Bachelor thesis Economics and Business Economics:

The current developments in the container shipping industry and port authority strategies in the context of the North American West Coast

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1. Introduction

1.1 Background

Globalisation and containerisation have had a vast impact on the shipping industry as globalisation increased the demand for transportation and containerisation improved its efficiency and reduced its costs (Midoro, Musso, & Parola, 2005). However, these developments attracted new competitors to the market and meant that shipping lines now had to invest to keep up with technological developments and remain competitive. These continuous investments into new technologies substantially increased container shipping lines' expenditures while technological innovations put downward pressure on freight rates, which deteriorated profits (McLellan, 2006). So, when economic growth and the demand for transportation slowed down during the 2009 global economic crisis, container shipping lines had to make adjustments in order to maintain profit margins and remain competitive (Wiedmer, Panayides, Andreou, & Louca, 2012). As a result, container shipping lines have since been using the four following strategies in order to reduce costs and remain competitive: (1) increasing vessel size, (2) horizontal cooperation through shipping alliances and vessel sharing arrangements, (3) slow steaming, and (4) vertical integration in terminal and inland operations. The outcome of these strategies has had an impact on the entire supply chain. However, this thesis will focus on ports in particular and the courses of action that port authorities can adopt to adjust to these changes.

Mainly increased vessel sizes, horizontal cooperation and vertical integration require action by port authorities. According to the terminal operator DP World, the growing vessel size will force port authorities to adjust. Port authorities will need to invest in new facilities and equipment in both the port itself and its hinterland in order to be able to handle more cargo at once. Ports that are located upriver like Hamburg and Antwerp also have other concerns, like the fact that a lot of the ports do not have berths that are wide enough for these large vessels to turn in, or that the river is not deep enough for these ships to access the port (Ship & Bunker, 2013). For example, in February 2016, a dozen tugboats were needed to free the mega-ship Indian River from the bank of the Elbe River so that it could call at the port of Hamburg (Braden, 2016).

Port authorities also need to adjust to the reality that container lines, through alliances and vessel-sharing arrangements, are concentrating their vessel calls at fewer ports and terminals because it allows them to use the capacity of their big ships more effectively. This will increase the competition between ports. (Mongelluzzo, 2014b). For instance, the 2M alliance has recently adjusted their network by reducing the number of direct port calls across their Asia-North Europe network to just Rotterdam and Bremerhaven to obtain more competitive transit times (Knowler, 2016). This trend is currently particularly pertinent for port authorities as container shipping lines are reshuffling their alliances and consequently modifying their networks (Meyer, 2017).

Conversely, port authorities may be able to turn vertical integration of container terminals or intermodal services by shipping lines into an advantage. When a shipping line invests in these other parts of the supply chain, they become more involved in the port where these facilities are located. This increased involvement can lead to increased loyalty to the port by the shipping lines (Heaver, Meersman, & Van de Voorde, 2001). However, this loyalty is not guaranteed due to the dynamic of alliances where different shipping lines have different stakes in different terminals and ports. For example, in its new network, 2M's choice of transhipment hubs do not correlate with the members' involvement in ports (Dupin, 2017a).

The above merely discusses a few examples of how developments in the container shipping industry have affected port authorities. However, the effect of these developments reaches much further, which is why it is important to discuss strategies that port authorities can employ to cope with these changes.

There has already been a considerable amount of research that focusses on the effectiveness of investments by port authorities and the criteria that are used in the decision-making process. A paper by García-Morales, Baquerizo, and Losada (2015) uses risk analysis and a stochastic multi-criteria analysis (SMAA-2) to determine how investments in different berthing extensions (150m, 250m, and 350m) impact the congestion problems in a hypothetical port and thus affect supply chain efficiency and competitiveness. Risk analysis shows that all extensions improved harbour operations and profit, the two longest extensions (250m and 350m) had very similar results which suggests that it is not profitable to increase the berthing length by more than 250m. According to SMAA-2, selecting the 250m berthing extension does not indicate any preference for either the port authority, licensed companies or shipping companies, while a further extension clearly favours the licensed companies (García-Morales, Baquerizo, & Losada, 2015). So, to a certain extent, investments by the port would prove profitable to all stakeholders.

There has also been research focussing on adaptations made by port authorities to remain competitive and specifically deal with the stress of increasing vessel sizes, a paper by Theo Notteboom (2016) that mainly focussed on the upstream ports of Antwerp and Hamburg found that these port authorities have managed to remain competitive because of their supply chain integration strategies, the scale of the existing logistics cluster and self-reinforcing processes of cargo consolidation via a high maritime and land connectivity. However, the port of Hamburg has not been doing as well as the port of Antwerp because it has met a lot of resistance on port extensions and dredging that are necessary to accommodate larger vessels (Notteboom, 2016).

These papers merely focus on increasing vessel sizes or the effectiveness of a single strategy and are thus limited in their scope, which is why this thesis will create a comprehensive overview of the developments in the container shipping industry and the strategies that scholars propose port authorities could employ to remain competitive. This thesis will use port authorities on the West Coast of North America as an empirical illustration.

1.2 Research question

This thesis will focus on the following research question:

"Which of the strategies described in literature on port management are the port authorities on the West Coast of North America adopting in order to react to the current developments in the container shipping industry?"

1.3 Approach and outline thesis

To obtain an answer to the research question, this thesis will consider the three following sub-questions:

1. What strategies are container shipping lines employing to remain competitive in the current market environment?
2. How are port authorities affected by these strategies and how should they react according to literature on port management?
3. How are the North American West Coast port authorities actually reacting to these changes?

This thesis will be structured as follows. Chapter two of this thesis will analyse the current trends in the container carrier industry to gain a better understanding of what the strategies applied by container shipping lines entail and what is causing their implementation. Chapter three will then consider the effect that the implementation of these strategies by container shipping lines has on port authorities. Subsequently, it will consider existing literature to find out how port authorities should react to these changes. These two chapters will thus review existing literature in order to provide a reliable academic background for chapter four and indicate how scholars believe port authorities are affected by and should react to these developments in the container shipping industry. Chapter four will then study the ports on the West Coast of North America and look into how their port authorities are in fact affected by these changes and how they are handling them in order to provide an empirical illustration of these developments. This chapter will be based on desk research and will mainly discuss information that can be found in newspapers and on the websites of the port authorities that are under discussion. Finally, chapter five will draw conclusions about which of the strategies that were previously discussed in literature are actually being adopted by West Coast port authorities. The thesis concludes that West Coast port authorities are mainly influenced by horizontal cooperation and vertical integration, and are implementing a reactive approach rather than a proactive one through cooperation and the provision of additional services to deal with the current developments in the container shipping industry.

2. Current trends in the container shipping industry

On April 26, 1956, a converted T2 tanker named Ideal X carried the first 58 containers from Port Newark to Houston, it thereby initiated the era of container transportation. One year later, the basic design of modern container ships was introduced in the form of a rebuilt World War II cargo ship, Gateway City (Tran & Haasis, 2015). Although, initially, a lot of large investments had to be made to adjust to the container, containerisation has ultimately vastly reduced costs throughout the entire transport chain and has led to increased global trade and integration (Donovan, 2004).

Globalisation really started to thrive in the 1990s when international trade and the globalisation of the production process led to increasingly close relationships between the world's economies. So, not only did carriers now transport finished goods, they were also transporting parts as it had become common to assemble materials from different parts of the world and have them brought together 'just in time' to meet customer demand (Midoro, Musso, & Parola, 2005). This led to a higher demand for shipping services which has been both a blessing and a curse for the industry. The increased demand initially led to higher revenues for shipping companies. However, it also attracted new competitors to the market and caused an increase in costs as shipping lines had to invest in new technologies in order to be able to offer frequent and competitive services, moreover, these technologies caused a decline in freight rates, which deteriorated revenues (McLellan, 2006).

So, when growth finally slowed down in the 2009 global economic crisis and the demand for transportation declined substantially, the period of large investments changed into one in which large capacity adjustments had to be made in order to maintain profit margins. So, especially in periods of low demand, the industry's high fixed costs create a highly competitive environment (Wiedmer, Panayides, Andreou, & Louca, 2012). As many shipping lines struggled to remain competitive in this new environment, a few managed to thrive which increased the level of market concentration. However, this degree of oligopoly varies per trade lane (Sys, 2009). Currently, the 20 largest shipping lines control 80% of the global market share (Álvarez-SanJaime, Cantos-Sánchez, Moner-Colonques, & Sempere-Monerris, 2013). Scholars largely agree that, as a result, container shipping lines have been employing the four following strategies to reduce costs and remain competitive: (1) increasing vessel size, (2) horizontal cooperation through shipping alliances and vessel sharing arrangements, (3) slow steaming, and (4) vertical integration in terminal and inland operations. Costs can thus be cut either by increasing the scale of operations and taking advantage of economies of scale, which can be done internally through increasing vessel sizes or externally through horizontal cooperation and vertical integration, or by cutting expenses by reducing vessel speed (Notteboom & Winkelmans, 2001). To provide a background for the effects that these trends have on port authorities, the remainder of this chapter will carefully discuss the four aforementioned strategies.

2.1 Increasing vessel size

At the outset of containerisation, it was too risky to build entirely new ships that were specialised for container transportation. Thus, it was commonplace for pioneer operators to convert ships so they could transport containers, these ships were rather small (less than 1,000

TEUs) but had a few advantages as they were a lot cheaper than specialised vessels and the delivery was a lot faster than that of new building orders (Tran & Haasis, 2015).

Container ships have experienced strong growth since, at the end of the 1960s, the first Hardy ships (1,000-1,999 TEUs) emerged. Soon thereafter, the sub-panamax (2,000-2,999 TEUs) and panamax (3,000-4,500 TEUs) ships were developed (Tran & Haasis, 2015). The developments in container ship size halted for over a decade after the sub-panamax and panamax vessels in the 1970s because it was considered extremely important that new vessels fit through the Panama Canal. Naval engineers had already increased the length of the container ships disproportionally to increase their size, however this was only possible for vessels that were smaller than 4,500 TEU. The performance of these longer ships was relatively poor compared to those that were not specifically designed to fit the Panama Canal, so at the end of the 1980s, the post-panamax generation emerged. These post-panamax vessels were restricted in their routes as they could not cross the Panama Canal, nonetheless, their economic performance was a lot better (Cullinane & Khanna, 2000). The post-panamax fleet experienced substantial growth since the mid-1990s and currently makes up over half of the world fleet (Tran & Haasis, 2015). Nowadays, the largest container ship is the Madrid Maersk with a capacity of 20,568 TEU, it is among the first vessels to break the 20,000 TEU barrier (Knowler, 2017a). The developments in container ship size can be seen in the following figure:

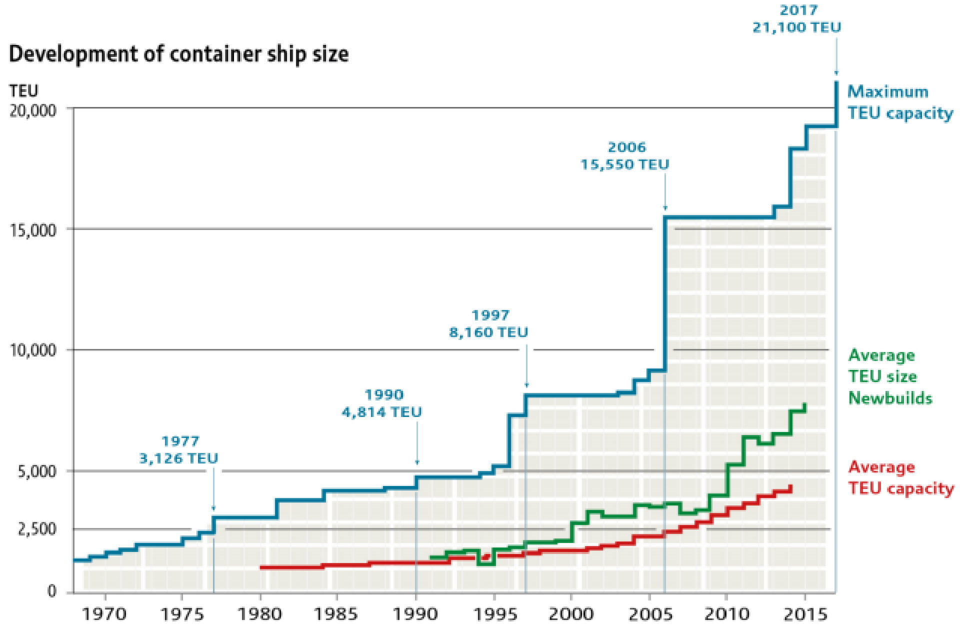


Figure 1: developments in container ship size (Merk, Busquet, & Aronietis, 2015)

Maersk has usually been the innovator with, e.g. the Emma Maersk in 2006 and the Triple E class in 2013, while other lines have had to follow because the oligopolistic market structure of the container shipping industry (Álvarez-SanJaime, et al., 2013). A substantial part of the growth in container ship size and the world fleet can be accredited to the 20 largest container shipping lines. Given that the capital requirement for these vessels is rather high, the majority of investments is made by these larger companies (Tran & Haasis, 2015). This is amplified by the fact that shipping lines have to invest in a series of these larger vessels in order to be able to provide homogeneity in services (Cariou, 2008). However, the emergence of shipping alliances, that will be discussed in the next section of this chapter, has reduced equipment costs and the financial risks of these investments and thereby encouraged the use of larger vessels, even by smaller shipping lines (Wu, 2009).

The main arguments for the deployment of larger vessels are that they produce a substantial reduction in cost per TEU because of their economies of scale at sea, and that they are more fuel-economic than their smaller counterparts (Notteboom, 2006). For instance, when fully loaded, the unit transportation cost of Triple E ships is 26% lower than that of other vessels currently in service. Additionally, the CO2 emission per container is 50% lower than the industry average on the Asia-Europe route (Tran & Haasis, 2015). However, larger vessels tend to cause higher port costs, inventory costs and transhipment/inland transportation costs for shipping lines (Cariou, 2008). It is not yet clear whether the economies of scale outweigh the additional costs (Tran & Haasis, 2015). Moreover, the economies of scale to be gained from deploying larger vessels can only offer short-term cost leadership as other container liners will imitate the strategy if it proves successful (Cullinane & Khanna, 2000).

Ship size has grown continuously in the past and there is currently no sign that the shipping lines' desire for container ship size growth will cease in the future. The growth in ship size will continue pushing technological boundaries (Tran & Haasis, 2015). However, it will presumably be economic and operational considerations on the landside that will form a ceiling for future ship size (Notteboom, 2006).

However, there are a number of factors that currently limit the use of these ultra-large vessels, some of which are technical, like the technological gap in propulsion that forces containerships of above 10,000 TEU to sail at a lower speed and the fact that the higher amount of containers above deck may generate a swinging effect that could put pressure on the hull and potentially damage the goods inside the containers. Another factor that affects ultra-large vessel deployment is that some ports may not be able to accommodate these vessels as they do not have the nautical conditions, infrastructure, superstructures, and inland connections that these vessels require (Cariou, 2008). There will even be an efficiency loss at the ports that are able to service the vessel as the vessel will unavoidably have to spend more time there to load and unload which increases voyage time (Cullinane & Khanna, 2000).

Larger vessels also increase the risk of under-utilisation of slots and have resulted in excess capacity in the container shipping markets. As the major shipping lines have entered a considerable number of large containerships into the most competitive trade routes, a deterioration of the loading factor and the ocean freight level has occurred. However, strategic considerations like discouraging market entry to maintain their competitive position can be an incentive for shipping lines to introduce larger vessels to the market and cause excess capacity (Wu, 2009). Additionally, the emergence of shipping alliances, which will be discussed in the next section of this chapter, has provided shipping lines with an opportunity to decrease slot under-utilisation (Chen & Yahalom, 2013).

2.2 Horizontal cooperation

Another way through which shipping lines have been trying to get a competitive edge has been the formation or membership of alliances with other shipping lines. The shipping industry was among the first in which companies cooperated to achieve particular business objectives, the first collaborations date back to the 1870s when companies made agreements to limit capacity and fix prices (Panayides & Wiedmer, 2011). Then, at the outset of containerisation, consortia were created between shipping lines. However, these were much too inflexible and the partnerships ended during the logistics revolution of the late 1980s when many of the lines' strategies were evolving at different paces (Ryoo & Thanopoulou, 1999). Consortia were ultimately brought to an end by the US Ocean Shipping Reform Act in the mid-1980s and later the abolition of the exemption of liner conferences from the European Union antitrust law which further intensified the competitive environment (Wiedmer, Panayides, Andreou, & Louca, 2012). Today's most common form of horizontal cooperation, strategic alliances, dates back to the end of 1995. These alliances are global as they are not limited to a single area but aim at servicing all major trade routes, and their formation is a lot more flexible than that of previous forms of cooperation (Midoro, Musso, & Parola, 2005).

Strategic alliances were formed to establish cooperation between shipping lines on major trade routes (e.g. transatlantic and transpacific). Alliance members share vessels over particular routes, which means that they must coordinate the vessel size/type, sailing schedules and itineraries, the use of joint terminals, and container movements on a global scale (Panayides & Wiedmer, 2011). However, there are a few aspects that alliances do not cover, for instance, the ship operator is responsible for the operation of the vessel, and each member is responsible for their own slot allocation, marketing and price fixing, and documentation. Furthermore, alliances do not share management and executive functions (Chen & Yahalom, 2013). Thus, the main aim of strategic alliances is the integration of services by its members.

A number of other types of collaborative agreements such as vessel sharing arrangements and slot chartering agreements between shipping lines have emerged in the last two decades. In a slot chartering agreement, a fixed percentage of vessel capacity is exchanged between lines for a certain period. This agreement can be very beneficial when two lines have vessels deployed on the same route with different departure schedules so lines can offer more frequent service. Whereas in a vessel sharing arrangement, shipping lines cooperate to fill the slots on a vessel, and share revenues/costs and information. Theoretically, these agreements can both be made inside or in addition to strategic alliances. However, alliance membership usually imposes some restrictions on the use of a non-member vessels (Panayides & Wiedmer, 2011).

There are a few reasons why it may be profitable for shipping lines to partake in horizontal cooperation through strategic alliances and vessel/slot sharing arrangements. Firstly, strategic alliances and vessel/slot sharing arrangements provide members with access to more loops and services with relatively low cost implications, which can expand a liner's market range and increase the frequency of its services (Notteboom, 2006). This gives smaller companies who wouldn't usually have the resources to invest access to advanced technologies and more frequent service, which can drastically improve their competitiveness (Cariou, 2008). Horizontal coordination also gives companies who struggle with under-utilisation of capacity the opportunity to fill up all of their excess slots, which is crucial as there is no revenue to be derived from unused space on board a vessel (Chen & Yahalom, 2013). Additionally, strategic alliances and vessel/slot sharing arrangements reduce the need for shipping lines to invest as these arrangements include joint deployment decisions, which could in turn help reduce overall capacity and create more value for shipping lines (Rau & Spinler, 2016). Finally, it may be beneficial for shipping lines to form an alliance if other shipping lines have already done so, as alliances have considerably more market power than individual lines. Hence, in the current market environment, it may be crucial to be part of an alliance in order to remain competitive (Álvarez-SanJaime, Cantos-Sánchez, Moner-Colonques, & Sempere-Monerris, 2013).

However, alliances have been rather unstable in the past. In late 2011, Hapag-Lloyd, NYK, OOCL, APL, HMM, and MOL joined forces and became the G6 alliance. Soon after, Maersk Line and MSC formed the 2M Vessel Sharing Agreement (VSA), COSCO, "K" Line, Yang Ming and Hanjin Shipping added Evergreen to the CKYH alliance which then became the CKYHE, and CMA CGM, CSCL and UASC started cooperating in the OCEAN3 alliance. However, as rates fell and profits turned into losses, shipping alliances realigned. Starting 2017, G6, CKYHE and the OCEAN3 alliance will be disabled and reform as the OCEAN and THE alliances while HMM will join the 2M VSA (Meyer, 2017).

Part of the reason for this instability is the individual agenda of the shipping lines that can have an impact on overall cooperation. Furthermore, other factors such as the number of alliance members, the nature of their role and contribution to the alliance, the level of mutual trust, and the level of intra-alliance competition may play a role in alliance instability. These problems have led to a strategic shift towards mergers and acquisition which has further destabilised alliances (Panayides & Wiedmer, 2011). Mergers and acquisitions are a form of horizontal integration, and have had a detrimental effect on shipping alliances as they have led to the reshuffling of alliance members, they can thus be seen as one of the reasons why none of the alliances have lasted in the long run. However, they have been very profitable for shipping lines as mergers and acquisitions have led to increases in economies of scale, market share, and market power. Other reasons why shipping lines often consider M&A relate to access to new markets and distribution networks, access to new technologies, and diversification (Notteboom, 2006). Mergers and acquisitions have largely contributed to the oligopolistic market structure of the container shipping industry.

2.3 Slow steaming

As has previously been pointed out, the world fleet has experienced tremendous growth in the last decades, which, in combination with the financial crisis, has led to overcapacity. In addition to the overcapacity in the liner shipping market, fuel prices have been increasing substantially. In order to cope with these changes, shipping lines have begun implementing slow steaming (Tezdogan, et al., 2015).

Slow steaming has since become commonplace as it has proven itself to be an effective way to cut fuel costs. For instance, Maersk saved 22% in bunker fuel costs in 2010, and the only adjustments they had to make to achieve this goal were to their network and their engine settings (Wong, Tai, Lau, & Raman, 2015). Reducing speed has such a large impact on fuel consumption because of reduced ship motions and thus lower power requirements at these slower speeds (Tezdogan, et al., 2015). These are important savings as fuel is a rather volatile and expensive cost item. Due to the volatility of fuel prices, fuel costs can vary between 20% and 60% of total operating costs, depending on the current fuel market situation (Wang & Meng, 2012).

Additionally, slow steaming has substantially reduced carbon emissions. Slow steaming has reduced emissions by around 11% from 2009 to 2011, which is close to the International Maritime Organisation's 2018 reduction target of 15%. This is an incredible competitive advantage as customer awareness of decarbonisation has grown in recent years (Cariou, 2011).

Slow steaming also aids the absorption of overcapacity during periods of low demand as shipping liners will have to deploy additional vessels at this slower speed in order to maintain the same frequency per liner service. It is estimated that slow steaming could absorb up to 4% of the excess fleet (Maloni, Paul, & Gligor, 2013). When both the Grand Alliance and CMA CGM added an additional vessel to their respective Asia-Europe routes during the summer of 2006, the cost savings generated by slow steaming more than compensated for the cost of deploying an additional vessel (Wang & Meng, 2012).

Finally, slow steaming reduces another important cost as shipping lines generally only achieve 50-60% on time arrivals, which increases port costs. Slow steaming improves schedule reliability as the reduced vessel speeds generate greater flexibility to adjust speeds and avoid delays (Maloni, Paul, & Gligor, 2013).

However, reducing speed has substantially increased voyage time and thus had an adverse effect on the quality of services, which has led to conflicts with shippers (Maloni, Paul, & Gligor, 2013).

2.4 Vertical integration

In recent years, shippers have not only developed a preference to deal with a smaller number of suppliers, but have also started to expect faster and more reliable services that cover a larger geographical scope and thus require greater efficiency from shipping companies. Additionally, capital costs in the container shipping industry have increased substantially. Jointly, these developments have encouraged shipping lines to extend their services through vertical integration (Heaver, 2010).

Vertical integration has a few advantages, it leads to efficiency gains as vertical integration reduces transaction costs and coordination problems through an improved exchange of information and business knowledge. Vertical integration also enables shipping lines to create closer relationships with the customer and reduce their dependence on third party logistics, which further improves efficiency. Additionally, vertical integration is an effective way to diversify and thus avoid a high dependency on the rather competitive, volatile, and ambiguous container shipping industry (Wiedmer, Panayides, Andreou, & Louca, 2012).

Vertical integration can take place in two main areas: container terminals and intermodal services (Heaver, 2010). Typically, shipping lines integrate the services that are the closest to their own services in the transport chain first. This means that shipping lines tend to invest in terminal operators first, before considering inland transportation (Wiedmer, Panayides, Andreou, & Louca, 2012). The remainder of this chapter will thoroughly discuss both integration in container terminals and intermodal services.

2.4.1 Container terminals

Because of the tremendous growth of container throughput in the last three decades, there has been a desperate need for long-term investments in port infrastructure. However, these investments were initially made difficult by the characteristics of ports as most ports used to be controlled by state-owned companies and public investment in them was rather low. At that time, stevedoring companies were small- or medium-sized companies, local or regional, and didn't have the resources to invest either (Cariou, 2008). However, as ports started to become privatised in the late 1980s, some terminal operators decided to shift their focus from a national platform to an international one. Consequently, international stevedoring companies emerged. This trend then accelerated in the 1990s. This time, however, stevedoring companies weren't the only investors. International terminal operators can since be distinguished into two groups: pure stevedores that are solely focused on port handling, and container shipping lines who decided to integrate by acquiring container terminal facilities (Midoro, Musso, & Parola, 2005). The latter of which will be discussed below.

There are a number of ways in which shipping lines can increase their involvement in terminal operators: (1) Direct ownership via subsidiaries or sister companies specialised in terminal operations, e.g. APM Terminals which is a sister company of Maersk Line; (2) Joint-ventures between shipping lines and independent terminal operators; and (3) Majority and minority shareholdings of shipping lines and shipping alliances in terminals (Notteboom, Kaselimi, & De Borger, 2011) .

One of the main reasons for container shipping lines to invest in container terminals in particular is that the mega-vessels they are increasingly deploying cannot be handled at all terminals. The larger vessels give rise to increased stevedoring costs and a tremendous increase in port time which endangers the profits gained from economies of scale at sea. Because of the increased costs associated with longer port times, port efficiency has become the most dominant element of international transport costs, which means that the efficiency of terminal operators has become increasingly important in the transport chain. Dedicated terminals also offer greater flexibility, reliability, and better integration in global supply chains which improves the line's quality of service (Álvarez-SanJaime, Cantos-Sánchez, Moner-Colonques, & Sempere-Monerris, 2013).

There are a few other factors that can influence a shipping line's decision to invest: (1) the line's financial capacity as the investment requires substantial resources, (2) the port authority's policy regarding shipping lines' investment in terminals. However, port authorities tend to approve of these investments as they are a way to make sure that the shipping line commits itself to the port in the future which stabilises the port's income, (3) it could be a way for a shipping line to defend its market position in areas that are facing increasing returns to scale or bottlenecks (Cariou, 2008); or (4) to diversify the line's portfolio and decrease its dependency on the container shipping industry (Wiedmer, Panayides, Andreou, & Louca, 2012).

When container shipping lines run their own terminal, they can choose to either only service their own vessels, or offer their residual services to other shipping lines as well and thus create a hybrid between a dedicated terminal and a multi-user facility. Most shipping lines choose to run their own dedicated terminals, however some are becoming a hybrid like APM Terminals by Maersk and the Japanese Yusin Kaisha (Álvarez-SanJaime, Cantos-Sánchez, Moner-Colonques, & Sempere-Monerris, 2013).

2.4.2 Intermodal services

Shipping lines can decide to invest in a port's hinterland by e.g. investing in rail or trucking companies; this is called carrier haulage. There are various reasons for a shipping line to consider carrier haulage: (1) to be able to offer more reliable and efficient transport, e.g. door-to-door service, (2) to gain control of the entire transport chain and be able to offer an intermodal rate that could comprise both sea and rail, and (3) to reduce risk by lowering its margins in sea transport and shipping companies so the effect of crises in the sector, like the oil crises, will have a lower effect on the company's balance sheet (Midoro, Musso, & Parola, 2005).

Inland logistics represents the part of the transport chain in which the most costs can be reduced. Currently, inland costs can account for anything between 40 and 80 percent of total transport costs. And contrary to ocean transport, inland transport relies on variable costs which makes it easier to reduce costs in this segment of the transport chain (Wiedmer, Panayides, Andreou, & Louca, 2012).

Carrier haulage is usually implemented through a combination of long-term contracts and short-term purchases under subsidiaries, e.g. Maersk Intermodal at Maersk. Whether a shipping line invests in a specific area depends on the size and other characteristics of the port's hinterland and the role of freight forwarders in the trade. These investments have recently been increasing in Europe and China as shipping lines are in a better position to guarantee a certain volume of traffic to make the investment viable than freight forwarders (Heaver, 2010).

As stated above, the aim of this chapter is to provide an overview of the current trends in the container shipping industry. The container shipping industry is currently under great pressure and companies are struggling to remain competitive in an oligopolistic market environment. There are four main strategies that shipping lines are employing to increase their competitiveness, namely increasing vessel sizes, horizontal cooperation, slow steaming, and vertical integration. Hence, shipping lines are increasing the scale and negotiating power of their operations, and cutting costs where they can in order to remain competitive. These trends will put significant pressure on port authorities, and the port authorities' strategies to handle these changes in the market environment will thus be vital.

3. Port authorities

As described in the previous chapter, the container shipping industry is quickly changing, which affects all of its stakeholders, including port authorities. The remainder of this thesis will focus on the impact on port authorities in particular. Shipping lines are becoming more demanding as they deploy larger vessels, more powerful through horizontal and vertical integration, and more ‘footloose’ due to the instability of alliances. This chapter will discuss how these changes affect port authorities and what strategies port authorities can employ to handle the changes.

For the sake of completeness, the previous chapter included slow steaming as one of the trends in the container shipping industry. However, slow steaming will be disregarded in the remainder of this thesis as it does not have a direct impact on the operations of port authorities.

3.1 Impact on port authorities

As an objective quantitative ranking of the factors impacting port authorities is not possible, this section will provide a qualitative overview, derived from literature, of the impacts of the previously discussed developments in the container shipping industry on the operations of port authorities.

3.1.1 Impact of increasing vessel size

As discussed earlier, the quest for economies of scale has led to tremendous increases in vessel size in the last decades. As a consequence, port authorities and terminal operators have been under pressure to swiftly make large investments in infra- and super-structures that are able to handle these vessels in order to maintain their competitive position. If a port authority is unable to do so, the older infra- and super-structures will inevitably lead to operational bottlenecks, port inefficiency, and increased turnaround times when handling large vessels (Parola, Risitano, Ferretti, & Panetti, 2017). As shipping lines have become rather ‘footloose’, these inefficiencies may encourage them to reorganise their transportation activities and leave out the congested port (Brooks, Pallis, & Perkins, 2014). However, much of the increased port capacity is only needed during peaks in demand and is otherwise idle (Donselaar & Kolkman, 2010).

Furthermore, in order to avoid the loss of the economies of scale gained at sea due to long turnaround times and congestion, a port’s hinterland must be able to efficiently handle the large amounts of cargo unloaded from these large vessels. Subsequently, the shipping lines’ demand for intermodality has increased (Mclaughlin & Fearon, 2013). This has put pressure on the port authorities of gateway ports to create better hinterland connections through high-capacity transport corridors serviced by rail, road, or barge (Parola, Risitano, Ferretti, & Panetti, 2017).

As only a few ports are able to handle large vessels, the use of hub-and-spoke networks by shipping lines has become increasingly common (Parola, Risitano, Ferretti, & Panetti, 2017). In a hub-and-spoke network, a hub port is connected to the mainline network through which vast amounts of cargo are transported in large vessels, these hub ports have sub-networks of smaller ports that are serviced by relatively small feeder vessels. These smaller ports thus receive smaller amounts of cargo that is first transhipped at the hub port (Lam, 2016). The ports that can handle larger vessels then become contenders to be the hub port and compete for the transhipment market, whereas smaller feeder ports that may not have the funds to acquire infraand super-structures to handle larger vessels are serviced indirectly via the hub (Parola, Risitano, Ferretti, & Panetti, 2017). Connectivity is also an important factor in a shipping line's choice of hub port as better coverage of markets can save the line significant costs (Lam, 2016). Competition among ports is thus intensified as liner services reduce their number of direct port calls (Notteboom, 2010). This network restructuring has also increased the range of competitors as ports that are further away can now act as a hub (Notteboom, 2006). This further increases the bargaining power of the shipping lines vis-à-vis port authorities as they will be unloading large amounts of cargo at their hub ports (Nam & Song, 2011).

The new requirements imposed by the deployment of larger vessels do not necessarily give existing large ports an advantage. Large established ports are to some extent threatened by medium-sized ports as those are more flexible and their port authorities may be able to invest in new infra- and super-structures more rapidly (Notteboom, 2006). However, large vessels do provide a competitive advantage for coastal port authorities (Notteboom, 2010) as port accessibility has become increasingly important due to the draft of these larger vessels (Grossmann, 2008).

3.1.2 Impact of horizontal cooperation

Due to horizontal cooperation between shipping lines, port authorities increasingly have to deal with large clients who possess strong bargaining power (Notteboom, 2010). There are two aspects of an organisation that affect its bargaining power; financial strength and the number of alternative options available. Financial strength is crucial as it enables organisations to follow their strategies, whereas disparities in the number of options available to two negotiating parties can result in an imbalance of power. For instance, a shipping line with a vast array of ports to potentially berth at will have power over port authorities with no alternative locations (Heaver, Meersman, & Van de Voorde, 2001). Hence, being part of an alliance will increase a shipping line's bargaining power as the alliance as a whole will have more financial strength and handles larger volumes. The financial power of large shipping lines, reinforced by strategic alliances is often used to play off one port or group of ports against the other (Notteboom, 2010). Consequently, port authorities are continuously at risk of losing important clients, not because of port performance, but because the client has decided to rearrange its service network. This loss can be devastating to a port as it could imply a loss of ten to even twenty percent of container throughput, as shipping lines control such large cargo flows (Notteboom, 2006).

The creation of alliances also poses a significant threat to port authorities as their alliances' joint choice of hub ports will intensify competition. The fact that there are, from April 2017 onwards, only three large players in the container shipping industry (the three alliances) means that while a few ports will gain a lot of volume as one of their hub ports, the majority of ports will lose out, which will intensify port competition (Mooney, 2017).

Moreover, because of horizontal cooperation, shipping lines can share vessels and do not have to sail as often themselves to be able to provide frequent services. Horizontal cooperation has thus not only impacted the port rotation schedule and the container volumes handled at each port, but also the frequency of port calls (Halim, Kwakkel, & Tavasszy, 2016).

Finally, vessel sharing by shipping alliances complicates the loading and unloading of containers, as the containers may be bound for different terminals within a port. This complication can lead to increased turnaround times and possible delays of other vessels due to terminal congestion (US Government Accountability Office, 2016).

3.1.3 Impact of vertical integration

Vertical integration of shipping lines with terminal operators has increased entry barriers to the container shipping market. A new shipping line would have to find a terminal that is not dedicated to a specific shipping line yet in addition to offering sea transport. This reduces the number of potential port customers and further increases the bargaining power of both existing shipping lines and existing terminal operators with respect to the port authority (Donselaar & Kolkman, 2010).

Additionally, vertical integration has put an end to traditional task divisions in the supply chain. Therefore, ports now have to compete as a node in a transport or supply chain, not as individual entities. This implies that the competitive position of a port authority has become dependent on external factors that influence the efficiency of the supply chain as a whole (Notteboom, 2006). Within the supply chain, there are many alternatives for a port, which erodes the port authority's bargaining power (Donselaar & Kolkman, 2010). In order to remain competitive, a port needs to add value to the entire supply chain (Zhang, Lam, & Huang, 2014).

However, the financial stake of a shipping line in a port, generated by vertical integration into container terminals or intermodal facilities may reduce the line's footloose nature and create a more stable, long-term relationship with the port authority (Heaver, Meersman, & Van de Voorde, 2001).

3.2 Strategies for port authorities

A wide array of strategies to handle the changes in the port environment has been discussed in literature, this chapter will provide a brief overview of those strategies.

3.2.1 Investment

Most port authorities have merely been reacting to changes in the container shipping industry. Some have done so more actively and efficiently than others by investing in new facilities and information technologies (Heaver, Meersman, & Van de Voorde, 2001). The quality of infrastructure such as quay length and draft of the waterways, and superstructure such as cranes and storage facilities is extremely important for a port as it determines the size and number of the vessels, and the amount of cargo it can handle. As alliances are deploying ever larger vessels, more investment is needed in physical infrastructure in order to keep up with the container shipping industry and remain attractive (Jacobs & Lagendijk, 2014).

However, ports are subject to limitations in available space, finance and technical capabilities, etc., which means that there are constraints to future port development through investment (Khalid, 2006). A port authority can opt to develop its available space through restructuring existing spaces, expanding into adjacent spaces, and developing in new locations if it has the required financial assets to do so. Port authorities usually use all three of these expansion strategies in order to gain or maintain a competitive edge (Yap & Lam, 2013).

Moreover, it is imperative for port policy makers to carefully match capacity to demand in order to reduce the risk of overinvestment (Brooks, Pallis, & Perkins, 2014). In practice, the risks of new investments made by the port authority are often underestimated, which means that the port authority may not always choose the best investment or development strategy. The port authority can reduce this risk through project-based financing which shifts the risk from the port authority to private investors and improves their decision making (Wiegmans, Ubbels, Rietveld, & Nijkamp, 2002).

Finally, it is important to note that investments in new facilities do not automatically imply higher port throughput or more customers, which indicates that investment policies remain speculative (Verhoeven, 2010).

3.2.2 Cooperation

It has been suggested that cooperation among port authorities may be an answer to the increasing "excessive demands" from increasingly powerful shipping lines and alliances (Heaver, Meersman, & Van de Voorde, 2001). Because of the increasing bargaining power of shipping lines and alliances, ports that were previously tied to a certain location are looking at cooperation with other ports elsewhere to provide countervailing power. Ports can cooperate with overseas ports in the same corridors, ports in the hinterland, as a main port with smaller satellite ports in the region, or even with adjacent ports. Cooperation between overseas ports in the same corridors can improve efficiency as an investment by one port would mean that the other port would have to invest as well. For instance, an investment by one port in larger cranes could attract larger vessels to the route which could damage the competitive position of the other port if it does not invest. If the two ports cooperate, these types of situations can be avoided. Cooperation with ports in the hinterland is a good way to improve the efficiency of the entire supply chain. In order to create such cooperation, a port authority can start strategic relations with inland transport nodes (Donselaar & Kolkman, 2010). This form of cooperation, in addition to cooperation as a main port with smaller satellite ports, will make the port a more attractive option to become a hub port in a shipping line's network (Lam, 2016). Reasons for cooperation between adjacent ports are less clear as these ports are usually each other's largest competition. However, ports can cooperate with rivals to receive reciprocal advantages through co-opetition. The extent of cooperation can range from contractual agreements to joint ventures. This type of cooperation can make the participating ports more exposed to each other but stronger in comparison to others. The advantages of cooperation include better capacity utilisation, economies of scale and scope, and the optimisation of investment policies (Donselaar & Kolkman, 2010). However, cooperation between ports could lead to problems with competition policies (Heaver, Meersman, & Van de Voorde, 2001).

A port authority can also cooperate with private companies at multiple locations through the development of various projects. Port authorities are often location bound which makes it more difficult for them to expand internationally. In order to start internationalisation and increase its bargaining power with respect to container shipping lines, a port authority can focus on marketing to international companies. This can be done by investing in permanent regional representatives abroad or by participating in events such as trade missions or trade fairs in order to improve the port's integration in supply chains and convince foreign companies to increase their activity in the port. Alternatively, a port authority can send some of its experts to e.g. developing countries to help local management improve port infrastructure in order to improve awareness of its own port at that location. Next, a port authority can invest directly into that location and build long-term relationships, commonly through license agreements, alliances and joint ventures with companies from those locations. This strategy has the added bonus that the port authority can use whatever revenue it receives from these collaborations to invest in its local port (Dooms, van der Lugt, & de Langen, 2013).

Embracing port regionalisation and cooperating with inland transport modes can be a way for a port to deal with increasing supply chain integration. Regionalisation is not instigated by the port itself, but by shippers and third-party logistics providers. If a port decides to embrace port regionalisation, its subsequent actions will go beyond the traditional role and geographic location of the port authority as efficiency is then attained through integration with inland transport companies, favouring the rise of transport corridors and logistics poles. In order to embrace port regionalisation and contribute to the process, a port can put its resources to reducing congestion and increasing handling capacity. It is thus crucial for port authorities to network with other nodes and market players so they will consider instigating port regionalisation (Notteboom & Rodrigue, 2005). If a port can ensure that cargo is smoothly transferred onto other modes of transport, the performance of the entire supply chain will be improved (Nam & Song, 2011).

3.2.3 The provision of additional services

There is often pressure for port authorities to invest in new infrastructure or technologies in order to handle the larger vessels that are deployed by alliances. However, as these investments are capital intensive, the planning and development of new infrastructure or technologies takes long lead times. The pressure to invest can then be reduced in the short to medium term by port productivity improvements and added services (Brooks, Pallis, & Perkins, 2014).

There are a number of ways in which the utilization of existing infrastructure can be improved, including small investments in container yard handling equipment, investment in new business processes and information technology systems, introducing port gate arrival reservation systems, introducing financial incentives to reduce port dwell time, extending gate hours, adding cranes, etc. (Brooks, Pallis, & Perkins, 2014). However, services such as extended gate hours can lead to truckers only wanting to use off-peak gate hours to avoid the mitigation fees that are often charged for daytime pickup (US Government Accountability Office, 2016).

Herein, the port authority should give additional attention to the proper design, planning, organisation, and management of logistics interfaces as these are the nodes where congestion is most likely to occur. If a port authority can optimise the operations of its logistics interfaces, it can deliver higher service levels and make better use of its infrastructure, which will increase its competitiveness (Paixao & Marlow, 2003).

Ports can also offer custom-made services such as free storage for transhipment containers, warehousing, and priority or dedicated berthing arrangements in order to become a more attractive option to be a hub port (Khalid, 2006).

3.2.4 The reassessment of existing services

A paper by Paixau and Marlow (2003) agrees with Heaver, Meersman, and Van de Voorde (2001) that ports are rather traditional and implement a reactive approach to industry developments. The paper argues that in the current environment, ports must adapt a new attitude in order to keep up with changes. Therefore, it suggests that ports should become a more agile element of the supply chain in order to be able to better compete with each other while simultaneously becoming an important node in the supply chain. By being agile, a port can become proactive rather than reactive. Agility is a strategy that can improve the connection between the internal and external elements of the port. In order to become more agile, the port has to go through two stages. The first phase adjusts ports to just-in-time strategies that are increasingly used by shippers (internal integration) while the second phase implements agile theories in ports (external integration). This strategy will help simplify port operations by focussing on the elements that produce the largest revenue and the ones that add the most value to the customer and scrapping the ones that produce excessive costs. The strategy is extremely effective as on average, 20 percent of services offered by the port are responsible for 80 percent of its revenue. If a port concentrates on the services that make up those 20 percent, it can become more proactive by improving the use of the remaining resources for daily operations and future investment (Paixao & Marlow, 2003).

Alternatively, it is possible to redevelop port land for new usages related to other economic sectors such as tourism and recreation that may be more profitable, especially if land in the area is scarce (Grossmann, 2008).

Port authorities are thus heavily affected by the strategies that are put in place by container shipping lines in their struggle to remain competitive. Because of shipping lines' strategies, port authorities essentially have to deal with larger, more powerful, and more demanding clients, which, in combination with the 'footloose' behaviour of shipping lines, has led to a very competitive and ambiguous market environment. Scholars seem to agree that port authorities are implementing a reactive approach rather than a proactive one to deal with these industry changes. Scholars propose investment, cooperation, the provision of new services, and the reassessment of existing services as strategies to remain competitive in spite of the current developments in the container shipping industry. The next part of this paper will look at the port authorities on the West Coast of North America to determine which of these strategies are used in practice.

4. The West Coast of North America

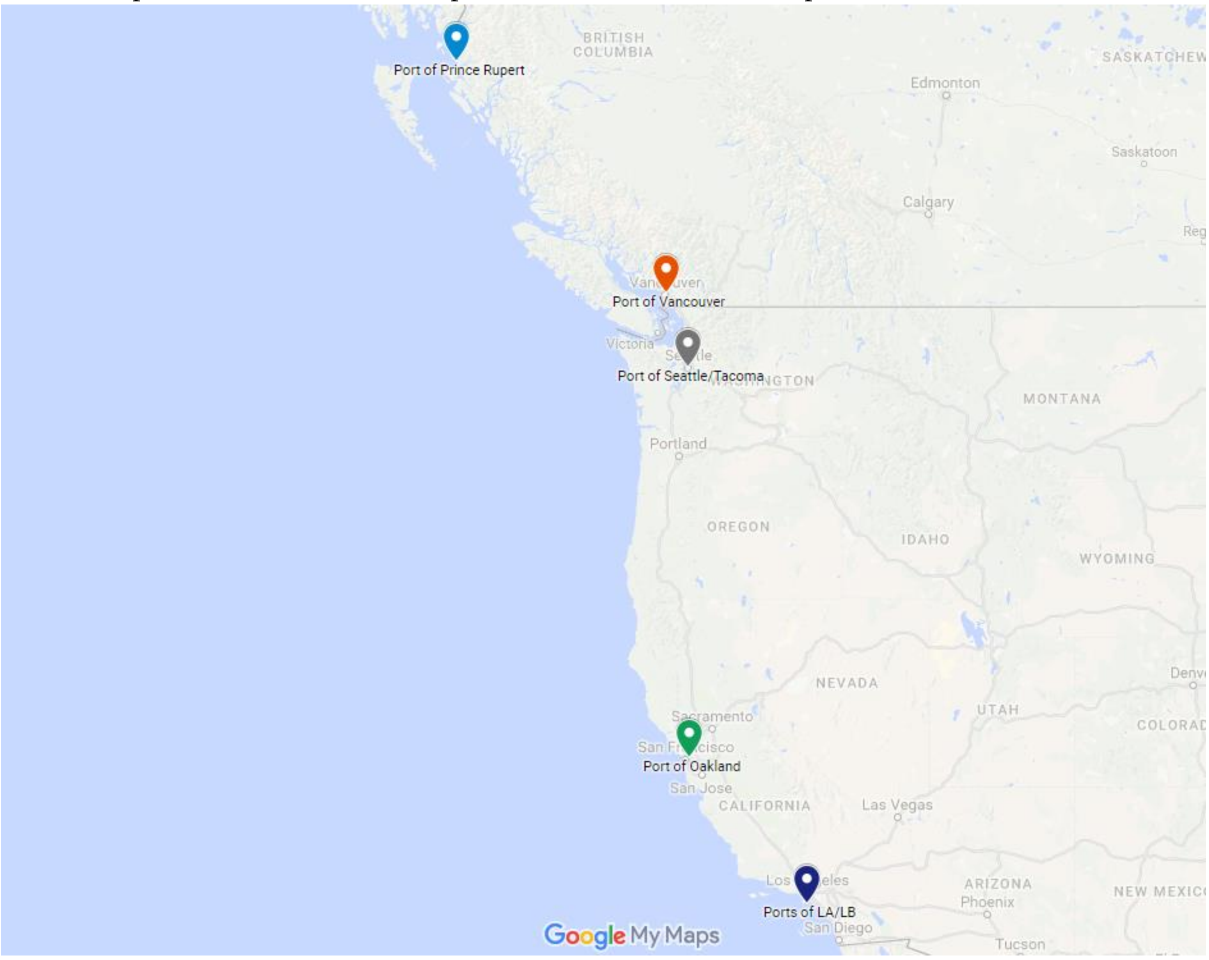
4.1 Ports on the West Coast of North America

This chapter will discuss the largest ports on the West Coast of North America in terms of container throughput based on the 2015 NAFTA container port ranking by the American Association of Port Authorities (AAPA). This thesis will be limited to ports in the top 25. According to the ranking, the port of Los Angeles is the largest port in the NAFTA and on the West Coast. The table below summarises the rank, country, and throughput in TEUs of all North American West Coast ports in the top 25.

Rank	*Port*	*Country*	*Throughput in TEUs*
1	Los Angeles	United States	8,160,458
2	Long Beach	United States	7,192,066
5	Seattle/Tacoma Alliance	United States	3,529,446
6	Vancouver	Canada	3,054,468
9	Oakland	United States	2,277,521
21	Prince Rupert	Canada	776,414

Table 1: The largest ports on the West Coast of North America (American Association of Port Authorities, 2016).

The more precise location of these ports can be seen on the map below.



Source: Adaptation of Google Maps (2017)

These ports will briefly be discussed below in order to provide an overview of their current state and competitive position.

As can be seen on both the table and the map, five of the ports are located in the United States of America, while the other two are located in Canada. All of the previously mentioned US American ports are proprietary departments of their respective cities and held in trust by these cities for the people of their respective states. The ports are operated independently from their cities by boards of port commissioners, whereas both Canadian port authorities were constituted under the Canada Marine Act and are accountable to the federal Minister of Transport. All of these port authorities operate from a landlord function, which means that they lease docks, wharves, warehouses etc. to private firms. So, although the port authorities are the owners of the facilities, they are not involved in daily cargo movements (Port of Los Angeles, 2016; Port of Long Beach, 2017; Port of Seattle, 2016; Port of Tacoma, 2016; Port of Vancouver, 2016; Port of Oakland, 2016; Port of Prince Rupert, 2017). This limits the strategies that port authorities can apply in order to react to the current developments in the container shipping industry. However, as the landlord model is rather common, this has already been taken into account by the papers that proposed the strategies discussed in this thesis.

The port of Prince Rupert has a main channel depth of 35 metres, which is by far the deepest on the West Coast of North America (Port of Prince Rupert, 2017), followed by the port of Long Beach which has a channel depth of 23 metres and a minimum depth of 15 metres at its container terminals. The ports of Los Angeles and Vancouver have a channel depth of 16 metres, and the port of Oakland and the ports of Seattle and Tacoma have a channel depth of approximately 15 metres. In combination with all of their availability of post-panamax cranes, this means that all ports on the North American West Coast are able to handle the mega vessels that are currently being deployed by alliances. However, the port of Prince Rupert is not able to handle many vessels at once, as it only has four post-panamax cranes at its sole container terminal (CBRE Research, 2015).

The ports of Los Angeles and Long Beach have a major competitive advantage as they serve the enormous local market of southern California, which has a population of over 17 million people (Starratt, 2005). These two ports will henceforth be discussed simultaneously as they are located right next to each other in San Pedro Bay and both their operations and their histories are heavily intertwined. In this regard, it is important to note that although the ports have had a long history of cooperation, which even included a few attempts to achieve consolidation, they remain each other's most important competitors (Jacobs, 2007). The ports of Seattle and Tacoma mainly serve the local market in Washington (Port of Seattle, 2016; Port of Tacoma, 2016). It is important to note that the ports of Seattle and Tacoma are competing as one container gateway, not as individual ports, since they formed the Northwest Seaport alliance (NWSA), which will be discussed in the strategy section of this chapter. The strategic location of the port of Vancouver provides it with a substantial competitive advantage because it allows the port to act as a gateway to Canadian markets (Port of Vancouver, 2016). The port of Oakland is located in a large metropolitan area whose economy is strongly connected to global trade. The port of Oakland serves as the main ocean gateway for container shipments in Northern California (Port of Oakland, 2016). The port of Prince Rupert has a rather small local market and is thus mainly dependent on markets that are further away (Mongelluzzo, 2017b).

Therefore, the port of Prince Rupert mainly serves the United States; about two-thirds of its cargo throughput originates from or is destined to go to the United States (Mongelluzzo, 2017b). The Vancouver Fraser port authority has also been trying to increase its market share in the United States as Canada is a rather small and mature market. The port of Vancouver's market share in the United States has traditionally been rather low; as recently as 2008, only 7.8 percent of cargo that went through the port of Vancouver originated in or was destined to go to the United States. The share of US cargo at the port of Vancouver has increased since, and amounted to 22.9 percent in 2013. However, this is still merely about a fifth of the port's cargo throughput (Mongelluzzo, 2017b). Although ports on the North American West Coast, which the exception of the port of Prince Rupert, thus primarily serve their local markets, all of these ports are also competing for cargo going to Chicago and the American Midwest by Rail (Mongelluzzo, 2016e). In North America, only limited, if any, inland barge services are possible (Rodrigue & Notteboom, 2010), which is why the remainder of this thesis will mainly focus on inland transportation by rail. Canadian ports have a slight competitive advantage vis-à-vis American ports as Canadian railways are currently much cheaper than their American counterparts that are raising intermodal rates as they are struggling with a reduction in coal and oil traffic (Talton, 2017). There is not merely a difference in intermodal rail rates. Other costs such as those related to terminal-handling and merchandise-processing on imports are much higher at US ports, which can lead to an overall price difference for an Asian container of up to US$600 (Mongelluzzo, 2017b). Moreover, Canadian ports are located closer to the Asian market, for instance, the port of Prince Rupert is North America's closest port to Asia by up to three days sailing, it's over 68 hours closer to Shanghai than the port of Los Angeles (Port of Prince Rupert, 2017).

As all North American West Coast ports are thus competing for cargo going to Chicago and the American Midwest by Rail, it is very important that they have sufficient hinterland connections. The ports of Los Angeles and Long Beach have great hinterland accessibility as they are served by two major railroads and are located at the terminus of two major Los Angeles freeways, which makes them attractive options to become hub ports in shipping lines' networks. These intermodal connections were mainly established by projects on which both ports collaborated. In August 1989, the port of Los Angeles and the port of Long Beach entered into a joint exercise of powers agreement to form the Intermodal Container Transfer Facility Joint Powers Authority (ICTF) and the Alameda Corridor Transportation Agency (ACTA). The formation of ICTF and ACTA was the first step in collaboratively creating a comprehensive transportation corridor, including related facilities. The transportation corridor is situated along Alameda Street between the Santa Monica Freeway and the Ports, linking them to the central Los Angeles area. The Alameda corridor finally began operations in April 2002 (Port of Los Angeles, 2016; Port of Long Beach, 2017). While the ICTF is an extremely successful multi-user operation, there are some customers at the port of Los Angeles that have even developed their own on-dock railyards to further increase the efficiency of their operations at the port (Port of Los Angeles, 2017). To further improve their intermodal connectivity, the ports could extend the Alameda corridor to areas such as Orange County and San Bernardino where the main distribution centres are located, and the ports could work on reducing their substantial freeway congestion problems (Jacobs, 2007).

The port of Vancouver's deep-sea terminals have extensive on-dock rail facilities serviced by both Canadian railways that significantly improve intermodal hinterland connectivity and reduce transit time through less handling (Port of Vancouver, 2017). As opposed to the ports of Seattle and Tacoma that do not have on-dock railyards. However, they do have nine intermodal rail yards in close proximity to the docks (The Northwest Seaport Alliance, 2017). The port of Oakland also does not have on-dock intermodal facilities (Port of Oakland, 2017). In order to improve the intermodal connections, the port of Oakland is currently transforming a former military supply depot into a logistics centre that will include new cross-dock and transloading facilities, a new manifest rail yard, a new intermodal rail terminal, and other related facilities. The development of this area will improve the efficiency of cargo movement into and out of the port's terminals, intermodal services, and the port's overall competitive position. This development is being phased according to market demand and the availability of funding. The first phase of the development, which included the construction of new main and support rail yards, is mostly complete (Port of Oakland, 2016) and the port is currently redeveloping the remainder of the land into a new logistics facility in cooperation with CenterPoint Properties, which will be discussed in more detail in the strategy section of this chapter (Dupin, 2016d).

Finally, the port of Prince Rupert is connected to all of North America by Canadian National Rail's (CN) network (Port of Prince Rupert, 2017). Prince Rupert was originally built in the early 20th century as the railhead for the Grand Trunk Pacific Railway (GTP). When GTP went bankrupt shortly after the outset of the First World War, the railhead was absorbed by today's CN Rail. Prince Rupert is the northernmost railhead on the continent of North America. The Port of Prince Rupert finally started building its first facility, the Fairview Terminal, when it got declared a National Harbour in 1972, the terminal was finished by 1975. The Fairview Terminal was the first dedicated intermodal terminal in North America and was converted into a container terminal as recently as 2007 (Port of Prince Rupert, 2017). Thus, Prince Rupert has a great hinterland connection by rail and is known for its speed in unloading and transferring containers to rail for imports and the reverse for exports, because of which the port is slowly growing. CN has even been investing in the route from Prince Rupert to Chicago by widening tunnels, reinforcing bridges and building sidings (US Army Corps of Engineers, 2012).

4.2 Impact of the developments in the container shipping industry

As the largest vessels go straight into the Asia-North Europe trade and the smaller vessels are then pushed into the transpacific, the transpacific is not a suitable trade route to base discussions on the impact of mega vessels introduced by increasing vessel sizes on as these mega vessels are not deployed on the transpacific trade (Barnard, 2017a). Additionally, as was discussed in the previous section of this chapter, all North American West Coast ports that are under discussion in this thesis appear to be able to handle the vessels that are currently deployed on the transpacific route without major adaptions. Therefore, the effects of increasing vessel sizes and the strategies that port authorities can employ to remain competitive despite them will henceforth be excluded. This section of the chapter will discuss the horizontal and vertical integration by container carriers at North American West Coast ports.

4.2.1 Impact of vertical integration

There is currently no example of vertical integration between container shipping lines and West Coast intermodal services. This is not surprising as mergers and acquisitions following the deregulation of American railroads led to a massive concentration of railroads in North America, with only two US American railroads (Union Pacific and Burlington Northern Santa Fe) and two Canadian railroads (CN and Canadian Pacific) being operated on the North American West Coast. Additionally, US American rail companies own the tracks they operate on and are able to freely set rates, close unprofitable railroads, and financially participate in multimodal operations, which has led to vast market entry barriers (Slack, 2016). Hence, the North American railroad industry is highly concentrated and leaves little room for shipping lines to integrate, which is why the remainder of this thesis will only take vertical integration by shipping lines in terminal operating companies into account when discussing vertical integration.

The terminals at the port of Vancouver are operated by DP World, GCT Canada, and the Fraser Surrey Docks LP, which means that there is no vertical integration at the port of Vancouver (Port of Vancouver, 2017). The same is true of the port of Prince Rupert, where the sole terminal is operated by DP World (Port of Prince Rupert, 2017). However, this cannot be said for any West Coast ports that are located in the United States. The table below shows the dedicated terminals and joint ventures between terminal operators and container shipping lines at the remaining West Coast ports, sorted by alliance.

	Port of Los Angeles	Port of Long Beach	Port of Oakland	Ports of Seattle/Tacoma
2M+HMM				
Maersk	APMT			APMT Tacoma
MSC		Pier T/Pier A		Terminal 46
Hyundai Merchant Marine	California United Terminal at APMT			Washington United Terminal
Ocean alliance				
CMA CGM	Global Gateway South	Pier J		
COSCO	West Basin Container Terminal	Pier J		
Evergreen	Everport Terminal Services		Ben E. Nutter Terminal	Pierce County Terminal
OOCL		Pier F		
THE alliance				
K-Line		Pier G		
Mitsiu OSK Lines (MOL)	Trapac Terminal		Trapac Terminal	
NYK-Line	Yusen Terminal			Yusen Terminal
Yang Ming	West Basin Container Terminal			Olympic Container Terminal
No alliance				
Matson		Terminal C60	Terminal B63	
Non-dedicated	0	2	4	5
Total	7	6	7	11

Table 2: Dedicated terminals and joint ventures on the US West Coast. *Source:* Adaptation of Port of Los Angeles (2017), Port of Long Beach (2017), Port of Oakland (2017), and the Northwest Seaport Alliance (2017).

Container shipping lines have acquired these stakes in a wide variety of ways. For instance, Maersk is the direct owner of its terminals in the ports of Los Angeles and Tacoma through its sister company APM Terminals (Maersk Group, 2017). MSC became the majority shareholder of terminal 46 at the port of Seattle and Pier T at the port of Long Beach when its subsidiary Terminal Investment Ltd. acquired 80% of Hanjin's Total Terminals International (Barnard, 2017b). HMM acquired the remaining minority stake of 20% in Total Terminals International (Mongelluzzo, 2016f). COSCO has a stake in Long Beach's Pacific Container Terminal located on Pier J through a joint venture with SSA Marine and CMA CGM (JOC Staff, 2012). Finally, CMA CGM became the owner of the Global Gateway South at the port of Los Angeles after it purchased APL, who's wholly owned subsidiary Eagle Marine Services had previously managed the terminal (Dupin, 2016a).

There are thus 32 container terminals on the West Coast of the United States and 5 on the West Coast of Canada which totals 38 on the West Coast of North America, 20 of which are dedicated to one container shipping line. Hence, over half of the terminals at North American West Coast ports are dedicated to a shipping line. There are a number of ways in which this can be explained based on the literature that was discussed in 3.1. Firstly, the strong presence of vertical integration by container carriers can be explained by the fact that there are only a few West Coast ports, which makes the competition among container shipping lines to berth at one of them fierce. In order to make sure that they can load/unload their cargo at one of the West Coast Ports, container shipping lines have created their own terminals or acquired stakes in existing terminals (Jacobs, 2007). It can be highlighted that competition to get slots to load/unload cargo at the ports of Los Angeles and Long Beach was particularly fierce as every container line that uses vertical integration has a dedicated terminal at one of these ports. It is interesting to note that the degree of vertical integration in southern West Coast ports (LA/LB and Oakland) is much higher than in their Northern counterparts (NWSA and Canadian ports). Another explanation for the popularity of the ownership of West Coast terminals could be that shipping lines put a lot of value on the efficiency of their supply chains that run through these ports. This would imply that port authorities should attend closely to ways that ports can add value to these supply chains in order to gain a competitive advantage and increase cargo throughput (Zhang, Lam, & Huang, 2014).

The strong presence of dedicated terminals at North American West Coast ports, especially at the port of Los Angeles, means that shipping lines that do not have a dedicated terminal on the West Coast may find it difficult to enter the market (Donselaar & Kolkman, 2010). These dedicated terminals reduce their options to either making a deal with another shipping line to let them use their terminal or trying to get a slot elsewhere. The Canadian ports that have no dedicated terminals could try to attract those lines' business and increase cargo throughput. However, as will be explained below, these lines only represent a small fraction of total cargo volume as 91% of the cargo from Asia destined for North American ports is carried by alliances that all have at least one dedicated terminal in each port, with the exception of the 2M+HMM VSA at the port of Oakland. The reduced threat from new market entrants and existing container shipping lines that are not members of an alliance further increases the alliances' bargaining power vis-à-vis port authorities.

It is also important to note that many alliances will have to deal with conflicting interests when configuring a new alliance network. For instance, Maersk of the new 2M+HMM VSA has a dedicated terminal in the port of Los Angeles, while MSC has a dedicated terminal in the port of Long Beach. This can make alliance network choices more complicated, and it suggests that the fact that a container shipping line has a dedicated terminal at a port does not automatically imply its loyalty or cargo volumes. Finally, it is important to note that Evergreen has some form of horizontal cooperation with a terminal in each of the US West Coast gateways, COSCO and CMA CGM have a stake in two terminals, one in each port in the San Pedro Bay, and MSC has stakes in two terminals in the port of Long Beach.

4.2.2 Impact of horizontal cooperation

As can be seen in the figure below, transpacific trade is expected to be dominated by alliances who are estimated to collectively handle 91% of capacity after their reshuffling in April 2017. This provides the alliances with substantial bargaining power vis-à-vis the port authorities. Four independent carriers will handle the remaining 9% of capacity (Alphaliner, 2016).

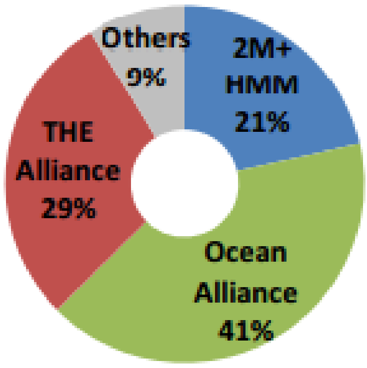


Figure 2: Asia-America projected capacity share by alliance (Alphaliner, 2016).

According to the literature that was discussed in 3.1, this bargaining power is often used to play off one port or group of ports against the other (Notteboom, 2010), such a strong dominance of alliances in the Asia-America trade will thus lead to tough competition for alliance cargo among port authorities. Additionally, ports are at a continuous risk of losing clients, not because of port performance, but because the client has decided to rearrange its service network e.g. when the rather instable alliances are reshuffled (Notteboom, 2006). The new networks of the recently reshuffled alliances will be discussed below to demonstrate the impact of horizontal cooperation on each port.

The Ocean Alliance will operate 20 transpacific services, which will include nine Pacific Southwest services and four Pacific Northwest services, the remaining services will call at the East Coast. All of the nine Pacific Southwest services are planned to call at the ports of Los Angeles/Long Beach, which is also the first North American port of call and thus the port that traditionally the largest amount of cargo is unloaded in, in eight out of the nine loops. These vessels will call at two terminals in each of the ports. There are even two loops in which the port of Los Angeles/Long Beach is the only North American port of call. Prince Rupert is the first North American port of call in the ninth loop, which is also the only Pacific Southwest loop that the port of Prince Rupert is included in. The port of Oakland is included in six out of the nine loops, however, it is never the first port of call. All four Pacific Northwest services will call at the port of Vancouver, however, it is the first North American port of call in only one service. Again, the port of Prince Rupert is included in only one service, of which it is the first port of call. The Northwest Seaport alliance is included in all three other services, with Ocean Alliance vessels calling at Seattle for two services and Tacoma for one, each of these ports is the first North American port of call in one of the services (CMA CGM, 2016).

THE Alliance will operate 16 transpacific services, which will include eight Pacific Southwest services and three Pacific Northwest services, the remaining services will call at the East Coast. The Pacific Southwest Services will only call at the ports of Los Angeles/Long Beach and Oakland. Seven out of the eight services serve both ports, calling at Los Angeles/Long Beach first. The eighth service will make its only North American call at the ports of Los Angeles/Long Beach. All three Pacific Northwest services will call at the port of Vancouver, however, it is the first port of call in only one of these services. The Northwest Seaport Alliance is also included in all three Pacific Northwest services, the port of Tacoma is part of two loops, in both of which it is serviced as the first North American port of call. The port of Seattle is included in only one service (Hapag-Lloyd, 2017). It is important to note that THE Alliance will not call at the port of Prince Rupert during any of its service loops.

Traditionally, 2M+HMM has a rather small transpacific network, especially in comparison to its Asia to Europe routes. However, 2M+HMM has recently been expanding its transpacific network (Andersen, 2016). 2M+HMM is operating four Pacific Southwest services and two Pacific Northwest services. All four Pacific Southwest services call at either the port of Los Angeles or the port of Long Beach, these ports are the first North American ports of call in all four services. 2M+HMM calls both the port of Los Angeles and the port of Long Beach in two of its services. The port of Long Beach is the only North American port of call in one of its services. 2M+HMM calls at the port of Oakland in three of its Pacific Southwest services. Both Pacific Northwest services call at the port of Vancouver, however, it is the first North American port of call in only one service. The port of Prince Rupert is included in only one service, of which it is the first North American port of call. The Northwest Seaport Alliance is only included in one service by 2M+HMM, which calls at the port of Seattle (MSC, 2017).

Hence, every Pacific Southwest service of every shipping alliance calls either calls at the port of Los Angeles or the port of Long Beach. Combined, these ports get called at 21 times per week by these shipping alliances. It is not clear which West Coast port receives the most port calls as many shipping alliances did not specify whether they call at the port of Los Angeles or the port of Long Beach. If a comparison of port calls on the West Coast were possible, the port of Oakland would be a close contender as it gets 16 port calls a week by the shipping alliances. However, it is important to note that the port of Oakland is never the first North American port of call, which means that the volumes of cargo that are unloaded at the port of Oakland are presumably lower than those at the first North American ports of call. Hence, the port of Oakland is mainly an export port (Mongelluzzo, 2016d). It is also noteworthy that there are a lot more services to the Pacific Southwest than to the Pacific Northwest. The Northwest Seaport Alliance and the port of Vancouver get called at the most in Pacific Northwest services as they are each included in nine loops. The port of Prince Rupert, which is substantially smaller than the other ports that are being discussed only gets three weekly calls by the alliances and is not included in any of the THE alliance's loops. However, it is the only port that gets called at by both Pacific Southwest and Pacific Northwest services. These port calls by alliances are extremely important as alliances handle 91% of transpacific cargo volumes.

The services operated by the new alliances have significantly less direct port connections than the ones operated by the previous alliances, which will lead to less product differentiation on the lines' part and less port calls, which intensifies port competition. A total of 150 direct port-pairs will no longer be available on the transpacific routes, while only 56 new ones are added. Additionally, the remaining port pairs will see a significant decrease in service frequency. This will lead to more cargo needing transhipment (Knowler, 2017b). This could be a sign of terminal consolidation by shipping alliances, wherein the number of transhipment hubs is reduced. Terminal consolidation not only reduces costs, it also reduces risks for the shipping line as it is a way to even out volatile regional cargo flows and increase vessel utilisation. (Mooney, 2017). As was discussed in 3.1, horizontal integration thus leads to strong competition for alliance transhipment cargo among port authorities, which will intensify when the number of alliances is reduced (Mooney, 2017). However, terminal consolidation is more likely to affect ports in more extended regions such as Asia than at the West Coast of North America, as cost savings will be larger in those regions. Moreover, there are many impediments to transhipment in the US due to American shipping regulations that were formed around the US Merchant Marine Act of 1920 (better known as the Jones Act) that favours a process of limited transhipment services between American ports. The Jones Act ultimately states that cargo is not allowed to be transported between two US ports unless it is transported by vessels owned by citizens of the US, built and registered in the US, and manned by a crew of US nationals, which limits domestic shipping in North America (Rodrigue & Notteboom, 2010). Therefore, it is not very likely that ports on the North American West Coast will have to compete for transhipment cargo.

Moreover, 135 out of the 354 remaining port pairs will see a decrease in service frequency after the alliance reshuffling (Knowler, 2017b). This is to be expected, as has been discussed in 3.1, because horizontal cooperation enables shipping lines to share vessels, which means that they do not have to sail as frequently themselves (Halim, Kwakkel, & Tavasszy, 2016).

4.3 Strategies adopted by North American West Coast ports

This section of the chapter will discuss whether and how the North American West Coast port authorities are implementing the strategies that were proposed by scholars in 3.2. The section will not discuss investment individually, but in combination with other strategies as investment in infra- and superstructures that was discussed in 3.2.1 is mostly aimed at handling increasing vessel sizes.

4.3.1 Cooperation

Locally, the port authorities of Los Angeles and Long Beach cooperate with each other and with their various stakeholders. The port authorities of Los Angeles/Long Beach have a long history of collaborating on projects such as the previously mentioned Alameda corridor and its intermodal facilities. The port authorities are currently cooperating on projects that aim to optimise the supply chain by improving chassis management, putting in place trucker appointment systems, making greater use of "peel-off" container piles at the terminals, and sharing of shipment information among all members of the supply chain (Mongelluzzo, 2016b), all of which will be discussed in 4.3.3. To do so, the ports of Los Angeles and Long Beach created a Supply Chain Optimisation Steering committee in May 2015. The Committee organises supply chain stakeholder working groups that create closer relationships between the port authorities and their stakeholders, and improve the port's supply chain efficiency (US Government Accountability Office, 2016). Globally, the port authorities cooperate with Asian port authorities in an effort to implement block stowage on vessels at their origin location so containers can be discharged and handled more efficiently with as little restowing as possible in order to save both costs and time at their port of destination in San Pedro Bay (Mongelluzzo, 2016b). As was discussed 3.1, this cooperation with Asian ports is necessary because vessel sharing by shipping alliances complicates the loading and unloading of containers at the port, which can lead to increased turnaround times and possible delays of other vessels due to terminal congestion (US Government Accountability Office, 2016).

The ports of Seattle and Tacoma have an even closer collaboration since they entered an alliance. The Northwest Seaport Alliance (NWSA) between the ports of Seattle and Tacoma was created in August 2015. The collaboration has helped the ports improve their competitive position on the West Coast, increase cargo volumes, and increase their bargaining power over shipping lines, which has deteriorated substantially since the implementation of horizontal and vertical integration by shipping lines. The purpose of the NWSA is to unify the management of maritime cargo terminal investments, operations, planning and marketing to improve the Puget Sound gateway and to attract more business to the region. This not only improves the financial position of both ports, it has the added advantage of creating less overcapacity as duplicative and thus potentially harmful capital investments can be avoided through coordination between the ports. Thus, being in an alliance helps the ports focus on serving the region as opposed to focusing on local competition, which could have been detrimental in the long run. The ports remain separate legal entities that are governed independently by their own commissioners. However, they have each licensed the Northwest Seaport Alliance exclusive use, operation, and management of certain facilities, although the ownership of these facilities remains with the ports. The investments in the alliance were split equally among the ports (Port of Seattle, 2016). The NWSA has also set up an executive advisory council that consists of the ports' stakeholders such as terminal operators, railroads, trucking companies, shipping lines, labour representatives etc. that focusses on specific areas and problems within the port in order to improve supply chain efficiency (Dupin, 2016b).

The Vancouver Fraser Port Authority is currently investing in numerous expansion projects at existing facilities, as well as the creation of new facilities at Roberts Bank near GCT Deltaport that will add another 2.4 million TEUs to the port of Vancouver's capacity. These investments are necessary for the efficient operation of the port as the port is currently operating rather close to its physical capacity. In 2015, the port of Vancouver's throughput was 3.1 million TEUs while its capacity is listed as 3.7 million TEUs. And as a large share of the cargo that goes through the port of Vancouver originates in or is destined to go to other parts of Canada or even as far as the United States, it is vital that further expansion includes close cooperation between the port authority and the Canadian railways in order to maintain overall supply chain efficiency (Mongelluzzo, 2017a).

The Oakland port authority is currently negotiating with CenterPoint Properties to redevelop part of the previously mentioned former military base into the Seaport Logistics Complex, a warehousing complex which would further improve supply chain efficiency (Dupin, 2016d). The location of these new distribution and transloading services at the waterfront will eliminate transport costs to warehouses and improve the port of Oakland's competitive position (Mongelluzzo, 2017d). Additionally, Oakland's port authority has made a new lease with TraPac, a subsidiary of MOL, which allows them to nearly double the size of their facility. The new facility will include a new truck entry gate, aimed at improving efficiency and reducing truck turnaround times, and increase the terminal's cargo handling capacity (JOC Staff, 2016). Finally, Oakland's port authority launched a Port Efficiency Task Force (PETF) in 2015 in an attempt to reduce the port's heavy congestion. The PETF addresses efficiency-related challenges in order to improve supply chain profitability. The PETF members stem from all sectors of the supply chain and meet on a quarterly basis (Port of Oakland, 2016).

The Prince Rupert port authority is currently developing a second container berth as it is close to its capacity of 850,000 TEU, having handled 800,000 TEU in 2016. The new container berth is set to open in August 2017 and will increase the port's capacity to 1.3 million TEU. The port will also be installing new cranes at its new berth so it is able to handle the larger vessels deployed by shipping alliances. The dock will also have direct access to railways as the fast hinterland connection via rail is one of the port of Prince Rupert's largest competitive advantages (Mongelluzzo, 2017a). Just like in Vancouver, the Prince Rupert port authority maintains close collaboration with the Canadian railways on this project.

The port of Prince Rupert is also collaborating with Ray-Mont Logistics on an expansion project on Ridley Island. The port and Ray-Mont Logistics will develop a transloading facility that will mainly focus on Canadian agricultural exports (Landrum, 2017).

4.3.2 The provision of additional services

In recent years, the port authorities on the West Coast of North America have been vigorous in creating additional service offerings and improving overall port productivity in order to reduce congestion and become a more efficient element of the supply chain.

Most port authorities on the West Coast of North American have implemented trucker appointment systems and night gates as gate congestion has caused great inefficiencies in the past. The port of Vancouver has a considerable competitive advantage in comparison to other North American West Coast ports through a 14-point action plan its port authority implemented as early as 2014 to reduce truck wait times and improve terminal fluidity. The plan obliges terminal operators to run five night gates each week, truckers to make appointments before going to the terminal, terminals to pay a fee each time a trucker transaction exceeds 90 minutes, and trucking companies to comply with pay rates as they will otherwise receive a penalty. This programme reduced average truck visit times from more than one hour to 38 minutes, which makes them the shortest on the West Coast of North America (Mongelluzzo, 2016g). Most ports implemented trucker appointment systems as a random-access system led to increasingly severe congestion as vessel sizes and logistical problems due to alliances sharing these vessels increased. Due to their cooperation and close proximity, the implementation of these appointment systems was rather complicated at the ports of Los Angeles and Long Beach and eventually came with a few rules that the terminals have to follow in order to provide continuity throughout the ports (Mongelluzzo, 2015). The port authorities of Los Angeles and Long Beach also reduced daytime congestion by introducing the PierPass programme, which funds terminal operators at the ports to operate at night and during the weekend and incentivises trucking companies by collecting fees on cargo that moves in and out of the terminals on weekdays. However, this increases congestion at off-peak times which is why trucker appointments for the PierPass programme are currently being discussed (Dupin, 2017b). The NWSA also temporarily set up an extended gates programme that reimbursed container terminals who extend their gate times during the peak season. However, contrary to the PierPass programme, the NWSA's programme is supported by funding for terminals by the port authority, not fees for truck drivers and it is temporary (Kulisch, 2016). The programme was originally supposed to end on November 11, 2016, however, due to its popularity, the programme got extended until December 2 (Dupin, 2016c). The port authority of Oakland initially implemented a night gate programme that was similar to the one in Seattle and Tacoma. The port authority started out funding the programme itself. However, as that funding was unsustainable in the long run, the port authority put in place a US$30 fee per laden container that is charged to shippers. The fee was established after consulting port users, who agreed with its amount and purpose. This fee allows the port of Oakland to extend its gate hours on four nights a week. (Mongelluzzo, 2016c). So, most port authorities on the West Coast of North America are using mandatory trucker appointments or night gates to reduce gate congestion and improve overall supply chain efficiency.

The port authorities are also introducing and testing new technologies to improve communication within the port, so large alliance vessels that contain containers from multiple lines and their increased cargo volumes can be handled more efficiently. In early 2017, a pilot project called the Port Information Portal which will involve the port authority of Los Angeles, GE Transportation, the 2M VSA, APMT, beneficial cargo owners, customs brokers, labour, truckers, and railroads, will be run at the port of Los Angeles. The pilot will be run for six to 12 weeks, after which it will shift to the port of Long Beach (Mongelluzzo, 2016b). The project will aim at supply chain integration through the gathering of information in each of the industries involved in moving containerised cargo, and digitising and filtering it to make it available through a common electronic portal. This project is supposed to let beneficial cargo owners, terminal operators, customs brokers, drayage companies, and railroads to plan their port and downstream supply chain operations 10 to 14 days before vessel arrival (Mongelluzzo, 2016a). The NWSA has released two mobile applications in order to reduce gate congestion. The first application is called DrayQ and will be used by truck drivers and provides estimates of waiting times so truck drivers can plan their terminal visit to minimise turnaround times. The second application is called DrayLink, which will allow users to track and record cargo moves, as well as create data reports which will help interconnect the port's stakeholders by sharing information and improve the movement of cargo through the supply chain (Meyer, 2016). The Vancouver Fraser Port Authority plans to create a Common Data Interface (CDI) through which truckers can keep track of container and appointment availability at each of the terminals, instead of having to search in every terminal's system. The system will enable real-time communication between trucking companies and terminal operators, it will be the first of its kind on the North American West Coast (Szakonyi, 2017). Finally, the port of Oakland also introduced new technologies so drivers can monitor wait times in- and outside marine terminals to better plan their trips and avoid congestion (Port of Oakland, 2016).

One of the supply chain stakeholder working groups at the ports of Los Angeles and Long Beach put in place by the Supply Chain Optimisation Steering Committee facilitated a port-wide neutral chassis pool that allows any chassis in the fleet to be authorised by any authorised user and expands the number of pick-up and drop-off locations (US Government Accountability Office, 2016). A neutral chassis pool can help significantly reduce congestion at a port as sharing chassis helps avoid truck capacity shortages (Mongelluzzo, 2014a). The actions undertaken by the previously mentioned working group have made the chassis pool more flexible (US Government Accountability Office, 2016). Additionally, The port authorities are collaborating to increase the use of "peel-off" container piles at the terminals, where whichever container arrives at the pile first is picked up by the trucker and delivered to whichever destination the shipper requested (Dupin, 2017b). In 2017, the port of Los Angeles will start redeveloping a former coal terminal into a container terminal support facility with "peel-off" container piles (Mongelluzzo, 2017c). The port of Oakland has also been repurposing port properties that have freed up through terminal consolidation for container storage, truck fuelling, container dray-off and other services to ease congestion at the terminals (Mongelluzzo, 2017d).

As the port of Prince Rupert is smaller than the other ports under discussion and its cargo is mainly transferred to rail (Port of Prince Rupert, 2017), its port authority does not yet appear to experience the need to put in place any of the previously discussed additional services. However, the port of Prince Rupert did invest in two navigational projects, namely a shore-based radar system and a light at the mouth of the Fairview Channel in 2016. The radar will provide extensive shore-based radar coverage as far as the Alaskan border and the light will provide mariners with a visual aid to identify the centre of the channel of the inner harbour (Desormeaux, 2016).

4.3.3 The reassessment of existing services

The NWSA is attempting to reshape its gateway by reducing the number of container terminals and investing in the capacity of the remaining ones in order to become more agile. The aim is to reduce the number of container terminals to four or five that can all handle the alliances' large vessels, with at least two of these terminals in each port (Dupin, 2016b). According to the NWSA's CEO, terminal operators should consider either merging their operations or serving other markets. In the future, the NWSA will thus increase its focus on its other strengths, namely non-containerised cargo such as breakbulk and automobiles (Dupin, 2015).

There appears to be no indication that any other port authorities on the North American West Coast are currently aiming to reassess their existing services through increased agility or repurposing port land.

The following table briefly summarises the strategies that the port authorities on the West Coast of North America are adopting to react to the current developments in the container shipping industry.

Ports	Cooperation	Provision of additional services	Reassessment of existing services
Los Angeles	Port of Long Beach, Supply Chain Optimisation Steering committee, & Asian port authorities	Trucker appointment systems and the PierPass programme, Port Information Portal, port-wide neutral chassis pool, & peel-off container piles	-
Long Beach	Port of Los Angeles, Supply Chain Optimisation Steering committee, & Asian port authorities	Trucker appointment systems and the PierPass programme, Port Information Portal, port-wide neutral chassis pool, & peel-off container piles	-
Seattle/Tacoma	NWSA, & executive advisory council	Trucker appointment systems and temporary night gates, & DrayQ and DrayLink	Reduction of container terminals to four or five and increased focus on non-containerised cargo
Vancouver	Canadian railways	Trucker appointment systems and night gates, & Common Data Interface	-
Oakland	CenterPoint Properties, TraPac, & Port Efficiency Task Force	Trucker appointment systems and night gates, new technological interfaces, & repurposed properties for storage, fuelling etc.	-
Prince Rupert	Canadian railways, & Ray-Mont Logistics	Navigational projects	-

Table 3: Strategies applied by North American West Coast port authorities

It can therefore be concluded that both horizontal cooperation and vertical integration have a strong presence on the North American West Coast as most terminals are dedicated to a specific shipping line and approximately 91% of transpacific trade is carried by alliances. In response, port authorities are prioritising the enhancement of efficiency by providing additional services such as extended gate hours, mandatory trucker appointments, and new technological interfaces. The ports of Los Angeles and Long Beach enjoy close project-based cooperation, and the ports of Seattle and Tacoma even entered in an alliance. What is more, all West Coast ports seem to cooperate with external parties to improve their competitiveness. Finally, strategies to become more proactive and agile by reassessing existing services are a lot less common and are only implemented by the Northwest Seaport Alliance.

5. Conclusion

This thesis has attempted to answer the following research question:

"Which of the strategies described in literature on port management are the port authorities on the West Coast of North America adopting in order to react to the current developments in the container shipping industry?"

From the literature that has been reviewed throughout this thesis, it can be concluded that the four strategies that container shipping lines are employing in their struggle to remain profitable, namely increasing vessel sizes, horizontal cooperation, slow steaming, and vertical integration, have a substantial impact on port authorities. As shipping lines gain more bargaining power through horizontal cooperation and vertical integration and are cutting costs where they can through increasing vessel sizes, slow steaming, and vertical integration, the competition among port authorities increases as their bargaining power deteriorates. This thesis merely discussed horizontal cooperation and vertical integration at the North American West Coast as slow steaming does not have an effect on the operations of port authorities and the West Coast port authorities are currently able to handle the size of the vessels that are being deployed on the transpacific route without any major adaptations. However, both horizontal cooperation and vertical integration have a strong presence on the North American West Coast as 91% of transpacific cargo is carried by alliances and the majority of West Coast terminals is dedicated to a specific shipping line.

The available literature indicates that port authorities are implementing a reactive approach rather than a proactive one to cope with these external changes in their market environment. Scholars propose investment, cooperation, the provision of new services, and the reassessment of existing services as strategies to remain competitive in spite of these developments. These strategies have been adopted by port authorities on the West Coast of North America in varying degrees. All North American West Coast port authorities are enhancing the efficiency of their port by providing additional services such as extended gate hours, mandatory trucker appointments, and new technological interfaces. Additionally, the ports of Los Angeles and Long Beach have a long history of close cooperation on various projects. The ports of Seattle and Tacoma are cooperating even more closely since they created the Northwest Seaport Alliance. Moreover, all West Coast ports are cooperating with external parties such as railways, stakeholders in advisory councils, logistics companies, and even Asian ports to improve their competitiveness. Finally, strategies to become more proactive and agile by reassessing existing services are a lot less common and only implemented by the Northwest Seaport Alliance. Hence, mainly cooperation and the provision of additional services is adopted by North American West Coast port authorities, although the Northwest Seaport Alliance also aims to become more agile.

However, this thesis merely provides an overview of the current situation, it would be pertinent to study the impact of the current developments in the container shipping industry on the operations of port authorities in a larger timeframe. For instance, by studying the changes in liner networks over the last decade and how these were affected by the many changes in shipping alliances, one could draw more substantiated conclusions about the effect of horizontal cooperation on the competitiveness of port authorities. These conclusions could then indicate what strategies port authorities could adopt in order to deal with horizontal cooperation.

Furthermore, research on other actors such as terminal operating companies that are also affected by the current developments in the container shipping industry could provide better insights into how all actors within the port, not merely port authorities, are affected by the current developments in the container shipping industry. Such research could result in a larger array of strategies that actors within the port can apply in order to improve the competitiveness of all of the actors within the port, especially since the competitiveness of actors within the port is heavily intertwined.

Finally, there is a large number of developments other than the ones in the container shipping industry that affect the competitiveness of North American West Coast port authorities. These developments include renegotiations with US American labour unions (ILWU), Vancouver’s tumultuous drayage community, potential future NAFTA renegotiations, which would be particularly pertinent for the Canadian ports as they increase their share in the US American market, and the Panama canal extension which can lead to increased competition from East Coast and Gulf Coast ports, to name a few. Future research should thus take these factors into account when studying the competitiveness of North American West Coast port authorities.

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