# 11 Unravelling dynamics in inter-container port relationships through an examination of liner service patterns

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## 1 Introduction

Container shipping plays a key role in the modern global economic system. The bulk of trade in containerised cargoes is transported by container shipping services which carried some 1.24 billion tonnes or 129 million twenty-foot equivalent units (TEU) in 2007 (Clarkson Research Services, 2008: 11 and 101). Global port throughput reached 466 million TEU in the same year and is expected to top 0.5 billion TEU in 2008. To support this trade, 10.5 million TEU of container vessel capacity were deployed in over 2,000 container shipping services (Informa Plc, 2007: 222–364). These services called at more than 500 ports around the world and provide opportunities for economies to engage in world trade. Every service is operated by at least one shipping line which deployed at least one vessel to call at a minimum of two ports. The diversity of these services ranged from a single 24 TEU vessel operated by Valfajre Eight which called at the ports of Bushehr in Iran and Doha in Qatar with an annualised slot capacity of 580 TEU to the Mediterranean Shipping Company's Silk Express which operates between North-West Europe and the Far East utilising nine fully cellular vessels totalling 82,466 TEU with an annualised slot capacity of 476,500 TEU that called at various ports in Northern Europe, the Mediterranean, the Middle East, South-East Asia and East Asia (ibid.: 303 and 356).

The diversity of elements embodied in container shipping services is a necessary development from the diversity in requirements from shippers, trading patterns, logistics flows, cargo volumes, government regulations, political circumstances, navigational conditions, weather conditions and local commercial norms. Operators of container shipping services will have to take these factors into account when formulating service schedules to determine which ports to call at and which ones to bypass. The decision by a container shipping service to switch from one port of call to another can lead to significant economic and commercial ramifications for both ports. Specifically, container shipping services play an important role in determining dynamics between container ports, as the decision to call at a port can bring additional cargo and result in beneficial spin-offs for the local, as well as hinterland, economies. In addition, the presence of inter-container port complementarity means that such benefits will be extended to other ports which complement the port in question. Conversely, the decision by container shipping services to stop calling at a port will result in reduced connectivity, choice of service providers and container throughput, which may have a negative impact on the competitive potential of its local and hinterland economies. The negative impact will also affect other ports which are complemented by services connected to the port.

As such, analyses of inter-container port relationships will be incomplete if complementary aspects are not accounted for. This contribution aims to analyse inter-container port dynamics by examining the intensity and extensity of inter-container port competition and complementarity from the perspective of container shipping services. The research will also adopt an integrated approach that combines the liner shipping and terminal-handling aspects of the container business when analysing these dynamics.

The chapter is organised as follows. The following section provides a critical review of literature related to relationships between container ports. Section 3 discusses supply characteristics of container shipping services. Section 4 deals with the research methodology and related data issues. The research findings will be presented in Section 5. The last section concludes, and suggests limitations of the study and recommendations for future research.

## 2 Inter-port relationships: going beyond competition

Numerous studies have been conducted to establish and understand factors and developments that influence and determine the state and impact of relationships between container ports. These studies were undertaken from a variety of perspectives including those of the shipping line, shipper, terminal operator, port authority or combinations of these and consisted of approaches using analytical hierarchy processes (Song and Yeo, 2004; Lirn et al., 2004; Chang et al., 2008); integer programming models (Mourão et al., 2002; Aversa et al., 2005); dynamic programming models (Zeng and Yang, 2002; Ting and Tzeng, 2003); principal component analysis (De and Ghosh, 2003; Sánchez et al., 2003); data envelopment analysis (Barros and Athanassiou 2004; Garcia-Alonso and Martin-Bofarull, 2007; Trujillo and Tovar, 2007); stochastic frontier analysis (Tongzon and Heng, 2005; Cullinane et al., 2006); discrete choice models (Tiwari et al., 2003; Malchow and Kanafani, 2004); and logit models (Nir et al., 2003; Veldman et al., 2005).

Other approaches also included using transport cost functions (Jara-Díaz et al., 2001); transhipment cost models (Baird, 2002); production functions (De, 2006); regression models (Zohil and Prijon, 1999); structural equation models (Lu, 2003; Bichou and Bell, 2007); cointegration tests and error correction models (Yap and Lam, 2006a); econometric models (Clark et al., 2004); game theories (Flor and Defilippi, 2003; Yang, 1999); oligopolistic models (Yap and Lam, 2006b) spatial–economic demand models (Luo and Grigalunas, 2003); contestability (Notteboom, 2002a); business strategy (Heaver et al., 2001; Heaver, 2002; Van de Voorde and Winkelmans, 2002; Midoro et al., 2005); container traffic flows (Guy and Urli, 2006; Lee et al., 2006); shipping networks (Robinson, 1998; Notteboom, 2006a; Yap et al., 2006); and supply chain networks (Notteboom and Winkelmans 2001; Robinson, 2002; Carbone and De Martino, 2003; Robinson, 2006).

The variety of methodologies involving qualitative and quantitative techniques suggested that a container port would enjoy greater success against competition if the port was:

- seen as the 'engine' of the local economy and if there has been a long tradition of high-level political support for port development;
- able to benefit from superior access to the open sea and avail itself of efficient and direct connections to its hinterland;
- able to reduce port costs through improved productivity, for example, in areas related to cargo handling;
- able to persuade and entrench carriers and shippers in relation to their cargo routeings;
- located in close proximity to major centres of production and consumption, thereby having a central geographical location with respect to the flow of both hinterland and transhipment cargo; and
- able to translate the aid received into lower port cost for users.

Additional factors identified to be important in influencing port competition included expanding capacity in time to meet anticipated demand (Fung, 2001), having sufficient space for future expansion (Cullinane et al., 2005), agility in coping with new logistics approaches and challenges (Paixão and Marlow, 2003) and ability to capitalise on the complementary and reinforcing effects of the container port cluster (De Langen, 2002, 2007). Notteboom and Rodrigue (2005) added that port authorities should embrace the concept of regionalisation and facilitate port development in order to address port-related challenges which counted congestion and increasing costs as the top-line issues.

Hence, container ports that are able to adapt to the process of integration within the liner shipping industry and add value to the commercial, operational and strategic pursuits of shipping lines (and their partners) will be rated as more competitive and hence, attractive as a port of call, relative to their competitors. However, differences in product and service requirements between different carriers and shipping alliances, and the instability of alliance and ownership structures increases the challenge for container ports as the competitive advantages they had created and fostered to secure a mega-carrier or shipping alliance can be rendered useless should the line(s) of concern be acquired by another shipping entity that hubs at a competitor port.

As a whole, the literature showed the extent and complexity of considerations involved in container port competition. Furthermore, given the fact that the container transport system is characterised by tight time schedules and an emphasis on a high degree of schedule reliability, the notion of port competition no longer remains the sole prerogative of the port. It has become imperative that container ports engage relevant key stakeholders as they strive to remain competitive (Notteboom, 2006b; Van der Horst and De Langen, 2008). The literature also indicated that container cargo flows will seek out routes that present the lowest cost for a given service level and as a node in the logistics chain; ports that can help to achieve this with the most competitive offering will be chosen as the port of call (Magala and Sammons, 2007). The competitive dimension covered by these studies suggested that container ports should seek to expand and entrench their captive hinterland and erode those of their competitors.

However, the basic fact that a port needs another port suggests the presence of complementary relationships (Notteboom and Winkelmans, 1999). Such relationships can already be seen in the various hub-and-spoke networks established around the world and origin and destination ports that are served by the same container shipping service schedule (Yap and Lam, 2004). Container ports which are focused on inter-container port competition may become myopic to the win–win relationships that can be forged from inter-container port complementarity where circumstances permit. Hence, the objective of this research is to account for the complementary aspects, as well as competitive elements in the analysis of inter-container port relationships, and draw policy and decision makers' attention to opportunities offered from inter-container port complementarity in order to advance the competitive position of their respective ports.

Another area which had not been adequately addressed by existing literature is that analyses of the competitive relationship between container ports are usually conducted at an aggregated level. With every market served by each port involving different decision makers, regions, routes, cargoes and shipping lines, it is therefore unlikely for a port to be competing with another port across the whole spectrum of sectors. Similarly, it is impossible for complementary relationships between two ports to extend to all their markets served. Hence, the objective of this research is to identify, where these relationships exist, the extensity and intensity of inter-container port complementarity and competition for specific markets.

**3 The supply of liner capacity: the complexity in liner service design**

This section seeks to unravel inter-port dynamics by examining the behaviour of shipping lines with respect to the supply of liner capacity. The supply of capacity for the seaborne transport of containers is provided by ships deployed in container shipping services that are operated by shipping lines. Liner services play an important role as a key component of many supply chain systems through their ability to add spatial value to the cargo (King, 1997). However, the manner and extent to which the value-adding process takes place is dependent on the objectives pursued by the shipping line, and these can be broadly classified into those that are oriented towards commercial, financial, operational or strategic goals.

The principal constituents of a container shipping service are the type, size and number of vessels to be deployed, the fleet mix, the trade route to serve, the service frequency, and the order and number of ports of call (Pearson and Fossey, 1983: 115–29; Fagerholt, 2004). These liner service design variables are highly interrelated and also link to other operational considerations such as the required vessel speed and associated bunker costs (Notteboom and Vernimmen, 2008). The service operator must also decide on the type of capacity to utilise; be it in the form of own capacity or slots chartered from vessels deployed by other shipping lines. Hence, it can be seen that the carrier has to contend with many variables in the course of operating container shipping services. An exhaustive list of 24 factors to be considered in the formulation of sailing schedules was detailed by Branch (1998: 135–43). The importance and weight carried by each variable will be different, depending on the objectives of each shipping company. In addition, Fusillo (2003) commented that rigidity of liner shipping capacity, coupled with variability in demand, meant that individual carriers had great incentives to minimise unit costs by maximising capacity utilisation on every voyage and thereby increasing the threat of destructive price wars. The considerations with respect to liner service design parameters are presented in Table 11.1.

The above characteristics manifested by the network structure of liner services and the possible combinations with which the attributes can be employed have been detailed by Notteboom (2002b). Specifically, container shipping lines aim to optimise network design at minimum cost which can be achieved by routeing cargo via transhipment hubs and/or amalgamated with other flows. However, Notteboom and Rodrigue

*Table 11.1 Operational parameters in liner service design*

| Operational parameters | | |
|---|---|---|
| Manner of operation | Type of capacity | Own capacity versus slot charter |
| | Type of arrangement | Independent operation versus consortium/alliance, joint service, joint venture, pooling etc. |
| Ships deployed | Size of ship | Post-panamax, panamax, handy, feeder etc. |
| | Type of ship | Fully cellular versus non-cellular |
| | Number of ships | Dependent on the time taken for the round trip and desired level of service frequency |
| | Fleet mix | The aim is to deploy vessels of similar size per individual liner service |
| Service level | Service frequency | Daily versus weekly, fortnightly, monthly etc. |
| | Service speed | 18 knots versus 20 knots, 22 knots, 24 knots, 26 knots etc. |
| | Service reliability | Punctual versus +/– 1 day of arrival, +/– 2 days from arrival etc. High schedule integrities might require more time buffers in the liner service to deal with possible disruptions (see Notteboom, 2006a) |
| Ports of call | Number of ports to call | Dependent on the trade route, e.g. Asia–Europe ≈ 15; transpacific ≈ 7 |
| | Mix of ports to call | Dependent on the trade route, e.g. intra-Asia ≈ 3 hubs + 4 feeder ports; Far East–Middle East ≈ 5 hubs + 4 feeder ports |
| | Order of call | Dependent on the trade route, e.g. Asia–Europe with Qingdao as the turnaround port for Asia, Rotterdam as the mainport for Europe, and Singapore as the last port of call for westbound leg to Europe |

(2008) noted that container shipping networks were also bound to the requirements of shippers which are represented in terms of frequency, direct accessibility and transit times. In addition, Notteboom (2002b) suggested that network configuration might be impeded by incorrect or incomplete information, thereby generating suboptimal designs, and that such situations can arise due to particular transportation preferences of shippers, opportunistic behaviour from other economic actors, and inertia associated with changes to the existing network design. As a whole, the carrier has to accommodate shippers' preferences and account for behavioural aspects while simultaneously attempting to minimise network costs that are linked to its shipping and landside operations, and the overall impact of these activities is manifested in the actual slot capacity deployed. The complexity associated with liner service design has resulted in a wide range of liner service patterns: triangle services, pendulum services, butterfly services, conveyor belt services and other forms of varying complexity with line-bundling services (loops with a limited number of direct port calls) and simple end-to-end services, and adapted for both mainline and relay services to create a network best fitting a carrier's requirements.

Taken together, container shipping lines have to possess sufficient means to fulfil the transportation requirements of a globalised economy through organic growth, mergers and acquisitions, or engage in various forms of horizontal and vertical cooperative arrangements with the purpose of generating greater customer value *vis-à-vis* competitors. In addition, the spectrum of activities in which carriers are engaged now includes an increasing portion of the logistics chain. As such, successful carriers will be able to generate greater economic value and cargo volume for the ports where they hub, although the same development will increase their desire and need for greater control over the logistics flow and work processes at those ports.

Hence, container ports which display less flexibility in accommodating such requirements can be bypassed. On the other hand, container ports which try to accommodate these requirements of carriers may find themselves bearing a substantial financial burden for this purpose. Although Martin and Thomas (2001) suggested that the balance of power will shift to favour container shipping lines, the costs of re-routeing traffic from one port to another can be considerable for these carriers as well. For example, carriers may have to contend with the possibility of losing major customers as a result of the move. Nonetheless, the fact remains that ports which are able to complement and add value to specific objectives of container shipping services will become the preferred conduits of containerised traffic.

## 4 Research methodology: analysing inter-container port complementarity and competition by means of annualised slot capacity figures

### *4.1 Annualised slot capacity*

In this section, we ascertain and establish the presence and magnitude of inter-container port dynamics by zooming in on three major container-handling regions of the world. We shall focus on the competitive and complementary relationships embedded within these regions by analysing the manner in which container shipping lines manage their container shipping fleet through the implementation of new, or removal of existing, service routeings.

For the purpose of this research, container port competition or complementarity are determined by gains made or losses incurred as a result of changes in annualised slot capacity (ASC) calling at container ports. Specifically, ASC can be derived from actual vessel capacity deployed in container shipping services and the computation of ASC for the individual port X for an individual service can be obtained with the formula:

$$T^k_{xt} = 2G^k_{xt}F^k_{xt}\frac{\sum_{h=1}^{n} V^{kh}_{xt}}{n^k_x} = 2G^k_{xt}F^k_{xt}W^k_{xt}, \tag{11.1}$$

where:

$T$ = ASC (measured in twenty-foot equivalent units: TEUs), calling at port X for a particular service $k$ for time period $t$;
$G$ = number of calls made at port X for the whole service loop;
$F$ = frequency of call during time period $t$;
$V_h$ = capacity of vessel $h$ for $n$ vessels deployed; and
$W$ = average capacity of vessels deployed.

Multiplication by a factor of 2 supposes that the services are fully loaded and all the containers will be unloaded and the vessels subsequently reloaded to their maximum capacity. However, container vessels generally carry containers that are destined for other ports when they call at port X. Hence, $T^k_{xt}$ represents the theoretical ASC limit for containers which can be handled at the port for the particular service $k$. In actual fact, the proportion of ASC allocated for containers to be handled at the port will be much lower as a percentage of the total ASC deployed. The actual number of containers handled at a port for a given two-way vessel capacity is dependent on factors such as:

- *The number of ports of call on the relevant side of the trade route* The higher the number of ports, the lower the average share of containers handled as a percentage of the ASC deployed per port of call.
- *The liner service network structure* A shipping line might decide to route most of its cargo via one specific hub without abandoning the multiple call system. In such a case, the hub will show a high share of containers handled as a percentage of the ASC deployed, while the other ports of call in the same liner service will incur a low share. For example, MSC has concentrated most of its North European cargo at the MSC Home Terminal in Antwerp, but the liner services of MSC remain line-bundling services with multiple calls in Northern Europe.

- *The cargo-generating effect of the ports of call* For example, Notteboom (2007) demonstrated that upstream ports in Northern Europe such as Antwerp and Hamburg typically have a higher share of containers handled as a percentage of the ASC deployed than coastal ports. Upstream ports need an elevated cargo-generating effect and a good terminal productivity to partly compensate for the time lost when the vessel sails up and down the river. Calling at coastal ports often involves only a little deviation.

Table 11.2 shows that the percentage of containers handled by the selection of container shipping services averaged 24.4 per cent, although the disparity ranged from a low of 5.0 per cent to a high of 39.8 per cent. However, removing the extremes will leave the share of container throughput as a percentage of ASC deployed lying mostly in the range 14–30 per cent.

Following from equation (11.1), summation of all container shipping services that call at port X will yield total ASC connected to the port. The formula for $k$ services can thus be represented by:

$$ASC_{xt} = \sum_{s=1}^{k} T^s_{xt} = 2\sum_{s=1}^{k} G^s_{xt} F^s_{xt} W^s_{xt}. \qquad (11.2)$$

Consider the example of the AES2 service operated by the CHKY Alliance comprising Asian carriers COSCO, Hanjin, K-Line and Yang Ming (Informa Plc, 2007: 246). The computed ASC deployed on this service (which turns around in Hamburg for the European end of the voyage) will be 582,140 TEU based on service attributes depicted in Table 11.3. However, the same service that calls at Hong Kong will generate twice the amount of ASC at 1,164,280 TEU because the service calls at the port for both the linehaul and backhaul legs of the voyage.

*4.2 Assessing inter-port dynamics by means of ASC information*

The information on ASC can be used to analyse inter-container port complementarity and competition. The basic framework of analysis aims to identify changes in shipping service patterns and to derive their corresponding implications for inter-container port relationships. Specifically, analyses will be conducted for ASC deployed by container shipping services that call at each pair of container ports in a particular region. This is in order to identify changes in their connectivity to other trade routes and geographical regions, as carriers adjust their service schedules to cater to changing market conditions. This method of analysis can be summarised by the schematic shown in Figure 11.1.

*Table 11.2 Share of containers handled as percentage of ASC deployed*

| Service/ carrier | Year | ASC | TEU | Port | TEU/ASC (%) |
|---|---|---|---|---|---|
| CSAV – Andex & Pacar | 2007 | 386,600 | 80,000 | Busan | 20.7 |
| CMA CGM | 2006 | 6,547,200 | 1,100,000 | Port Klang | 16.8 |
| Mærsk Line | 2006 | 657,200 | 200,000 | Cartagena | 30.4 |
| Mærsk Line | 2006 | 9,049,600 | 3,000,000 | Algeciras | 33.2 |
| MSC | 2006 | 3,917,600 | 400,000 | Busan | 10.2 |
| Horizon Lines | 2006 | 719,000 | 35,991 | Tacoma | 5.0 |
| Horizon Lines | 2005 | 719,000 | 43,950 | Tacoma | 6.1 |
| Mærsk Line | 2005 | 4,526,600 | 1,800,000 | Gioia Tauro | 39.8 |
| CMA CGM | 2005 | 1,874,600 | 450,000 | Busan | 24.0 |
| CMA CGM | 2005 | 5,196,800 | 754,000 | Port Klang | 14.5 |
| P&O Nedlloyd | 2005 | 5,017,600 | 1,500,000 | Singapore | 29.9 |
| New World Alliance – APX | 2005 | 453,400 | 120,000 | Rotterdam | 26.5 |
| P&O Nedlloyd | 2005 | 2,482,200 | 500,000 | Hamburg | 20.1 |
| CSCL | 2005 | 2,714,000 | 350,000 | Port Klang | 12.9 |
| Grand Alliance – A and F | 2005 | 1,112,000 | 170,000 | Rotterdam | 15.3 |
| Grand Alliance | 2005 | 3,918,000 | 1,500,000 | Rotterdam | 38.3 |
| Total | | 49,291,400 | 12,003,941 | | 24.4 |

*Sources:* Various including Lloyd's List.

ASC which calls at the two ports can be divided into three categories, namely:

category A: those that call exclusively at port X;
category B: those that call at both ports; and
category C: those that call exclusively at port Y.

The presence, extent and development of inter-container port competition and complementarity can be established by examining the performance

*Table 11.3 Service attributes of the AES2 service of the CHKY Alliance*

| | Service attributes |
|---|---|
| Service name: | AES2 |
| Port of rotation: | *Hamburg* – Le Havre – Singapore – *Hong Kong* – Kobe – Nagoya – Tokyo – Shenzhen – *Hong Kong* – Singapore – Port Said – Rotterdam – Felixstowe – *Hamburg* |
| Regions connected to: | North-West Europe, South-East Asia, East Asia and Near East |
| Trade routes connected to: | Europe–Far East |
| Service partner(s): | COSCO, Hanjin, K-Line, Yangming |
| Service frequency: | Weekly |
| Vessels employed: | 8 (by K-Line) |
| Total vessel capacity employed: | 44,780 TEU (1 × 5,500 TEU, 5 × 5,600 TEU and 2 × 5,640 TEU) |
| Annualised slot capacity: | 582,140 TEU |

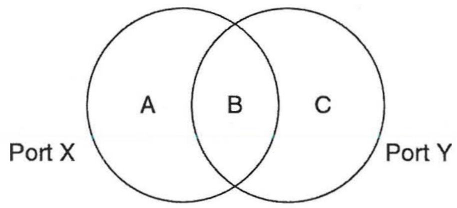


*Figure 11.1 Framework for analysing inter-container port relationships for the case of two ports*

of ASC handled in each of the categories. This can be illustrated by using the scenarios that are presented in Figure 11.2.

In the case of Figure 11.2(a), the situation will result in an increase in ASC in category B, as the container shipping line is making parallel calls at both ports, indicating complementarity between the two ports. For Figure 11.2(b), new container services operated by the shipping line will lead to an improvement of ASC deployed under category A, which is a direct indication of greater competition between both ports. Other indications of scenarios with the presence of inter-port competition are shown in Figures 11.2(c) and 11.2(d) which will lead to a higher share of ASC for category A at the expense of categories B and C. As for Figure 11.2(e), the removal of services from both ports can be interpreted as an indication of

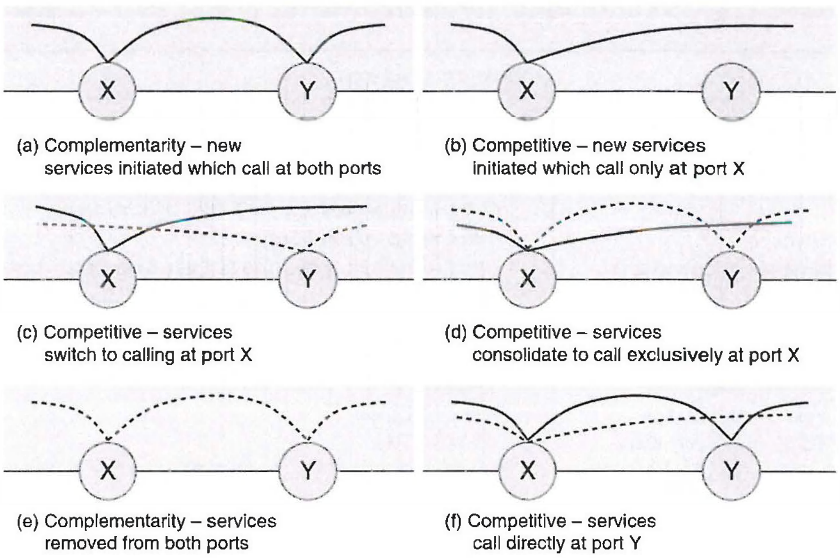


*Figure 11.2 Analysis of changes in container shipping services for two ports*

complementarity between the ports. This will reduce ASC in category B. Turning to Figure 11.2(f), this situation will lead to an increase in ASC deployed under category B. However, this development can be interpreted as a sign of competition for cargoes that are previously handled for port Y in port X and will now be handled directly by the former.

As a whole, the framework presented shows that the evaluation of container port relationships has to take into account both absolute changes in ASC deployed, as well as changes in market share experienced for the three categories (that is, A, B and C). In particular, inter-port competition between two container ports is likely to see the more-competitive port gaining market share. The relationship for inter-port complementarity is not as clear and has to be determined by examining the specific service attributes of container shipping services that call at both ports, in relation to the service dynamics involved.

Overall, analysing inter-container port relationships using container shipping services that are operated by container shipping lines presents an objective and direct way of ascertaining the nature of such relationships where they exist. Furthermore, the information is publicly available through service schedules publicised by container shipping lines. Details on vessels deployed and other itineraries associated with the shipping service can also be found from a variety of industry publications such as Containerisation International yearbooks, Containerisation International magazines and other regular reports from various maritime-related publications. Such data have been processed to obtain the following information for the time period considered in this study:

- slot capacity that called at the ports;
- number of container shipping services that called at the ports;
- number of container shipping lines that called at the ports;
- number of vessels that called at the ports; and
- number of trade routes connected to the ports differentiated by slot capacity, number of services and number of shipping lines involved.

### *4.3 Coverage of research: geographical region and time period*

The regions to be covered in the empirical part of this chapter are: the Pearl River Delta in East Asia with a specific focus on the relationship between Hong Kong and Shenzhen; the Straits of Malacca in South-East Asia consisting of the ports of Singapore, Port Klang and Tanjung Pelepas; and the Antwerp–Hamburg range in North-West Europe with a specific focus on the relationships between the four largest ports in the regions (that is, Rotterdam, Hamburg, Antwerp and Bremen/Bremerhaven). Together, these ports handled 23.8 per cent of the world's total container throughput in 2007 (Informa UK Ltd, 2008). Hence, the objective is to analyse the nature of inter-container port relationships embedded within these major container-handling regions in the world and provide comparisons across regions where the situation permits.

The research also covers a 12-year period from 1995 to 2006 which takes into consideration the situation prior to the formation of shipping alliances until the latest major development in the liner shipping industry, which involves the acquisition of P&O Nedlloyd by Mærsk, Delmas by CMA-CGM, and CP Ships by Hapag-Lloyd. The reason for this is because resulting changes in shipping service schedules affected were only apparent in 2006.

## 5 Research findings

### *5.1 Inter-port dynamics in the Straits of Malacca*

Container ports in South-East Asia handled an estimated 64.0 million TEU in 2007, out of which 63.3 per cent was accounted for by the three largest container ports in the region, that is, Singapore, Port Klang and Tanjung Pelepas (ibid.). Located within a span of 400 kilometres, container terminal operators in these ports actively sought to position themselves as important links within value chains that connect between South-East Asia and major markets in Europe, East Asia and North America. This resulted in inter-container port dynamics occurring in three areas. In the first area, the focus was centred on enticing major shipping lines to hub their transhipment operations at the terminals, while focus in the second area was targeted at specific services operated by specific shipping lines or alliances with the purpose of strengthening the level of connectivity on particular trade routes and to particular regions. As for the third area, the objective was to encourage shippers located in southern Malaysia to handle their local containers through either of the ports. On the whole, the main objective is to capture as large a share of the transhipment traffic as possible because such containers are seen to provide greater growth opportunities when compared to local containers.

In 2006, the container ports of Singapore, Port Klang and Tanjung Pelepas were connected to 21 trade routes which saw 105.8 million TEU of ASC deployed by 96 shipping lines in 344 shipping services. As can be seen from Figure 11.3, this was almost triple the capacity that called at the selected ports in 1995. As a whole, the average annual rate of growth experienced for ASC that called at the three ports was 17.2 per cent in the period of our analysis. Figure 11.3 also shows that the entry of Tanjung Pelepas into the market resulted in a marked decline in ASC received by Singapore. Prior to 2000, the share of ASC that called at Singapore was generally 100 per cent but began to slip from 2001 and the period between 2000 and 2001 also witnessed the largest decline in percentage terms as shown in Figure 11.4. The share of ASC which called at Singapore continued to decline as other major container shipping lines chose to follow Mærsk by relocating their hubs from Singapore to Port Klang or Tanjung Pelepas. By 2006, the share of ASC which called at Singapore had declined to 75.3 per cent whereas the shares for Port Klang and Tanjung Pelepas reached 33.3 per cent and 18.1 per cent, respectively.

In direct contrast to Singapore, Port Klang saw its share of ASC rise from 15.7 per cent in 1995 to reach a peak of 36.8 per cent in 2003 before declining to 33.3 per cent in 2006. The reason for the rise in capacity was attributed to an increasing number of shipping lines, such as members of the Grand Alliance, United Alliance, COSCO and Evergreen, which chose to schedule some of their capacity to call at both Port Klang and Singapore in the same service instead of calling exclusively at the latter. In addition, the decision by CMA-CGM and CSCL to relocate their operational hub in South-East Asia to Port Klang rather than Singapore also contributed substantially to the increase in ASC received from 2001 onwards. However, the decline experienced after 2003 was attributed to

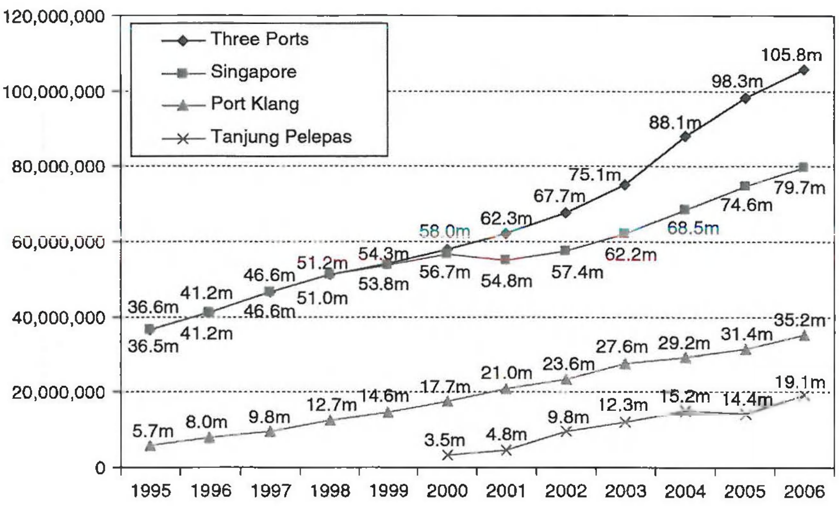


*Figure 11.3 Development of ASC calling at Port Klang, Singapore and Tanjung Pelepas*

new services that were initiated by MSC, PIL, the CHKY Alliance and New World Alliance which chose to call only at Singapore. This development also caused the share of ASC received by Tanjung Pelepas to dip in 2005. However, the port quickly recovered and its share of ASC reached a new high at 18.1 per cent in 2006, as the acquisition of P&O Nedlloyd by Mærsk saw the majority of the former's services reorganised to call at Tanjung Pelepas instead of Singapore.

The routes which were connected to the selected ports included all the major east–west trades, as well as a variety of north–south and intra-regional trades with the majority consisting of capacity deployed between Europe/Mediterranean and East Asia. This was followed by capacity deployed within South-East Asia and those that plied between East Asia and the Middle East. Altogether, ASC deployed on the top five trades accounted for 78.5 million TEU or 74.2 per cent of the total capacity received by the three ports.

Altogether, empirical evidence from analysing inter-container port dynamics between the three largest container ports in South-East Asia for the period from 1995 to 2006 showed Singapore remaining the dominant player *vis-à-vis* Port Klang and Tanjung Pelepas, although the share accounted for by exclusive calls at the port had declined for most of the major trades from almost 100 per cent in 1995 to 50 per cent or less by 2006. This was attributed to the emergence of Port Klang and Tanjung Pelepas

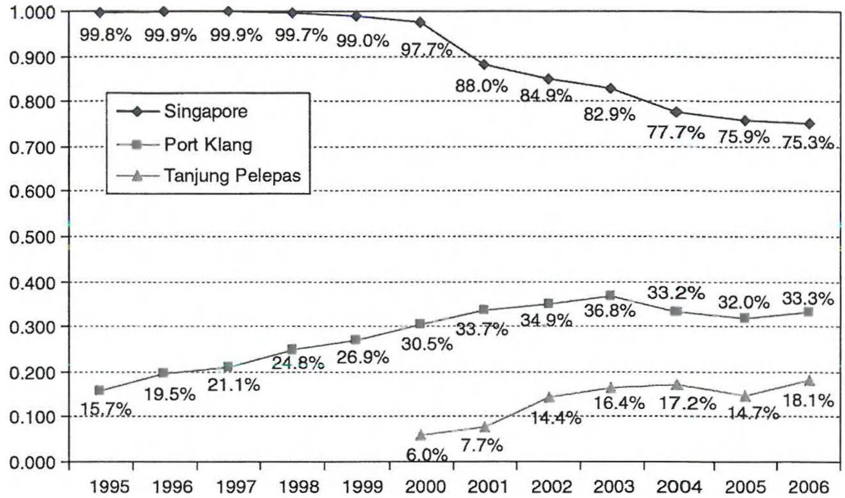


*Figure 11.4 Development in share of ASC connected to the selected ports*

as competitive alternatives for transhipment operations. In the case for Port Klang, the period saw various carriers schedule about one-third of their capacity to call at the port. Specifically, Port Klang was able to persuade more services that were operated by the Grand Alliance to include the port in their port of rotation in addition to Singapore. Furthermore, the port also made successful inroads into increasing its connectivity for the Europe–Far East and Mediterranean–Far East trade routes as a result of success in persuading CMA-CGM and CSCL to hub at the port and thereby attracting more services that made exclusive calls. Hence, in the analysis of inter-container port relationships between Port Klang and Singapore, Port Klang would consider these changes in capacity deployed to be beneficial as the period saw the port being included in an increasing number of services which initially called at Singapore. However, the same developments would be considered to be unfavourable from Singapore's perspective, as these developments had the effect of siphoning off cargo which would otherwise be handled at the port.

In the case of Tanjung Pelepas, the entry of the port into the regional container port scene had a direct and immediate impact on Singapore's dominant position. Specifically, the decision by Mærsk to take a 30 per cent stake in the port resulted in the relocation of its hub in South-East Asia to the port and the shift in capacity, which began to take place at the end of 2000, was generally completed by mid-2001. As Mærsk Line operated several services which connected Singapore to many of the major east–west trade routes, the result was a decline in the share of capacity accounted for by Singapore from 2001 onwards and this can be seen in Figures 11.3 and 11.4. The decision by Evergreen to emulate Mærsk's move in 2002 exacerbated the situation and saw this gap widen especially for trade routes connecting the Far East to Europe and the Mediterranean. In the case of the Mediterranean–Far East trade, Singapore's share of capacity deployed on the route fell to 55.5 per cent by 2006.

As a whole, Table 11.4 reveals most of the inter-container port relationships uncovered for changes in ASC deployed in South-East Asia to be competitive in nature for the three largest trades. In particular, 85.5 per cent of changes in ASC deployed for the Europe–Far East trade, which accounted for almost a third of total shipping capacity received, were attributed to competition. The largest intensity of competition was found to occur between Singapore and Port Klang, and Singapore and Tanjung Pelepas. Although the percentages registered for the second largest trade, connecting between the Mediterranean and the Far East, were significantly lower at 68.2 per cent, the changes affected a substantial 34.9 million TEU of ASC. Specifically, intense competition was uncovered between Singapore and Port Klang, although the competitive impact was countered by a significant amount of inter-port complementarity discovered between Port Klang and Tanjung Pelepas, mostly involving services operated by Evergreen. This development also resulted in most of the changes recorded for ASC received by Tanjung Pelepas to be complementary in nature. In addition, it was observed that inter-container port complementarity exerted a strong influence for changes in ASC deployed within South-East Asia. This affected 47.6 per cent of all changes to shipping capacity. In particular, Port Klang and Tanjung Pelepas saw most of the changes in shipping capacity received to be complementary in nature. Nonetheless, the substantially larger amount of ASC attributed to competition with Singapore ensured that changes in capacity deployed remained largely competitive for this trade. Overall, the results showed that most of the changes in ASC deployed affected Singapore and Port Klang, and Singapore and Tanjung Pelepas. By comparison, there were relatively few changes in capacity which affected Port Klang and Tanjung Pelepas. Furthermore, the changes in shipping capacity were also found to be largely competitive in nature.

### *5.2 Inter-port dynamics in the Pearl River Delta*

The major ports located in this region are Hong Kong and Shenzhen, which together handled 45.1 million TEU in 2007 and accounted for 81.3 per cent of total container throughput handled in the Pearl River Delta (Informa UK Ltd, 2008). Guangzhou is fast becoming a major gateway port in the region, partly as a result of the rather recent start of operations

*Table 11.4 Summary of inter-container port dynamics in South-East Asia (in TEU)*

| | Europe–Far East | | |
|---|---|---|---|
| | Complementary | Competitive | Total |
| Singapore | 15.9% | 84.1% | 35,687,900 |
| Port Klang | 17.5% | 82.5% | 29,437,000 |
| Tanjung Pelepas | 4.0% | 96.0% | 12,807,400 |
| Overall | 14.5% | 85.5% | 77,932,300 |
| | Mediterranean–Far East | | |
| | Complementary | Competitive | Total |
| Singapore | 31.4% | 68.7% | 12,218,600 |
| Port Klang | 26.2% | 73.8% | 18,410,040 |
| Tanjung Pelepas | 57.8% | 42.2% | 4,256,800 |
| Overall | 31.8% | 68.2% | 34,885,440 |
| | Intra-South-East Asia | | |
| | Complementary | Competitive | Total |
| Singapore | 35.0% | 65.0% | 21,873,920 |
| Port Klang | 66.8% | 33.2% | 8,363,220 |
| Tanjung Pelepas | 68.9% | 31.1% | 5,458,200 |
| Overall | 47.6% | 52.4% | 35,695,340 |

at the new Nansha terminals. However, given the chosen timeframe of 1995–2006, we decided to focus the analysis solely on the relationship between Hong Kong and Shenzhen.

Containers are handled mainly at six facilities, with Kwai Tsing Container Terminals and River Trade Terminals belonging to Hong Kong, and Yantian, Chiwan, Shekou and Mawan belonging to Shenzhen. Examination of the terminals also revealed several of the operators to be located in a number of facilities in both ports. For example, Modern Terminals Limited has a presence in Kwai Tsing, Shekou, Chiwan and Mawan, whereas Hutchison Port Holdings is simultaneously present in Kwai Tsing, River Trade Terminals and Yantian. The proximity of these terminals suggests the presence of a high level of inter- as well as intra-container port dynamics, where container terminal operators in the two ports actively sought to position themselves as important links for value chains that connect between Southern China and major markets in other parts of Asia, North America, Europe, Australasia and even Africa. Unlike the scenario for South-East Asia, where the focus was to attract specific shipping lines or services to call at the port, the focus of inter-container port dynamics in the Pearl River Delta is centred on attracting containerised exports from Southern China to be channelled through their respective facilities.

In 2006, the container ports of Hong Kong and Shenzhen were connected to 13 trade routes which saw 113.6 million TEU of ASC deployed by 90 shipping lines in 314 shipping services. As can be seen from Figure 11.5, this was almost triple the amount of capacity that called in 1995. As a whole, the average annual rate of growth experienced for ASC that called at the two ports was 17.1 per cent in the period of our analysis. The figure also shows that Hong Kong's share of capacity received began to decline from 1998 as more container shipping lines chose to call direct at Shenzhen. Nonetheless, the port continued to receive the bulk of capacity that called in the region, with many of the services making parallel calls at Shenzhen in the same schedule. This development also contributed significantly towards boosting the share of capacity received by Shenzhen from 5.3 per cent in 1995 to 64.9 per cent in 2006. Overall, as shown in Figure 11.6, Shenzhen was able to rapidly close the gap with Hong Kong in terms of ASC received.

Unlike the scenario presented for South-East Asia, which received a spread of ASC from east–west, north–south and intra-regional services, the situation faced by Hong Kong and Shenzhen saw two-thirds of capacity that called at these ports accounted for by east–west trades. The largest of these was the transpacific trade, which saw 38.3 million TEU of ASC deployed, with a share of 33.7 per cent. This was followed by the Europe–Far East trade and South-East Asia–Far East trade. Altogether, ASC deployed on the top five trade routes accounted for 97.2 million TEU or 85.5 per cent of total capacity supplied at the two ports.

Empirical evidence from inter-container port dynamics between the two largest container ports in the Pearl River Delta showed that although Hong Kong dominated the container shipping scene by attracting, in most cases, more than 90 per cent of ASC deployed to call exclusively at the port in 1995, the emergence of Shenzhen as a viable alternative saw services which began to call at both container ports overtake exclusive calls (at Hong Kong) to form the largest segment of capacity supplied to the region. In addition, the end of the period saw the share of capacity received by Shenzhen for the transpacific and Mediterranean–Far East trade routes exceeding those that called at Hong Kong. Specifically, Shenzhen was receiving more capacity than Hong Kong for two of the three major east–west trades. This is an important achievement considering the fact that two-thirds of capacity that called at the region was generated from such trades.

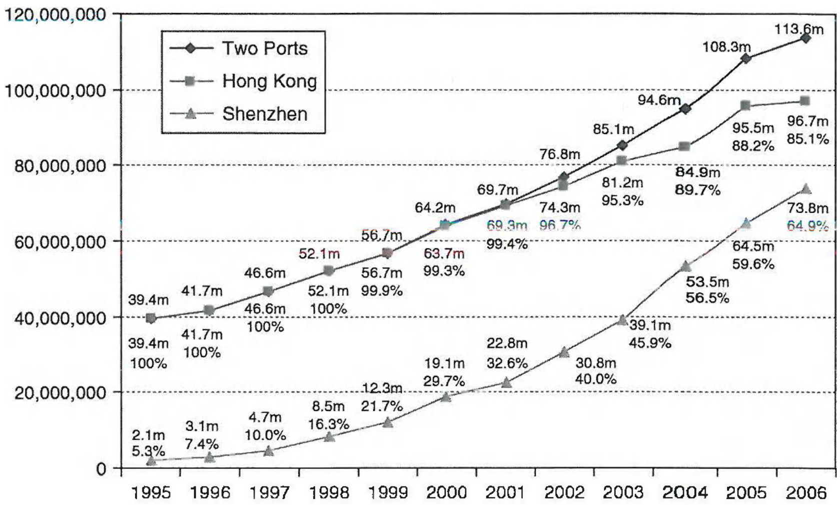


*Figure 11.5* *Development of total ASC calling at Hong Kong and Shenzhen (in TEU)*

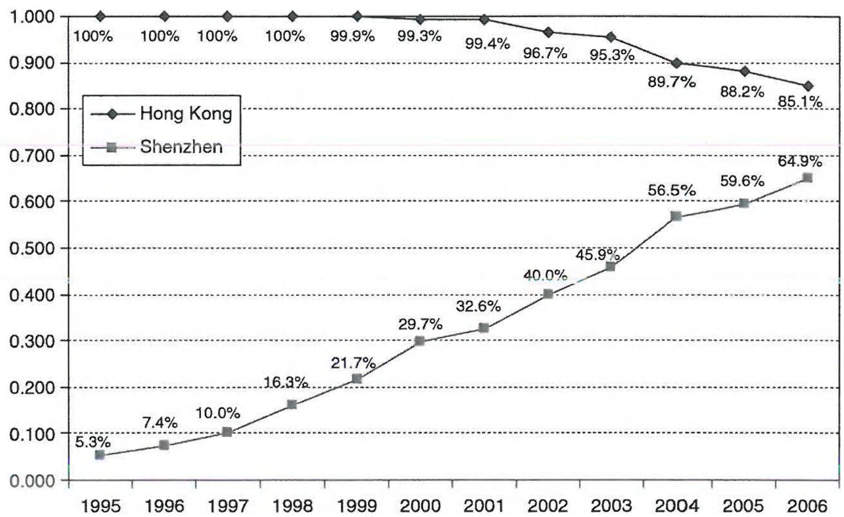


*Figure 11.6* *Development in share of ASC connected to the selected ports*

The basis for Shenzhen's strong performance was attributed to the period between 1996 and 2001 which saw many container shipping lines beginning to include the port in their port of rotation in addition to Hong Kong. The norm was for carriers to pair Hong Kong with one of the terminals in Shenzhen. This would be considered as a positive development for Shenzhen because users of the port would benefit in terms of improved connectivity and a larger choice of shipping lines to choose from. Economies of scale and scope generated from higher traffic volumes could also lead to lower cost per TEU handled for both shippers and shipping lines. However, Hong Kong would see the same development as unfavourable because container traffic that could have been handled through its terminals was diverted to Shenzhen. This phenomenon could be ascribed to two developments. The first saw the presence of internationally renowned terminal operators in Shenzhen which contributed towards improving the confidence of port users and persuaded an increasing number of container shipping lines to route their services to call at either of the container terminals in Shenzhen in addition to Hong Kong. Specifically, the series of investments by Hong Kong-based professional container terminal operators, which took place between 1994 and 1999, lent credence to the reputation of Shenzhen as a viable alternative to Hong Kong. Second, the lack of investment in major container-handling facilities between the completion of CT8 in 1994 and CT9 in 2003 (and beyond) resulted in facilities in Hong Kong becoming increasingly congested and expensive. For example, the terminal handling charge for a container levied on Hong Kong by the Intra-Asian Discussion Agreement rose from HK$600 in July 1992 to HK$1,200 in January 1995 and reached HK$1,800 by June 1998 (Drewry Shipping Consultants Ltd, 2003: 223). Capacity utilisation for container terminals at the port also reached 95.8 per cent in 2001 (Ocean Shipping Consultants Ltd, 2003: 99).

In the period after 2001, most of the services initiated or removed from the region affected both Hong Kong and Shenzhen. Specifically, most of the container shipping services which began to call in the region chose to call at both container ports. Similarly, services that were withdrawn also affected both ports in the same manner, although the degree of impact could vary because capacity supplied would be affected by the frequency of call (that is, single versus double call). Hence, inter-container port dynamics between the two container ports appeared to have moved from being competitive to becoming complementary in nature.

Table 11.5 reveals most of the changes in ASC deployed for both ports to be largely complementary in nature. The corresponding figures for changes in ASC deployed that were attributed to inter-container port complementarity reached 56.7 per cent for the transpacific trade and 65.0 per cent for the Europe–Far East trade. However, examination of changes to shipping capacity deployed between South-East Asia and the Far East found most of it to be competitive in nature, affecting mainly those that called at Hong Kong. This could be explained by the lower scale of cargo

*Table 11.5* *Summary of inter-container port dynamics in the Pearl River Delta (in TEU)*

| | Transpacific | | |
|---|---|---|---|
| | Complementary | Competitive | Total |
| Hong Kong | 63.2% | 36.8% | 59,966,340 |
| Shenzhen | 51.4% | 48.6% | 73,705,300 |
| Overall | 56.7% | 43.3% | 133,671,640 |
| | Europe–Far East | | |
| | Complementary | Competitive | Total |
| Hong Kong | 70.0% | 30.0% | 36,263,300 |
| Shenzhen | 60.7% | 39.3% | 41,850,800 |
| Overall | 65.0% | 35.0% | 78,114,100 |
| | South-East Asia–Far East | | |
| | Complementary | Competitive | Total |
| Hong Kong | 18.8% | 81.2% | 27,030,220 |
| Shenzhen | 60.1% | 39.9% | 8,453,800 |
| Overall | 28.6% | 71.4% | 35,484,020 |

volumes involved and the fact that shipping lines that plied on the trade tended to call at either of the ports, with most choosing to call exclusively at Hong Kong.

Comparison of container shipping statistics for the two ports also revealed that Hong Kong remained as the focus in the service schedules operated by major container shipping lines. Most of these entities tended to deploy more capacity and services to call at Hong Kong instead of Shenzhen. The exceptions were the Grand Alliance, MSC and CMA-CGM. Examination of the overall container shipping statistics also showed that while Shenzhen received calls from 153 container shipping services that were operated by 41 shipping lines, the comparative figures for Hong Kong were 290 services and 90 lines. In fact, only 24 services called exclusively at Shenzhen, with the rest making simultaneous calls at Hong Kong as well. By comparison, 158 shipping services called exclusively at Hong Kong and these were mostly services that operated within East Asia and between the Far East and South-East Asia. This also suggests that unlike Shenzhen, which derived its container throughput mainly from the vicinity of the east bank of the Pearl River Delta, container traffic handled at the port of Hong Kong came from a wider geographical region which extended beyond the delta to include other parts of China, Taiwan, Vietnam and the Philippines. The connection of Hong Kong to these regions is supported by a strong network of feeder services which are operated by a host of dedicated and common feeder operators, many of which are based in Taiwan (for example, CNC Line, Evergreen, TS Lines, Wan Hai and Yangming), Korea (for example, Dongnama, Heung-A, KMTC and Sinokor), or China (for example, COSCO, CSCL, OOCL, Sinotrans, SYMS and Xiamen Harvest). Hence, unlike Hong Kong, which has a well-established feeder network, the port of Shenzhen received only 17.2 per cent of ASC that are deployed on feeder services.

Taken together, Shenzhen was able to make strong gains on the major east–west trade routes. This resulted in the profile of ASC supplied at the port being mostly mainline services. In contrast, Hong Kong was able to retain a sizeable feeder network which has supported its premier hub status in the region thus far. Specifically, the development of calling patterns at both container ports suggests that most container shipping lines called at both Shenzhen and Hong Kong in order to pick up direct cargo at the former and direct cargo at the latter, with an increasing share of transhipment cargo which is fed from the region. However, Hong Kong runs the risk of losing a significant share of the feeder business should these services follow their mainline counterparts by increasing the number of calls, or even relocating, to Shenzhen.

### *5.3 Inter-port dynamics in the Antwerp–Hamburg range*

Container ports in North-West Europe handled an estimated 56.9 million TEU in 2007 and continue to account for the third largest source of container traffic generated worldwide at 11.6 per cent (East Asia: 35.7 per cent; and South-East Asia: 13.6 per cent) (Drewry Publications, 2007). This case study does not focus on the well-known and much-researched Le Havre–Hamburg range (see, for example, Notteboom, 2007). Instead the group of ports under consideration is narrowed down to the four main ports in the Antwerp–Hamburg range, thereby excluding the seaports in northern France and smaller container ports in the region such as Zeebrugge and Amsterdam. Together, the ports of Rotterdam, Hamburg, Antwerp and Bremerhaven handled 33.8 million TEU or 59.3 per cent of all containers handled in North-West Europe (Informa UK Ltd, 2008). This choice of ports was partly instigated by the fact that Le Havre and Dunkirk are largely focused on serving the French hinterland, while the geographical location of the selected container ports showed that they are well placed to serve the major economic centres of production and consumption all over Western Europe by various modes of transport, including road, rail, inland shipping and coastal shipping (Hafen Hamburg Marketing eV, 2008; Port of Antwerp, 2008; Port of Rotterdam, 2008). It is only very recently that Le Havre and Dunkirk have developed strategies to capture container cargoes linked to non-French hinterland regions.

Quite a number of operators of container terminal facilities located in the selected ports operate terminals in other ports:

- Eurogate has facilities in Bremerhaven and Hamburg;
- PSA International operates the main container terminal in Antwerp (and Zeebrugge) and operates a small container facility in Rotterdam;
- APM Terminals of the Mærsk group operates large dedicated facilities in Bremerhaven and Rotterdam (and also in Zeebrugge);
- MSC developed the MSC Home Terminal in Antwerp (joint venture with PSA) and a similar facility in Bremerhaven; and
- DP World operates several terminals in Antwerp and is expected to start operations at Rotterdam's Maasvlakte 2 in 2013.

If we include new projects scheduled to come on-stream by 2013, the sample would include CMA-CGM (Antwerp and Rotterdam). In addition, the four largest European container shipping lines (that is, Mærsk, MSC, CMA-CGM and Hapag-Lloyd) are also found to have shareholding interests in these ports. Hence, proximity of these facilities and operators suggests the presence of a high level of inter- as well as intra-container port dynamics, where container terminal operators in these ports actively seek to position their facilities as important links within value chains that connect between Europe and major markets in Asia and North America.

In 2006, the container ports of Antwerp, Bremerhaven, Hamburg and Rotterdam were connected to 11 trade routes which saw 64.1 million TEU of ASC deployed by 162 shipping lines in 413 shipping services. Figure 11.7 shows that ASC supplied to the four container ports registered an average annual rate of growth reaching 12.9 per cent in the period lasting from 1995 to 2006. Examination of ASC that called at the selected ports revealed the largest amount of shipping capacity being received by Rotterdam, followed by Hamburg, Antwerp and Bremerhaven (Figure 11.8). However, while the beginning of the period saw Rotterdam receiving 82.5 per cent of all capacity that called at the four container ports, its share had declined to 61.7 per cent by 2006. As for the other ports, the same period saw the share of ASC received by these ports remaining fairly constant, with those of Hamburg and Antwerp ranging between 40 and 50 per cent and those of Bremerhaven fluctuating between 27 and 34 per cent.

The profile of ASC deployed consisted mainly of shipping capacity

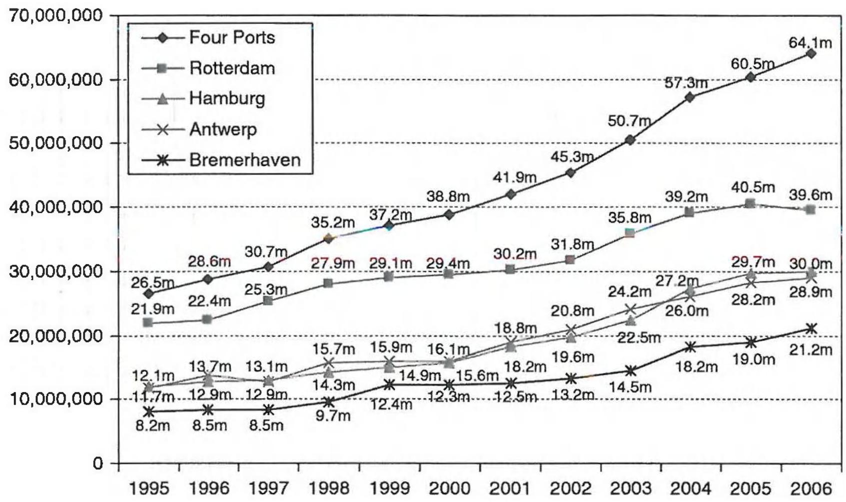


*Figure 11.7 Development of ASC calling at selected ports in North-West Europe (in TEU)*

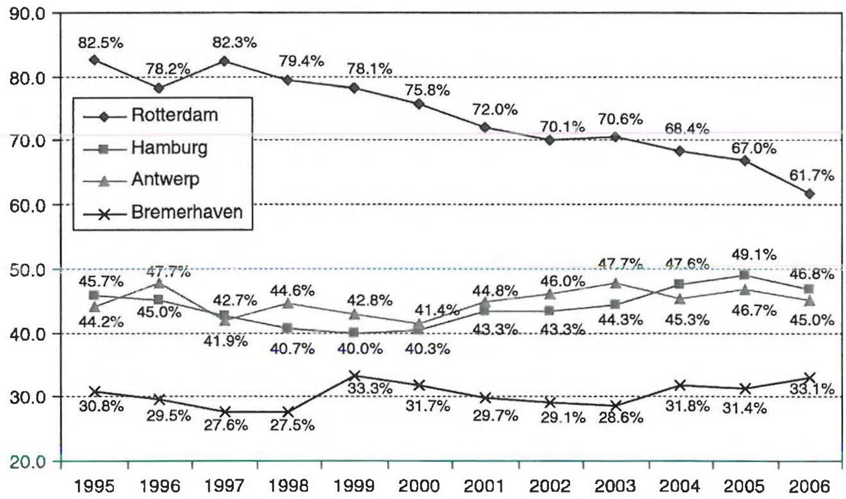


*Figure 11.8 Development in share of ASC connected to the selected ports*

operating on the major east–west trades. Such capacity accounted for 35.5 million TEU or 55.4 per cent of all ASC supplied. The remaining capacity was made up of shipping services connecting various regions within Western and Northern Europe. The largest of the trades that called at the selected container ports was the Europe–Far East trade which accounted for 22.0 million TEU or 34.3 per cent of total ASC supplied. This was followed by the intra-Europe and transatlantic trades. Specifically, the top five trades accounted for 95.2 per cent or 61.0 million TEU of total capacity that called at the selected ports.

Empirical evidence from inter-container port dynamics between the selected ports in North-West Europe revealed non-exclusive calls to be the predominant feature. The share of ASC involved in such calls ranged from a high of 94.2 per cent registered on the Europe–Far East trade, to a low, but still significant, 52.2 per cent for the intra-Europe trade. The respective shares for the other trades were 82.6 per cent for the transatlantic trade, 61.3 per cent for the Europe–Mediterranean trade, and 54.9 per cent for the Europe–Africa trade. Trade routes that exhibited a significant proportion of capacity which called exclusively at either of the selected ports were mostly at Rotterdam or Antwerp. The large proportion of capacity calling simultaneously at a number of the selected ports was translated into a large amount of inter-container port dynamics involving both inter-port competition as well as inter-port complementarity (see Table 11.6 for details). With regard to inter-container port complementarity, this was found to occur mainly between Rotterdam and Hamburg on the Europe–Far East trade, Hamburg and Bremerhaven, and Rotterdam and Antwerp on the intra-Europe trade, and Rotterdam and Bremerhaven on the transatlantic trade. For inter-port competition, this was found to occur mainly between Rotterdam and Hamburg, and Rotterdam and Bremerhaven on the Europe–Far East trade, Hamburg and Bremerhaven on the intra-Europe trade, and Rotterdam and Antwerp on the transatlantic trade.

Although the share of ASC affected by competition between the various pairs of container ports was generally lower than inter-port complementarity uncovered for the same port pairs, the amount remained significant. Hence, the situation observed for the state of inter-port dynamics between the selected container ports was one which involved complementary, as well as competing, relationships. Specifically, a particular pair of container ports could be complementing each other on one trade route while at the same time competing with each other on another trade route (for example, Rotterdam competing with Bremerhaven on the Europe–Far East trade, while complementing each other on the transatlantic trade). The relationship could also be manifested on the same trade route where both ports are actively competing with, as well as complementing, one another (for example, as seen in the case of Rotterdam and Hamburg, Rotterdam and Antwerp, and Rotterdam and Bremerhaven on the Europe–Far East trade).

The analyses also revealed that the leading carriers on the trades

*Table 11.6 Summary of inter-container port dynamics in the Antwerp–Hamburg range (in TEU)*

| | Europe–Far East | | |
|---|---|---|---|
| | Complementary | Competitive | Total |
| Antwerp | 59.0% | 41.0% | 22,522,700 |
| Bremerhaven | 64.4% | 35.6% | 19,161,840 |
| Hamburg | 54.5% | 45.5% | 38,160,360 |
| Rotterdam | 46.7% | 53.3% | 45,386,280 |
| Overall | 58.0% | 42.0% | 125,231,180 |
| | Intra-Europe | | |
| | Complementary | Competitive | Total |
| Antwerp | 44.7% | 55.3% | 15,218,000 |
| Bremerhaven | 67.4% | 32.6% | 16,561,700 |
| Hamburg | 60.5% | 39.5% | 18,781,700 |
| Rotterdam | 68.6% | 31.4% | 22,429,000 |
| Overall | 59.3% | 40.7% | 72,990,400 |
| | Transatlantic | | |
| | Complementary | Competitive | Total |
| Antwerp | 65.8% | 34.2% | 33,612,820 |
| Bremerhaven | 60.1% | 39.9% | 26,756,740 |
| Hamburg | 59.0% | 41.0% | 21,682,780 |
| Rotterdam | 67.4% | 32.6% | 38,286,040 |
| Overall | 63.2% | 36.8% | 120,338,380 |

generally consisted of the same entities. These were Mærsk, MSC, the Grand Alliance, CMA-CGM and Hamburg Süd. These entities were found to play an active part in shaping inter-port relationships in the region. This was most evident for the majority of services operated by Mærsk which were deployed to call jointly at Rotterdam and Bremerhaven where APM Terminals is present. The case for MSC also revealed the carrier to deploy most of its services to call at Antwerp where MSC has a 50 per cent stake in the MSC Home Terminal. The carrier also scheduled a significant portion of its capacity to call at Bremerhaven, where it has a 50 per cent stake in the MSC Gate Terminal.

## 6 Conclusions and recommendations for future research

Container shipping services have been shown to exert a direct and immediate effect on inter-container port dynamics. This, in turn, affects container port performance. Specifically, the supply of container shipping services at a port brings about connectivity through which containerised cargo can be handled and results in beneficial spin-offs for the local as well as hinterland economies. The presence of inter-container port complementarity means that such benefits will be extended to other ports which complement the port in question. Conversely, the decision by container shipping services to stop calling at a port will result in lower connectivity and higher transport cost (including time and distance) which reduces the amount of container throughput handled and exerts a negative impact on the competitive potential of its local and hinterland economies. The negative impact will also affect other ports which are complemented by services that called at the port.

Given the important role played by container shipping services towards influencing inter-container port dynamics, this chapter attempted to analyse these dynamics by examining the calling patterns of container shipping services and to establish the trade routes and markets where competition or complementarity exist, participants involved, and the intensity and extensity of such relationships. The analyses were conducted for the major container-handling regions in the world and uncovered distinctive characteristics for each region in relation to the competitive, as well as complementary, aspects of relationships between container ports. In particular, empirical evidence obtained from South-East Asia found most of the inter-container port dynamics to be competitive in nature, occurring mainly between Singapore and Port Klang, followed by Singapore and Tanjung Pelepas. A major source of competition was in the form of new services initiated at Singapore which could have called at the other ports. By comparison, there were relatively few changes in shipping capacity that affected Port Klang and Tanjung Pelepas. As a whole, Singapore remained the preferred port of call in the region by most container shipping lines.

In contrast to South-East Asia, the state of inter-container port dynamics for the Pearl River Delta changed from a competitive stance to become largely complementary, mostly in the form of services initiated to call at both Hong Kong and Shenzhen. However, exceptions were seen for the South-East Asia–Far East trade route where changes to shipping capacity were largely competitive in nature due to services initiated to call at Hong Kong. The period of analysis also saw Shenzhen being included in an increasing number of services which used to call exclusively at Hong Kong and resulted in container traffic being handled directly at the port. As a whole, the presence of Hutchison Port Holdings and Modern Terminals Limited in a number of facilities in both ports contributed to the large number of complementary, as well as competitive, relationships as these container terminal operators sought to position themselves as important links for value chains that connect between Southern China and major markets in other parts of North America, Asia and Europe. Nonetheless, evidence from container shipping services revealed Hong Kong to remain the focus of calls by receiving more services and shipping capacity than Shenzhen. Furthermore, unlike Shenzhen which derived its container throughput mainly from the vicinity of the Pearl River Delta, container traffic handled at Hong Kong came from a wider geographical region to include other parts of China, Taiwan, Vietnam and the Philippines, where connectivity is supported by a strong network of feeder services.

Turning to North-West Europe, inter-container port dynamics witnessed between the selected ports presented another picture which was different from that experienced in South-East Asia and the Pearl River Delta. Specifically, investigation of inter-port relationships between Rotterdam, Hamburg, Antwerp and Bremerhaven found the ports to be actively competing with, as well as complementing, one another. A particular pair of container ports could be complementing each other on one trade route while, at the same time, competing with each other on another trade route. The relationship could also be observed on the same trade route where both ports are actively competing as well as complementing each other. As a whole, the region witnessed a higher amount of changes to shipping capacity that were attributed to inter-container port complementarity, as compared to inter-container port competition. Nonetheless, Rotterdam remains the port which handled the largest amount of shipping capacity.

As a whole, there have been numerous studies and much research effort committed to understanding and keeping pace with an industry that has seen many changes since the containerised transportation system was inaugurated by Malcolm Mclean in 1956. Although many aspects of the system have been analysed from a variety of perspectives and in great detail, very few have attempted to integrate the liner shipping aspects of the business with the port when analysing relationships between container ports. Furthermore, these studies tended to focus only on factors that are quantifiable. Hence, this research has attempted to address these issues by analysing relationships between container ports from the perspective of inter-container port complementarity and competition. Specifically, the contributions of this research can be found in two major areas.

First, it was shown that analyses of inter-container port relationships would be incomplete if complementary aspects were not accounted for. Shipping lines and container ports which focused on the competition aspect of the business would be missing out on opportunities that could be capitalised upon from the perspective of the complementary relationships that exist between ports. In other words, focusing on addressing inter-container port competition may become myopic; a focus that may well compromise the win–win relationships that can be forged, where circumstances permit, from inter-container port complementarity. The above analyses have shown that inter-container port complementarity accounted for a significant share of developments in the supply of shipping capacity. Hence, this research hopes to draw policy and decision makers' attention to considerable opportunities offered from inter-container port complementarity in order to advance the competitive position of their respective ports.

Second, the research has shown that analyses of relationships between container ports should not be conducted at an aggregated level. With every market served by each port involving different decision makers, regions, routes, cargoes and shipping lines, it is unlikely for a port to be competing with another port across the whole spectrum of variables and sectors. Similarly, it is impossible for complementary relationships between two ports to extend to all their markets served. This was put across explicitly for all the regions analysed and the case for North-West Europe especially showed that two container ports could be competing on a particular trade while complementing each other on another route. Hence, the aim was to draw decision makers' attention to the need to identify the extensity and intensity of such relationships in order to craft and implement decisions with greater precision.

The research findings presented were based primarily on evidence provided by container shipping services that called at the selected ports between 1995 and 2006. The merits of this approach have been discussed. However, the research findings can be complemented with other information and perspectives. Specifically, the analyses were conducted at the level of the container port. As such, examination of inter-container port dynamics from the perspective of individual shipping lines and terminal operators for each container port may uncover greater insights into the market structure, nature of relationships, and level of competitiveness as differentiated by cost and price. Hence, future research on this issue that is able to address these concerns should offer deeper insights into the dynamics of relationships between container ports.

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