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CONNECTING INLAND PORTS AND SEAPORTS VIA INTERMODAL TRANSPORTATION: A PROCESS EVALUATION

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ABSTRACT

The objectives of this research are to identify and qualitatively assess the seaport processes that can be carried out at an inland port to improve economic value add and contribute to supply chain performance. The general frameworks of seaport processes and inland port processes were developed based on the analysis of literature on container seaports, intermodal transportation, and intermodal terminals in inland ports. Face-to-face semi-structured interviews were also conducted on three seaport-inland port pairs that actively use intermodal transportation to move freight between the seaports and connected inland ports. The three pairs are the port of Virginia and Virginia inland port in the United States, the port of Sydney and Minto terminal in Australia, and the port of Gothenburg and Hallsberg terminal in Sweden. To ensure the validity of data, interview data were triangulated with multiple means of data collection, including site visits, e-mail correspondence, and secondary data drawn from internal company reports, archival records, and publicly available port and trade data from port websites. The three port pairs were qualitatively assessed with business model analysis to form possible business models for integrating the inland port with the seaport via intermodal transportation. Findings of this research provide essential understanding for further investigating inland port services offered, examining the business benefits, and offering a benchmark for ports around the world to achieve business and process efficiency.

Keywords: inland port, container seaport, intermodal transportation, business model

INTRODUCTION

Over the past ten years there has been unprecedented growth in the volume of international trade around the world. Supply chains have become progressively more complex as a result, involving production processes that are increasingly geographically fragmented (Jaffee 2010; Mangan, Lalwani, and Fynes 2008; UNCTAD 2010). This development has stimulated logistics activities and demand for supporting infrastructure such that the importance of the transportation and logistics sectors in the global economy is significantly elevated. Maritime is the predominate mode in international freight transportation (Jaffee 2010; Mangan, Lalwani, and Fynes 2008; Monaco, Moccia, and Sammarra 2009). Ocean containerized freight traffic in particular has experienced substantial growth, increasing more than fivefold, from approximately 29 million TEUs in 1990 to 152 million TEUs in 2008. Its average annual growth rate of 10 percent over the last two decades (UNCTAD 2010) compares impressively to that of 5 percent seen in world GDP during the same time period (The World Bank Group 2011).

Growth in ocean container freight traffic manifests itself in increased container port traffic volumes and demand for port services that render the need for seaports to expand not only capacity, but also functionality of their services. However, due to the constrained supply of land available for seaport expansion, congestions, notably at major container ports, have intensified. To relieve congestion and enhance competitiveness, seaports strive to increase freight flows via two broad avenues: port operations and inland extension. The former emphasizes improving efficiency of port operations such as loading and unloading, ship bunkering, customs clearance, and security screening. The latter entails seaport's inland extension as evident by the growing number of inland ports of varying size and scope of functionalities across the world (Rahimi, Asef-vaziri, and Harrison 2008). Inland ports have notably evolved to become prominent anchors in improving seaport productivity, helping to relieve seaport congestion, increasing seaport's terminal capacity, and improving seaport inland access (De Langen and Chouly 2004; Roso 2008).

The improvements made possible by inland ports underscore the significance of dynamics and relationships between inland ports and seaports in determining the overall system performance (Magala and Sammons 2008). Inland port-seaport dynamics span both functionality and hinterland connectivity. Functionalities of inland ports have hitherto varied widely, ranging from conventional transloading activities to full service logistics in which consolidators, forwarders, and freight carriers operate as an integrated intermodal group (Magala and Sammons 2008; Rahimi, Asef-vaziri, and Harrison 2008; Rodrigue et al. 2010; Roso et al. 2009). Services such as storage, track and trace, maintenance of containers, and customs clearance are also available at some inland ports (Roso 2008). In terms of inland port-seaport connection, hinterland connectivity is key and has become an important feature of contemporary port logistics development patterns (De Langen 2008; Notteboom 2008). Today's top container ports have evolved into ones that provide a crucial interface not only within sea transportation networks, but also between sea and inland multi-modal transportation (Anderson, Opaluch, and Grigalunas 2009; Clark, Dollar, and Micco 2004; Cullinane and Wang 2010; Giuliano and O'Brien 2008; Laventhal 2009; Mangan, Lalwani, and Fynes 2008; UNCTAD 2010). Essentially, these dynamics suggest that successful inland port-seaport connection requires close integration both in terms of operation and infrastructure, and inland freight transportation (Laventhal 2009; Novo-Corti and González-Laxe 2009; Rodrigue and Notteboom 2009).

OBJECTIVES

A primary motivation for this research is rooted in the increased reliance on the hinterland connection between inland ports and seaports. This connection is increasingly important in assuring effective and functional international freight flows. Current inland port spheres encompass facilities of varying sizes, locations, and functions, suggesting that the business model of these inland port-seaport dynamics is still evolving. Apparently, different dynamics have different impacts on inland transportation capacity and operations, seaport handling and storage capacity, and seaport terminal efficiency, among others. Thus, a research undertaking to understand such important dynamics and their implications on the port logistics systems is warranted. To contribute to the body of knowledge in this area, the objectives of this research are to identify and qualitatively assess the seaport processes that can be carried out at an inland port to improve economic value add, reduce impact and contribute to supply chain performance. Specifically, this study contemplates the following questions: (1) what are the typical seaport processes? (2) what are the typical inland processes? and (3) what are the possible business models for integrating the inland port with the seaport?

METHODOLOGY

To accomplish the objectives of the study, we undertook a comprehensive analysis of relevant literature as well as conducted face-to-face semi-structured interviews with relevant actors of container terminal management. Literature on container seaports, intermodal transportation, and intermodal terminals in inland ports were drawn from supply chain and transportation academic journals and trade journals in the logistics and global trade arenas. In terms of interviews, given the exploratory nature of the study and in accordance with recommendations by Stuart et al. (2002), semi-structured interviews was chosen as the appropriate method to explore the issues as it allowed the interviewees to introduce new issues and the interviewer to follow up topics more fully. A check list of issues was used to ensure that every pre-decided topic was covered and to give a sequence of questions.

Face-to-face semi-structured interviews were conducted with informants of three seaports and their belonging inland ports, including Port of Gothenburg and Hallsberg terminal in Sweden, Port Botany/Sydney Ports and Minto terminal in Australia, and Port of Virginia and Virginia inland port in the United States. The three seaport-inland port pairs, which fit into the concept of dry port according to Roso et al. (2008), were selected due to their success and uniqueness. Virginia Inland Port was chosen not only because it is reputable as a successful inland port for the Port of Virginia, but also because the Port itself initiated inland port implementation in order to expand its access to hinterland. Sydney's Port Botany has daily rail shuttles to six intermodal terminals situated within 45-kilometers (km) proximity of the Port, which is very unique in the world. Port of Gothenburg, with its 24 rail shuttles transporting more than 40 percent of the Port's total TEUs, is quite exceptional and considered very successful by other ports. The three port pairs are also located in three different continents with very different intermodal transportation solutions for their hinterland access, making them of a special interest for this research.

Interview informants were managerial- and tactical-level professionals who are directly involved in inland or marine container terminal management. Table 1 summarizes the interviewees' titles and the description of their roles in their organizations. They were selected due to their good overview of the issues discussed, and their ability to influence the development processes. In order to insure validity, the triangulation with multiple means of data collection has been used (Stuart et al. 2002; Voss et al. 2002). Apart from having face-to-face interviews and site visits at seaports and inland terminals, secondary data were drawn from internal company reports, archival records, and publicly available port and trade data from port websites. Some additional phone interviews as well as e-mail correspondence were also conducted to clarify and fill the gaps in data.

Table 1 – Summary of interviewees' responsibilities

Company	Interviewee's title	Position description
Port of Gothenburg	Business development manager	Developing the RailPort system and implementing quality control system
Hallsberg Terminal	Terminal manager	Operations planning and control
Port Botany/ Sydney Ports	Rail logistics manager	Port rail planning and operations; supply chain integration
Minto Terminal	General terminal manager	Terminal, rail, and warehouse operations planning
Virginia Inland Port	Terminal manager/sales executive	Operations planning – to call on everyone in the transportation decision-making process to influence cargo to move over the Port of Virginia

Data analysis

Analysis of literature content, publicly available port data, and interview data follows the constant comparison approach (Glaser and Strauss 1967; Strauss and Corbin 1998) to develop comparative assessment of seaport processes and inland port processes. Data were examined and coded on three levels to produce a set of key port operations currently perform at seaports and inland ports, and to create the premise of our understanding of the seaport-inland port dynamics. The first level focuses on dividing data into segments based on the commonalities that could reflect key activities and operations at seaports and inland ports. Then, in the second level, we made connections among the identified activities by exploring the conditions and interactions that influence the processes of moving freight containers through the port logistics systems. This second-level coding produced a list of all services provided to a container and freight within as it moves through the port logistics systems. Using this list of services as a guide, we selectively coded the secondary data (literature, port websites, internal company reports, and archival records) and primary data (interviews, site visits, and e-mail correspondence) to describe the three case scenarios investigated in this study with respect to the types of services currently offered at the inland ports. At the end of this third-level coding, we have established the descriptions of the three seaport-inland port scenarios for qualitative assessment.

Qualitative assessment of seaport-inland port scenarios

The three seaport-inland port scenarios were qualitatively assessed with business model analysis to form possible business models for integrating the inland port with the seaport via intermodal transportation. The concept of business model has been the subject of continuing academic and practitioner-oriented studies (Lindgren 2012), resulting in a host of different business models in existence. Examples of notable business models are business model innovation by Chesbrough and Rosenbloom (2002), business model innovation in the digital economy by Stähler (2002), component business model by IBM Institute for Business Value (2005), business model canvas by (Osterwalder and Pigneur 2009), the four-box business model by Johnson (2009), Environment-Strategy-Structure-Operations (ESSO) Business Model Development by Lim (2010), and value networks by Allee and Schwabe (2011). Each of these and many other business models differs in its characterization of the business situation, depending largely on the industries and circumstances in which the characterization has been applied (Sinfield et al. 2012), such as e-commerce, market strategy, network collaboration, and business innovation, among others. For the purpose of this study, we will explore business model for seaport-inland port integration by addressing three key elements that the majority of business model researchers include in their models, including: (1) service/product value proposition, (2) value formula (revenue model and cost structure), and (3) key resources and processes.

LITERATURE REVIEW

Seaports as important nodes in the intermodal transport have replaced their earlier narrow focus on cargo handling with a wide range of logistic activities, giving them a more active role in the transportation chain. There has been a trend in organizational and technological changes towards offering door-to-door transport solutions rather than port-to-port (Paixão and Marlow 2003; Robinson 2002). This trend has expanded the area over which the seaports' hinterland spans and therefore created a competition among neighbouring seaports. Prior to containerization the carrier's responsibility for the goods terminated at the side of the vessel, and all inland movements were controlled by shippers or forwarders, giving them substantial market power. The new requirements imposed by containerization contributed to the decline of some established seaports and to the growth of new ones (Notteboom 1997). The concept of containerization, together with intermodality, extended seaports' inland access and redefined seaport competition in a way that seaports have to strive for a position in intermodal corridors (Nottebom 1997). There is a strong interdependency between a seaport's foreland and hinterland, which is particularly apparent in intermodal transportation. The notion of seaports' role and spatial coverage is dealt with, e.g., by Heaver et al. (2001), Notteboom (2002), Notteboom and Winkelmans (2001) and Robinson (2002). Many seaports, as well as shipping lines, integrate vertically with inland intermodal terminals to control hinterland transport (Nottebom 1997). With an increasing level of functional integration, many intermediate steps in the transport chain have been removed. An intermodal road-rail terminal can simply be described as a place equipped for the transhipment and storage of intermodal loading units (ILUs) between road and rail. There are intermodal terminals in a great variety of shapes and sizes; and a number of value-added services, such as stuffing and stripping, storing and repair of ILUs, might be offered. As suggested by Höltgen (1995), intermodal terminals can be classified according to some basic functional criteria like traffic modes, transhipment techniques, network position or geographical location. Nevertheless, the transhipment between traffic modes is the characterising activity. Depending on the role and the services offered, the transport industry operates different kinds of inland terminals under different names, such as Inland Clearance Depot, Dry Port, Inland Container Depot, Logistics Centre, Freight Village, and Inland Port (Roso and Rosa 2012).

The institution of the port sector has undergone significant reform in recent years, driven primarily by the intense global competition in the port sector brought about by economic globalization. Although the practices and processes of transformation are not uniform across ports, a large part of reform policies have focused on the restructuring of port ownership and management models. Worldwide, the ownership and management of ports shift from dominance of publicly owned and operated ports to a "landlord" port model in which port authorities cede control of the business of port operations to private firms. It is conceded that in addition to taking portions of commercial risks of port operation to private firms, the separation of port authority and service provision increases port efficiency and enhances service qualities as competition among multiple service providers within a port is introduced (Cheon et al. 2010; Van Reeven 2010). Seaport container terminal services may be divided into three interfaces: land side interface (delivery/receipt), container terminal interface (transfer, storage and internal transport) and marine side interface (ship/shore transfer) (Holguin-Veras and Walton 1997), whereas effectiveness of one interface affects the performance of another. Delivery/receipt represents movements of containers through the gate, i.e., land gate entrance and external vehicle transport. The gate is an interface between external modes of transport and a container terminal. Movement of containers from the gate to the storage area, usually with straddle carriers or forklifts, is identified as loading/unloading and internal vehicle transport. Storage is the area for short- or long-term storing of units waiting to be loaded on a ship or a train; in the case of ship loading/unloading the same may be identified as transfer ship/shore.

GENERAL CHARACTERISTICS AND SERVICE OFFERINGS OF THE SEAPORT-INLAND PORT CASE SCENARIOS

General characteristics of each seaport-inland port case scenario are summarized in Table 2 and described in more details as follows.

Table 2 – Inland port and connected seaport general characteristics

Inland port (Connected Seaport - Country)	**Inland Port Ownership***	**Inland Port First Operational Year**	**2011 Container Throughput** (TEUs/Year)**		**Inland port-Seaport Rail Distance (Km)**
			Inland port	**Seaport**	
Hallsberg Terminal (Port of Gothenburg - Sweden)	Mix	2003	65,000	887,000	260
Virginia Inland Port (Port of Virginia - USA)	Public	1989	30,000	1,900,000	330
Minto Terminal (Sydney Ports - Australia)	Private	2002	50,000	2,020,000	45

***** Owner(s) of the infrastructure and/or financier(s) of the inland port facility

******Total number of container TEUs handled per year at the seaport and the corresponding dry port (including rail units)

Port of Gothenburg and Hallsberg Terminal

The Port of Gothenburg is the largest container seaport in Scandinavia, handling 25 percent of Sweden's foreign trade and approximately 67 percent containers in the country. Its location is within a distance of 500 km to 70 percent of industry and the population in the Nordic Region, including the capital cities of Stockholm, Oslo, and Copenhagen. The Port's container terminal has been operated by the global terminal operator APM Terminals since January 2012, succeeding the former operator Skandia Container AB under a 25-year concession agreement with Gothenburg Port Authority, the owner of the land and the quays. In 2011, the Port handled 887,000 TEUs of containers, with even balance between imports and exports at 448,000 TEUs and 439,000 TEUs, respectively (Port of Gothenburg 2012a). Increasing volume of freight is transported by rail to and from the Port of Gothenburg as shown in Figure 1. The electrified rail shuttle system called Railport Scandinavia directly connects the quayside "on-dock rail terminal" to 23 inland RAILPORT terminals located in towns and cities in Sweden and Norway. The Port has established and developed the shuttles in cooperation with nine rail operators and began running the rail shuttles in 2002.

Since then the volumes moved by train have more than tripled and daily shuttles have grown from 2 to 23. Thus far, the rail system carries mainly containers, almost 400,000 TEUs, or approximately half of all the containers transported to and from the Port each year (Port of Gothenburg 2010, 2012a, 2012b).

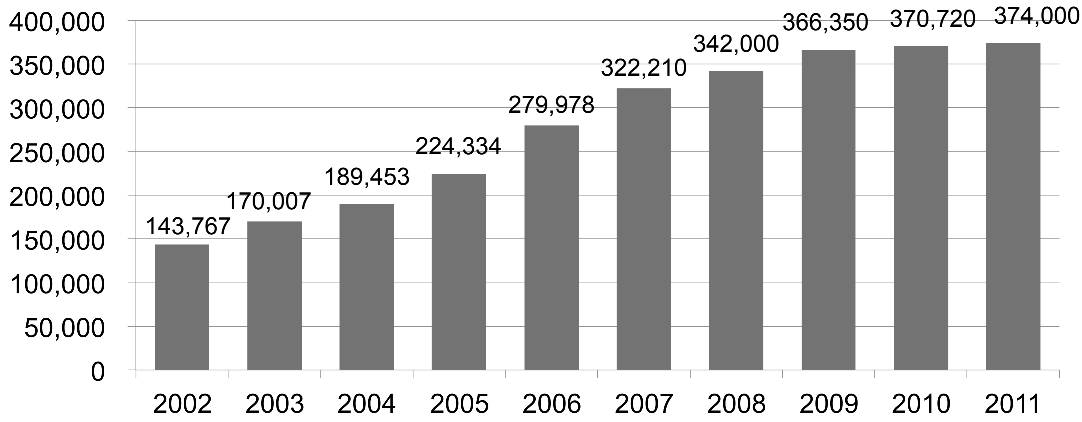

Figure 1 – Port of Gothenburg Rail Volume (TEUs)*

* Total TEU volume handled at Port of Gothenburg in 2011 is 870,000 TEUs (nearly 50% moved via rail).

Source: Port of Gothenburg (2012b)

One of 23 RAILPORT terminals with a direct rail link to the Port of Gothenburg (Port of Gothenburg 2010), Hallsberg intermodal terminal is jointly owned by the local municipality and the Swedish logistics company Green Cargo (Baltic Transport Journal 2012). On its 6.2 hectares (ha), the terminal is equipped with three railway tracks (each 750 meters in length), two reach stackers (lifting capacity up to 50 tons), and 17,000 square-meters (m^2) of heated and 4,000 m^2 of unheated warehousing space (Baltic Transport Journal 2012). The rail shuttle, operated by SCT Transport AB/Tågfrakt AB (Port of Gothenburg 2012b), departs five days a week in both directions between the Port of Gothenburg and Hallsberg terminal. Inbound shuttle travels directly from the Hallsberg terminal to the Port of Gothenburg where freight can be loaded at quayside directly from rail onto vessels for export, and vice versa for outbound shuttles where freight can be unloaded from vessel to rail for direct transport to the Hallsberg terminal (Transport Weekly 2012). Hallsberg terminal started as a conventional intermodal terminal with basic terminal services and gradually developed into an inland port by introducing new value-added services. Today, it is a well established inland port, handling 65,000 TEUs per year. In addition to its direct rail connection to the ports of Gothenburg (260-km distance), it also has direct rail connection to Trelleborg port (500-km distance) and Malmö port (470-km distance).

The Port of Virginia and Virginia Inland Port

The Port of Virginia (also referred to as the Port of Hampton Roads) is located midway between North and South on the US East Coast, with over three-fifths of the US population and two-thirds of US major manufacturers located within its 759-mile radius (Virginia

Maritime Association 2012). Hampton Roads harbor offers the deepest shipping channels on the US East Coast and hosts a privately-owned APM Terminal of Virginia (APM), and three state-owned marine terminals, including Norfolk International Terminals (NIT), Portsmouth Marine Terminal (PMT), and Newport News Marine Terminal (NNMT). The three state-owned terminals are all operated by a private operating company, Virginia International Terminals (VIT) (Virginia Port Authority 2012). NNMT handles break-bulk, roll-on, roll-off and bulk cargoes; while NIT (the largest and busiest) and PMT (the second largest) are dedicated to handling containers. NIT contain over 53,000 ft. of on-terminal rail with over 25,000 ft. of working track for loading/unloading rail cars on terminal, served by Norfolk Southern (NS) and the Norfolk and Portsmouth Belt Line Railroad. PMT container terminal also has shipside rail service, and direct rail service connection with CSX and with NS via Norforlk and Portsmouth Belt Line Railroad (Virginia Maritime Association 2012). In 2011, the Port handled 1.9 million TEUs, 1 million of which were exports and 0.9 million imports (see Figure 2), making it the third-largest US East Coast container port. Its 12-percent market share of US East Coast container port market follows only New York/New Jersey port (34%) and Savannah port (18%) (Virginia Port Authority 2012). It is ranked the eighth in the country by TEU traffic in 2011 (American Association of Port Authorities 2012).

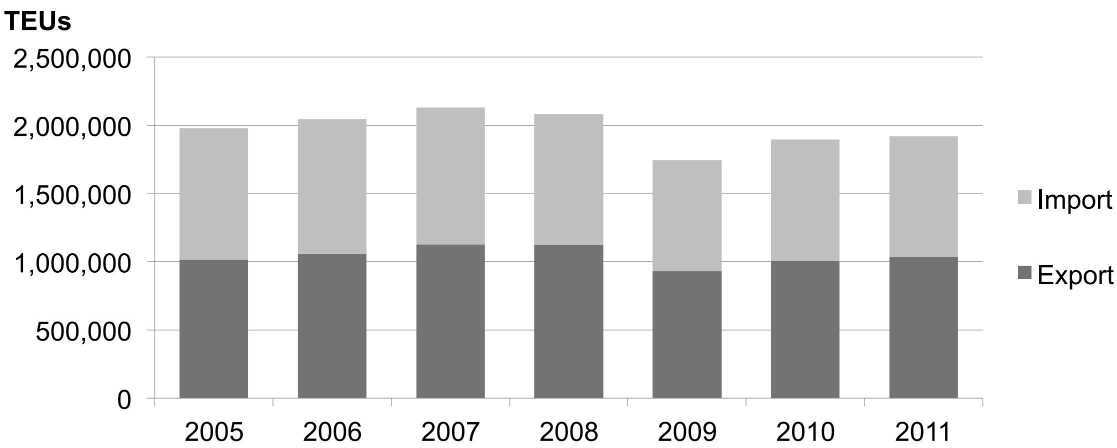

Figure 2 – Containers Handled at the Port of Virginia (TEUs) 2005-2011*

*In 2011, the Port of Virginia moved 30 percent of cargoes via rail (up from 28% in 2010)

Source: Virginia Port Authority (2012)

The Virginia Inland Port (VIP), owned by the Virginia Port Authority (VPA) and opened in March 1989, is located 220 miles northwest of Norfolk in Front Royal, VA. It is also operated by the private company VIT that operates all three VPA-owned marine terminals (Virginia Port Authority 2012). VIP, generally recognized as America's first successful inland port, serves as an intermodal container transfer of ocean-going containers to and from the Port's terminals in Hampton Roads. Cargo from the three marine terminals travels to VIP five days a week each way via direct intermodal rail serviced by NS railroad (Virginia Maritime Association 2012). Trains leave both the VIP and the Port's marine terminals late each afternoon, taking 13 to 15 hours for trains to complete the route, and arrive at the other terminal the next morning (Hampton Roads Transportation Planning Organization 2011).

Average truck haul length from VIP is 100 miles, typically heading towards Fredericksburg, MD, and Central Pennsylvania or Pittsburgh, PA; while freight traveling to the Port via VIP is trucked to VIP from West Virginia, Pennsylvania, and Ohio (Steele et al. 2011). All freight handled at VIP is international freight of approximately equal split between imports and exports, with containerized freight representing the largest portion of revenue generated by VIP (Steele et al. 2011). As shown in Figure 3, the number of containers handled by VIP has increased significantly since mid-2000. As of July 2012, VIP registered a 17.6 percent increase in the number of containers it handled (2,328 TEUs) compared with the number in July 2011 (Progressive Railroading 2012). Although the number of containers handled by VIP is small in relation to the total TEUs handled by the marine terminals in Hampton Roads, the VPA conceded that more than 90 percent of the business generated by VIP is traffic that has been captured from other ports (Hampton Roads Transportation Planning Organization 2011). In fact, despite the fact that the facility itself only employs fewer than 20 people and has warehousing capacity of one three-door cross-dock warehouse, its strategic location and direct access to the Port through VIP for import distribution have attracted as many as 39 major companies to locate near VIP. Current large customers include: Worldwide Auto, Rubbermaid Commercial, Pilgrim's Pride Poultry, Family Dollar, DuPont, Red Bull, Coors, and Home Depot (Steele et al. 2011).

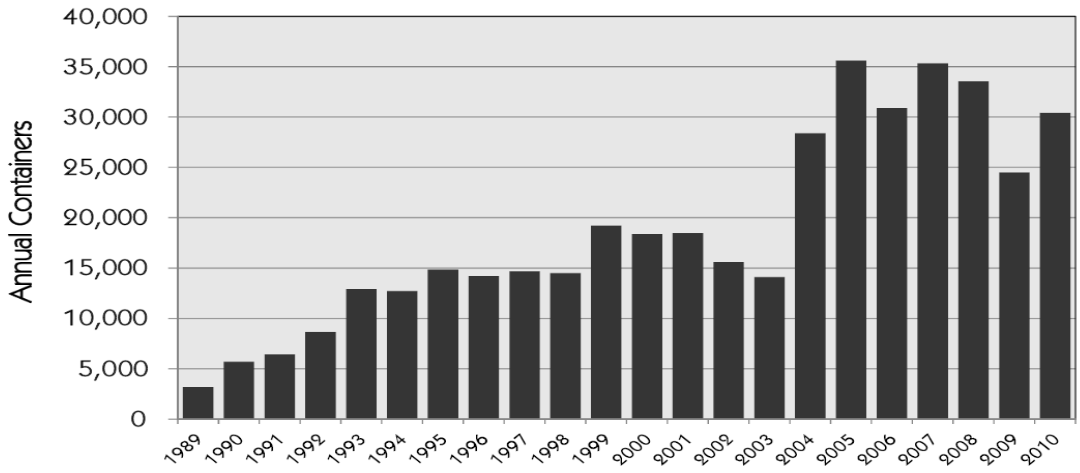

Figure 3 – Containers handled by the Virginia Inland Port

Source: Image courtesy of Hampton Roads Transportation Planning Organization (2011)

The Port of Virginia moves the highest percentage of containers by rail than any other port on the US East Coast (Virginia Maritime Association 2012). In 2011, the Port of Virginia moved 30 percent of cargoes via rail (up from 28% in 2010), 66 percent via truck (down from 68% in 2010), and 4 percent via barge (same as 2010) (Virginia Maritime Association 2011; Virginia Port Authority 2012). As of July 2012, rail containers totaled 32,941 TEUs, a 22.5 percent increase compared with the number in July 2011 (Progressive Railroading 2012). Given that intermodal traffic continues to be a high-volume, high-growth commodity, the upward trend of the Port's rail container traffic is expected to continue in the foreseeable future. The Port continues to improve its expedited, single-system intermodal service operated by two of the nation's largest railroads NS and CSX railways (Virginia Maritime Association 2012) that provide on-dock, double-stack intermodal service. The system was designed to directly link the Port to key inland markets in the Midwest, Ohio Valley, and the Southeast (Norfolk Department of Development 2010; Virginia Maritime Association 2012).

The Sydney Port-Port Botany and Minto Terminal

Port Botany, belonging to the state-owned Sydney Ports Corporation (SPC), is the second largest container port by container volumes in Australia. It is a natural transport hub for New South Wales (NSW), with 85 percent of cargo having an origin or destination within 40 km of Sydney Port's facilities at Port Botany (Sydney Ports Corporation n.d.). The facilities at Port Botany consist of three container terminals and container support businesses, handling nearly one-third of Australia's total containerized trade each year (Sydney Ports Corporation 2011a). The three terminals are operated by stevedoring companies DP World (formerly P&O Ports), Patrick (owned by Asciano), and Hutchison Port Holdings. Each terminal has its own road bridge that connects to Foreshore Road (the main port access road), allowing for more efficient truck movements into and out of the Port (Sydney Ports Corporation 2011a). Container trade has been the dominant type of trade through the Port, accounting for over 83 percent of total revenue for SPC in financial year 2010/11. Total container trade through Port Botany reach 2.02 million TEUs during 2010/11 (up from 1.93 million TEUs during 2009/10), more than 90 percent of which have their origin and destination within the Greater Sydney Metropolitan Area (Sydney Ports Corporation 2012). As shown in Figure 4, the Port's total container throughput in 2010/11 consisted of 1 million TEUs full container imports (up from 0.95 million TEUs), 0.46 million TEUs full container exports (up from 0.44 million TEUs) (Sydney Ports Corporation 2011a), and 560,930 TEUs empty container movements (up from 533,711 TEUs). While imports dominate full container movements, empty container movements are export dominant (540,823 TEUs empty container exports versus 20,107 TEUs of empty container imports in 2010/11). Not included in the Port's total container throughput shown in Figure 4 were containers transshipped through Sydney's ports. In 2010/11, 236,710 TEUs of containers were transshipped through the Port, a 1.3-percent decrease compared to 2009/10 (Sydney Ports Corporation 2011b).

Minto terminal, owned and operated by a private company Macarthur Intermodal Shipping Terminal (MIST), is one of Sydney metropolitan NSW intermodal terminals that functions as a transfer point for interstate cargoes (Sydney Ports Corporation 2008). This 16-ha facility uses Independent Rail as its train operator for dedicated daily 45-km rail shuttles to and from Port Botany on Sydney Metropolitan Rail Network that currently owned and maintained by RailCorp. The network is a mixture of dedicated passenger rail lines, dedicated freight rail lines (the Port Botany Freight Line), and shared passenger/freight rail lines (where priority given to passenger services) (Sydney Ports Corporation n.d.). The Minto terminal's throughput is about 65,000 TEUs a year in 2010, one third of which is exports (Roso 2008).

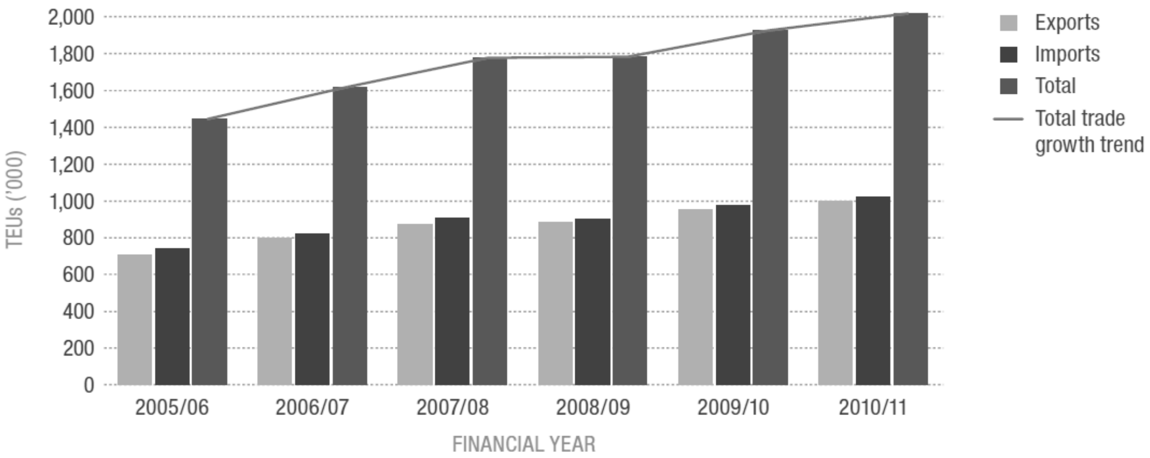

Figure 4 – Port Botany's total container trade in TEUs financial year 2005/06 to 2010/11
Note: total container trade includes both full and empty container movements, excluding transhipments
Source: image courtesy of Sydney Ports Corporation (2011b)

Its throughput fell slightly in January 2011, handling close to 50,000 TEUs (Transportation and Logistics News 2011). Besides dedicated rail shuttles connecting to Port Botany, Minto terminal has rail connection to other inland terminals where empty containers from Port Botany are sent to be filled with grains for export. On its 600-meter rail sidings, the terminal is able to accommodate long trains that will result in increased rail volumes. There is about 25,000-m^2 covered storage and an additional 10,000-m^2 warehouse (Roso 2008). MIST is undertaking significant site improvements that will allow the terminal capacity to grow to 200,000 TEUs (Transportation and Logistics News 2011).

Overall, 86 percent of containers (1,738,000 TEUs) are transported to and from Port Botany by road (increased from 81% in 2009/10) and 14 percent (250,000 TEUs) by rail (fell from 19%) (Sydney Ports Corporation 2011a, 2012). Note, however, that the rail share volumes to-and-from Port Botany do not include rail volumes that are moved through metropolitan intermodal terminals in port precinct (e.g. Minto terminal). Approximately 18,000 TEUs of export-orientated containers in 2010/11 were transported from their point of origins to metropolitan intermodal terminals to be exchanged onto a truck for the final leg of transportation to operational sidings in Port Botany, while approximately 7,000 TEUs of import containers were moved by road from the Port to intermodal terminals and then delivered by rail to their destinations. To enable more container freight to travel by rail instead of road, the Port Botany rail freight line is being improved and a new dedicated freight Southern Sydney Freight Line (SSFL) is being developed with planned service beginning in late 2013 (Sydney Ports Corporation 2011a). SSFL will provide a third track in the metropolitan rail corridor specifically for freight services (Sydney Ports Corporation 2012). Upon the completion of the SSFL, the metropolitan freight network will be leased and maintained by the Australian Rail Track Corporation (ARTC), taking over from the current RailCorp (Sydney Ports Corporation n.d.).

Service offerings

A range of services are provided at each inland port of study as summarized in Table 3.

Table 3 – Inland port services

Services	**Hallsberg Terminal (Sweden)**	**Virginia Inland Port (USA)**	**Minto Terminal (Australia)**
Container services:			
Transhipment	●	●	●
Storage	●	●	●
Customs clearance	●	●	●
Cleaning	●		●
Repairs	●	●	
Inspection		●	
Quarantine			●
Stripping and stuffing	●	●	
Empty container depots	●		
Reefer plugs		●	●
Warehousing and distribution services:			
Cross-docking	●	●	
Quality and inventory control	●		
Pre-assembly	●		
Packing / unpacking / repackaging	●		●
Freight forwarding	●		●
Container haulage	● (Road and rail)	● (Road)	● (Road)

QUALITATIVE ASSESSMENT OF THE SEAPORT-INLAND PORT DYNAMICS

We have organized this assessment in accordance with three key aspects of a business model. These business model aspects were identified in the majority of business models proposed by business model researchers The three key business model elements are: (1) service/product value proposition, (2) value formula (revenue model and cost structure), and (3) key resources and processes.

Service/Product Value Proposition

In general, the services that appear standard offerings for an inland terminal are transhipment, storage, and customs clearance. By offering these standard services at inland ports, the inbound and outbound cargo do not need to be cleared at the seaports and the containers do not need to be stored in the seaport area. These service offerings, thus, provide considerable benefits to shippers in terms of time as handling is brought much closer and can take place much more quickly. The seaport terminals also benefit as the container flows become faster and congestion is reduced, enabling the handling of larger volumes of freight (Port of Gothenburg 2012a). While all three inland ports offer customs clearance for the convenience of their customers, the service gets limited use due to cargo insurance issues.

Introduction of new value-added services at inland ports is seen as the key to survival for some seaports (Cheung et al. 2003). Beyond the aforementioned standard services, only Hallsberg inland terminal in Sweden offers value-added services of empty container depots, quality and inventory control, and pre-assembly. Compared to the other two inland ports, Hallsberg's investment in value-added services is substantial with ten different value-added services offered in addition to the standard services. While the services at Hallsberg are mostly provided in accordance to a large customers request, the terminal has chosen to focus on value-added services because there is a large demand for these different services and because they contribute to the revenues. Accordingly, personnel at Hallsberg are appropriately highly cross trained to respond to the wide range of services offered. The terminal has reduced its costs by 15% due to the fact that the highly-trained personnel can be used both at the terminal and in the warehouse performing these different types of services.

Virginia and Minto inland ports offer only six services beyond the standards. Minto terminal offers forwarding, road haulage, packaging, reefer plugs, quarantine, and cleaning in addition to the standard services. Virginia inland port offers repairs, inspection, stripping and stuffing, reefer plugs, cross-docking, and container haulage. Comparing the two sets of services, there are just two types of value-added services (beyond the standard services) offered in common at Virginia and Minto inland ports, highlighting the fact that different ports are rooted in different revenue streams. The main source of revenues for Hallsberg is the value-added services; Virginia is focused on transport and cross-docking as a primary revenue source; while trucking drayage is Minto's focus.

Each revenue focus area is meeting with varying levels of success. Recently, Hallsberg volumes dropped to almost no containers on rail because of the global economic recession as well as the intense competition in the region. There was pure competition that Hallsberg experienced from other terminals in the region that offer lower rates for their services. Despite intense competition, Hallsberg was able to gain business, primarily the wagon shipments from Italy and Germany that were transported in the form of consumer goods freight. As for Virginia, it was initially focused on reaching into new markets that would require their existing seaport customers to switch from road to rail for a portion of the journey.

This mode switch is an ongoing effort as VIP achieved only about a third of its 100.000-TEU annual capacity. Clearly, customers have been slow to convert to using the rail connection from the Virginia Port to VIP. One reason could be that at VIP there was not a serious congestion problem which has been a primary driver to customers considering inland port services. In contrast, congestion was the issue around the Sydney Port. Expanding its existing truck-based business offerings to rail and rail related services, Minto has experienced success building volumes, which appears to be from customers responding to a better alternative that relieves congestion from the seaport side.

Value Formula

All three inland ports earn their revenue from handling throughput of freight enhanced by their strategic location and transferring freight from road to intermodal rail. The operators of Hallsberg inland terminal, for instance, initiated the inland port with the municipality because they saw business opportunity in handling the large volumes, responding to the demand for transportation services in and out of the port. As for VIP, even though it still struggles to capture business, for the business it has captured, as much as 90 percent was generated from other ports (Hampton Roads Transportation Planning Organization 2011). Its strategic location is credited with attracting major companies to locate near VIP (Steele et al. 2011). Thus, by being within a cluster of distribution centres for major businesses, these inland ports achieve economies of scale and on-going viability, while providing efficiencies and cost savings to customers by bringing freight directly to and from rail (Austrak 2008).

Key Resources and Processes

To make a profit, the highly capital intensive, modern inland ports need to achieve the rail freight volumes necessary to underpin the investment. They need to be connected to a network of other inland terminals and port facilities (for network efficiencies) and it needs on-going complementary investment in track capacity and rolling stock. Key implications of this requirement are twofold. First, the cooperation and the common goal between the seaport and the inland port is of crucial importance. Otherwise the inland port might be seen as a competitor to the seaport with the same range of services offered, thus inhibiting the necessary freight volumes. For example storage of containers at the seaport terminals brings profit to the seaport and if the seaport does not face space/capacity issues, moving container storages to an inland location means profit loss; unless the inland port is owned by the seaport. Second, future opportunities for inland ports depend, to the large extent, on strategic infrastructure improvements of rail track networks and operational coordination among rail operators sharing the networks. For inland ports where ownerships of rail track network and rail operation are separated as in the cases of Hallsberg and Minto terminals, it is vital that inland ports secure long-term contract port shuttle train paths with rail track network owner, and then appoint rail operators to use those paths (Austrak 2008). As for VIP, US rail carriers owned the rail track network on which they operate, thus the burden of infrastructure investment lies on rail firms that also operate rail services. Hence, to make the development of short rail haul from the Hampton Roads terminals to VIP possible and operations economically feasible, VIP owner, Virginia Port Authority, engaged in partnerships with Norfolk Southern (NS) railroad. Specifically, while NS railroad provides rail services, the port authority covers the capital costs of expanding rail spur, and providing labour at both NIT and VIP (Steele et al. 2011).

CONCLUSIONS

In this work we have identified the general dynamics between three unique and successful pairs of seaports and inland ports, and observed types of services or processes that have been moved inland to improve economic value add, and contribute to supply chain performance.

Our business model assessment indicates that transhipment, storage, and customs clearance, are viable inland port processes, offering business benefits at seaports on three different continents – North America, Europe, and Australia. There were 13 additional inland port value-added services identified that are offered by at least one of the ports assessed and are adding business value.

Beyond identifying and assessing the inland port value-added services, we observed that Virginia inland port (VIP) does not appear to be employing a growth strategy and it seems as though there is demand that could drive its growth, particularly given its geographic placement and volumes. Virginia seaport handles large volumes, two million TEUs passing through the seaport. With VIP volumes of 30,000 TEUs, Virginia seaport is running just 1.6 percent of its volumes through its inland port. Port of Gothenburg in Sweden is running a much higher percentage through its inland port with 65,000 of its 850,000 TEUs, or 7.6 percent, running through the inland port. The Sydney port in Australia is moving 40,000 of its 2,020,000 TEUs, or approximately 2 percent. Sweden and Australia do appear to be employing a growth strategy as they are running higher volumes of freight through their inland ports and investing in value-added services beyond the standard services of transhipment, customs clearance, and storage.

In summary, this work uncovers that there are at least 16 port services that can be carried out at inland ports to add value to the business equation for shippers. Of these 16 services, three are practiced commonly across the three inland ports investigated here. The other services have nominal overlap across ports, but no particular pattern of consistency.

As this work continues, additional ports will be investigated, further exploring the range of services offered, the business benefits, and offering a benchmark for ports around the world to achieve business and process efficiency. This further research undertaking is imperative to provide insights for: (1) port management bodies in devising its port management policies and strategies, (2) investment and development policies associated with provisions of logistics infrastructure that facilitate hinterland accessibility and inter-connectivity among different modes of transportation, and (3) business research, particularly additional regional and country-specific research related to reducing congestion at seaports and effectively moving processes inland to support global trade.

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