long Beach	7,192
East Asia		
China	Nansha, Guangzhou(1)	11,770
China	Shanghai	36,537
Hong Kong, China	Hong Kong Port	20,073
Chinese Taipei	Kaohsiung	10,264
Southeast Asia		
Malaysia	Westports, Klang(2)	9,053
Singapore	Singapore	30,900
Viet Nam	CMIT, Cai Mep (3)	725

Notes: 2015 throughputs: (1) Guangzhou Port: 17.59 million TEU; (2) Port Klang: 11.89 million TEU; Port of Tanjung Pelepas: 9.16 million TEU; (3) Cai Mep / Thi Vai area: 1.47 million TEU.

1) Container Port Functions

Most container ports usually undertake three functions:

- **Gateway function** – moving cargo between the hinterland and the ultimate destination ports, the latter usually located overseas. The hinterland-port movement is referred to "inland connectivity", and can involve trucking, rail, and/or barging, depending on the geography of the port. Hinterland is usually defined as the land area within 250 km from the port.
- **Relay transshipment function** – interchange of containers between mainline / deep-sea / long-haul liner services. The volumes are not captive to a specific region of geography, and can be performed almost anywhere along the primary shipping route.
- **Hub-and-spoke transshipment function** – interchange of cargo between mainline vessels and feeder services. The feeder legs are usually captive to a specific region and narrow geography.

This Study focuses on the ports performing the gateway function, but it is acknowledged that other transshipment functions are also an integral part of some of the world's leading ports in the APEC region.

2) Global Trends in the Shipping Industry

In the near term global trade will continue to grow, but likely at a slower rate than in the last two decades. Within the largest trading partners in the world, China's import and export growth rates have slowed down significantly, and Europe and USA are facing an uncertain economic outlook due to Brexit and the outcome of the US Presidential Election. Subdued growth in the volumes of import/export containers between the major economies are expected in the near term.

3) Container Vessels are Getting Ever Larger

Shipping lines are introducing larger vessels with the intention of reducing unit costs by achieving economies of scale. Some shipping lines order mega vessels in order to gain or protect market share. As a result, the average size of container vessels has grown across all trade lanes: the largest vessels are typically deployed in the Far East – Europe trade, and the vessels freed up on this trade lane have been deployed into other trade lanes, growing the average vessel sizes across the board due to the "cascading effect".

Despite a rapid increase in the average ship size per trade in the past 3-5 years, mega vessels are unlikely to continue to grow much further in light of general overcapacity, slowing volume growth, and technical challenges in building and operating the next generation of even larger vessels. Shipping lines will likely focus much of their new investment on the Neo-Panamax class of ships (10,000-13,000 TEU), which has better flexibility in terms of deployment for many trade lanes.

Container terminals looking to service the larger vessels will need adequate quay lengths, required water depth alongside the quay and along the approach channel, suitable turning basin diameter, sufficient container yard area, and the superstructure necessary to handle the vessels and deliver the required productivity.

4) Panama Canal Reopening

The Panama Canal was reopened in mid-2016 with an additional lane and wider locks, and now allows for more and larger vessels up to 13,000 TEUs. It has significantly improved the connectivity between the Pacific and Atlantic Oceans.

However, the combination of freight rate and transit time of the alternative routing via the Panama Canal does not favor a cargo owner choosing the all-water route for North American Midwest-bound cargo. Hence, the Panama Canal is not expected to bring about significant shifts in port throughput over the short term. However, the US ports, especially those on the West Coast, will still need to prepare for the larger vessels.

5) Mega Alliance and Shipping Line Consolidation

As shipping lines have been ordering ever larger vessels, many shipping lines are unable to fully utilize their capacities on their own account. As a result, new operating alliances and vessel sharing agreements have been formed between carriers to defray the risk of introducing larger vessels in subdued demand conditions. Moreover, by forming alliances, carriers are better placed to secure a sufficient number of vessels of similar size to offer a fixed schedule. Today, the alliances account for 93% of total weekly TEU capacity on the Far East – North America trade.

Nonetheless, the current form of mega alliances is still subject to change. New alliances are being formed in April 2017 and shipping lines (members of the alliances) are being replaced and reshuffled among alliances, merged and acquired by each other (e.g. CMA CGM – NOL and its subsidiary APL, COSCO – China Shipping, Hapag-Lloyd - UASC), are forming joint operations (e.g. NYK – MOL – K-Line), or are declaring bankruptcy (e.g. Hanjin). In addition, the alliances may not deliver the expected level of cost reduction to the participating shipping lines.

6) Positioning of Terminal Operators, and Implications on Profitability

For commercially focused terminal operators, the key challenge is to meet customer service requirements at minimum cost. In other words, their goal is to deliver customer productivity KPIs (e.g. Berth Productivity) whilst also maintaining high utilization at the terminal. Conversely, state-backed or subsidized ports or operators may compete with less regard to financial returns, albeit the long-term sustainability of such a strategy has to be questionable.

Terminal operators need to make the necessary investments to provide the adequate infrastructure and superstructure and to deliver the capacity at the port and productivity required by the customers. A port servicing mainly gateway cargo can base their decisions largely on the expected volume of hinterland cargo it will handle, and the profile of vessels that will be calling at the port to load / unload the cargo. The introduction of larger vessels and the major alliances mean that terminals' investment requirements are increasing.

However, gateway ports enjoy some risk minimisation, especially in the absence of other competitor gateway ports, as their hinterland cargo provides a major incentive for shipping lines and direct services to call at them. However, some terminal operators may position themselves to also handle transshipment cargo. Transshipment containers can quickly increase throughput levels (each container is counted twice as it is lifted / unlifted from the vessel), but the per TEU revenue is typically lower, hence diluting the overall profitability.

7) Economic Impacts of Gateway Cargo

Port regulators / authorities may also consider the economic impacts of the ports by cargo type when developing a port terminal. More sectors are involved in moving gateway hinterland cargo than transshipment cargo – for instance, hinterland cargo involves the road freight haulage and warehousing industries, and possibly railway and barging, but transshipment handling does not involve these sectors. Hence, each TEU of hinterland cargo generates more economic impacts (broadly defined by the expenditure in local economic by the sectors directly or indirectly involved in providing the relevant services), as compared to transshipment cargo.

Nonetheless, the per unit economic impacts must not be confused with the total economic impacts. Transshipment cargo generates positive economic impacts as well, and these are entirely additional for a port. Moreover, there are other benefits of handling transshipment cargo: the increased connectivity and choice of services for importers and exporters at the transshipment port that would otherwise not exist. These benefits are however difficult to quantify by conventional economic impact analysis.

Common Success Drivers and Challenges of Gateway Ports

Based on the observation and analysis of ports selected, some common success drivers and challenges have been identified as follows.

1) Strategic Location and Hinterland

Location is one of the most important factors that determines the success of a Gateway port. This means a successful Gateway port needs to:

- Support a robust hinterland with base cargo nearby; and
- Be located along a major trade lane.

Base load cargo plus a hinterland takes priority when shipping line companies decide which port to call. There are nonetheless exceptions, for example, if the port is strategically located as the preferred list of ports on the trans-Pacific trade route and is connected by railway to a large hinterland (e.g. Prince Rupert). While ports without the support of a large hinterland can also develop high volumes (e.g. Singapore), these ports are generally viewed as transshipment ports.

2) Inland Connectivity

There are two types of inland connectivity: connections between the port and the hinterland, and the "last mile" connectivity.

Connectivity between the port and its hinterland is critical to functioning successfully as a gateway port. Without proper connectivity, the capability to move cargo to/from the hinterland will be severely limited, undermining the port's competitiveness. Highway is the most typical mode to move cargo between the hinterland and the port, but railway is the more efficient mode over longer distances (say 250 km or more). As a result, some ports are not connected to a freight rail system if their major hinterland is less than 250 km from the port. Barging is another popular and low cost option for inland connectivity, but is clearly only available at ports next to a river or coastal network.

The "last mile" connectivity leading from the common sections of the highway / railway to the port boundary is one of the most easily neglected links in a port's connectivity. It often involves the interface of different road / rail systems that are under the jurisdiction of different government departments and stakeholders and, as a result, it can easily become a bottleneck in achieving good gateway port connectivity. The cause of bottlenecks can be either physical (inadequate infrastructure) or institutional (miscommunication, new procedures, or incapacity to streamline the documentation processes).

3) Port Infrastructure

An efficient port needs to provide the necessary infrastructure and adequate capacity to handle both the port's current throughput and its potential future business. Flexibility for future expansion will also make the facility attractive for longer term investment by the private sector.

These considerations must, however, be reviewed against the overall cargo profile by type, projected demand, and vessel profile. Smaller gateway ports without large amounts of base load cargo can be serviced more efficiently by smaller vessels, and therefore need not necessarily invest to accommodate larger vessels. However, it is also possible that the shipping lines may seek to deploy a large vessel to a port because it also calls at other large ports on the same service.

4) Institutional – Government Planning, Industry and Community Support, and Evaluation Tools

Strong institutions supported by stakeholders from across industries and the local communities are essential, and must be included / considered for effective planning, development, and operation of gateway ports. Local engagement with stakeholders starting from an early stage of port planning is therefore important to ensure that the port is designed to deliver services that meet the users' demand while respecting the local communities.

When initial consensus cannot be reached on particular issues, policy makers can deploy tools such as economic / social / environmental impact assessments to help evaluate the pros and cons of different port development options. These methods are deemed scientific, and it is typically easier to achieve buy in from stakeholders when they are part of those assessments.

Measuring and Monitoring Gateway Port Connectivity

A major port today requires multiple development inputs and near real-time performance indicators and business intelligence to have a good understanding of their own and competitors' operations in order to make better and informed decisions and to achieve and maintain the status of a major gateway port. These inputs can be categorised into physical connectivity indicators (e.g. connectivity inland, at port, and between ports) and non-physical connectivity indicators (e.g. institutional and capital capability).

Physical connectivity indicators of a gateway port can be broadly grouped into three components:

- Marine connectivity – how the port is connected to other ports

  These indicators are standard and are easy to measure. However, they do not explain the causality (or lack of) between marine connectivity and other factors (e.g. cargo volume). In addition, the performance of many of these indicators are beyond the control of the port (port regulator or terminal operator). A terminal operator can react to marine side connectivity, but it can hardly proactively change it; it is the liner company's private business decision which vessels of what capacity to call at certain ports and at which frequency.

- "At port" connectivity – how much cargo the port can handle over a period of time (capacity), how quickly the cargo is handled (productivity), and how costly it is to handle the cargo (efficiency)

  Although this "at port" connectivity only accounts for a relatively small portion over the whole supply chain, its significance should not be undermined as "a port can only be as strong as its weakest link". This is probably where the port authorities and terminal operators have the most control and make the largest contributions to connectivity enhancement.

- Inland connectivity – how the port is connected to the hinterland, or how efficiently the cargo can be moved between the hinterland and the port

  The measurement of inland connectivity is considered the most challenging of the three physical connectivity components. Options for inland transportation are hugely dependent on a number of factors such as the geography of the region, location of the port's hinterland, and the market structure of the hinterland. It would be difficult to derive standards applicable at all ports.

Non-physical components of gateway port connectivity are difficult to quantify and qualify. Examples include level of government support, role of government in trade facilitation, cabotage content and implications, existence of a strong freight forwarding community, etc. It is difficult to apply a uniform standard to measure these components, but they are nevertheless important factors underlying a port's performance.

Existing Methods and Issues

Some indices, such as the Liner Shipping Connectivity Index (LSCI) and the Liner Shipping Bilateral Connectivity Index (LSBCI), both developed by the United Nations Conference on Trade and Development (UNCTAD), have been developed to measure port connectivity. While these indices can capture how well economies are connected, they do not distinguish the performance among ports within the same economy / economy pair. Moreover, inland connectivity – one of the key components determining overall port performance – is not measured by these indices.

Practicality of a Comprehensive Connectivity Index

If a gateway port connectivity index is to be developed to fill the gap of the existing indices, the following issues will need to be addressed and clarified:

- purpose and application of the index;
- identity of the index developer;
- primary target users of the index;
- components / activities to be covered, the rationale and approach to measure these components, and the methodology to compile an index comprising these components;
- frequency to update the index, and responsibilities to update;

For example, applying one approach to measure inland connectivity is a challenge, given that the geography and local economic structure of each port is unique. Balancing interests among stakeholders from various economies and economic sectors would be another challenge.

There is no short cut to the answers to the above issues; instead consensus should be sought after rounds of discussions with various stakeholders.

Technical and Policy Recommendations

Common Lessons

Inland connectivity between the hinterland and the port is critical. Good infrastructure planning and implementation can remove potential bottlenecks along the supply chain. While infrastructure planning is traditionally undertaken by the government, the private sector can also participate through procurement models or other public-private-partnership (PPP) initiatives. A properly designed and implemented PPP project can improve cost and operational efficiency, and allocate risks to the parties that are best placed to manage them.

The "last mile" connectivity, or connection between the port gate and the main arterial roads, can be problematic for ports, and issues in this component can be either physical or institutional. Improved communication and coordination between stakeholders is a major first step to solving many of the last mile connectivity issues. Information sharing on common platforms, and streamlining documentation requirements can also be possible solutions to the "last mile" bottleneck. Online documentation, or an "inland port" where documentations customs clearance are done at a more spacious and better designed location before moving via a "green lane" to the port for loading, can also be another solution.

Base load cargo is essential to ensure sustainable demand for a gateway port. Without a hinterland of base load cargo, gateway demand does not exist. A successful gateway port is not constructed on the "build it and the demand will come" mentality; the gateway port function facilitates cargo movement, but only when the base load cargo already exists.

The **government's involvement** in a port varies among APEC economies, but in general the government should at least play the following roles:

- To facilitate and coordinate port development;
- To ensure level playing field;
- To ensure consistent regulations and internationally accepted concession requirements;
- To ensure stakeholders are engaged and informed; and finally
- Comprehensive and holistic planning is important, but requires appropriate execution.

Process of port planning – it was generally agreed that stakeholders representing various sections along the supply chain need to be consulted to understand actual developments in their industry and their requests. Tools to help decisions makers evaluate various options include: engineering feasibility, financial viability, economic impact assessment, environmental impact assessment, and social impact assessment. These tools can help evaluate whether the development options are technically feasible; the relative costs involved and benefits expected to yield in each options; and the possible economic, financial, social, and environmental impacts of each option. If no one option stands out in all evaluation criteria, the decision maker will need to apply discretion in selecting the best development option.

Priorities of Port Development

A port involves many stakeholders, all of whom have different development preferences, objectives, and agenda. It is important that these priorities are considered and prioritized appropriately.

Profit vs throughput volume – the private port operator aims to maximize profits; however for the public sector, profit maximization is not necessarily their highest priority. This issue could arise when the public sector and the port have different views on whether it should focus on its gateway port functions or transshipment functions.

Who benefits, and who pays – port development involves substantial investment. In a typical port development project, the government pays for the basic infrastructure, and the private operator pays for the port equipment. The agency responsible for port superstructure depends on how the concessionary agreement is drafted. It is possible that some ports receive very strong state support through direct and indirect financial subsidies. The important point is that public finance requires justification. The economic assessment must also be open to the public for review.

Wider economic impacts – development options that seek government funds should include an economic assessment of the development proposals. Without this economic assessment framework in place, there seems to be no common yardstick or objective way to judge the pros and cons of different projects from a domestic perspective and to decide how best to allocate taxpayers' funds, or whether to allocate any funds at all.

Trade facilitation vs customs requirements – when new policies and procures are rolled out, it is recommended that a conservative approach is used – i.e. any changes, if at all, should be clear and transparent, straight forward, gradual, and should not be causing confusion or requiring great learning from the users.

Technical details of the container terminals – gateway ports wishing to compete for the larger vessels and specifically the mega-vessels (+18,000 TEU and above) must invest in and deliver the necessary infrastructure and services to accommodate and service these vessels. For commercially focused terminal operators, the key challenge is to meet customer service requirements at minimum cost. However, ports will need to evaluate the expected cargo volume and vessel profile – what is the likely volume and vessel size to be handled? It may be possible that a much smaller scale of investment could deliver the capacity and productivity required at the port, hence saving substantial capital and operating costs.

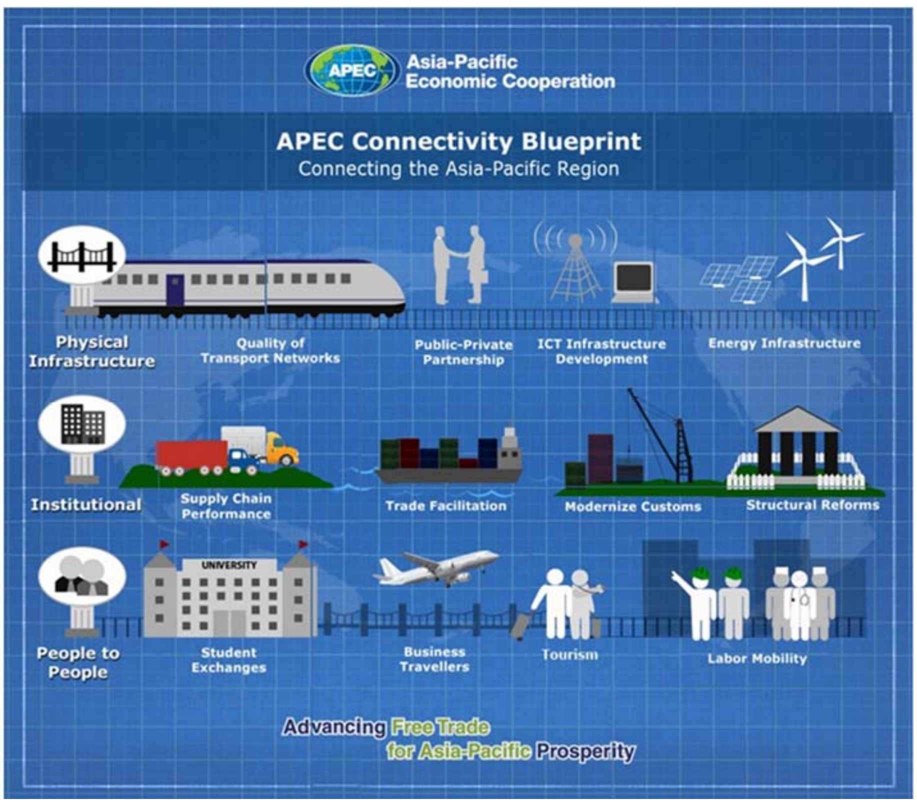
1 Introduction

This Final Report for the study on the Promotion of Regional Economic Integration by Developing APEC Gateway Port Connectivity ("The Study") was prepared by ICF Consulting Services Hong Kong Limited (ICF, 'the Consultants') for the Asia Pacific Economic Cooperation (APEC) Transportation Working Group (TPT-WG).

1.1 Study Background

APEC is a regional economic forum established in 1989 to leverage the growing interdependence of the Asia-Pacific Region. APEC's 21 members aim to create greater prosperity for the people of the region by promoting balanced, inclusive, sustainable, innovative, and secured growth and by accelerating regional economic integration. One of the key drivers to achieve APEC's agenda is the 1994 Bogor Goals, which aim for free / open trade and investment in the Asia-Pacific region. APEC Leaders also aspire to achieve a seamless and integrated Asia Pacific Region through improved connectivity. In 2014, APEC Leaders adopted the *APEC Connectivity Blueprint 2015-2025* to guide its work to achieve connectivity under three distinct pillars: Physical Connectivity, Institutional Connectivity, and People to People Connectivity.

Figure 1.1 APEC Connectivity Blueprint Infographic



Source: APEC

A well connected, efficient, and safe transportation system is a critical component of APEC's Physical Connectivity pillar, as it directly supports the flows of goods and people regionally and internationally across such a geographically diverse area as the APEC region. The APEC Transportation Working Group (TPT-WG) is the forum responsible for addressing the issues and challenges involved with creating a seamless and integrated transportation system across all transport modes by land, sea, and air.

Maritime transport is the most important transportation mode in supporting global trade, especially since the rise and expansion of containerization. According to the International Chamber of Shipping, over 90% of global trade by weight is carried by maritime transport. Given their proximity to major shipping lanes, urban population centers and major manufacturing centers, ports in the Asia-Pacific region are well connected and some of the biggest port terminals are in the Asia-Pacific Region. The performance of APEC's ports and terminals is therefore a direct driver of the competitiveness of the APEC economies.

A well connected transportation system also depends on the availability and quality of road and rail modes to facilitate multimodal and intermodal connectivity with the maritime mode in order to bring trade to and from the hinterland beyond the coastal area. A well-integrated land and maritime system provides shippers and manufacturers better and more affordable access to international markets and improves business competitiveness.

1.2 Study Objectives

The purpose of the Study is to provide information to APEC TPT-WG members on the underlying drivers of gateway port functions and the ports' ability to facilitate trade and to promote economic growth. Specifically, the goal is to understand how to establish a successful and efficient network of gateway ports in the APEC region, the intermodal connectivity and supply chain logistics required between seaborne transport, and the intermodal connectivity required to the gateway ports' hinterland via supply chain logistics. This study is specifically focused on container port terminals.

There are five main objectives of the Study:

- Increase APEC economies' understanding and awareness of Gateway ports in the APEC region to better appreciate Gateway ports' function and their importance in promoting economic integration;
- Review and share the best practices regarding development trends of Gateway ports;
- Identify key success factors and challenges that influence and enhance Gateway port connectivity;
- Assess tools and indices that can be used to monitor levels of Gateway port connectivity; and,
- Provide technical and policy recommendations on Gateway port development.

The deliverables and objectives of each milestone stage of the Study are summarised in Table 1.1 below.

Table 1.1 Project Timeline of Major Deliverables

Milestone	Deliverable	Summary
Step 1: Data Collection	Technical Memorandum #1 Data Collection	■ Identify leading ports and intermodal stakeholders in the APEC region; ■ Conduct stakeholder consultations (email / phone); ■ Undertake literature research: robust definition of a "Gateway" port; ■ Collect information on current development plans and connections of APEC ports; ■ Summarise common characteristics and best practices of establishing Gateway port connectivity; and ■ Review existing tools to measure and monitor supply chain and maritime trade connectivity.
Step 2: Data Analysis	Technical Memorandum #2 Data Analysis	■ Develop an inventory of issues, trends, and success factors for Gateway Port development from the survey results and literature review; ■ Review monitoring tools for the APEC region, similar to the UNCTAD Liner Shipping Connectivity Index currently in place; and ■ Develop preliminary technical and policy recommendations on establishing a well-connected Gateway Port.
Step 3: Workshop	2016 Workshop with APEC Economies	■ Prepare workshop program, material and preliminary study findings; ■ Organize workshop venue and logistics details;
	Workshop Summary	■ Review stakeholders' comments and key takeaways from the workshop in addition to further data analysis.
Step 4: Final Report and Research Paper	Draft Report Submission	■ Prepare draft report of all findings; ■ Seek TPT-WG members' comments on the report;
	Final Report Submission	■ Revise and finalise report based on feedback;
	Research paper submission	■ Prepare research paper

1.3 Structure of Report

This report follows the structure as shown below:

- Section 2 lays out the approach undertaken for this Study;
- Section 3 summarises the key findings from the Consultants' research;
- Section 4 discusses the issues associated with existing connectivity indices and the feasibility of developing a new one;
- Section 5 provides the Consultants' recommendations to enhance gateway port connectivity; and
- Section 6 details the conclusions of this Study.

1.4 Acknowledgement

The Consultants would like to thank the following persons / parties for their advice and guidance at various stages of the Study:

- APEC TPT-WG, especially the Chairs and members of the Intermodal and ITS Expert Group and the Maritime Expert Group, for their continued support of the study;
- APEC Secretariat for providing support during the study implementation;

- Thomas Kwan from Transport Canada, for acting as the Project Overseer of this Study; liaising between APEC Secretariat, various workshop participants, and the Consultants; and providing valuable research and reporting guidelines throughout the Study;
- Participants at the workshop held on 5 September 2016 (list of attendants provided in Annex 4), for actively sharing their views and experience about port operations and regulations, and their expectations for the Study;
- All stakeholders consulted, including operators and users of the ports selected, for providing frontline experience with the Consultants (consultation list in Annex 2); and
- Dr Jonathan Beard from Arcadis and Dr Venus Lun from the Hong Kong Polytechnic University, for delivering keynote speeches at the workshop.

2 Research Approach

2.1 Definition of Gateway Port Function

In undertaking this study, it has been important to define "gateway port function", as it appears that the interpretation and use of this term varies across different stakeholder groups. The study has reviewed the many definitions of "Gateway Port" amongst the various academic literature and industry understanding, but often there is no single consensus in a common definition.

In the context of this Study, the Consultants have reviewed how most stakeholders worldwide defined port functions by the three main port activities: gateway, relay, and hub, where relay and hub refer to transshipment functions. These three port functions are briefly described below:

- **Gateway function** – refers to activities of a port in a geographical location that requires the substantial utilization of the ships' capacity to transport cargo to and from the economic agglomeration of the port and its *hinterland*. Hinterland is the "natural" catchment area of import and export cargoes that originate or are destined for locations beyond the immediate local market of a port. In today's environment of rail, river and highway connectivity, these hinterlands can reach well into an economy's geography and the hinterland can be common to two or more ports. For example in North Europe, Hamburg, Rotterdam, and Antwerp compete for the same cargo base from a common hinterland within Germany, Austria, Hungary, and beyond.

  Gateway ports have a strong cargo base and are located in close proximity to major shipping lanes. A port's hinterland, for the purpose of the Study, is defined as within 250 km of the port if the port is mainly served by truck, or over 250 km if it is served by rail or barges.

- **Relay function** – refers to one kind of transshipment, involving containers interchanged between mainline / deep-sea / long-haul liner services. Shipping lines do this to create a greater quantity of product and service offerings to their customers, which could only otherwise be achieved through all vessels calling at all ports. Relay port functions usually handle cargo to/from the extremities of a trade-lane, from secondary or tertiary ports. As an example for the Asia-North America trade:

  - Primary ports would include: Port of Tanjung Pelepas (PTP), Singapore, Shenzhen, Ningbo, Shanghai – Los Angeles, Long Beach.
  - Secondary ports would be: Busan, Yokohama/Tokyo, Kobe/Osaka, Bohai, Hong Kong Port, Port Klang, Colombo, Salalah – Oakland, New York / New Jersey, Savannah etc.
  - Tertiary ports would be: Kwangyang, Shimizu, Nagoya, Lianyungang, Laem Chabang, Jakarta – Santos, Seattle / Tacoma, Prince Rupert.

  This function overlaps with the other functions cited. It is not captive to a specific region or geography, but can be performed almost anywhere along the East-West primary shipping route.

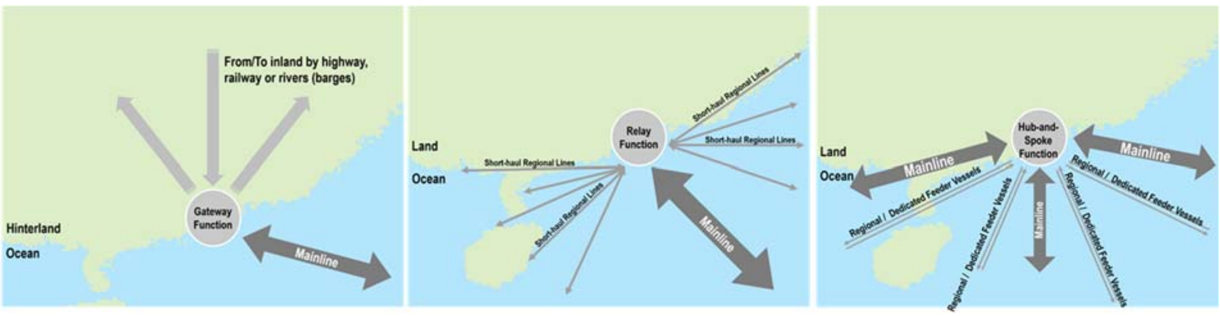
- **Hub-and-spoke function** – refers to the other kind of transshipment, involving containers which interchange between mainline vessels and feeder services. Shipping lines do this to reduce the overall quantity of calls on the larger vessels – vessels which very often are physically too large for the "out-fed" ports. This allows small (demand-wise) hinterlands to be connected globally through hub ports. These volumes are usually captive to a specific region and narrow geography.

  Hub-and-spoke can also be understood as a function at a port that is dedicated to the transfer of containers between mainliners and a network of scheduled regional or dedicated feeder vessels serving the local region or other inter-area mainliner services. Examples are Singapore, PTP in Malaysia, and (to a certain extent) Hong Kong Port.

These three activities are not mutually exclusive within a port. Most ports serve multiple functions, although few only have a single gateway function. An example of the latter is Prince Rupert in Canada, which is a port linked solely to a railroad line for long haul shipment of containers to the hinterland. There are very few local or regional port-supporting activities at Prince Rupert which has a very small local population of about 12,000 people.

Figure 2.1 illustrates these three port functions.

Figure 2.1 Illustration of Port Functions: Gateway (left), Relay (middle), and Hub-and-spoke (right)



Source: ICF

2.2 Research methodology

The research method adopted for this Study includes desktop and literature research, stakeholder consultations, and Consultants' expertise.

2.2.1 Desktop and Literature Research

Desktop and literature research was drawn mainly from statistical databases and publications from the public domain, including the IHS Markit / the Journal of Commerce (JOC), APEC, the Organization for Economic Cooperation and Development (OECD), the United Nations (UN), the World Bank (WB), the World Trade Organization (WTO), various port authorities and government statistical bureau / departments, and academic journals (e.g. HAL, Transportation Research, Journal of Transport Geography, Transport Policy, Journal of the Royal Society).

The research also covered various gateway initiatives proposed by multinational organisations, and governments of various levels. Some of these initiatives have been presented at various APEC working group meetings, in particular presentations by various government representatives on their initiatives to promote port connectivity.

Another important source of literature research was the United Nations Conference on Trade and Development (UNCTAD), which publishes the Liner Shipping Connectivity Index (LSCI) and the Liner Shipping Bilateral Connectivity Index (LSBCI) annually. These databases and information are needed to assess the applicability of similar indices to measure Gateway Port Connectivity in the Asia Pacific Region.

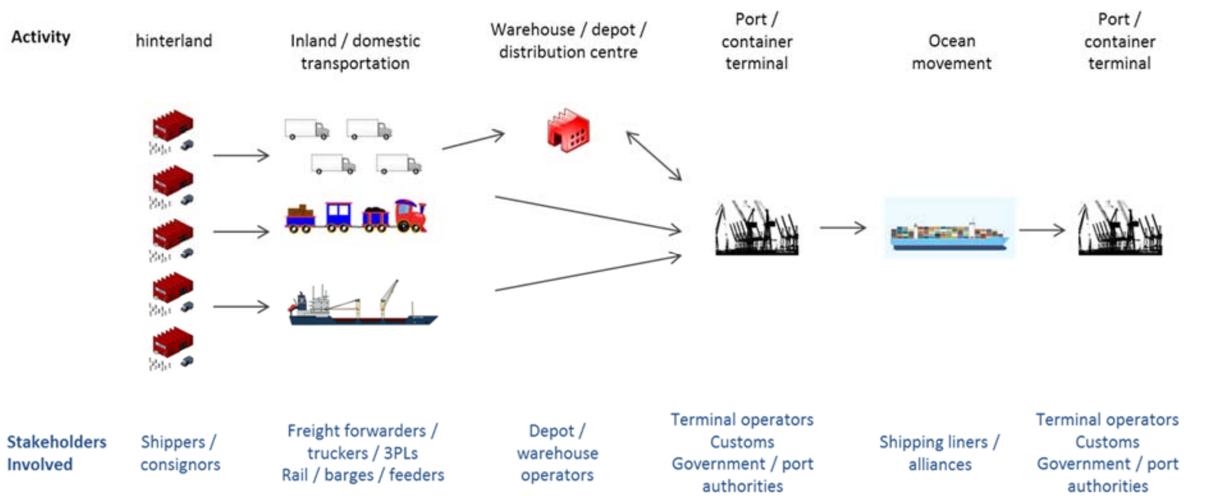
2.2.2 Stakeholder Consultations

Stakeholders representing different sectors of the maritime and port industry were also consulted to verify information collected from desktop and literature research, and to supplement information unavailable from the public domain. Another critical output from stakeholder consultations is the direct port users' expectation of how gateway port connectivity enhancement can promote economic integration, and if (and how) this objective can be measured through a gateway port connectivity index.

2.2.2.1 Roles of Stakeholders along the Supply Chain

A number of stakeholders are involved along this supply chain (Figure 2.2). The roles of these stakeholders are summarized below.

Figure 2.2 Key Stakeholders Involved along the Supply Chain of Typical Container Cargo Movement



Source: ICF

At either end of the supply chain are the **shippers** (consignors) and **consignees**, or **beneficial cargo owners** (**BCO**). While some larger shippers / consignees move their cargo by their own fleet of trucks, most of them hire **third party logistics** (**3PL**) service providers (**freight forwarders / cargo agents / truckers**) to move the containers. Shippers / consignees usually pay the 3PL an overall fee, and the 3PL then decides which port and/or which shipping line to use. For container traffic (as distinct from bulk commodities), the 3PL usually obtains quotations from a number of shipping lines and selects the lowest price consistent with the quality standards required (e.g. time to market). It is usually the shipping line's decision on which port to use, and the related distances from ports to inland origins and destinations based on this port choice cannot be explained solely on the basis of inland distribution costs. Therefore, the preferred port is usually one that costs the 3PL the least (e.g. located closer to the hinterland, port used by a preferred shipping line), or provides them with more profit-making opportunities.

Inland transportation is primarily by **truck** for which there are a number of transportation providers. It may also be undertaken by **rail** or **barges**, especially for longer distance movements. **Coastal feeders** are also another important mode.

At the port, the **Port Authority** and **container terminal operators** (**CTOs**) are key stakeholders. The CTOs charge port users (the shipping lines) for handling cargo and other ancillary services. Port tariffs are regulated and the conditions are set out in the concessionary agreements, although in practice, the tariff adjustment process may differ. In addition to the charges levied by the CTOs, the Port Authority may also collect fees from shipping lines for a variety of services, notably pilotage.

Most **shipping lines** are international companies. Route planning is based on a number of factors, such as volume of base load (i.e. basic volume of hinterland cargo), competitiveness of ports (e.g. tariffs / charges and efficiency) and proximity to major trade lanes. Liners charge shippers / consignees an ocean freightage or freight rate and other surcharges (e.g. fuel or bunker, security). Major cost items facing the liners include terminal costs (specifically the charge for lifting cargo on/ off the vessel), vessel costs, bunker costs, and inland transportation costs.

Finally, the **government** (via various agencies) plays various roles in regulating the industry, promoting the industry, and providing certain services, for example: terms and conditions of concessionary agreements of container terminals (sometimes involving rounds of discussions); endorsement of the design and sometimes implementation of some infrastructure projects (e.g. container terminal layout, breakwater, connecting roads); location, scale, and nature of economic activities; land licensing; tax and tariff collection; policies (e.g. security, cabotage, assignment of certain ports to be the load centre by default). As mentioned above, the government sometimes directly or indirectly subsidises the industry via various mechanisms and projects.

2.2.2.2 Stakeholder Consultation Process

The stakeholders were consulted through (i) face-to-face, phone, or email interviews; and (ii) a workshop held on 5 September 2016. The interviews were conducted on a confidential, non-attributable basis. The categories and names of stakeholder groups consulted is included in Annex 2. A template outlining the questions customized for each stakeholder group was used to guide the discussions (also see Annex 2).

The 5 September workshop reporting the interim findings of this Study was attended by 39 individuals, representing port regulators / authorities, operators, users, and researchers from 11 economies. Breakout sessions and panel discussions were also organized at the workshop, encouraging participants to share their views on gateway port connectivity. This also served to provide valuable inputs to the Consultants' analysis.

A list of the workshop participants is in Annex 4.

2.2.3 Consultants' Expertise

The Consultants also applied their expertise and knowledge of the latest development in the maritime and port industry in analyzing the role and application of gateway port connectivity, bringing unique value added as it is combined with the findings from desktop and literature research, and stakeholder consultations.

2.3 Port Terminal Profile

The study includes a detailed profile of 10 port terminals within the APEC region (Table 2.1, Figure 2.3) to better understand the effect of developing / operating the port facility and achieving gateway port connectivity. The selection of ports strives to cover ports of various sizes with a gateway port function:

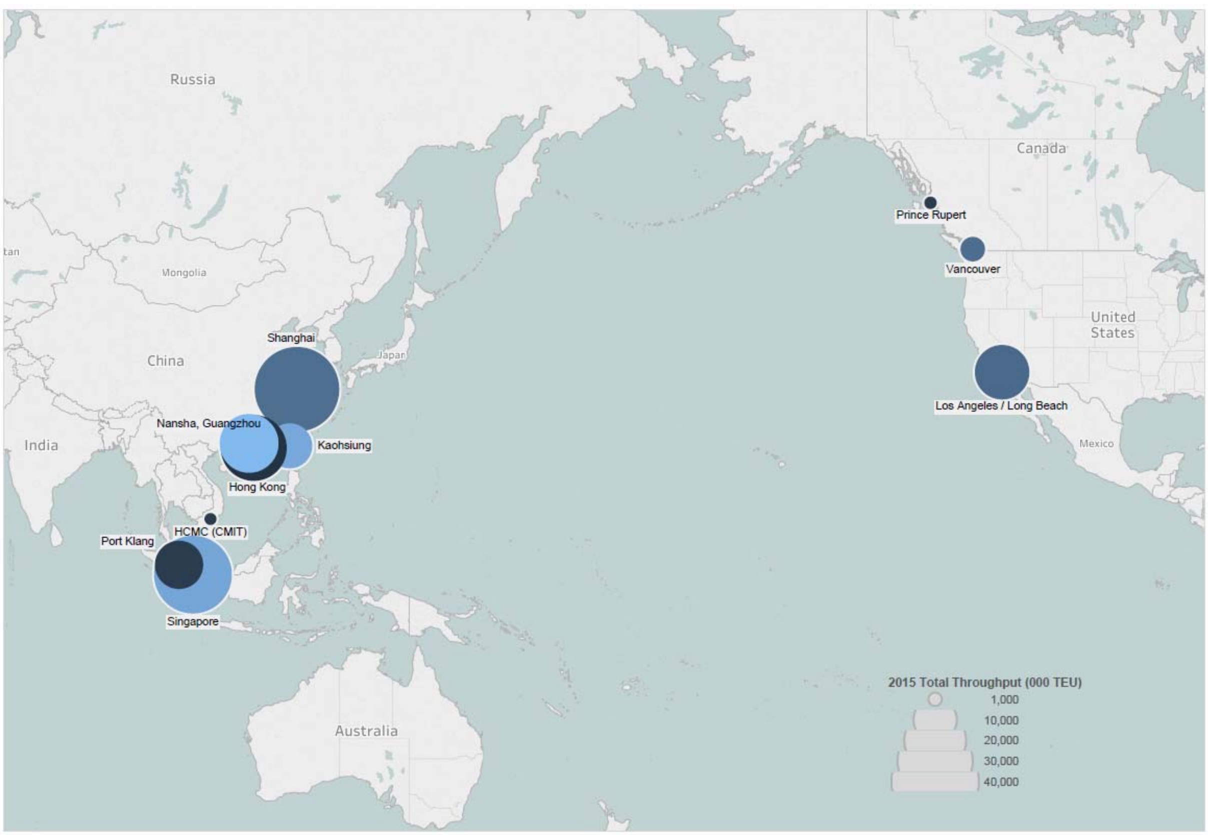
- 15 million TEU or above;
- 5-15 million TEU;
- 5 million TEU or below

These ports are also selected from locations that are representative of APEC geographies.

Table 2.1 Selection of Ports

Economy	Port	2015 TEU ('000)	
North America			
Canada	Prince Rupert	776	
Canada	Vancouver	3,054	
USA	Long Beach	7,192	
East Asia			
China	Nansha, Guangzhou	11,770	(Guangzhou: 17,590k TEU)
China	Shanghai	36,537	
Hong Kong, China	Hong Kong Port	20,073	
Chinese Taipei	Kaohsiung	10,264	
Southeast Asia			
Malaysia	Westports, Klang	9,053	(Klang: 11,887k TEU; PTP: 9,159k TEU)
Singapore	Singapore	30,900	
Viet Nam	CMIT, Cai Mep	725	(Cai Mep / Thi Vai: 1,468k TEU)

Figure 2.3 Location and Relative Size (by throughput) of Ports Selected



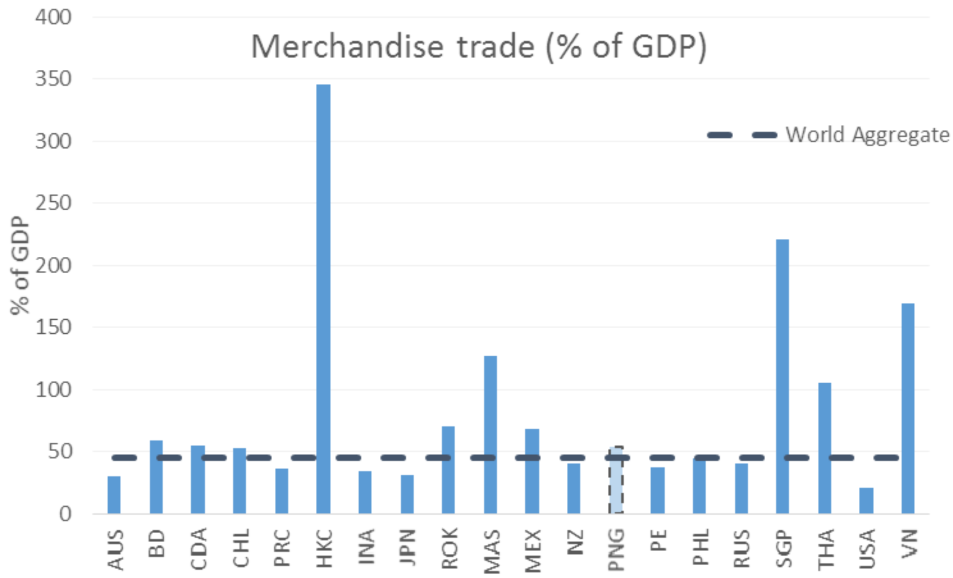
Source: ICF

3 Key Findings

3.1 Overview: Global Trend in Shipping Industry

Merchandise trade accounted for 45% of world GDP in 2015; this is almost triple the proportion in 1960 (17.5%). The contribution by merchandise trade of GDP in certain APEC economies was much greater than the share of the world's total: 345% in Hong Kong, China, 221% in Singapore, 170% in Viet Nam, 127% in Malaysia, and 106% in Thailand[1] (Figure 3.1).

Figure 3.1 Merchandise Trade as % of GDP in 2015, APEC Economies



Source: ICF based on World Development Indicators, WTO, World Bank
Notes: The database does not cover Chinese Taipei. Papua New Guinea (PNG) 2015 data was estimated from 10-year trend. A list of full names of APEC member economies' abbreviations is provided in the Glossary.

It is estimated that about 90% of world trade is carried by the international shipping industry[2]; hence, a port with good connectivity is critical in the facilitation of domestic and international economic development.

An overview of global trends in the shipping industry provides important background information on the expected roles for the ports; this also helps decision makers plan and operate ports in such a way as to facilitate economic development.

3.1.1 Container Shipping Industry – Demand Remains Subdued

APEC trade accounts for about half of global trade, and has grown significantly since the 2000s. Global merchandise trade has been dominated by China in the last decade. However, China's import and export growth has slowed down significantly in recent years and this trend is

[1] Source: World Economic Indicators, WTO, World Bank.

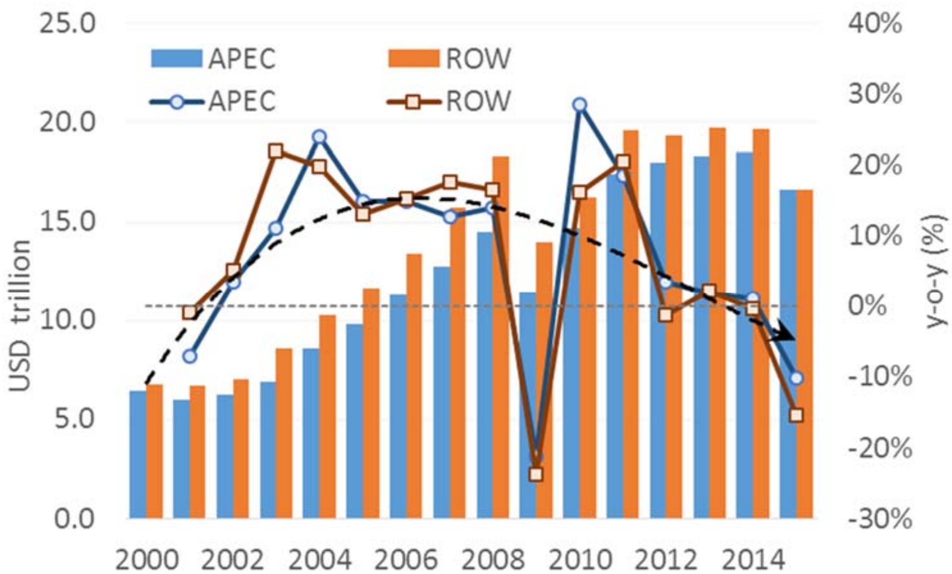
GDP is the sum total of Personal Consumption (C) + Government Expenditure (G) + Investment (I) and Net Exports (X-M). Net export is defined as export minus import.

Total merchandise trade is the sum total of export and import, and can be larger than the total value of GDP. For small economies that are active in merchandise trade, export and import values can be much larger than the other GDP components, but most of the trade is re-export and only bypasses the economy.

[2] Source: International Chamber of Shipping

expected to continue. This has led to a slowdown in global trade (Figure 3.2). Among the largest economies, China is no longer enjoying double-digit import and export growth rates, and Europe and USA are facing uncertain economic outlooks due to Brexit and the US Presidential election. These developments may lead to subdued growth in the volume of import/export containers moved between the major economies in the near term.

Figure 3.2 Merchandise Trade in APEC and Rest of the World (ROW): Significant Growth but Slowing Down

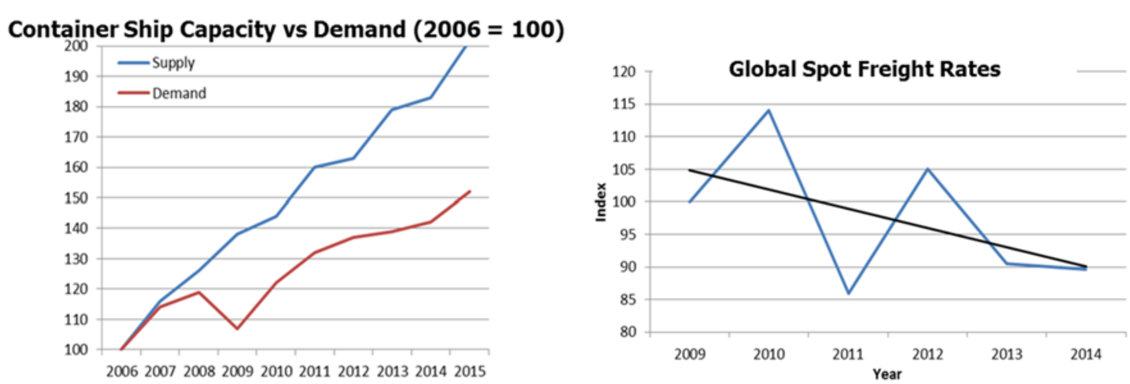


Source: ICF based on World Bank

3.1.2 Port Customers Continue to Struggle Financially

The slowing growth in trade volumes, combined with a large increase in the supply of container vessels in recent years (Figure 3.3, left), has put downward pressures on freight rates (Figure 3.3, right) and consequently the financial position of most shipping lines.

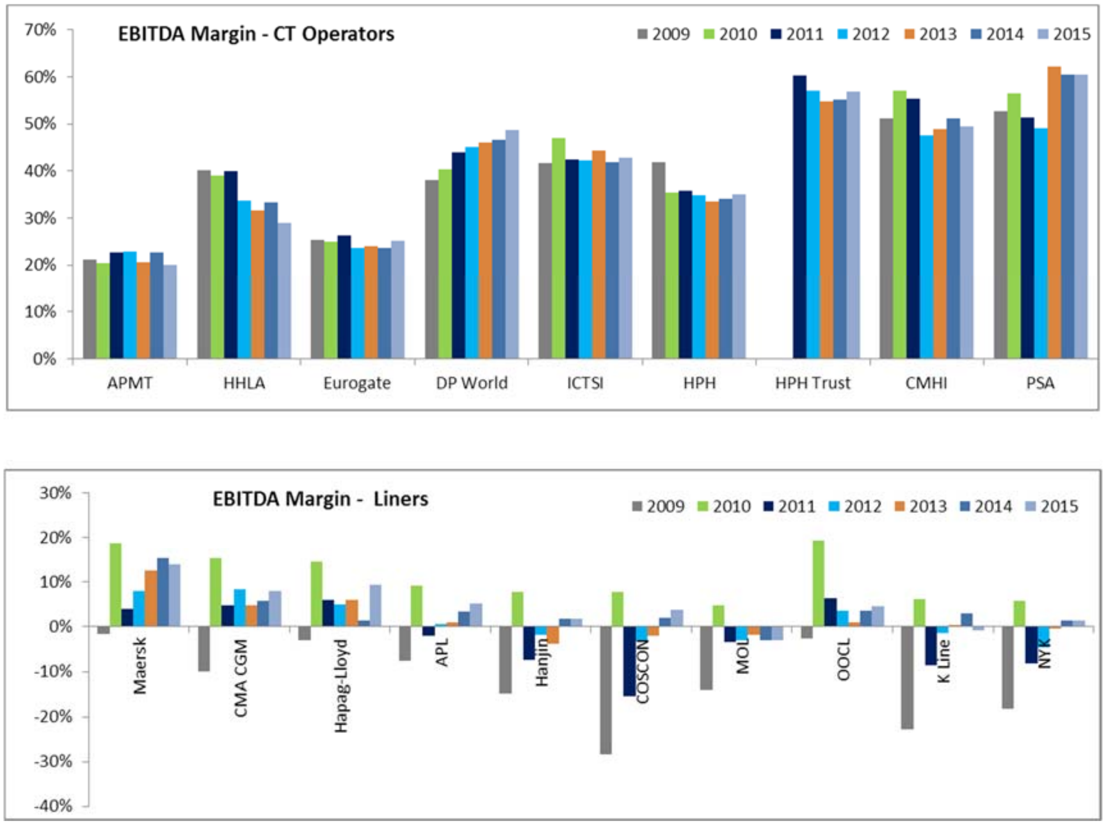
Figure 3.3 Container Ship Capacity vs Demand (left), and Global Spot Freight Rates (right)



Source: ICF based on SeaIntel and Shanghai Composite Freight Index

Both shipping lines and terminal operators make substantial long-term investments; however, whilst the latter have generally delivered healthy EBITDA margins (Earnings Before Interest, Taxes, Depreciation and Amortization – a relevant profit metric for the shipping industry), the former have not (Figure 3.4). There was some recovery in profit levels for shipping lines in 2014, but declining or low profitability is expected to continue. All else being equal, this means that port customers (i.e. shipping lines) are seeking lower handling and port charges. In September 2016, Hanjin, the seventh largest shipping line in the world, filed for bankruptcy. This is an unprecedentedly large bankruptcy case in the shipping industry, and clearly highlights the financial pressure facing many shipping lines.

Figure 3.4 EBITDA Margin of Terminal Operators (above) and Container Shipping Lines (below)



Source: ICF based on port operators and shipping lines annual reports

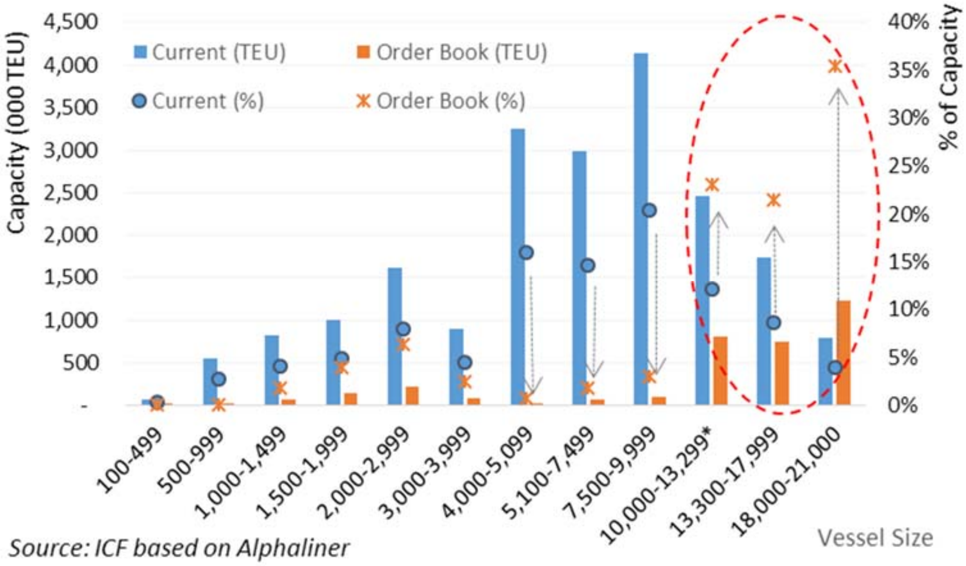
A number of commercial and operational initiatives have been put in place to alleviate the poor financial performance of the shipping lines, and these are discussed below.

3.1.3 Economies of Scale to Reduce Unit Costs

With unit revenues stagnating or declining, there is intense pressure on shipping lines to reduce unit costs. One possible cost-reduction measure is for shipping lines to order larger vessels with the intention of reducing unit costs by achieving economies of scale. Maersk typically leads the way - its Tripe E class vessel at TEU 18,000 pushed the envelope further than previous vessels. However, a ‘herd mentality’ tends to characterise the liner industry and other carriers quickly followed suit – the Triple E was rapidly overhauled by new vessels of TEU 19,000. Then in May 2015, Maersk itself announced an order for a new class of 20,000 TEU vessels with a maximum draft of 16.5m, which would require **a channel depth of 18m below Chart Datum** (minimum tidal water levels) to ensure fully laden vessels had access at all times. This order was rapidly exceeded by OOCL’s order for 6 x 21,100 TEU vessels, for delivery in 2017.

To conclude, mega vessels (18,000+ TEU) are no longer rare; these larger vessels have been ordered in an attempt to reduce unit costs through economies of scale in order to gain or protect market share (Figure 3.5).

Figure 3.5 Capacity by Vessel Size, Current Fleet vs Order Book: Expect More Mega Vessels in the Market



Source: ICF based on Alphaliner

3.1.4 Container Vessels are Growing in Size across All Trade Lanes

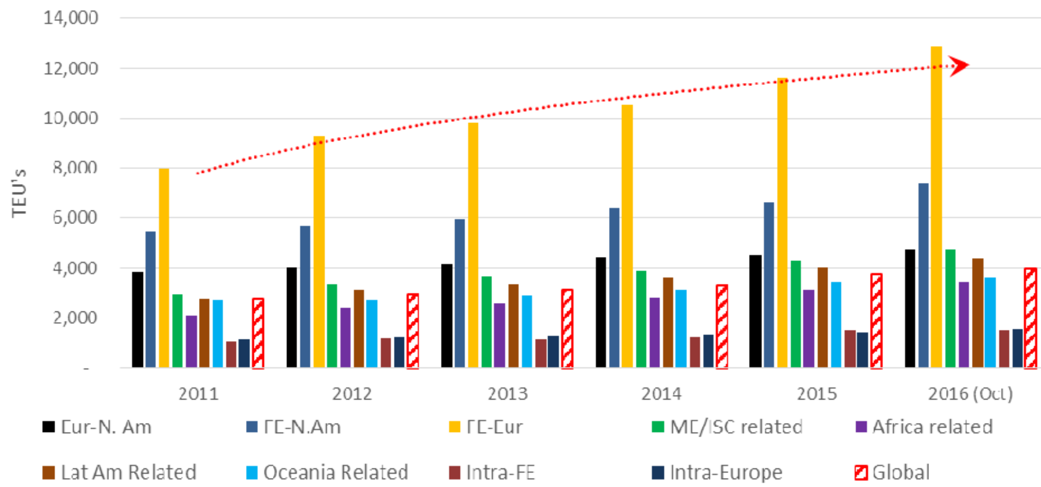
While the largest vessels are typically deployed on the Europe-Asia trade, the new vessels also increase the average vessel sizes in other trades due to the “cascading effect”.

The increase in average vessel size per trade lane from 2011 to October 2016 has been significant:

- Far East – Europe: + 61%
- Far East – North America: 36%
- Intra-Asia: +42%
- Middle East / India Sub-continent related: +58%
- Africa related: +65%
- Latin America related: +58%

In absolute terms, the Far East-Europe trade has seen the highest increase in vessel sizes with average vessel sizes increasing from 7,984 TEUs in 2011 to 12,828 TEUs in October 2016 (Figure 3.6).

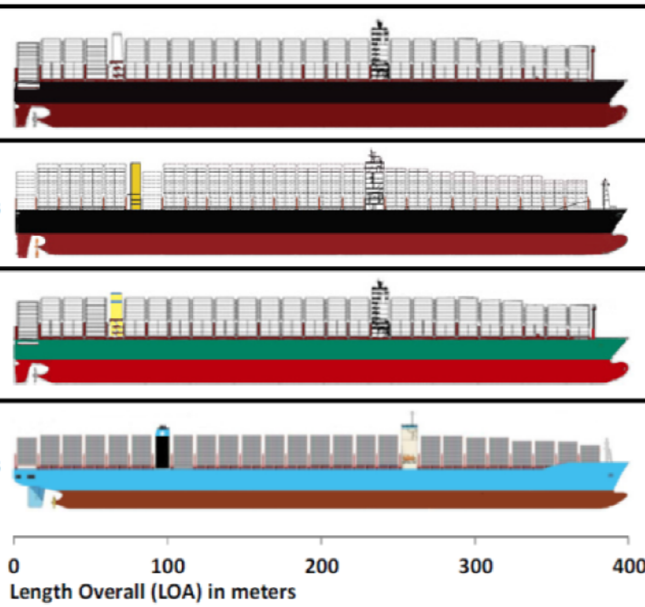
Figure 3.6 Average Vessel Sizes by Trade Lane



Source: ICF based on Alphaliner

Despite a rapid increase in the average ship size per trade over the past 3-5 years, this trend is unlikely to continue much further – container ships exceeding 400 meters long and 60 metres wide (23 TEUs across) are not felt to be practical for any line or port: the maximum is likely to be TEU ~21,000 (Figure 3.7). The overcapacity within the industry coupled with slowing volume growth (particularly from China/Asia) and the technical challenges in building and operating the next generation of vessels (~24,000 TEU or Malaccamax) should apply the brakes.

Figure 3.7 Mega Vessel Specifications



	TEU (declared) tdw	LOA m	Breath m	Draft m
BARZAN 6 units in series from Apr 2015	**TBA** TBA	**400.0**	**58.6**	**16.0** **UASC** Hyundai Samho/Hyundai H.I.
MSC OSCAR 12 units in series from Jan 2015	**19,224 teu** 197,362 tdw	**395.4**	**58.6**	**16.0** **MSC** Daewoo (DSME)
CSCL GLOBE 5 units in series from Nov 2014	**18,982 teu** 184,320 tdw	**399.7**	**58.6**	**16.0** **CSCL** Hyundai H.I.
Maersk 'EEE' 20 units in series from Jun 2013	**18,340 teu** 194,153 tdw	**399.2**	**59.0**	**16.0** **Maersk** Daewoo (DSME)

Source: Alphaliner

Shipping lines will now look more towards fleet flexibility and will probably focus much of their new investment on the Neo-Panamax class of ships, 10,000-13,000 TEU. The Neo-Panamax ships have great flexibility in terms of deployment, being well suited for the Trans-Pacific, Asia-

Mediterranean, Asia-Middle East and ultimately Asia-USEC (via Panama) trade lanes. Vessels larger than 14,000 TEU are essentially restricted to operating on the Asia-Northern Europe trade as no other trade has the critical mass of volume required to fully utilise them consistently, nor the necessary port infrastructure and productivity to service these vessels adequately. The Trans-Pacific trades also provide adequate volumes, although until recently West Coast US ports have not provided the necessary infrastructure and concerns remain about the lower productivity offered by US ports. Nonetheless, in December 2015, CMA CGM announced plans to test the readiness of US West Coast ports to handle an 18,000 TEU vessel.

3.1.5 Panama Canal Reopening – will it change inter-modal demand?

The Panama Canal, with an additional lane and wider locks was inaugurated in mid-2016 and now allows for more and larger vessels (up to 13,000 TEUs, as compared to 4,400 TEUs before the expansion – also see Table 3.1), and significantly improves the connectivity between the Pacific and Atlantic Oceans.

Table 3.1 Dimensions of Ships Allowed, Before and After Panama Canal Expansion Programme

Ship Parameter	Before Expansion	After Expansion
Maximum size	4,400 TEU	13,200 TEU
Vessel Draft	12.4m	15.2m
LOA	294m	366m
Width	32.3m	49m

Source: ICF based on Canal de Panamá official website

The time required and estimated cost involved to move a container via the Panama Canal has been compared by the Consultants to that via the traditional routing at the West Coast ports. Table 3.2 shows the new routing option via the Panama Canal: it does not save time for some major inland destinations.

Table 3.2 Estimated Travel Time, Major Destinations from Northeast Asia, All-Water vs Inland

Destination	Inland (before Panama expansion)		All Water (new option after Panama expansion)	
Chicago	Via Oakland / LA / LB	17-18 days [13-14 days (sea) + 4 days (inland)]	Via East Coast Ports	27 days [22 days (water) + 3 days (inland)]
Dallas	Via LA/LB	18 days [14 days (sea) + 4 days (inland)]	Via Houston	22 days [21 days (water) + 1 day (inland)]
Atlanta	Via LA/LB	18 days [14 days (sea) + 4 days (inland)	Via Savannah	23 days [22 days (water) + 1 day (inland)]

Source: ICF based on Panama Canal Expansion Study, Parsons Brinkerhoff. Notes: LA = Port of Los Angeles; LB = Port of Long Beach

For a container from an Asian base port (e.g. Shanghai), the estimated average all-inclusive sea freight cost based on the Shanghai Container Freight Index (including the canal surcharge) is 30%-60% higher via the Gulf and East Coast, compared to via the West Coast Ports.

The combination of freight rate and transit time of the alternative routing via the Panama Canal does not favor a cargo owner choosing the all-water route for Midwest-bound cargo. Hence, the Panama Canal is not expected to bring about significant shift in port throughput over the short term. However, the US ports, especially those on the West Coast, will still need to prepare for the larger vessels.

As of October 2016, 49% of TEU capacity in the Far East – North America route was delivered by 7,500-10,000 TEU vessels, and 19% by vessels with 10,000+ TEU capacity. As discussed in Section 3.1.4, there has been a trend of growing average vessel size across all trade lanes. Given the demand of this trade and the current average vessel size, it is highly possible that larger vessels will be deployed on this trade lane.

To conclude, the demand for intermodal container movements across the Americas is unlikely to be significantly impacted unless the all-water freight rates drop substantially, or inland distribution costs are significantly reduced through the hypothetical development of distribution centers in the Gulf over a longer term. Moreover, ports in the Americas will need to maintain / upgrade their infrastructure to meet the requirements of the larger vessels that can now call at these ports.

3.1.6 Mega Alliance and Shipping Line Consolidation

Despite the highly fragmented nature of the liner shipping industry, carriers can form alliances, an agreement allowing liners to share vessels and hence save cost. Today, most carriers belong to one of the four alliances.

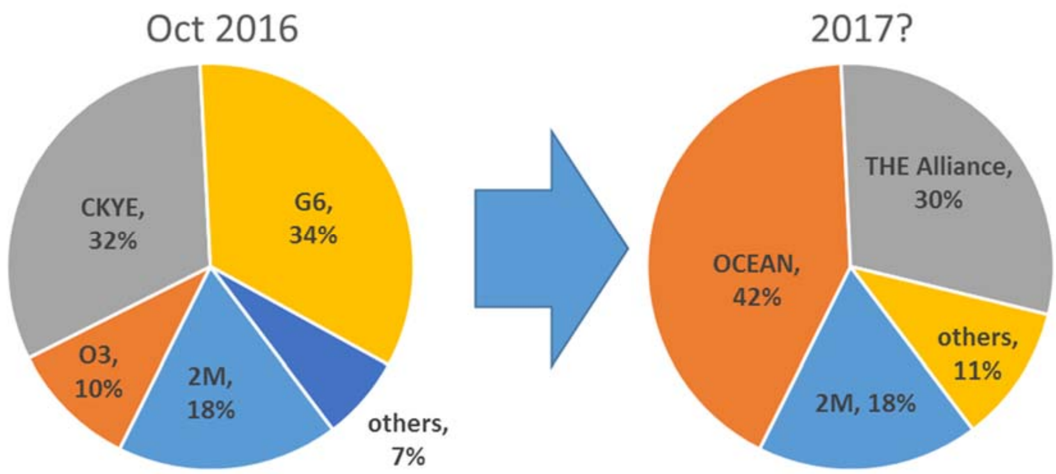
As noted earlier, shipping lines have been ordering seemingly ever larger vessels with the intention of reducing unit costs through economies of scale (and newer more efficient engines). A number of factors are required to deliver the economies of scale promised by the largest vessels (especially ≥ 18,000 TEUs or “mega vessels”), the key being the need to **have enough cargo to fill these huge ships**. Even the largest carriers are not able to fully utilise their capacity on their own account.

Partly for this reason, new operating alliances and vessel sharing agreements have been formed between carriers to defray the risk of introducing larger vessels in subdued demand conditions – alliances are focused on ensuring the survival of participants, each carrying overcapacity. Moreover, by forming alliances, carriers are better able to secure enough numbers of vessels that are of same size / same magnitude of size to offer a fixed or weekly schedule. Shippers seek lower costs, but they also require a certain frequency of services – this requires an adequate number of vessels for any service rotation.

Today, 16 of the top 20 liners belong to one of the four alliances. On the Far East – North America trade, these alliances account for 93% of total weekly TEU capacity.

However, the current form of mega alliances may not survive for long. New alliances are to be formed in April 2017 (Table 3.3); shipping lines are also being replaced through the reshuffling of liners among the newly formed alliances, and the recent mergers and acquisitions in the liner shipping industry (most notably: CMA CGM – NOL (and its subsidiary APL), COSCO – China Shipping, and Hapag-Lloyd – UASC) (Figure 3.8). The three Japanese shipping lines, NYK, MOL, and K-Line also announced in October 2016 that they would merge their operations into a single entity, subject to regulatory approval. Shippers and forwarders have been complaining about service quality (e.g. deterioration in schedule reliability, frequently poor communications between carriers and shippers around delivery delays or change in port calls, and unpredictable services) offered by mega-alliances. Shipping lines are also concerned that the vessel-sharing agreements are unable to reduce variable costs (e.g. terminals procurement or container flow management) in most cases.

Figure 3.8 Weekly Capacity by Alliance, Far East-North America



Source: ICF based on Alphaliner. Notes: Hanjin Shipping is removed from CKYHE from September 2016, becoming CKYE from Oct 2016.

Table 3.3 Allocation of Shipping Lines by Alliance

Current		Future (starting 2017)	
Alliance	**Liners**	**Alliance**	**Liners**
2M	Maersk, MSC	2M*	Maersk, MSC
O3	CMA CGM, CSCL, UASC	OCEAN	CMA CGM (+APL), COSCO (+CSCL), Evergreen, OOCL
G6	Hapag-Lloyd, OOCL, MOL, APL, NYK, Hyundai	THE Alliance	Hapag-Lloyd (UASC), MOL, K-Line, NYK, Yang Ming
CKYE	COSCO, K-Line, Yang Ming, Evergreen		

**Notes: a mega alliance with 2M and Hyundai were considered, but it is confirmed in November 2016 that Hyundai would not join 2M. Source: ICF; industry intelligence.*

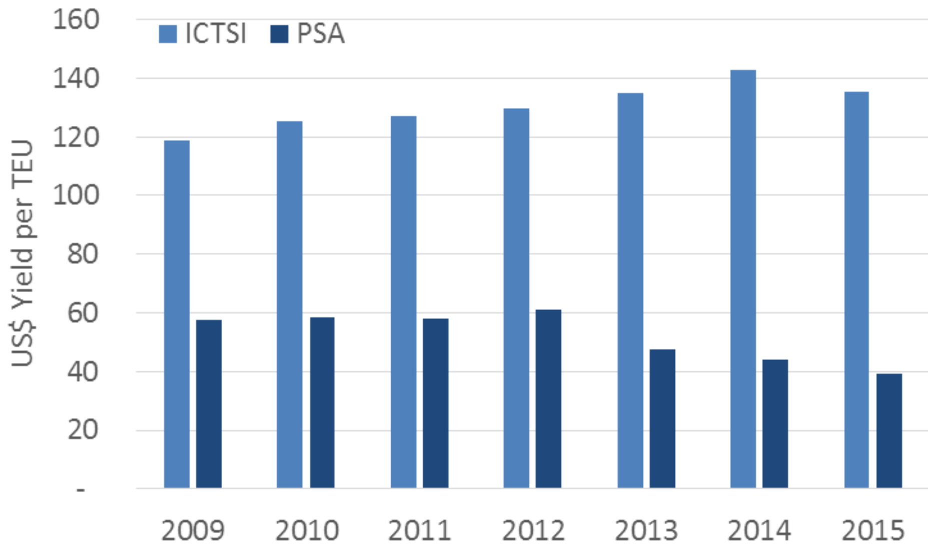
3.1.7 Positioning of Terminal Operators and Implications on Profitability

For commercially focused terminal operators, the key challenge is to **meet customer service requirements at minimum cost**. In other words, their goal is to deliver customer productivity KPIs (e.g. Berth Productivity) whilst also maintaining high utilisation (e.g. TEUs/m of quay/per annum; TEUs/Quay Crane/per annum; TEUs/hectare of yard/per annum; etc.). Conversely, some other competing ports or operators may be state-backed or subsidized, and may compete with less regard to financial returns, albeit the long-term sustainability of such a strategy has to be questionable.

In developing new capacity, consideration of investment returns will invariably be a key concern – although again, less so in those jurisdictions where port infrastructure and operations may be heavily subsidised. With the arrival of larger vessels, terminal investment requirements are increasing and, in the case of the major alliances, the amount of capacity that needs to be provided has also increased. Gateway ports enjoy some risk minimisation via the attraction or pull of their hinterlands. In the absence of other competitor gateways, this baseload of hinterland cargo provides a major incentive for shipping lines and direct services to call at the port.

For transshipment hubs, the market is more fluid and the financial returns are typically lower – revenue per transshipment lift is often 50-60% of that for import/export cargo. Figure 3.9 compares the typical per TEU yield of International Container Terminal Services Inc (ICTSI) – whose portfolio focuses on gateway ports and handles mainly hinterland cargo, and that of PSA – a global operator of the largest transshipment port (Singapore) in the world, which dominates its portfolio. Hence the risk / reward balance is somewhat different.

Figure 3.9 Yield per TEU (US$) – ICTSI vs PSA as a Proxy of "Hinterland vs Transshipment"



Source: ICF based on ICTSI and PSA annual reports

3.1.8 Economic Impacts of Container Handling by Type

The economic impact of any activity can generally be measured through reference to expenditure, value added[3], and persons engaged[4] in all sectors of the economy that enable the respective activity to happen. Within the ports sector, the economic impact can be assessed in three categories:

- Direct impacts – expenditure in local economies by the sectors providing direct services to cargo handling, e.g. port operations, inland freight transport, sea and inland water freight transport, cargo handling and stevedoring, storage and warehousing, shipping and forwarding agencies, etc.
- Indirect impacts – expenditure by providers of goods or services to those described in "direct services" above, as a result of receipts of direct expenditure.
- Induced impacts – expenditure within the economies from employment created as a result of the direct expenditure above.

Handling **hinterland containers has a higher economic contribution than transshipment containers**, because more sectors (e.g. road freight haulage, warehousing) are involved in

[3] Value added is the incremented value of commodities and services contributed by the relevant stakeholders in the economy, and is derived as the difference between the value of gross output and the cost of intermediate inputs.

[4] Persons engaged includes both full-time and part-time employees, working proprietors and business partners, and unpaid family workers.

moving the hinterland cargo. In other words, more economic sectors are included in the handling of each TEU of hinterland cargo than for transshipment. While the scale of economy, geography, and capital intensity differ by economy, the general observation is that the **per TEU economic impacts** of hinterland cargo is 2-3 times that of transshipment cargo. Port Authorities in North America, such as Port of Vancouver[5] and Port of Long Beach[6], are considered leaders in the industry in having conducted economic impact studies to illustrate their contribution to the local, regional, and international economy.

Nonetheless, the per unit economic impacts must not be confused with the total economic impacts. Transshipment cargo generates economic impacts – it is only lower as measured by per TEU term when compared to hinterland cargo. Economic impacts by transshipments are entirely additional. In other words, if the transshipment cargo is not handled at the port at all, all the relevant economic benefits would be lost completely. Moreover, there are other additional benefits of transshipment, namely the increased connectivity and choice of services for importers and exporters at the transshipment port that would otherwise not exist. However, these benefits are barely quantified by conventional economic impact analysis.

3.1.9 New Business Landscape of the Port Sector

A number of port development plans have been announced / implemented in the past decade in the APEC region. Many of these plans do not compete over their gateway cargo market unless their hinterlands overlap; however, some of these port proposals are seen to compete over the international transshipment market where the competition spans over a wider landscape.

3.1.9.1 Malaysia

Malaysia has 13 major federal or state ports, the former under the administration of the respective port authorities and the latter under the administration of the states. The largest port is Port Klang with two operators, Westports and Northport, closely followed by Port of Tanjung Pelepas (PTP). A significant volume of transshipment is handled at both PTP (about 95% of total throughput) and Westports (73% of total).

Port planning in Malaysia currently follows multiple processes and they often are not coordinated. For example in Klang, both Westports and Northport have their own version of expansion plans, but neither of these plans have obtained any official status to date. PTP has also been making the case to expand its capacity, but its efforts have recently been set back by a property development in the area.

In addition, there are also unofficial rumours and media reports regarding a new deep sea port development proposal at Malacca with foreign investment from China. No details for this proposal are available in the public domain, but the Consultants note that no major cargo base currently exists in the area. If this Malacca hub proposal is to be developed, it would bring intense competition to the existing major transshipment ports, Westports (less than 170 km away) and PTP (less than 240 km away).

3.1.9.2 Indonesia

The governance, regulation, maintenance, and operation of ports in Indonesia are the responsibility of the Pelindos (or PT Pelabuhan Indonesia in Indonesian Bahasa). There are four Pelindos, whose jurisdiction corresponds to the geographic coverage of ports. Massive port

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[5] Port of Vancouver – 2012 Port of Vancouver Economic Impact Study - http://www.portvancouver.com/wp-content/uploads/2015/03/2012-port-metro-vancouver-economic-impact-study2.pdf

[6] Port of Long Beach Economic Impact Report - https://www.google.ca/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&cad=rja&uact=8&ved=0ahUKEwi78vfnzf7PAhXhx4MKHezqDiYQFggsMAI&url=http%3A%2F%2Fwww.polb.com%2Fcivica%2Ffilebank%2Fblobdload.asp%3FBlobID%3D2103&usg=AFQjCNEClUTAAqY2SFXAYA6N-lPZ3EwDwg&bvm=bv.136811127,d.amc

development plans, covering a number of ports, have been proposed and endorsed by the current Indonesian President, Joko Widodo. Some major port proposals covered by these plans are:

- New Priok (Jakarta) – targeting mainly Indonesian gateway cargo and domestic transshipment;
- Batam, Riau – intending to take market share from Singapore; and
- Kuala Tanjung, Sumatera – targeting the Sumatra hinterland and Malacca Strait transshipment

Implementation of these plans have been delayed since announcement, and further delay is highly possible given the unpromising public finance outlook in the economy.

3.1.9.3 Viet Nam

Driven by expectations of future demand growth and Government port strategy, many port developments have taken place in the Ho Chi Minh City (HCMC) delta, in particular new container terminal capacity in the Cai Mep and Thi Vai area. Consequently, the region now has an abundance of capacity, although utilisation within individual areas differs.

The port cluster in southern Viet Nam consists of older, draft constrained, but well established terminals in HCMC and several newer and generally deep-sea terminals south of HCMC at Cai Mep-Thi Vai and Vung Tau. The newer terminals have been developed through a series of joint ventures involving many of the world's major international terminal operators. The South Viet Nam port cluster as a whole handled more than 70% of Viet Nam's total container throughput volume in 2013.

In an attempt to mitigate urban road congestion, the Vietnamese government has been promoting the relocation of port activities from HCMC to the Cai Mep area outside the city since the early 1990s. However, progress has been slow and many old HCMC terminals remain in operation handling the vast majority of cargo through the system in southern Viet Nam. Consequently, as new capacity has been developed and demand growth has slowed following the global economic downturn, surplus capacity at the Cai Mep terminals has become increasingly severe.

The ports in southern Viet Nam mainly target gateway cargo. The overall development has been fragmented, with little opportunity for terminal operators to expand or develop any economy of scale. Until the cluster develops a dense network of connecting services, and has the necessary infrastructure (e.g. deep enough channel for large vessels), the facilities will struggle to become competitive.

3.1.9.4 Thailand

Thailand has two major gateway container-handling ports: Laem Chabang and the older facilities in Bangkok. Laem Chabang handled approximately 6.4 million TEU in 2014; Bangkok handled 1.5 million TEU in the same year. Neither of these two ports has experienced significant growth in recent years.

Laem Chabang is a greenfield port built in 1990. Despite its location further away from the capital city, it enjoys deep draft at 14-16m, and therefore is the mainline destination for carriers seeking to serve the economy. It was developed to ease congestion at the draft constrained Bangkok terminals. However, much like southern Viet Nam, these older city centre terminals have not been closed down, and have remained surprisingly resilient to competition from Laem Chabang, not least due to their proximity to key hinterlands and the risk averse nature of some freight forwarders and lines. Consequently Laem Chabang still has spare capacity.

One of the biggest challenges of Laem Chabang is its inland connectivity, in particular the "last mile" connection to the port. Congestion on the road for hours is not uncommon, further undermining the competitiveness of the port.

Another initiative that could possibly change the shipping pattern in southeast Asia is the proposed Kra Canal. If developed, it would offer an alternative shipping route to the Malacca Strait, bypassing the hubs of Singapore, PTP, and Klang.

This proposal, although being frequently discussed, faces some major challenges. Commercial feasibility is one of the major concerns: even the low end estimated construction cost of US$20 billion[7] is considered substantial by any scale, and some other sources estimate that it could cost as much as US$28 billion. Routing via the Kra Canal could save sailing time by about two days and the subsequent savings in fuel cost; however, there are new costs of using the Canal. If similar toll rates to Panama Canal's are charged, there would hardly be any cost savings for east-west services (e.g. between Hong Kong Port and Colombo).

Other challenges include the time required to commission this large scale project. New ports on each side of the Canal would also need to be built to fully realize the transshipment potential of the Canal. These projects would take at least ten years to complete. The Canal is also considered politically sensitive as it is viewed as "dividing the kingdom into two halves".

In short, the probability of the Kra Canal becoming a reality remains highly questionable, and even if it happens, the volume of cargo diverted is unlikely to be considerable.

3.1.9.5 Singapore

Singapore is possibly the largest *transshipment* hub in the world, and has one of the most ambitious port development plans.

Currently, PSA[8] operates Phases 1 & 2 of the Pasir Panjang Terminals with annual capacity of up to 40 million TEU. Phases 3 & 4 kicked off in 2015 and are currently under construction; upon opening (full operations are scheduled for 2020), the total capacity (including the existing terminals at Pasir Panjang, Brani, Tanjung Pagar, and Keppel) will reach 50 million TEU. However, PSA's existing leases will expire in 2026, therefore the development at Phases 3 & 4 will be subsequently redeveloped for residential or commercial uses.

In light of the redevelopment of existing container handling facilities, **a brand new container terminal at Tuas with 65 million TEU annual capacity has been planned[9]**. The first set of berths at Tuas Port is expected to be ready in 2022.

While Singapore's development plans present significant competition to other major transshipment ports in the region, it is unlikely that the development will affect the volume of its gateway cargo. If anything, competition over transshipment may lead to reduction in transshipment tariffs, offering a lower cost alternative for cargo routing.

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[7] Source: Japan Global Infrastructure Fund study; Forbes, "*Easing the Malacca Energy Bottleneck: Is it Time for the Kra Canal?*", 29 June 2015. A number of reports (incl. Journal of Commerce, 20 May 2015) suggest that it could cost US$28 billion.

[8] In 1997, a parliamentary bill was passed to corporatise the Port of Singapore Authority, and it was renamed PSA Corporation Ltd.

[9] The Next Generation Port (NGP) 2030 Master Plan was formulated by a multi-agency taskforce in consultation with the maritime industry, and jointly facilitated by Singapore Shipping Association, PSA International, and Jurong Port. PSA will be the lead operator of Tuas upon its commissioning.

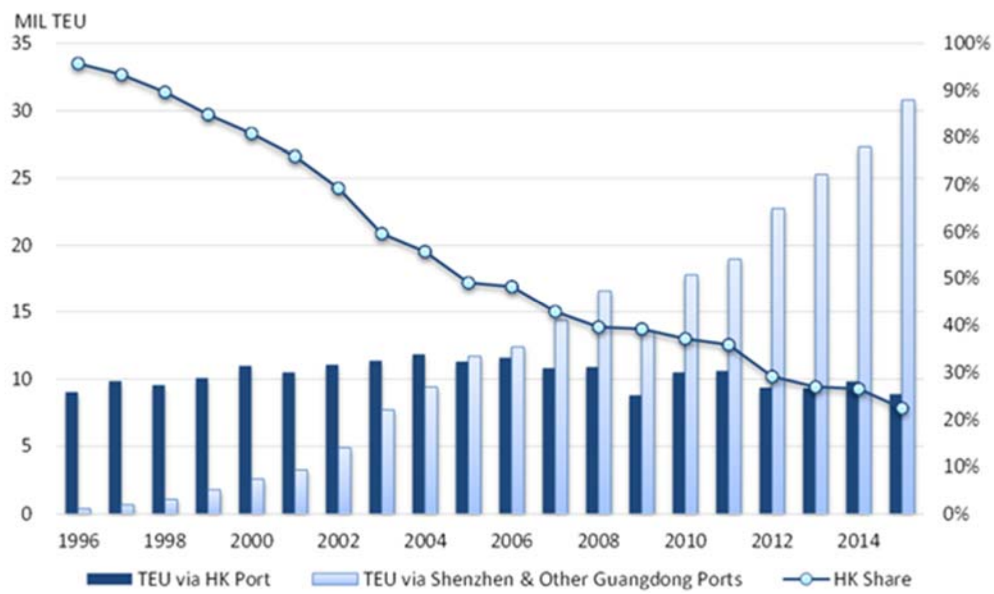
3.1.9.6 South China

There are a number ports (mainly Hong Kong Port, Shenzhen, and Guangzhou) in South China (Pearl River Delta), sharing the same hinterland. These ports belong to different port jurisdictions.

The Port of Hong Kong used to be the only major port in south China, servicing both international and Mainland China destinations. In the 1990s, more than 90% of South China's hinterland cargo was moved by cross-border trucks or barges to Hong Kong Port, then loaded onto container vessels for transport to overseas destinations.

In the mid-1990s / early 2000s, ports in Shenzhen and Nansha, Guangzhou started to develop. International operators were introduced: Yantian Port (Shenzhen east) was operated by Hutchison Ports, and Shekou/Chiwan Port (Shenzhen west) was operated by China Merchants and Modern Terminals Ltd. Operations of these two ports followed international practices and standards. More importantly, the ports in Shenzhen and Guangzhou are located closer to the hinterland than Hong Kong Port, and trucking costs to these ports were much lower than that to Hong Kong Port[10]. Hence, over the last 20 years, cargo has been diverted from Hong Kong Port to the ports in Shenzhen and Guangzhou because the latter offer similar productivity, while inland transportation costs are lower due to shorter distances. The critical mass built up also attracted more liner services, further reinforcing the competitiveness at these ports. In 2015, Hong Kong Port's market share of South China gateway cargo had declined to only about 20% (Figure 3.10).

Figure 3.10 TEU handled by Hong Kong Port and Shenzhen & Guangzhou Ports, and Market Share by Hong Kong Port of Gateway Cargo, 1996-2015



Source: ICF based on port authorities

[10] Distance to Hong Kong Port from the hinterland is longer, hence fuel cost (and time cost) is higher. Adding to the complexity to the southern China inland trucking market was the different driving licenses required to operate in Hong Kong Port and mainland China. Only truck drivers from Hong Kong, China could apply for licenses to drive in Mainland China, but truck drivers from Mainland China could not obtain license to drive in Hong Kong, China. Therefore, the supply of cross-border drivers is limited, which added costs to customers. In addition, drivers from Hong Kong, China receive higher salaries.

3.2 Common Driver of Successful Gateway Port

This section summarises the key drivers that contribute to the success of Gateway Ports, based on the observation and analysis of ports selected for this Study, and outcomes from discussions at various stakeholder consultations and the study workshop.

3.2.1 Strategic Location and Hinterland

Location is one of the most important factors that determines the success of a Gateway port. This means a successful Gateway port needs to be:

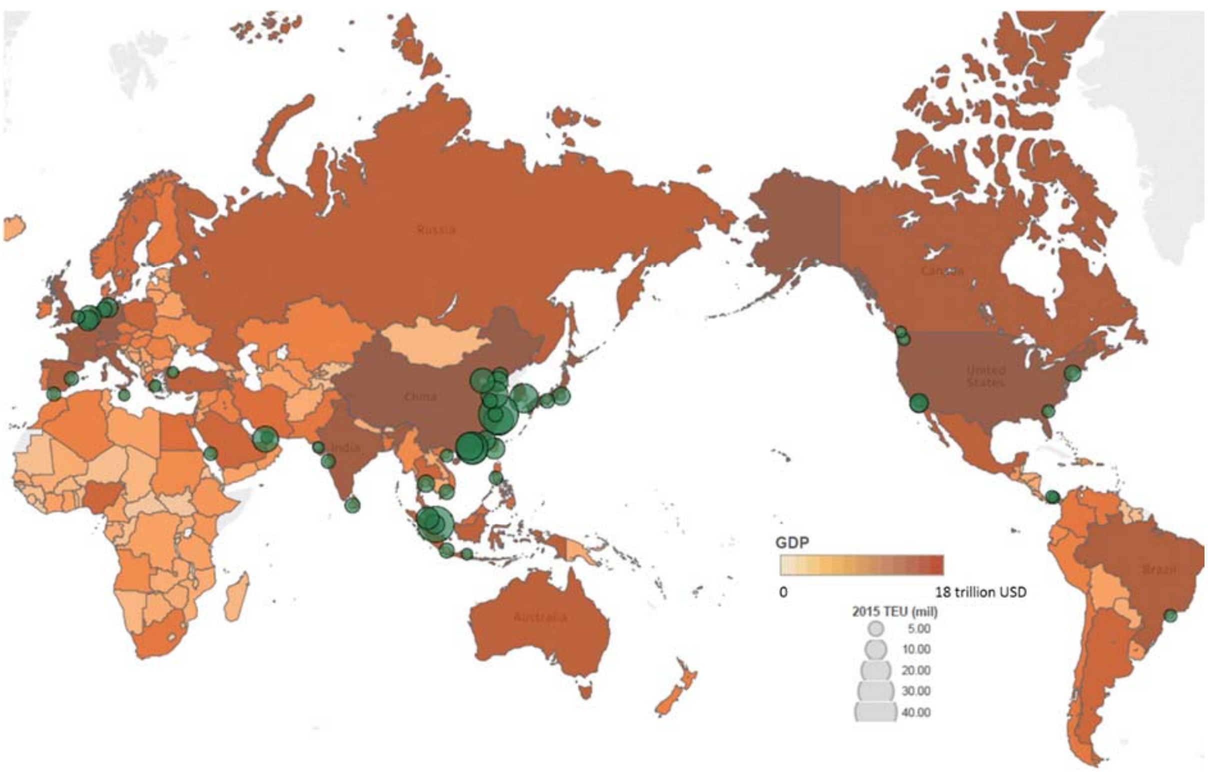
- Supporting a robust hinterland with base cargo nearby; and
- Located along the major trade lane.

Figure 3.11 shows the locations of the world top 50 container ports and GDP by economy, and Figure 3.12 presents the spatial relationship between these ports and the major trade lanes.

Base cargo plus a hinterland takes priority when liner companies decide which port to call. Most of the largest ports are found next to a large hinterland (measured by GDP). East and southeast Asia region has the highest concentration of top container ports because they are located next to significant hinterlands. The rapid industrialization in the coastal areas of the Yangtze River Delta and Pearl River Delta in China have also created the busiest port clusters of Shanghai / Ningbo-Zhoushan and Hong Kong Port / Shenzhen / Nansha (Guangzhou). When the greater Ho Chi Minh City region economy took off in the late 2000s, so also did the ports in the area.

Vancouver, Long Beach, and a number of ports in North America have the advantage of being located next to a large hinterland, or are accessed by intermodal transport linking to the hinterland. As a result, these ports have become the focal points for shipping services.

Figure 3.11 Port Throughput vs GDP



Source: ICF. Notes: only showing the top 50 container ports in 2015.

Some ports, however, have developed high volumes of throughput without the support of a large hinterland. Examples are Singapore, Balboa / Colon, and Colombo. Common to these ports are their proximity to major trade lanes: Singapore along the Malacca Strait, Balboa / Colon on the two sides of the Panama Canal, and Colombo near the Indian Sub-continent (and the India port system operating at a sub-optimal standard by most measures). However, these ports are generally viewed as transshipment ports, and their gateway function carries a small weight.

There are nonetheless exceptions. For example, Prince Rupert is considered a successful Gateway port because it is **strategically located** as the preferred first port of call on the West Coast of North America for trans-pacific trade, is the closest North American west coast port to Asia, and is connected by railway to its hinterland. These two factors enable the gateway function of the port although there is very little base cargo nor is it located along a major trade lane.

Figure 3.12 World Major Water Transportation Route and Top 50 Container Ports

Source: ICF based on Britannica and World Shipping Council

3.2.2 Inland connectivity

3.2.2.1 Connectivity between the port and the hinterland

Inland connectivity between the port and hinterland is critical to the successful gateway port functions. Without proper connectivity, the capability to move cargo to/from the hinterland will be severely limited, undermining the port's competitiveness.

Unfortunately, inland connectivity is also one of the most frequently forgotten and undervalued factors in port development because the planning, management, and operations of inland connectivity infrastructure is not always well defined, or are outside of the jurisdiction of the private terminal operators. These functions often fall under different private and public stakeholders and their planning and construction span over a long time frame, hence smooth transitioning and coordination can be challenging. For example, the highway system could be planned, built, and operated by the government or by private entity through various type of Public-Private Partnership. The port operators' involvement throughout this process varies across economies and projects.

Highway is the most common mode of inland transport, and development is measured by: the number of lanes, whether the highways are paved and well maintained, level of congestion, and time taken to move certain distance. Degree of penetration into the key hinterland areas also describes how well connected the highway networks it.

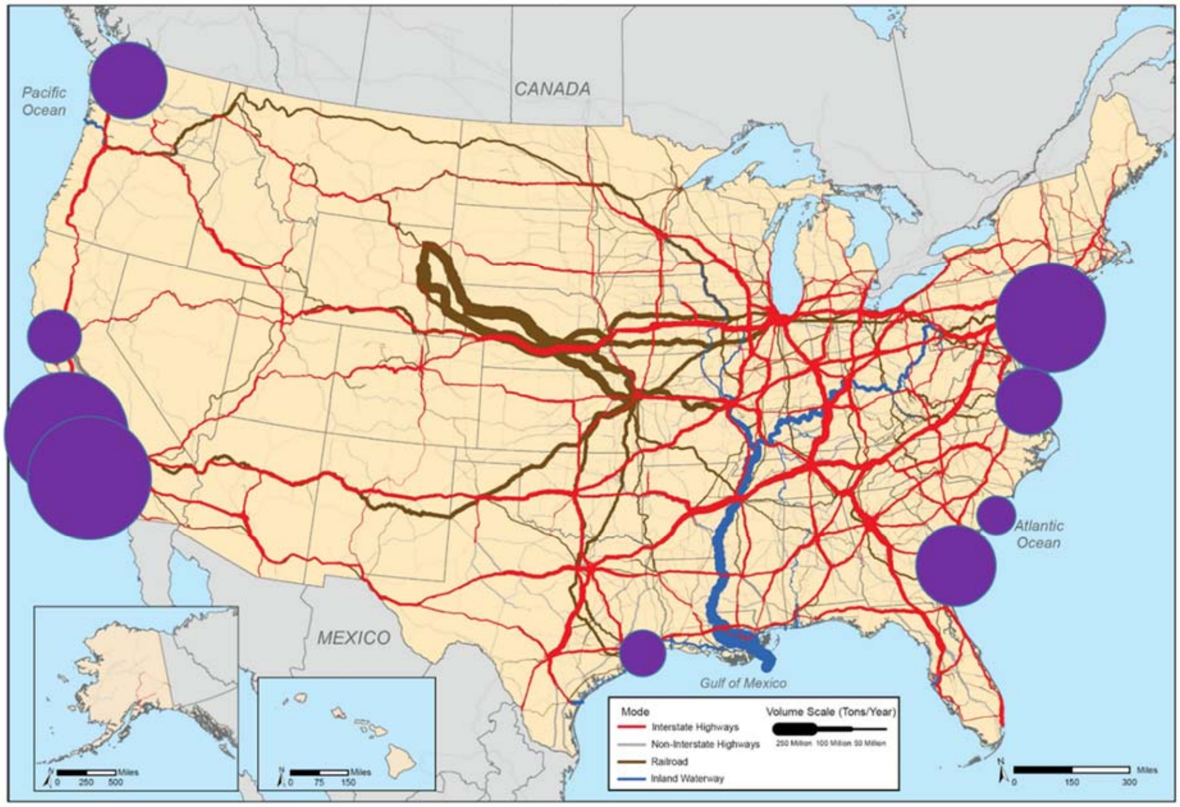
However, highway is only efficient for the transfer of cargo across relatively short distances up to around 250 km from the port, and may serve as a secondary mode in some geographies. For example, Prince Rupert Port is connected to its hinterland in Canada and the US Midwest more than 4,000 km away by the freight rail (Figure 3.13), and the local highway is of limited use for inland connectivity to the port.

Figure 3.13 Prince Rupert Rail Network

Source: Port of Prince Rupert

Another example where highway is of reduced importance is the Port of Long Beach, which is also connected to its key hinterlands by freight rail. In the USA, the major ports are connected to both freight rail *and* highways (Figure 3.14). The hinterlands that these ports service spread over a wide area, from within a few hundred kilometers from the ports to further away in the Midwest or even the East Coast US.

Figure 3.14 Freight Flows by Highways, Railroad, and Waterway, USA, 2010



Source: ICF based on US Department of Transportation, Federal Highway Administration, Survey Transportation Board, US Army Corps, Institute of Water Resources.

While freight rail can enhance inland connectivity of a port, it would be misleading to asses a port's competitiveness based on the availability and quality of rail. For ports with hinterland less than 250 km from it, freight rail is considered inefficient, and some successful ports servicing gateway functions (e.g. Hong Kong Port) do not have port rail because they are already located very close to their hinterlands via other intermodal transportation.

Barging / coastal feeders can be an important inland transportation mode in geographies where the river networks extend over a wide area, e.g. the Pearl River Delta, the Yangtze River Delta, southern Viet Nam, or where economic development happens along an extensive coastline (e.g. Indonesia). However, in regions where an inland / coastal water system does not exist, local water transportation may not even be an option for the gateway ports. Therefore, any indicator of inland water transport measuring inland connectivity should be applied carefully.

3.2.2.2 *The "Last Mile" connectivity*

The "last mile" is generally known as the connectivity leading from the common sections of the highway or railway to the port boundary, and is one of the most easily neglected links throughout the port planning exercise because this often involves the interface of different road / rail systems, transportation planners, and operators. As a result, the "last mile" can easily become a bottleneck in gateway port connectivity. This "last mile" bottleneck can be either physical or institutional, or both.

In Canada and the US, for example, the "last mile bottleneck" usually refers to the physical infrastructure of the road and rail network connecting to the port. In the case of Vancouver, the issue is traffic congestion on the road and rail network to handle current trade volume in a major urban metropolitan city. Therefore, the government, port, railway and local municipality are working together to identify the bottleneck or gap in the transportation system and to develop infrastructure solutions to improve the capacity, safety, and efficiency of the system.

Miscalculated volume forecasts could result in a facility capacity that cannot meet actual demand; miscommunication between stakeholders or systems could also result in congestion during operations. Sometimes, the obstacles that hinder the “last mile” connectivity are introduced some time after the port becomes operational. It is possible that the highways leading to the port are planned with adequate capacity, but the limited number of gates at the entrance of the port area, and/or the speed that the officers process the documents could slow down port road traffic.

New requirements imposed by local customs or international authorities may also cause congestion in the last mile. In the wake of the 9/11 attacks, the US Congress passed the Security and Accountability for Every Port Act of 2006 (SAFE), requiring all US-bound containers be scanned at ports or origin before they are allowed into the US. Implementation has been delayed – it is both costly to set up the equipment and to train the necessary personnel; moreover, it is not yet clear who would pay for the purchasing, operating, and maintaining of the scanning equipment. The operational feasibility of the Act has been questioned by international freight forwarders, customs brokers, and port operators. Communication channels to coordinate between US and overseas port officials has yet to be worked out, and it is unclear how the US can enforce this act beyond its border. The US Congress has been lobbied by interested parties to waive the requirement to scan 100% of importing containers, but the likely outcome is uncertain.

Until now, some ports have already installed scanners in preparation for this possible requirements from the US and other importers. Relevant to the issue of “last mile” connectivity is the location, quantity of scanners, time required to scan the containers, and procedure to investigate questionable containers.

As any system is only “as strong as its weakest link”, removing a “last mile” bottleneck can significantly enhance the overall competitiveness of a port. A process not streamlined enough could delay one container; for a port that handles thousands of containers a day, the accumulated delay can cause serious congestion problems. Simplification of documentation through a secured and user-friendly platform that shares necessary information to the relevant parties can speed up document processing times. More efficient port layout, with adequately located scanners, and space on the container yard that allows temporary waiting and efficient traffic flow, can also reduce congestion.

3.2.3 Port infrastructure

3.2.3.1 Having Adequate Capacity

An efficient port needs to provide the necessary infrastructure and adequate capacity to handle the current throughput and potential future business. The flexibility for future investment would also make the facility attractive for longer term investment by the private sector. Port development in Viet Nam and Singapore illustrates two extreme examples of the adequacy of port capacity.

The new port clusters in Cai Mep and Thi Vai in southern Viet Nam illustrate the importance of adequate capacity. The ports in southern Viet Nam mainly target gateway cargo, and the overall development has been fragmented, with little opportunity for terminal operators to expand or develop any scale economies.

Starting in the mid-2000s, at least six “ports” have been planned and built in this new port region. Although the combined capacity appears to be large, most of the container handling facilities have limited capacity to expand / upgrade, constrained by the quay lengths (only one straight quay longer than 600m), yard area (smaller than 50 ha for most), and draft depth (usually 14-

15m) for each port (Table 3.4). These new ports are **challenged by the fragmented port planning processes**, as well as lack of coordination in overall port development policy (see later).

Table 3.4 Physical Parameters of Ports in Cai Mep

Terminal / Port	Yard Size (ha)	Berth Length (m)	No. of Berths	Draft alongside (m)	Depth of Access Channels (m)	Investor / Operator
SITV	34	730	2-3	14	12	HPH, SICC
SP-PSA	27	600	2	14.5	12	SP, Vinalines, PSA
TCIT/TCCT	60	690+260	3	14	14	SNP, Hanjin, MOL, Wanhai
CMIT	48	600	2	16.5	14	SP, Vinalines, APMT
TCOT	48	600	2	15	14	SNP
SSIT	48	600+425	2	16	14	SP, Vinalines,SSA

Source: ICF, terminal operators

On the other hand, Singapore has aggressive port development plans. While Phases 3 & 4 of Pasir Panjang Terminals are still under construction (with full operations of all terminals at 50 million TEU scheduled for 2020), a brand new container terminal at Tuas is already being planned. Construction of Tuas began in April 2016, and Phase 1 is scheduled for completion by the early 2022. Tuas Phase 1 will have a capacity to handle 20 million TEU, and all four phases of Tuas will have a combined capacity of 65 million TEU upon completion. Ultimately, Tuas is planned to have 66 berths, 1,337 ha of land, and its berths will be linear with at least 400m in length to provide flexibility for different vessel sizes.

The ultimate capacity at Tuas would more than double Singapore's 2015 throughput volume of 30.1 million TEU, and there are queries over whether the demand will materialize to fill the planned capacities. These queries are not groundless, for Singapore has limited hinterland base cargo, the majority of its throughput is transshipment cargo and this is footloose by nature. Hence, it is possible that the planned capacity may not be utilized soon. However, the Tuas Terminal is scheduled to be constructed in four phases to allow flexibility for Singapore to decide whether / when to build the later phases of Tuas, in response to the latest market developments.

3.2.3.2 Knowing the Market and Customers

Some key infrastructure requirements for ports to handle the latest generation of mega-vessels are already listed in Section 3.1.7. It is emphasized, however, that these are the requirements for the mega vessels to date, and may not be suitable for smaller ports that do not plan to receive the mega vessels.

Port planners and executives are advised to review their overall cargo profile by type and the projected demand at their facilities, by the profile of vessels calling at their port, and by the forecast of its possible future development. For example, what is the average number of boxes exchanged per call, and are they imports, exports, or transshipment cargo? What is the average size of vessel calling at the port, and what are the related physical parameters (e.g. length, draft, breadth)? Such port profiling will provide port executives with the necessary information for an overall economic and financial assessment to evaluate the cost and benefits of installing different types of infrastructure and equipment which are typically high cost (both capital and operating expenditure) in nature.

Smaller gateway ports without a large amount of baseload cargo can be serviced more efficiently by smaller vessels. However, it is also possible that shipping lines may seek to deploy a large vessel to the port for strategic reasons, because it also calls at other large ports on the same service.

3.2.4 Institutional – government planning, industry and community support, and evaluation tools

Strong institutions supported by stakeholders from the industry and local communities is another essential factor that must be included / considered for effective planning, development, and operation of gateway ports. The importance of strong institutions is illustrated by the examples of Viet Nam, Singapore, and Canada below. The case of Viet Nam illustrates how the lack of a strong institution could lead to undesired port development, while the examples of Singapore and Canada highlight how much a strong government can achieve.

3.2.4.1 Government Planning and Implementation

As discussed in Section 3.1.9.3, southern Viet Nam was mainly serviced by the ports located in Ho Chi Minh City (HCMC) / Hiep Phuoc area until in the mid-2000s, when more options became available as ports in Cai Mep / Thi Vai area (about 50km south of HCMC) were developed (Figure 3.15). The older ports in HCMC are draft constrained but well established; the newer facilities in Cai Mep / Thi Vai were developed through a series of joint ventures involving many of the world's major international terminal operators.

The Vietnamese Government has, for some years, stated an intention to close the HCMC ports to alleviate the road congestion problems in the area. The plan was that the HCMC container traffic would be absorbed at the new deepwater ports in Cai Mep that have recently opened or are under development. However, the port relocation plan was not followed through. Progress has been slow and many old HCMC terminals remain in operation handling the vast majority of cargo through the system in southern Viet Nam system. After operations started at Cai Mep, the HCMC terminals still handle the vast majority of the throughput – 5.6 million TEU in 2014[11], or more than 80% of southern Viet Nam hinterland cargo.

Consequently, as new capacity has been developed and demand growth has slowed following the global economic downturn, capacity surplus at the Cai Mep terminals has become increasingly severe.

[11] In 2009, SP-PSA was the first port opened in Cai Mep.

Figure 3.15 Location of Incumbent and New Ports in Southern Viet Nam

Source: ICF

On the other hand, messages delivered by a government known to be strong in implementation can give the impression that the plan would be implemented even if details are lacking. As discussed in Section 3.2.3, in Singapore the “Next Generation Container Port (NGCP)” with an ultimate capacity of 65 million TEU is in planning at Tuas. This ultimate capacity is large by any standard – it is more than doubling the current throughput handled at the port which is the second busiest in the world. The fact that the Tuas development was announced while the current facilities at Pasir Panjang were yet to be completed also reinforces the impression that the Singapore government is keen to build the port.

The Singapore government’s reputation for efficiency and implementation means that there is considerable confidence that Tuas will be delivered and successful, although the exact programme and other details of the later phases of Tuas NGCP are yet to be made available to the public. Nonetheless, the assumption that Tuas will happen may be enough to deter other potential transshipment hub competitors from proceeding with their plans.

In Canada, international trade has always accounted for a significant share of the economy (about 54% off GDP). With generally decreasing logistics cost and the rise of the Asian economies, the Government of Canada worked closely with the private sectors to develop policy and program to support effective gateways and efficient multimodal transport operations as a potential source of competitive advantage.

In 2016, the Government of Canada launched the Asia-Pacific Gateway and Corridor Initiative (APGCI) as an integrated set of investment and policy measures focused on trade with the Asia-

Pacific Region (Figure 3.16). The goal is to ensure the transportation corridor is able to move goods efficiently, reliably and seamlessly between production and distribution facilities and end markets.

Figure 3.16 Canada’s Asia-Pacific Gateway and Corridor Initiative

Source: Canada's Asia-Pacific Gateway and Corridor Initiative website
http://asiapacificgateway.gc.ca/investments.html

The APGCI consists of strategic transportation infrastructure projects including British Columbia’s Lower Mainland, the principal road and rail connections stretching across Western Canada and south to the United States, key border crossings, and major Canadian ports. Many of these infrastructure projects are specifically developed to address the "Last Miles" issue to improve the road and rail transportation corridor leading to the port terminals in Vancouver and Prince Rupert.

The Government of Canada works closely with the private sector and local / provincial governments, and has invested approximately $1.4 billion in infrastructure projects for a total project value of approximately $3.5 billion. The gateway approach of linking trade and transportation together in an integrated, multi-modal, and public-private strategy was widely recognized as a Canadian best practice.

Beyond infrastructure investment, the APGCI also introduced a range of non-infrastructure competitiveness measures, touching on gateway performance, skills and labour supply, systems analysis, customs, and international marketing, to deepen and broaden the gateway concept.

3.2.4.2 Local Engagement

Industry and community engagement is also important to ensure that the port is designed to deliver services that meet the users’ demand at the right time. With greater attention on issues like climate change and globalization, the government and port operators are deploying various scientific and objective tools to engage the stakeholders and analyse the impact of various development and operation options in order to balance different requirements when developing and implementing their plans.

Some jurisdictions require that any major infrastructure development (e.g. port, connecting roads) need to go through several rounds of public consultations and environmental assessments to gauge views from the general public. This could involve town hall forums, and making announcements in public (gazettes, newsletters, media, and website) of major plans to discuss key issues of the major development plans. Some ports also have regular community engagement programmes to provide additional channels to provide important information regarding port planning to the community. This is a community-friendly channel for the general public to pass their opinions to the port operator.

Ultimately however, the decision maker needs to strike a balance between professional judgment and public opinion. Without counter-balances, being overly reliant on public opinions can be inefficient. An example is the port tariff adjustment process in Malaysia. Private port operators are allowed to propose tariff adjustments, but the rates need to be discussed with and agreed by the port's stakeholders (including port users). As can be imagined, port operator proposals to increase tariffs are usually not welcomed by ultimate customers. As a result, many ports have not had their applications to increase tariffs approved, resulting in tariffs that have been static for many years despite inflation.

3.2.4.3 Evaluation Tools

When initial consensus cannot be reached on particular issues, policy makers can deploy tools such as economic / social / environmental impact assessments to help evaluate the pros and cons of different options. These methods are deemed scientific, and it is typically easier to achieve buy in from stakeholders when they are part of those assessments.

4 Measuring and Monitoring Connectivity

4.1 Components of Port Connectivity

A major port today requires multiple development inputs and near real-time performance indicators and business intelligence to have a better understanding of their own and competitors' operations to make better and informed decision to achieve and maintain the status of a major gateway port. These inputs can be categorised into those relating to physical connectivity (e.g. connectivity inland, at port, and between ports) and non-physical connectivity (e.g. institutional and capital capability). Each of these are discussed below.

4.1.1 Physical connectivity - Inland, at port, and between ports

Physical connectivity of a gateway port can be broadly grouped into three components:

- Marine connectivity (between ports);
- “At port” connectivity; and
- Inland connectivity (between the hinterland and the port)

4.1.1.1 Marine Connectivity

Marine connectivity refers to how the port is connected to other ports. Some common indicators of marine connectivity are:

- Number of destinations
- Number of calls
- Weekly vessel capacity
- Average TEUs exchanged per call
- Maximum vessel size
- Vessels On-Time Performance
- Number of liner companies

These indicators are standard and are easy to measure. However, it does not explain the causality between marine connectivity and other factors. For example, marine connectivity is developed when shippers’ demand is strong, building up demand for liners to call at the port or to deploy larger vessels, improving the port’s marine connectivity. Hence, this raises the levels of the indicators listed above (perhaps except for “number of liner companies”). However, the reverse does not hold true: high levels of these indicators do not necessarily create a large cargo base.

In addition, the performance of many of these indicators are beyond the control of the port (port regulator or terminal operator). The terminal operator can react to marine side connectivity, but it can hardly proactively change it. For instance, it is a liner company’s private business decision which vessels of what capacity to call at certain ports and at which frequency. If a port achieves high values of vessel size and number of ship calls, it may signal to the port to upgrade its infrastructure and necessary equipment, or even to prepare more land for port expansion to cope with these vessels. However, if the value of these indicators is low, there is little the port / port regulator can do to improve marine connectivity. This is are discussed further in Section 4.2.

4.1.1.2 *"At Port" Connectivity*

Connectivity at the port can be understood as how much cargo the port can handle over a period of time (capacity), how quickly the cargo is handled (productivity), and how costly it is to handle the cargo (efficiency). A port with high ratings in all these aspects can better connect the vessel and the inland. Although this "at port" connectivity only accounts for a relatively small portion over the whole supply chain, its significance should not be undermined – "a port can only be as strong as its weakest link". This is probably where the port authorities and terminal operators have the most control and make the largest contributions to connectivity enhancement.

Some common indicators to measure port connectivity are:

- Container handling capacity
- Quay length
- Depth of berth
- Yard area
- Number of quay cranes
- Number of liftings before loading containers onto the train (if applicable)

These indicators clearly list out the infrastructure and superstructure availability at the port, but do not inform the user as to how well the containers are handled.

Port productivity can measure how quickly the port handles containers, but there are challenges of using and interpreting port productivity. For example, there lacks a uniform standard that is consistent across *all* ports to measure productivity. In measuring the time required to handle a vessel, the cut off time varies from port to port, or from terminal to terminal. Some ports start to measure time from when the vessels enters the port area, but some start measuring once the vessel is berthed. This makes it difficult to compare turnover and congestion information across ports.

Another challenge is the measure of "capacity". Generally speaking, capacity is largely determined by the container yard area, but it can sometimes be improved through more efficient use of port backup land or using equipment to stack up containers. This "actual" capacity as measured by container yard area can therefore be adjusted over time without increasing land.

4.1.1.3 *Inland connectivity*

Inland connectivity refers to how the port is connected to the hinterland, or how efficiently the cargo can be moved between the hinterland and the port.

Since highways / rails / barges are the most common modes of inland transportation, one basic measure can be the availability of these inland transportation infrastructure systems. Other possible ways to measure inland connectivity are:

- Costs of using each mode
- Network of coverage – distance and time to the nearest (major) hinterland, and degree of penetration to the hinterland
- Quality of inland connections, for example:
  - Measure of road congestion (e.g. average time per km travelled)
  - Physical condition of roads (Are highways paved?)
  - Number of lanes-kilometers of highways
  - Frequency and network coverage of port rail

- Frequency and network coverage of barges (short-sea shipping)
- Availability of road transportation services (e.g. number of trucks / truck companies)
- Transit time of container from port to end destination.

The measure of inland connectivity is, however, considered the most challenging among the three physical connectivity components, because the options for inland transportation are hugely dependent on a number of factors such as the geography of the region and the location of the port's hinterland. As a result it would be difficult to derive standards that are common to all ports.

One example of a measure to capture total inland transportation time is an initiative developed by Canada: the Fluidity Indicator Program. This evaluates how gateways and strategic trade corridors interact together operationally. The purpose of the indicator is to examine end-to-end supply chain performance, focusing on the time component, i.e. the total transit time of inbound containers from overseas markets to strategic North American inland destinations via various Canadian gateways. Total transit times are calculated by summing up all modal segments of end-to-end movement. No single data source (or provider) can capture transit time data for the entire container trip; hence, a variety of data exchange partnerships are in place with several stakeholders. This method relies on genuine primary data from private sector carriers supplied on a voluntary basis, and this level of cooperation is believed to be challenging in a number of economies.

In considering freight rail and barge connectivity, besides reviewing its availability and degree of penetration, other measurement approaches should reflect the need to have double or triple handling of cargo between two modes, container dwell time, and availability and quality of loading / unloading facilities.

For all modes (trucks, barge, and rail), one may be inclined to measure the quality of inland transport services by the number of operators involved. However, indicator selection needs to be assessed carefully. For example, it is generally believed that more operators can introduce competition, thereby encouraging enhancement of service quality so that the operator can remain competitive. However, too many operators may lead to fragmentation of industry, which is difficult to monitor. Small operators may also be reluctant to invest in productivity enhancements. On the other end of the spectrum, some services enjoy a natural monopoly or oligopoly situation, and this is not necessarily an adverse factor for port connectivity. For example, it would be difficult to identify more operators to run the freight rail systems, because barriers to entry including availability of assets (railway, and most important, the land) and technological know-how, are too high.

Hence, measuring inland connectivity is important in understanding how efficiently the port is servicing its hinterland, but there is more than one way to measure the quantity and quality of inland connectivity. No one standard can be applied to all ports, and suitable measures would need to be derived taking into account unique geographic features of the port and its hinterland.

One extreme case is Prince Rupert where no significant local cargo base exists; but which is well connected by rail. This rail means that it is possible to move containers to the Canadian and US Midwest hinterland more than 4,000 km away with a train journey of 4.1 days[12].

The number of inland transport operators can sometimes be used as an indicator of port competitiveness, but it may not be ideal to measure inland connectivity. The number of operators is determined by a number of factors, such as the mode of operation (e.g. the rail industry is natural monopoly, whereas the trucking industry has relatively low entry barriers and operators are many), market size (a small hinterland cannot afford too many operators), and

[12] Source: Prince Rupert Port Authority

local business culture. In economies where labour unions are strong, even large number of small players can reach consensus easily. The measure of road congestion and conditions also lacks standardization across different economies, and sometimes involves professional judgement.

4.1.2 Non-physical connectivity

Non-physical components are difficult to quantify and qualify, and judgement is often required to achieve measurement – if possible at all. Some examples are:

- Availability of a strong freight forwarding community – how to define a “strong” community?
- Cabotage – what is allowed and what is not?
- Free zones – are they available? What is the nature of cargo produced, and at what quantity?
- Port governance & trade facilitation? How is it measured?
- Relative competitiveness against the competitor port? What are the criteria to measure “competitiveness”?
- Customs – what are the functions, do they enforce customs clearly, fairly, and efficiently? What is the dwell time at the customs?
- Availability of skilled and stable labour?
- Environmental Performance - again, methods of measurement are diverse; from carbon footprint, to CO_2 emission, to MARPOL generation and collection, amongst other issues.
- Local government / resident support – is port development supported locally?
- Inland terminal / depots to facilitate logistics flow – do these facilities exist? Where are they located, and what roles do they play to facilitate logistics flow? Are they regulated? Are they easy to use, and how much costs can be saved?
- What is the government’s role in trade facilitation? What is the time required for cargo to clear customs / bio security?

4.2 Existing Methods

After some research over the existing indices, it was concluded that the Liner Shipping Connectivity Index (LSCI) developed and published by the United Nations Conference on Trade and Development (UNCTAD) is one of the more well-known and established indices that measure port connectivity. To supplement the missing elements of this index, the Liner Shipping Bilateral Connectivity Index (LSBCI) has also been developed and updated regularly. However, no consistent, standardized, comprehensive measure of inland connectivity can be identified so far.

The features of LSCI and LSBCI are summarized below, based on the descriptions provided from the UNCTAD websites.

4.2.1 Liner Shipping Connectivity Index (LSCI)

LSCI is updated on an annual basis, and is maintained by UNCTAD based on data from Containerization International Online (www.ci-online.co.uk) and Lloyd’s List Intelligence.

LSCI indicates an economy’s integration level into global liner shipping networks. The index base year is 2004, and the base value is on an economy showing a maximum figure for 2004.

The index was developed with the aim of capturing an ***economy's*** level of integration into global liner shipping networks, which also provides some indications of the economy's access to world markets, especially as regards regular shipping services for the import and export of manufactured goods.

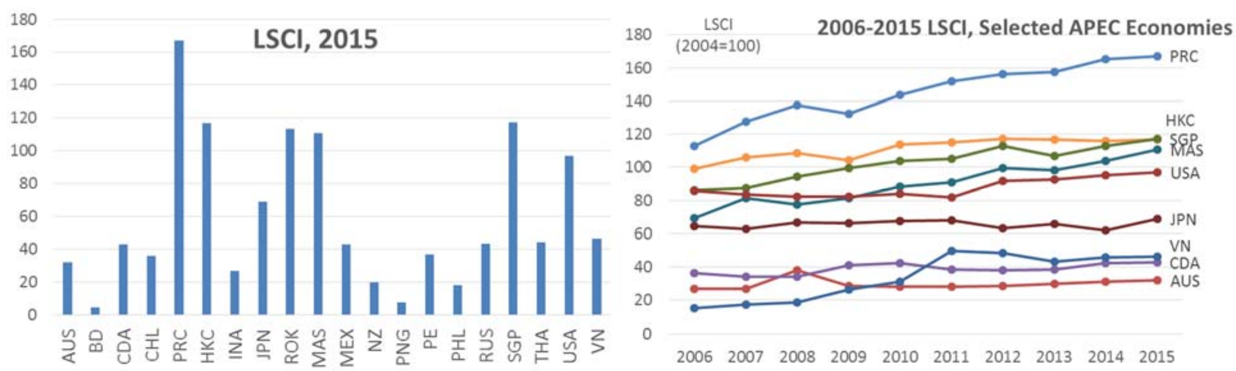
The current version of the LSCI is generated from five components:

- the number of ships;
- the total container-carrying capacity of those ships;
- the maximum vessel size;
- the number of services; and
- the number of companies that deploy container ships on services from and to an economy's ports.

The index is generated as follows: for each of the five components, an economy's value is divided by the maximum value of that component in 2004, and for each economy, the average of the five components is calculated. This average is then divided by the maximum average for 2004 and multiplied by 100. In this way, the index generates a value of 100 for the economy with the highest average index of the five components in 2004.

The LSCI covers 237 economies in total. The 2015 indicators for all APEC economies and the change of this index for selected APEC economies in 2006-2015 are summarised in Figure 4.1 below. LCSI for all APEC economies over the period 2006-2015 are presented in Annex 3.

Figure 4.1 2015 LCSI, All APEC Economies* (left) and 2006-2015 LCSI, Selected APEC Economies (right)



*Source: ICF based on UNCTAD. Notes: *database does not cover Chinese Taipei. A list of full names of APEC member economies' abbreviations is provided in the Glossary.*

4.2.2 Liner Shipping Bilateral Connectivity Index (LSBCI)

LSBCI is updated annually, and is also maintained by UNCTAD, also based on data from Containerisation International Online and Lloyd's List Intelligence.

LSBCI indicates an **economy pair**'s integration level into global liner shipping networks. The LSBCI is an extension of UNCTAD's economy-level Liner Shipping Connectivity Index (LSCI) and based on a proper bilateralization transformation.

The index was developed to reflect specifically the liner shipping connectivity **between pairs of economies**.

The current version of the LSBCI includes five components. For any pair of economies A and B represented in our sample, the LSBCI is based on:

- the number of transshipments required to get from economy A to economy B;
- the number of direct connections common to both economies A and B;
- the geometric mean of the number of direct connections of economy A and of economy B;
- the level of competition on services that connect economy A to economy B;
- the size of the largest ships on the weakest route connecting economy A to economy B.

In order to establish a unit free index, all components are normalized using the standard formula:

Normalized_Value = (Raw - Min(Raw)) / (Max(Raw) - Min(Raw)).

This formula rather than the Raw/Max(Raw) formula has been chosen essentially because of the existence of minimum values which differ from zero. If all minimum values for all components were zero both formulas would be equivalent and would generate identical normalized values.

The LSBCI is computed by taking the simple average of the five normalized components. As a consequence, the LSBCI can only take values between 0 (minimum) and 1 (maximum). As to the first component, we simply take its complement to unity that is 1-Normalized_Value to respect the correspondence between higher values and stronger connectivity.

The LSBCI covers 157 economies.

4.2.3 Issues with LSCI and LSBCI

The LSCI and LSBCI can both capture how well ***economies*** are connected. These two indices measure marine connectivity to a certain extent, but they do not measure inland connectivity. In other words, they do not comprehensively measure door-to-door connectivity.

These two indices are measured at the economy level. An economy can have a number of ports with very different performance measured by cargo size and profile of vessels. LCSI and LSBCI however do not distinguish among ports within an economy.

As discussed in Section 3.1, the shipping liner industry is currently under a trend of consolidation. The declining number of liner companies will result in lower LSCI, and this is a common phenomenon across the world. It is also noted that most ports are serviced by the same liners. Therefore, the component "number of companies that deploy container ships" may not seem to be a meaningful measure, as it does not really differentiate among economies nor among ports.

Another issue is the application of LSCI and LSBCI. While these two indices were developed to understand how well an ***economy*** is connected to overseas markets by marine connectivity, it does not seem to affect the behavior of shipping lines. For instance, when liner companies order new (and larger) vessels, these two indices do not appear to be of great reference values.

4.3 Practicality of a "Comprehensive Connectivity Index"

To develop a gateway port connectivity index, some issues will need to be addressed. The discussion below is prepared to highlight some of the issues and challenges, but is not meant to be comprehensive:

- The **purpose** and the **target primary users** of the index needs to be identified. Who will use the index, and what can they achieve in using it? How does it align with the primary functions of these users?

  Many stakeholders are involved in the supply chain and their background and functions vary. Some are private sector players whose primary interest is to maximise their own profits and need to make quick decisions despite limited information; some are from the public / semi-public sectors whose functions are supposed to balance and optimise interest of various stakeholders, and who tend to make their decisions with reference to a lot of information. Of the latter, there are multinational institutions, governments of various levels, and they all focus on serving their stakeholders in different jurisdictions.

Some stakeholders are from a fragmented industry with little resources; some industries are more monopolistic / oligopolistic in nature and may avail spare resources to undertake research and development (R&D). Some, like the academics or some government departments have R&D as one their primary functions.

It will be best to clarify the purpose and the target primary users of the index in order to achieve maximum efficiency in both developing and utilising the index.

- The **components** covered by the index will need to be confirmed.

  As discussed earlier, the movement of hinterland cargo between the origin and the destination involves a number of activities, and generally can be categorised into: inland transportation, port interface, maritime connectivity, and intangibles. An index will be comprehensive only if the connectivity / competitiveness of *all* these components can be measured.

- The **composition** of the index: following the discussion on index components, factors from each of the above components will need to be selected. These factors will need to be representative and objective, quantifiable, and easy to obtain.

  - Representative and objective: these factors need to be able to measure the key features that are important to most ports. For example, inland connectivity is critical, but the approach to measure inland connectivity would need to be adapted based on the geographies of the ports. The availability and quality of freight rail services are important for ports with hinterlands that stretch over several hundreds of kilometres, but less so for ports with concentrated hinterlands, or for ports located by a river where barging becomes the primary inland transport mode.

  - Quantifiable: some factors, especially the intangible ones, are more difficult to quantify.

    For example, the availability of a strong freight forwarding community is more than a simple "checking the box" exercise. It is both a perception and a relative concept. It would be unfair to rate a freight forwarding community simply by the number of players: while a larger number of players usually encourages competition and hence performance, it can also mean a fragmented industry structure with a large number of small players, lacking coordination and with limited sharing of industry knowledge.

    Another example would be flexibility of government regulations. Usually a transparent and fair jurisdiction is preferred, but that could also be translated into a lack of flexibility to respond to unplanned incidents.

  - Easy to obtain: some factors are not readily quantifiable (see above) and are considered difficult to obtain. Some factors are quantifiable, but the availability depends on the capability of data management where the data are generated. For example, port interface / productivity can be quantified, but data can only be supplied by the port / terminal. The terminal operators will need to agree on the approach to measure these factors, have the capability to record the data, and be willing to share the information.

    The Consultants' prior experience suggests the *lack of capability to collect and compile data* is a common challenge among many smaller terminals. Many ports / terminals and transportation service providers, including the more established ones, consider such information commercially sensitive and are unwilling to share. If the purpose of the index is agreed by all players, and if the index developer is regarded as having a high reputation for keeping information confidential, it would be easier to obtain data from the sources where data are generated.

  - Finally, the relationship and relative weighting among these factors will need to be established. Should the relative weighting be determined by the respective contribution to GDP or number of persons engaged, or the degree of importance along the supply chain – and how can that be measured?

- The **frequency** of update for the index. Like any other indices, the gateway port connectivity index being explored needs to be periodically updated. What time frame can balance both the timeliness of the index and yet be sufficiently pragmatic, given that the underlying data update frequency varies from daily (e.g. number of shipping lines calling a port is information that can in theory be obtained daily from the ports or other public maritime sources) to much more infrequently updated?

  Apart from regularly updating the index using the latest available statistics based on the current index structure, there is also a need to regularly review the appropriateness and quality of the index – whether the components and formula can reflect the latest market structure and meet the requirements of the stakeholders.

- The **developer** of the index: depending on the complexity of the index structure and the ease of updating the index components, the index can be developed by an established research institute who collects raw data from individual data sources, or if the skills required to develop the index is standard easily transferable, it can be developed by the individual ports who then release the information regularly.

5 Technical and Policy Recommendations

Based on data analysis, desktop and literature review, and stakeholder consultations described above, the key success factors, trends and issues affecting the existence, development and success of Gateway port functions are summarised below. The technical and policy recommendations identified below could support the development of Gateway port functions and help improve a port's connectivity.

5.1 Common Lessons

5.1.1 Ports and Their Functions

Three main functions are performed at a port: gateway, relay transshipment, and hub-and-spoke transshipment. Most ports serve multiple functions. The "gateway port function" in the context of this Study refers to the activity a port undertakes to move hinterland cargo in and out via the port. Hinterland is the natural catchment area of the port, and typically spans within 250km of the port if it is mainly served by trucks, or over 250km if it is also served by rail or barges.

The complete supply chain of the gateway port starts from the hinterland and finishes at the cargo's ultimate destination. Activities along the supply chain can be broadly grouped into three categories: (i) inland, or between hinterland and the port; (ii) at the port; and (iii) marine, or between the origin and destination ports. A comprehensive measure of gateway port connectivity will need to cover the performance of all these activities. Key factors affecting the performance of a port's gateway function are highlighted below.

Inland connectivity between the hinterland and the port is critical. A number of ports indicate that even if they have good maritime connectivity (between the port and overseas ports), the hinterland-port connectivity is sometimes sub-optimal. Good infrastructure planning and implementation can remove this bottleneck along the supply chain. While infrastructure planning is traditionally undertaken by the government, the private sector can also participate through procurement models or other public-private-partnership (PPP) initiatives. A properly designed and implemented PPP project can improve cost and operational efficiency, and allocate risks to the parties that are best placed to manage them.

The "last mile" is another connectivity issue facing many stakeholders. It refers to the connection between the port gate and the main arterial roads/railway. The cause can be either physical or institutional, but it is unlike what causes the wider inland connectivity issues for which designed capacity is the most common issue. It is possible that neither the government departments nor the port authorities spend enough consideration on the infrastructure because they were unaware that the "last mile connectivity" is also a critical port component; sometimes it is the lack of proper coordination as too many stakeholders are involved in this interface. It could also be the documentation required, new requirements to scan or investigate a higher percentage of containers, or other procedural requests that slows down the process at the last mile.

It appears that improved communication and coordination between stakeholders is already a major first step to solving many of the last mile connectivity issues. Information sharing on common platforms, and streamlining documentation requirements can be possible solutions to the "last mile" bottleneck. Online documentation, or an inland port where documentations customs clearance are done at a more spacious and better designed location, before moving via a "green lane" to the port for loading, can also be another solution to solve port congestion problems – although if not properly done, it is only relocating the congestion problems from the marine port to the inland port.

Base load cargo is essential to ensure sustainable demand for a gateway port. Without a hinterland of base load cargo, gateway demand does not exist. A successful gateway port is not constructed on the “build it and the demand will come” mentality. The gateway port function facilitates cargo movement, but only when the base load cargo exists.

This concept must not be confused with port throughput by transshipment cargo. By definition, transshipment cargo is generated from outside of the economy. A properly designed and built port along a key trade lane could generate some transshipment cargo – the shipping lines would see a new option to tranship their containers when a new port is built. How these containers are routed does not change the total number of containers moved; it only affects the number of container liftings (throughput), depending on how the containers are transhipped. This is different from the concept of base load cargo, where the container is loaded at the gateway port only once. Building a larger port would not generate more hinterland container throughput.

The **Government’s roles** vary among APEC economies. Some are more engaged and play a heavy role in designing, building, and operating the port themselves or through a state-owned company (e.g. Singapore, China). Some adopt a more laissez faire approach, where the government’s main roles are ensuring all relevant parties compete on level playing field and the operations meet safety requirements (e.g. Hong Kong Port). In general, the workshop participants agree that the government should at least play the following roles:

- To facilitate and coordinate port development;
- To ensure a level playing field;
- To ensure consistent regulations and internationally accepted concession requirements;
- To ensure stakeholders are engaged and informed; and
- Comprehensive and holistic planning is important, but requires appropriate execution.

Process of port planning – it was generally agreed that stakeholders representing various sections along the supply chain need to be consulted to understand the actual development in the industry and their requests, although there are different opinions as to who should be engaged, the length of consultations, issues consulted, and how the advice is to be followed through. However, it is generally agreed that the consultations should begin from an early stage. The process should be fair and transparent, and should involve scientific tools (see more below).

To help decisions makers evaluate various options, a number of tools can be used such as: engineering feasibility, financial viability, economic impact assessment, environmental impact assessment, and social impact assessment. These tools can help evaluate whether the development options are technically feasible; can help assess what are the relative costs involved, can test whether benefits expected to yield in each options; and can explore the possible economic, financial, social, and environmental impacts of each option. If no one single option stands out in all evaluation criteria, the decision maker will need to apply discretion in selecting the most appropriate development option.

5.2 Priorities of port development

A port involves many local, regional, and other stakeholders from the public and private sectors, who have different development preferences, objectives, and agenda. How can these priorities be reconciled when they do not align?

5.2.1 Profit vs throughput volume

The private port operator aims to maximize profits; however for the public sector, profit maximization is not necessarily their highest priority. This issue could arise when the public sector and the port have different views on whether it should focus on its gateway port functions or transshipment functions.

Typical transshipment yields high throughput volumes (all containers are moved twice) but usually lower revenue per TEU (also see 3.1.7). If the port prioritises the servicing of transshipment cargo, TEU numbers could be high, but port profits may not be proportionally high because transshipment containers typically have lower per unit tariffs. In light of the very strong competition over the transshipment market in the region, ports may further lower their charges to attract cargo – hence reducing the port's profitability.

Nonetheless, transshipment containers still yield positive profits to the operator most of the time. It is however the port regulator's decision regarding how to prioritise their investments in order to attract which cargo segment.

5.2.2 Who benefits, who pays

Port development involves substantial investment, which can be generally categorised into three types:

- Basic infrastructure which can be used by anyone, e.g. connecting highways, capital dredging of approach channel, breakwater, etc.;
- Port superstructure used by the port, e.g. quay ways, container yards, etc;
- Port equipment used by the operator and other players on site, e.g. quay cranes.

In a typical port development project, the government pays for the basic infrastructure, and the private operator pays for the port equipment. The agency responsible for port superstructure depends on how the concessionary agreement is drafted.

Some ports receive very strong state support through direct and indirect financial subsidies (an example of the latter includes subsidised premium rates for using the site). This will however disrupt the level playing field in the industry, as these subsidised ports can compete with a much lower charge. This regional competition applies on the transshipment cargo but to a less extent on gateway cargo; however the shipping lines attracted to the transshipment port could also bring intangible benefits to the port through better maritime networks.

The important point is that public finance requires justification. The economic assessment to provide such justification must typically also be open to the public for review.

5.2.3 Wider economic impacts

Where hinterlands overlap, infrastructure investment need to be carefully considered in order to avoid duplication.

Economic impact assessments can be a useful tool, but many ports (especially in Asia) have not developed this as a tool for the port planning process and to form the interface with the responsible authorities and terminal operators. In these cases, there is often not enough emphasis on the potential multiplier effect of investment funds and economic activities.

Development options that seek government funds should include an economic assessment of the development proposals – i.e. presenting the case for the economic benefits to the government for a particular proposal (in addition to the financial assessment which, amongst other things, details the level of viability gap financing required). Without this economic assessment framework in place, there seems to be no common yardstick or objective way to judge the pros and cons of different projects from an economy-wide perspective and to decide how best to allocate taxpayers' funds, or whether to allocate any funds at all.

5.2.4 Trade facilitation vs Customs Requirements

It was discussed in the “last mile” connectivity section that documentation requirements at a port could be one reason for last mile bottlenecks. As a result, and in order to avoid creating or worsening bottlenecks, when new policies and procures are rolled out, a conservative approach is recommended. Any changes, if at all, should be clear and transparent, straight forward, gradual, and should aim to avoid confusion or require great learning from the users.

Efficiency and good productivity are important factors that all ports needed to keep in mind. These impact virtually all links in the supply chain from the shipping line to the local trucking company and warehouse.

5.3 Gateway Port Connectivity Index

Some indices, such as the Liner Shipping Connectivity Index (LSCI) and the Liner Shipping Bilateral Connectivity Index (LSBCI), both developed by UNCTAD, have been developed to measure port connectivity. While these indices can capture how well economies are connected, they do not distinguish the performance among ports within the same economy or economy pair. Moreover, inland connectivity – one of the key components determining overall port performance – is not measured by these indices.

If a gateway port connectivity index is to be developed to fill the gap of the existing indices, the following issues will need to be addressed and clarified:

- purpose and application of the index;
- identity of the index developer;
- primary target users of the index;
- components / activities to be covered, the rationale and approach to measure these components, and the methodology to compile an index comprising these components;
- frequency to update the index, and responsibilities to update;

This Study has identified the above issues. For example, applying one approach to measure inland connectivity is a challenge, given that the geography and local economic structure of each port is unique. Balancing interests among stakeholders from various economies and economic sectors would also be another challenge.

There is no short cut to the answers to the above issues. Instead, consensus should be sought following successive rounds of discussions with various stakeholders.

5.4 Technical Details of the Container Terminals

Gateway ports **wishing to compete for larger vessels and specifically the mega-vessels** (+18,000 TEU and above) must invest in and deliver the necessary infrastructure and services to accommodate and service these vessels. Port investment and planning parameters or KPIs for these vessels are:

- 18m water depth;
- long straight quays (1,000 m or longer) to deliver maximum flexibility in handling a range of vessels and deploying equipment most efficiently;
- cranes with outreach for 23-24 TEU across;
- adequate yard area to support quay face operations and large box exchanges per call – ideally 600-650 m average of yard depth; and
- inland connectivity.

In addition, this infrastructure and related port operations must be managed to meet the service requirements of the lines. Typically the carriers demand:

- More than 35 moves per crane hour and 230-250 moves/ship hour at berth for larger vessels; and
- Reliable berth windows and turnaround time, ideally with surplus capacity to 'catch up' late vessels.

A further consideration is the ability of major ports to deliver enough cargo or moves per call, to ensure that the large vessels deliver the required economies of scale. Theoretically, the best port infrastructure and operations are of little use, if a port is unable to deliver this critical volume of moves.

For commercially focused terminal operators, the key challenge is to **meet customer service requirements at minimum cost**. In other words, the terminal operators need to deliver customer productivity KPIs (e.g. Berth Productivity) whilst also maintaining high utilisation (e.g. TEUs/m of quay/per annum; TEUs/Quay Crane/per annum; TEUs/hectare of yard/per annum; etc.). In developing new capacity, consideration of investment returns will invariably be a key concern. With the arrival of larger vessels, terminal investment requirements are increasing and, in the case of the major alliances, the amount of capacity that needs to be provided is also increasing. Gateway ports enjoy some risk minimisation via the attraction or pull of their import/export (hinterland cargo). In the absence of other competitor gateways, this base load of hinterland cargo provides a major incentive for shipping lines and direct services to call.

6 Conclusion

No two ports are identical. The economies driving the development of a port's hinterland cargo, the geography and market structure of the transportation markets that determines how the hinterland is connected to the port, and the operations / concessions model of the port / terminal, are unique for every port. Nonetheless, some commonalities can be observed:

- Most ports perform more than one function (gateway, relay transshipment, and hub-and-spoke transshipment), but the form and degree of these functions vary across ports and over time.
- Most ports have the involvement of the state or local government to some extent in port planning or operations. The extent of this involvement can vary; from fully state run (either directly or through state owned operations) port operations such as China or Singapore, to highly devolved, arm's length operations where the government is involved in issues such as port development facilitation, competition enforcement and stakeholder engagement such as Hong Kong Port. The extent of government involvement may also determine the port's financial objectives in relation to its operations.
- Most ports are facing requirements to deal with increasing vessel sizes, as the introduction of large and mega vessels on the busiest trade routes results in the cascading effect of vessel sizes throughout other trade routes. Increasing vessel sizes require increased and different port infrastructure, superstructure and equipment requirements, but the needs of individual ports to invest/upgrade these systems depends on their customer profiles and port function.
- Most ports are under pressure to deliver high quality services and productivity to their customers, while maintaining high utilization in order to achieve financial returns. Although specific financial objectives vary by port (and particularly by the level of government ownership and government strategy for the port) this results in a need to balance investment, risk and return with regards to provision of capacity, services and tariff setting.
- Most ports must constantly seek to balance interests, objectives and agendas from a wide variety of stakeholders at the port including customers, government, local residents and logistics providers. A suitable balance must be achieved between engaging stakeholders in decision making whilst also taking the actions and decisions required for the development and progression of the port.
- Connectivity including maritime, at port and local connectivity is crucial for all ports. Connectivity drives a port's function, performance and development opportunities, and of particular importance – as it is most often overlooked during port planning and operations – is "last mile" connectivity as inland intermodal networks meet port operations.

In addition to these commonalities, there are also specific attributes that define and characterize gateway ports, or those with predominantly gateway port-type functions. These include:

- Strategic location along a major trade lane or in the vicinity of a strong base cargo-bearing hinterland. Exceptions to these location attributes do exist, but only where alternative attributes are sufficiently significant to overcome the absence of the above. For example, Prince Rupert has no local hinterland with base cargo, but instead has a strategic location with freight rail connection to the North American cargo heartland.
- Very strong inland connectivity, including "last mile" connectivity. As the main priority of gateway ports must be to efficiently service cargo from its hinterland, efficient, low cost connectivity between the port and its hinterland is crucial. The mode of this connectivity; highway, rail or barge, is less important than the efficiency and cost at which the mode can

transport cargo to the port, and the efficiency at which the cargo can be admitted into and through the port itself.

Key success factors and challenges for the efficient development and operation of gateway ports are therefore predominantly based around both these port commonalities and the gateway port specific characteristics. In developing gateway ports, and in particular in attempting to improve their ability to facilitate trade and promote economic growth, port stakeholders must firstly review these drivers and challenges at a broad level, before analyzing them in the context of their specific port and its unique geographical features, customer base and existing port attributes.

Finally, the connectivity of a gateway port; including its maritime connectivity, inland connectivity, "last mile" connectivity, at port connectivity, and non-physical connectivity may be one of the most important drivers and challenges in its development and operation. In recognition of this, the concept of whether and how a connectivity index could be used in order to support the development of gateway ports has been explored. This has shown that existing connectivity measures and indices; namely LSCI and LSBCI are unsuitable for this purpose as they do not capture port connectivity specifically (as opposed to economy connectivity), they do not include consideration of inland connectivity – already noted as a key success factor for gateway ports, and they do not account for current changes in the shipping liner industry.

However, potential issues with the practicality of designing and implementing a more suitable connectivity index have also been discovered. These include the requirement of a clear definition of who and what the index would be for amongst the broad array of stakeholders and their very different objectives, the need for a broad array of index components to be included in order for the full complexity of connectivity issues in relation to a gateway port to be captured, and achieving a balance in index update frequency given varying input data update timetables, and the cost and complexity of update.

Annex 1 Basic Facts of Selected Ports

This annex summarizes the features of the ten ports selected for this Study.

Figure A1.1 Location and Relative Size (by throughput) of Ports Selected for Further Analysis

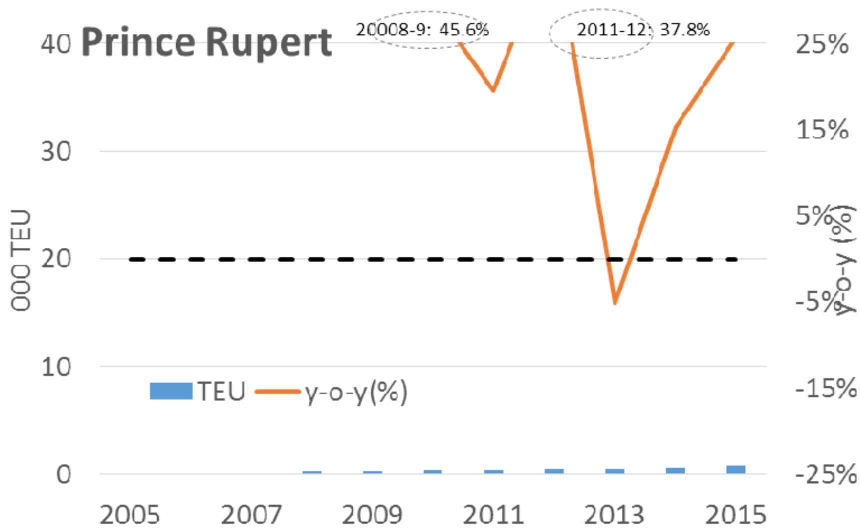
Source: ICF

A1.1 Prince Rupert

Prince Rupert is a relative small port, handling 776,000 TEU in 2015. It was selected because its function is mainly to service gateway cargo – this compares with most other ports where both gateway and transshipment cargo is handled.

The port had rather high year-on-year (y-o-y) growth rates in a few recent years, but this was largely because it started with a small cargo base (Figure A1.2).

Figure A1.2 TEU and Growth Rate, Prince Rupert



Source: ICF

The primary hinterland of Prince Rupert is hundreds of kilometres away in the US Midwest and Canada. Its main competitors are other North America US West Coast Ports. Prince Rupert is connected to its hinterland by rail freight, with the largest unloading points in Chicago and New Orleans.

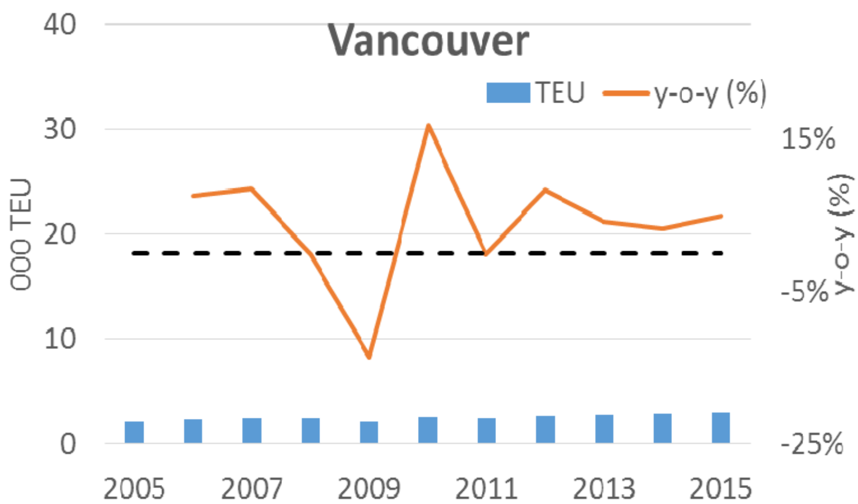
Key success factors for Prince Rupert include its relatively short distance from north Asia, and a direct inland connectivity to the US Midwest and Canada by freight rail. The port's biggest challenge is the lack of base cargo – there is basically no economic activity where the port is located; it is only a rail gateway.

The port became fully operational in 2008.

A1.2 Vancouver

Vancouver Port handled about 3 million TEU in 2015 (Figure A1.3). The port had rather healthy y-o-y growth in recent years, with a compound annual growth rate (CAGR) of 3.3% (2005-2010) and 4.0% (2010-2015).

Figure A1.3 TEU and Growth Rate, Vancouver



Source: ICF

The primary hinterland of Vancouver Port is Edmonton, Canada, and the US Midwest, overlapping with that of Prince Rupert's. Besides Prince Rupert (with 776k TEU in 2015), competitor ports of Vancouver also include Seattle / Tacoma (3.3 million TEU), less than 300 km away.

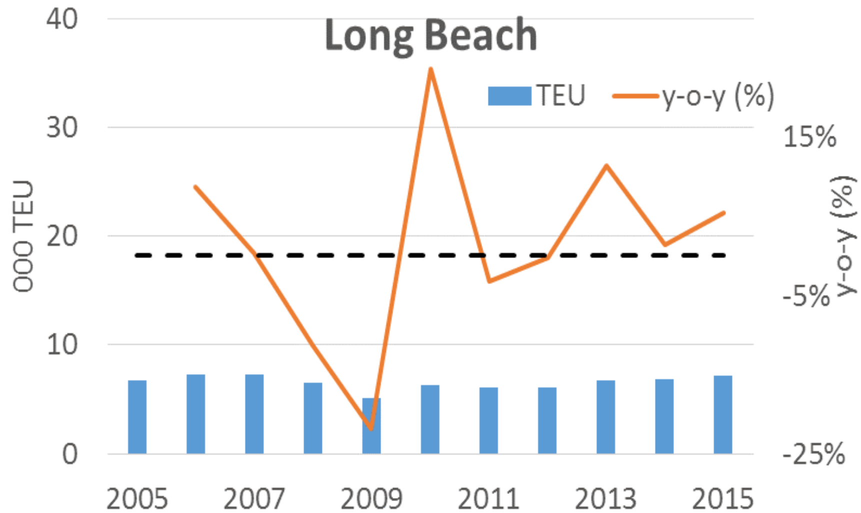
Vancouver is connected to its hinterland by rail to other parts of Canada and Chicago. Road is also an option, although that is only preferred over shorter distance (e.g. within British Columbia and sometimes to Alberta).

The key success factor for Vancouver Port is its good road and rail connectivity to all main destinations – it is connected by three Class One rail roads. Its biggest challenge is the relatively small base cargo near the port.

A1.3 Long Beach

The Port of Long Beach is one of the largest ports on the US West Coast, handling 7.2 million TEU in 2015. Y-o-y growth rates at the port have fluctuated over a rather wide range, from -22% in 2009 to +24% in 2010. Overall average throughput growth (as measured by CAGR) was low at -2.0% for the period 2005-2010 but recovered to 3.5% from 2010 until 2015 (Figure A1.4).

Figure A1.4 TEU and Growth Rate, Port of Long Beach



Source: ICF

The primary hinterland of Long Beach is the vast territory of the US: in particular the Southwest, Midwest, and East Coast. The Consultants have identified that Port of Long Beach's main competitors are ports of similar throughput: Port of Los Angeles (8.2 million TEU in 2015) and Oakland (2.3 million TEU), although its relationship with the Port of Los Angeles is mixed: the two ports compete for business, but cooperate regularly on various areas including security, infrastructure projects, and environmental programmes.

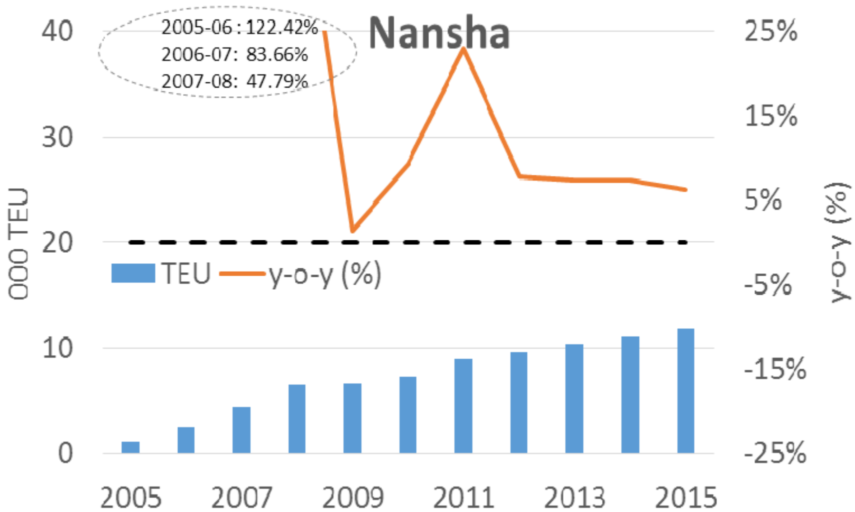
The Port of Long Beach is connected to its key hinterland by freight rail and highway. The rail connects the port to the US Midwest and Southwest.

Key success factors for the Port of Long Beach include good road and rail connections to all major destinations as it has two railroads. It also has a large immediate base cargo: southern California is one of the most populous and economically active regions in North America. One of its biggest challenges is the potential competition from the Manzanillo, a new port in Mexico, on top of its existing competition from Los Angeles and Oakland.

A1.4 Nansha Guangzhou

Nansha Guangzhou handled 11.8 million TEU in 2015. It is a relative new port, hence its recent growth rates have been rather buoyant. The port's throughput CAGR was 46.2% in 2005-2010, and 10.2% in 2010-2015 (Figure A1.5).

Figure A1.5 TEU and Growth Rate, Port of Nansha



Source: ICF

The primary hinterland of Nansha Port is south China, which pretty much overlaps with that of Hong Kong Ports. Its key competitors are the Hong Kong Port (20.1 million TEU in 2015) and Shenzhen (24.2 million TEU).

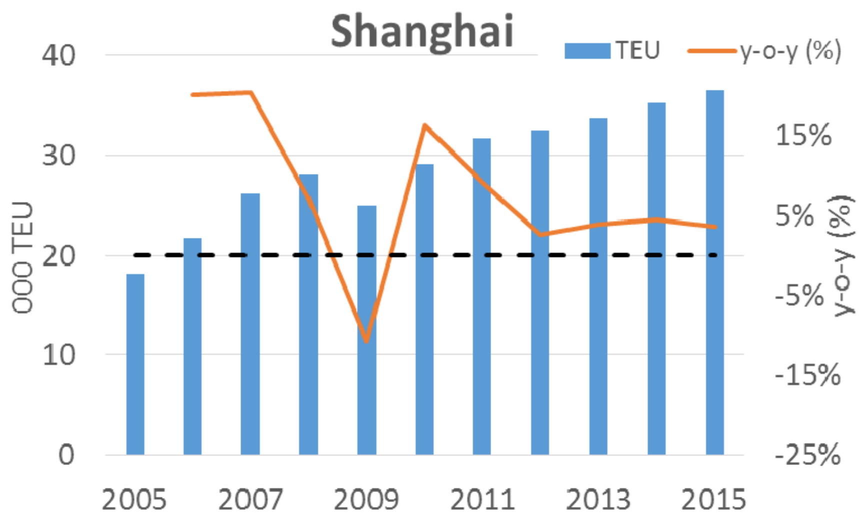
Nansha Port is connected to its hinterland by road and barge.

Key success factors of Nansha Port include its proximity to a large base cargo and good intermodal connectivity to its hinterland. Its biggest challenge is the strong competition from Shenzhen, a very mature port, and Hong Kong Port, also very mature although declining in volume due to competition from regional ports.

A1.5 Shanghai

Shanghai Port has become the busiest port in the world since 2010. In 2015, the port handled 36.5 million TEU. The port's growth rate in recent years has been robust, although there has been some deceleration since 2010 due to the slowdown of the global economy. The port's throughput CAGR was 10.0% in 2005-2010, and 4.7% in 2010-2015 (Figure A1.6).

Figure A1.6 TEU and Growth Rate, Shanghai



Source: ICF

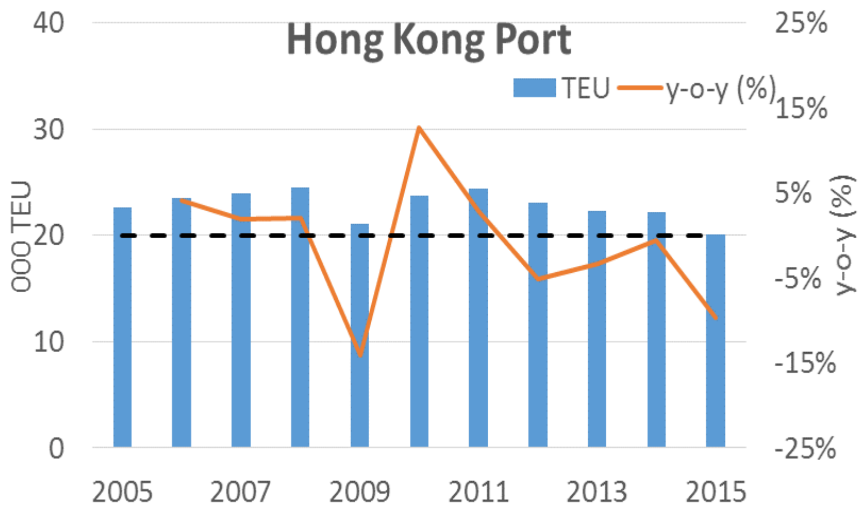
The primary hinterland of Shanghai Port is the manufacturing clusters in the Yangtze River Delta (YRD) on the east coast of China. Its key competitor is the Port of Ningbo-Zhoushan (20.6 million TEU in 2015). The port is connected to its hinterland by various modes: highway, barging, coastal feeders, and rail.

The very strong base cargo in the YRD has been driving the rapid growth of Shanghai Port, enhanced by good inter-modal connectivity to the hinterland. The Government is also determined to provide the necessary infrastructure to facilitate container movement. The port is however also facing challenges from other ports (e.g. Ningbo-Zhoushan) in the region which service basically the same hinterland. It also appears that the rapid growth rate in the port's base cargo may not be sustained as the economy slows down. In addition, the port also has very little international transhipment at present, despite the Government's effort to make the port a transshipment centre.

A1.6 Hong Kong, China

The Port of Hong Kong handled 20.1 million TEU in 2015. The port is shrinking: CAGR has declined from low growth of 1.0% in the period 2005-2010 to -1.3% in 2010-2015 (Figure A1.7**Error! Reference source not found.**).

Figure A1.7 TEU and Growth Rate, Port of Hong Kong



Source: ICF

The primary hinterland of Hong Kong Port is the market in southern China on the other side of the border[13], also known as the Pearl River Delta (PRD). Its key competitors are Shenzhen Port (24.2 million TEU in 2015) and Guangzhou Port (17.6 million TEU).

Hong Kong Port is connected to the PRD by a highway and barging system – the latter mainly connects Hong Kong Port to western PRD. The port does not have freight rail, but the vast majority of its hinterland is less than 100km from the port, and is not economically served by rail.

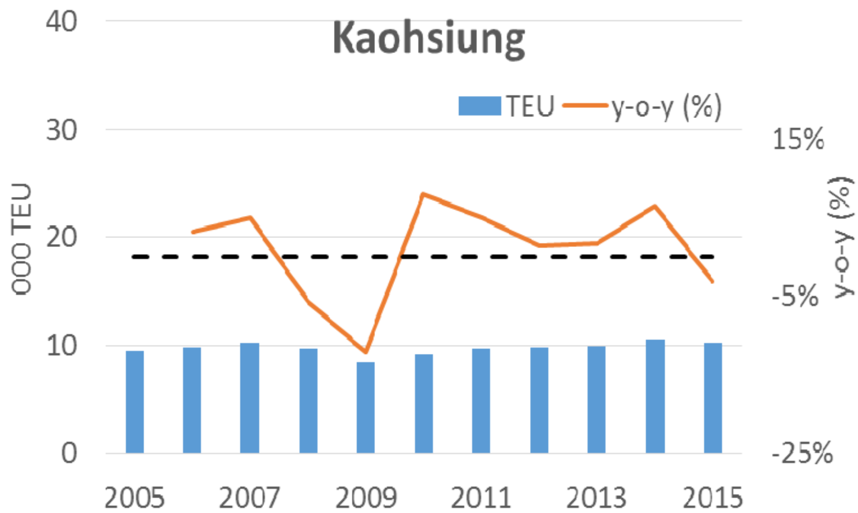
Key success factors for Hong Kong Port include the large cargo base from southern China, the large volume of transshipment cargo, and the availability of barges which reduces the costs of inland transport. However, Hong Kong Port is also facing challenges of strong competition from the ports in Shenzhen and increasingly, Guangzhou, combined with the slowing down of the southern China economy and hence cargo base. It also does not have a huge hinterland of its own – the population of Hong Kong, China is relatively small (7.2 million people), and 90% of its GDP is generated from the services sector which does not produce a lot of cargo.

A1.7 Kaohsiung

The Port of Kaohsiung handled 10.3 million TEU in 2015. The port's recent growth has been rather stagnant: CAGR was -0.6% in 2005-2010, and 2.3% in 2010-2015 (Figure A1.8).

[13] The Hong Kong Special Administration Region of the People's Republic of China and is under a different jurisdiction of customs, tax, and legal system. Hence, the south China hinterland is considered as another jurisdiction.

Figure A1.8 TEU and Growth Rate, Kaohsiung Port



Source: ICF

The primary hinterland of Kaohsiung's gateway cargo is the island of Chinese Taipei. Other ports on the island are Keelung Port (1.4 million TEU in 2015), Taichung Port (1.4 million TEU), and Taipei Port (1.3 million TEU), but their throughputs are not comparable to Kaohsiung's.

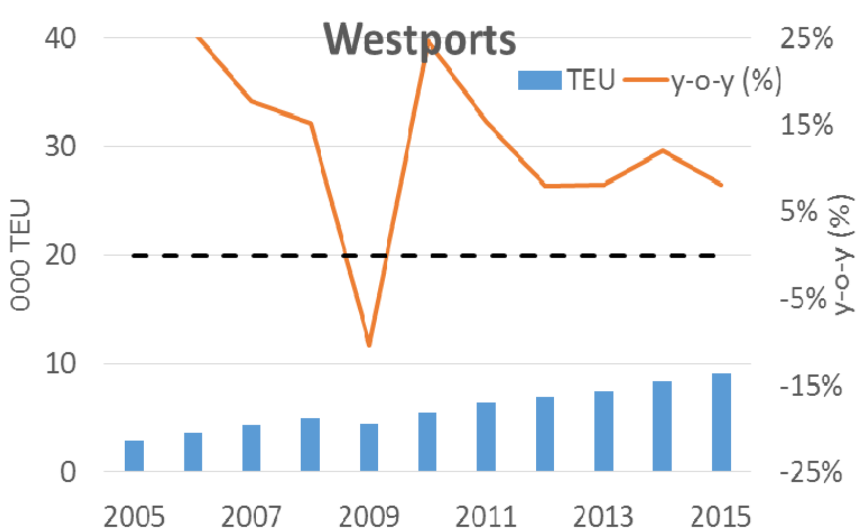
The port is connected to its hinterland mainly by road.

The key success factor for Kaohsiung Port is its base cargo from the island of Chinese Taipei, which is largely captive on the island with limited choice of port. However, its greatest challenge is the rapid loss of transshipment cargo to regional competitors, in particular Hong Kong Port and Busan, which will affect its overall throughput volume.

A1.8 Westports, Port Klang

Westports in Port Klang handled 9.1 million TEU in 2015. The port's growth has been rather robust in recent years: CAGR was 13.8% in 2005-2010, and 10.3% in 2010-2015 (Figure A1.9).

Figure A1.9 TEU and Growth Rate, Westports



Source: ICF

The primary hinterland of Westports is the Klang Valley in Malaysia – one of the most economically active regions in the economy. Its key competitors include Northport (2.8 million TEU in 2015), also in the Klang Valley, for gateway cargo from this hinterland. However, Westports is also known as handling significant volumes of transshipment cargo: in 2015, transshipment accounted for about 73% of its total throughput. If transshipment ports are also considered, Westports' competitors additionally include Port of Tanjung Pelepas (PTP, 8.8 million TEU) and Singapore (30.1 million TEU).

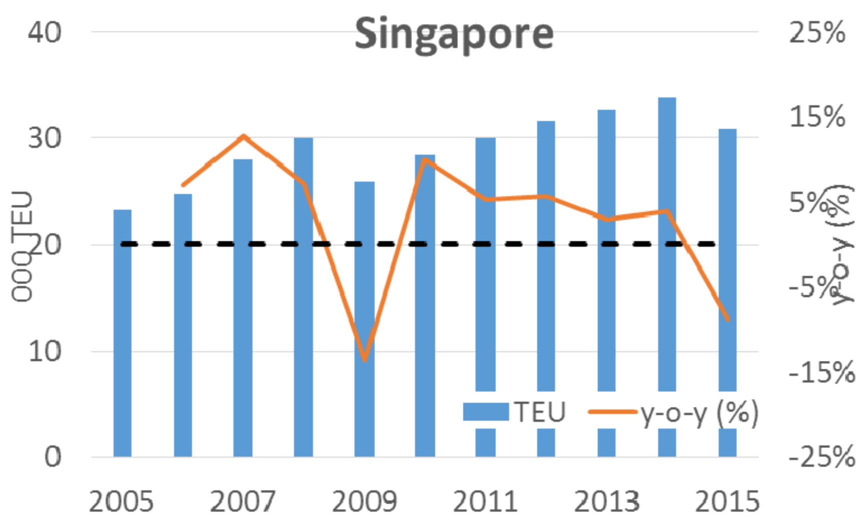
Westports is connected to its hinterland by roads.

Westports' success in gateway cargo growth has been largely attributable to its large and stably growing hinterland, but it is facing very strong competition from Northport for hinterland cargo, and Singapore and PTP for transshipment cargo.

A1.9 Singapore

Singapore Port has been one of the busiest ports in the world, handling 30.1 million TEU in 2015. Official data of volume breakdown are unavailable, but it is estimated that about 85% of the throughput is transshipment containers. The port's growth rate has slowed in recent years: throughput CAGR dropped from 4.2% in 2005-2010 to 1.7% in 2010-2015, while 2014-2015 year-on-year growth was -8.8% (Figure A1.10).

Figure A1.10 TEU and Growth Rate, Singapore



Source: ICF

The hinterland of Singapore Port's gateway cargo would be the city state of Singapore itself. Some volumes are moved from Johor in Malaysia to Singapore via the causeway; while the actual volume is not officially recorded and released, it is believed the volume of such cargo is limited. Cargo moved from other economies in the region (in particular Malaysia and Indonesia) to Singapore by other modes (e.g. feeder) is defined as transshipment cargo, and is not considered "gateway cargo" in the context of this study.

Within Singapore, containers are moved by trucks.

Singapore Port does not have a real competitor for its hinterland cargo – it is extremely unlikely that local shippers / consignees would prefer to move their containers via the ports in Johor, which do not have better connectivity and are likely to be more costly due to longer distance.

However, for the majority of its containers, i.e. transshipment, it is facing strong competition from other ports along the Malacca Strait: PTP (8.8 million TEU in 2015) and Westports in Klang (11.9 million TEU).

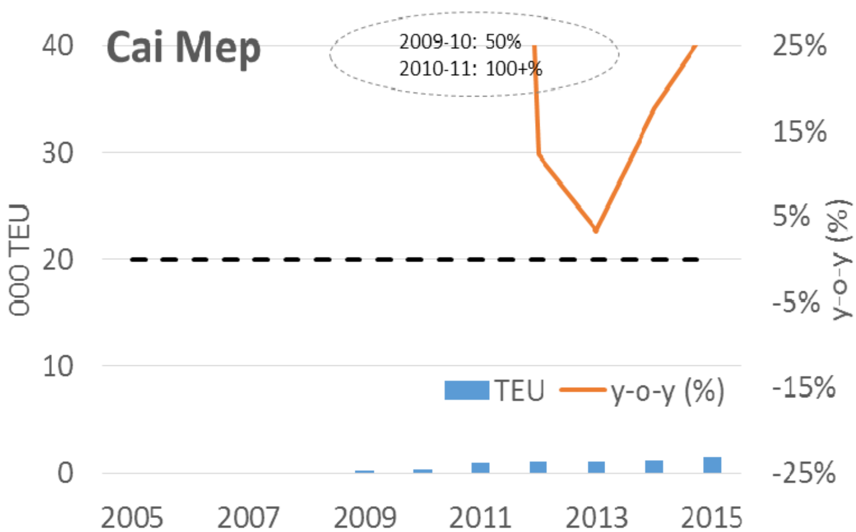
The biggest success factor for the Port of Singapore is the strong support it receives from its government in many aspects, including administrative and policy facilitation, among others. For example, with the government's support, the development of the initial phases of the Tuas container terminal with a stated capacity of 65 million TEU is in progress. The economy is also known for its strong legal and finance system. However, the volume of hinterland cargo is limited by its population and size. Further, the development of other economies in the region, e.g. Viet Nam and Indonesia, can also pose a threat to Singapore's transshipment volume – as these economies develop their critical mass, it would be easier for shipping lines to arrange direct shipment from these ports to the ultimate destinations instead of feeding through Singapore, because direct shipment is usually preferred to transshipment.

A1.10 Cai Mep, Viet Nam

There are a number of ports / container handling facilities in Cai Mep port cluster in southern Viet Nam. The "port" selected in this Study is Cai Mep International Terminals (CMIT).

CMIT handled 725,000 TEU in 2015. It is a very new port, just opened in 2015; hence growth rates to date are not considered representative. Figure A1.11 shows the TEU and growth rate of all container handling facilities in Cai Mep, of which CMIT throughput accounted for 49% of total in 2015.

Figure A1.11 TEU and Growth Rate, CMIT



Source: ICF. Notes: SP-PSA, the first container handling facility opened in Cai Mep, started operations in 2009.

The primary hinterland of CMIT / Cai Mep is southern Viet Nam, although it could be argued that it extends across the whole economy. However, the size of the cargo base is relatively small. Containers are trucked to the port, but the road conditions are far from ideal.

CMIT's competitors are many, from other "ports" in the Cai Mep port cluster, to the container handling facilities in other port clusters in Thi Vai, Ho Chi Minh City (HCMC), and Hiep Phuoc – total throughput from these clusters in southern Viet Nam was 7.2 million TEUs in 2015.

The ports in southern Viet Nam are supported by the robustly growing cargo base in the area. CMIT has the deepest water draft for 14,000 TEU vessels, and its productivity is the highest locally.

However, all ports in southern Viet Nam are challenged by fragmented port planning and lack of coordination in port development policy. Most of them have limited capacity to expand / upgrade, constrained by the quay length (only one straight quay longer than 600m), yard area (most are smaller than 50 ha), and draft depth (usually 14-15m) for each port (Table A1.1). Moreover, the lack of strong government implementation also undermines growth of the new port areas. For example, there were plans to close down the incumbent ports in HCMC so that all containers would be diverted to the new ports in Cai Mep / Thi Vai after their opening in the late 2000s / early 2010s. However, as a result of pressure from the local logistics stakeholders / incumbent HCMC port operators, the HCMC ports are still being used at present, directly competing with the new ports in Cai Mep.

Table A1.2 Physical Parameters of Ports in Cai Mep

Terminal / Port	Yard Size (ha)	Berth Length (m)	No. of Berths	Draft alongside (m)	Depth of Access Channels (m)	Investor / Operator
SITV	34	730	2-3	14	12	HPH, SICC
SP-PSA	27	600	2	14.5	12	SP, Vinalines, PSA
TCIT/TCCT	60	690+260	3	14	14	SNP, Hanjin, MOL, Wanhai
CMIT	48	600	2	16.5	14	SP, Vinalines, APMT
TCOT	48	600	2	15	14	SNP
SSIT	48	600+425	2	16	14	SP, Vinalines,SSA

Source: ICF, terminal operators

Annex 2 Stakeholder Consultations

A2.1 List of Stakeholders Consulted

Table A2.1 List of Stakeholders Consulted

Category	Name / Organization
Regulators	■ Prince Rupert Port Authority, Canada ■ Port of Vancouver, Canada ■ Westports, Port Klang, Malaysia ■ Taiwan Port Authority, Kaohsiung Office, Chinese Taipei ■ Port Authority of Long Beach, USA
Container Terminal Operators	■ CMIT, Cai Mep ■ Taipei Container Terminal Co, Chinese Taipei ■ Terminal 3, Port of Kaohsiung, Chinese Taipei ■ Berth 120/121 (public berth) operator, Kaohsiung Port, Chinese Taipei ■ Total Terminals International, Long Beach
Beneficial Cargo Owners (BCOs)	■ Taiflex ■ ASE Taiwan, Chinese Taipei ■ One of the largest Canadian importers of consumer goods ■ An exporter in Malaysia
Freight Forwarders / Logistics Service Providers	■ Panalpina ■ Kao-Europe Transport Co ■ Westward Shipping ■ 3PL Global ■ Kuehne & Nagel Malaysia ■ MTT Transport, Malaysia
Researchers	■ Dr Dong Yang, Dept of Logistics & Maritime Studies, The Hong Kong Polytechnic University ■ Prof Meifeng Luo, Dept of Logistics & Maritime Studies, The Hong Kong Polytechnic University

A2.2 Question Templates used

A2.2.1 Port information

- Landlord or Port Authority operated?
  - If landlord who are the terminal operators?
- Water depth in Metres
  - Entry channel depth
  - Quayside depth
- TEUs handled by the port during 2014 and 2015
  - Imports
  - Exports
  - Empties
  - Split between local and transshipment
  - Split between local and inland volumes

- Terminal operators, can we define by number of TEUs handled
- No of gantry cranes
  - Number of rows outreach
  - Dual or single operation
- Total quay length
  - Are deep sea and short sea/feeder vessels separated?
- port size in hectares including by terminal operator
- no. of deep sea services
  - main trade routes
- no. of short sea services
- Cabotage services i.e. coastal waterway services within an economy
- number of transshipment services by route
- Total annual ship calls by size range
  - Up to 2,000 TEU
  - 2001-4,000
  - 4,001 -5,200
  - 5,201-6,000
  - 6001-10,000
  - 10,001-12,500
  - 12,501-16,000
  - >16,001
- Rail connections
  - On Quay
  - Outside of port
- Highway connectivity – single or dual carriageway
- Barge/river transport
- Free zone availability-on or off port
- Warehousing/distribution facilities; distance from port
- Existence of a strong forwarding community
- Regulatory regime - good/bad/indifferent?
- Financial institutions available: regulated/unregulated
- Are productivity measures available, if so what are they?

A2.2.2 Interviews Questions

- Port Authority
  - Are you a landlord Port Authority or an operating one?

- Do you consider yourself to be a Gateway port?
  - If yes, why?
  - If no, why not?
- Are there plans to further develop the port? If yes, can you elaborate?
- How many people are employed at the port directly? And can you estimate how many are employed indirectly?
- What do you consider to be your hinterland?
- Avg customs clearance time for Imports and Exports
- Avg time for container to clear port

- Terminal operators
  - Is the business environment flexible and does it encourage growth of business activity?
  - What, if any, are the issues that detract from the free flow of trade?
  - Is your business primarily import or export or both?

- **2-3 carriers**, at least one deep sea, one feeder/regional and if available one cabotage
  - Why do you call at this port? Can you please elaborate?
  - How efficient is productivity at the terminal/port?
  - How many moves per crane hour on average do you expect?
  - What port productivity do you receive (moves/per total port hours*)?
  - Do you suffer from congestion?
  - How much of your container flow is local [within 50 Km.] vs hinterland?

- 2 logistics providers
  - Do you find the flow of goods to be free or are there regulatory or bureaucratic issues?
  - What is the ratio to carrier haulage vs merchant haulage?
  - How do you see the flow of goods to the hinterland? Is there a preferred mode of transport?
  - Average trip distance + time. (From container pickup to gate)
  - Average delay at Port Gate
  - Truck turnaround time - Gate to Gate (either container pickup of drop-off)
  - Value added services provided by your company (customs clearance, documentation, container storage)

- 2-3 shippers
  - Do you get the service that you expect at the port?
  - Are there problems with customs or other regulatory authorities?
  - Do you make use of local distribution centres and warehouses?
  - Is there a sufficient choice of carriers for shipping goods?
  - Do you use forwarding agents to handle the movement of your goods?

- Free zone/warehouse/distribution centre operator
  - Are you able to operate within the port, or is your operation outside the port?
  - Are there any customs issues related to your business?
  - Do you service mostly the local traffic [50– km radius] or also the regional hinterland?
  - Can your business operation be improved to increase your reach into the hinterland? How?

*port hours defined as waiting time + steam in + alongside to last lime off

Annex 3 LCSI, APEC Economies, 2006-2015

Economy	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Australia	27.0	26.8	38.2	28.8	28.1	28.3	28.8	29.9	31.3	32.0
Brunei Darussalam	3.3	3.7	3.7	3.9	5.1	4.7	4.4	4.6	4.3	4.6
Canada	36.3	34.4	34.3	41.3	42.4	38.4	38.3	38.4	42.5	42.9
Chile	16.1	17.5	17.4	18.8	22.1	22.8	33.0	33.0	32.5	36.3
People's Republic of China	113.1	127.9	137.4	132.5	143.6	152.1	156.2	157.5	165.0	167.1
Hong Kong, China	99.3	106.2	108.8	104.5	113.6	115.3	117.2	116.6	116.0	116.8
Indonesia	25.8	26.3	24.9	25.7	25.6	25.9	26.3	27.4	28.1	27.0
Japan	64.5	62.7	66.6	66.3	67.4	67.8	63.1	65.7	62.1	68.8
Republic of Korea	71.9	77.2	76.4	86.7	82.6	92.0	101.7	100.4	108.1	113.2
Malaysia	69.2	81.6	77.6	81.2	88.1	91.0	99.7	98.2	104.0	110.6
Mexico	29.8	31.0	31.2	31.9	36.4	36.1	38.8	41.8	40.1	42.9
New Zealand	20.7	20.6	20.5	10.6	18.4	18.5	19.4	19.0	21.0	20.1
Papua New Guinea	4.7	6.9	6.9	6.6	6.4	8.8	6.9	6.6	9.0	7.6
Peru	16.3	16.9	17.4	17.0	21.8	21.2	32.8	32.8	33.6	36.9
The Republic of the Philippines	16.5	18.4	30.3	15.9	15.2	18.6	17.2	18.1	20.3	18.3
The Russian Federation	12.8	14.1	15.3	20.6	20.9	20.6	37.0	38.2	37.6	43.3
Singapore	86.1	87.5	94.5	99.5	103.8	105.0	113.2	106.9	113.2	117.1
Thailand	33.9	35.3	36.5	36.8	43.8	36.7	37.7	38.3	44.9	44.4
United States	85.8	83.7	82.5	82.4	83.8	81.6	91.7	92.8	95.1	96.7
Viet Nam	15.1	17.6	18.7	26.4	31.4	49.7	48.7	43.3	46.1	46.4

Source: World Development Indicators, World Bank (Last Updated: 08/10/2016).

Notes: database does not cover Chinese Taipei.

Annex 4 Workshop Participants and Presentations

A Study workshop was held on 5 September 2016 at Royale Chulan Hotel, Kuala Lumpur, Malaysia. This annex contains:

- Workshop Agenda
- List of participants

A4.1 Workshop Agenda

Promotion of Regional Economic Integration by Developing APEC Gateway Port Connectivity

Study Workshop Programme (tentative, as at 23 August 2016)
5 September 2016 (Monday)
The Royale Chulan Hotel, Tun Sri Lanang 1 & 2
Kuala Lumpur, Malaysia

Time	Activity
0830 – 0900	Registration
0900 – 0910	**Welcome Speech** – Thomas Kwan (Project Overseer)
0910 – 1000	**Presentation of Preliminary Study Findings** - ICF International ▪ What is a Gateway Port and Gateway Port Connectivity? ▪ Literature Review ▪ Importance of Data
1000 – 1030	Coffee break
1030 – 1130	**Presentation of Preliminary Study Findings** – ICF International ▪ Gateway Port Connectivity Indicator ▪ Key Success Factors and Challenges in Developing and Maintaining a Well Connected Gateway Port
1130 – 1200	**Keynote Speech #1**, - Dr Jonathan Beard, Head of Transportation and Logistics, Asia, Arcadis Topic: "Measuring Container Port KPIs – DOs and DON'Ts"
1200 – 1330	Lunch Break (Complimentary Buffet Lunch)
1330 – 1400	**Keynote Speech #2** – Dr Venus Lun, Hong Kong Polytechnic University Topic: "Positioning of gateway port, against competitions from more regional transshipment hubs and increasingly larger vessels"
1400 – 1530	**Forum Discussion / Breakout Session** – All Participants ▪ Participants will be split into several groups and discuss their own view and experience on developing a Gateway Port in the Asia-Pacific Region ▪ Participants can also share their feedback on the study findings.
1530 – 1600	Coffee break
1600 – 1645	**Panel Discussion** – major challenges of the port, from the perspectives of: port operator, port user, and port regulator
1645 – 1700	**Concluding Remarks** – Thomas Kwan (Project Overseer)

A4.2 List of Participants

Economy	Name	Organization	Position
Group 1 : Organizers / Speakers			
Canada	Thomas Kwan	Transport Canada	Project Overseer
Hong Kong, China	Wai-duen Lee	ICF	Project Consultant
Singapore	Ben Hackett	ICF	Project Consultant
Group 2: Speakers			
Hong Kong, China	Jonathan Beard	Arcadis	Keynote Speaker
Hong Kong, China	Venus Lun	Hong Kong Polytechnic University	Keynote Speaker
Group 3: Participants			
Australia	Mr Matthew Squire	Department of Infrastructure and Regional Development	Member of the Land Experts Group
China	Ms Lynn Wang	Asia-Pacific Model E-Port Network Operation Center	
Japan	Mr Motohisa Abe	National Institute for Land and Infrastructure Mgmt.	Head, Port Planning Division
Japan	Mr Naohiro Akagi	Ministry of Land, Infrastructure, Transport, and Tourism (MLIT)	Director for International Policy, Industrial Port Policy Div, Ports and Harbors Bureau
Malaysia	Mr Lean Hin OOI	Evergreen	Chairman of Shipping Association of Malaysia
Malaysia	Mr Mohammed Ashril Ahmad Noordin	Iskandar Regional Development Authority	Vice President, Economics & Investment
Malaysia	Mr Mohd Idi Amin Salleh	Kuantan Port Authority	Senior Manager (Corporate and Development)
Malaysia	Mr Francis Choong	Lumut Port	Sr Mgr Corp Planning
Malaysia	CDR Ang Chin Hup (R)	Maritime Institute of Malaysia (MIMA)	Researcher
Malaysia	Mr Masri Idris	Malaysian Investment Development Authority	Deputy Director
Malaysia	Ms Prem Kaur d/o Bahal Singh	Maritime Institute of Malaysia (MIMA)	Researcher
Malaysia	Mr Badrulhisyam Fauzi	MMC Corporartion Berhad	Head of Group Strategy
Malaysia	Mr Ian James	MMC Corporartion Berhad	Group Chief Executive Officer
Malaysia	Mr Mohd Faiz Hakim Husain	NCB Holdings Bhd	Head, Group Strategy

Economy	Name	Organization	Position
Malaysia	Mr Zai Bin Abas	Northport (Malaysia) Bhd	Head of Facilities Division
Malaysia	Mr Azman Shah Mohd Yusof	Northport (Malaysia) Bhd	Chief Executive Officer
Malaysia	Mrs Wan Siti Fatimah Wan Ahmad	Port Klang Authority	Administrative Officer
Malaysia	Mr M Hanif A Hamid	Reach Integrated	Managing Director
Malaysia	Dr Chong Vun Leong	Sabah Economic Development and Investment Authority	Vice President, Development Planning Co-ordination and Evaluation Division
Malaysia	Mrs Siti Noraishah Azizan	Sabah Ports Sdn Bhd (SPSB)	General Manager
Malaysia	Mr Low Pooi Choon	Sunship	Vice Chairman of Shipping Association of Malaysia
Malaysia	Mr Desmond Yong	United Arab Shipping Agency Company	Country General Manager (Malaysia, Singapore)
Malaysia	Mr Mathanaseelan Thavasimuthu	Westports Malaysia Sdn Bhd	Marketing Manager
Singapore	Mr Biju Ninan Oommen	World Bank Group Transport & ICT	Senior Port and Maritime Transport Specialist
Singapore	Mr Emmanuel San Andres	APEC Policy Support Unit	Analyst
Singapore	Ms Frances Goh	Maritime and Port Authority of Singapore	Deputy Director (Port Policy)
Chinese Taipei	Dr Moses Lin	Department of Navigation and Aviation, MOTC	Senior Engineer
Chinese Taipei	Mrs Chia-Wen Chang	Maritime and Port Bureau	Deputy Director
Thailand	Mr Nuttapon Boonchokchuay	Port Authority of Thailand	Cargo Operation Officer
Thailand	Miss Praew Ritthirungrat	Port Authority of Thailand	Technical Officer, Research Division
Thailand	Mrs Porntipa Taweenuch	Port Authority of Thailand	Assistant Director of Planning Division
USA	Mr Tony Padilla	U.S. Maritime Administration	Senior Advisor for International Affairs
Viet Nam	Mr Nguyen Viet Hung Do	Ministry of Transport of Viet Nam	Official, International Corporation Department
Viet Nam	Mr The Cuong Trinh	Viet Nam Maritime Administration	Director, Shipping and Maritime Services Department

Notes: The participants within each group are listed by the following order: (1) order of the economies, following APEC guidelines; (2) alphabetical order of the name of organization; and (3) alphabetical order of the participant's last name (surname).

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