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# **University of Southampton**

Faculty of Social Science

Department of Decision Analytic and Risk

Business Studies and Management

**Building sustaining port competitiveness constructs: a case study of ports in China**

by

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Thesis for the degree of Doctor of Philosophy

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# University of Southampton

## Abstract

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#### *Background*

Ports play a pivotal role in global logistics and the supply chain by handling a significant volume of cargo transported worldwide. The continual investment and expansion of ports necessitate new requirements for their sustainable management. With the rapid spread of the COVID-19 pandemic worldwide, there has been a profound impact on global economic and trade development, leading to surge shipping prices have surged, and regional policies have also affected port production activities. Global port congestion, labor shortages at ports, and other challenges underscore the critical role of ports in the maritime supply chain. Similarly, trade conflicts between China and the United States have disrupted the normal operations of the port industry, underscoring the significance of ports in the maritime network. Port competitiveness is an increasingly pertinent subject due to the value that ports bring to enterprises in the maritime supply chain, and more broadly, to the economic, social, and environmental development of the regions in which they are located.

#### *Purpose*

With the constantly changing port market environment, shipping backgrounds, and local policies, the factors affecting port competitiveness need to be reconsidered and updated. Some factors may have become less influential on port competition than before, while others, previously overlooked or lacking in-depth research, may potentially improve port competitiveness. To address this gap, this research aims to explore issues important for port competitiveness in Chinese ports and how can port competitiveness be improved through sustainable competitiveness strategies. Insights are drawn from cutting-edge topics of research in port management, including port supply chain integration, port collaboration and port sustainability, for the investigation of the port competitiveness and competition.

#### *Approach*

First, a systematic literature review was conducted, comprehensively gathering and reviewing 81 journal papers on port competitiveness published in the past two decades. Research trends, gaps, and opportunities in the field were discussed based on a critical

analysis of the port competitiveness mechanism. Then, a grounded theory approach was utilized to systematically construct the theory of sustaining port competitiveness grounded in the data. This research utilized a theoretical sampling approach to investigate how port operators and stakeholders understand sustaining port competitiveness. The data were primarily collected through 35 semi-structured interviews with representatives of experts, Chinese port companies, and stakeholders, including shipping lines, cargo forwarders, and port service providers. After data collection, the strategy of coding and comparative analysis was adopted to categorize issues and construct the prototype of the theory. By summarizing findings and comparing them with the literature, several dimensional frameworks and the model of sustaining port competitiveness were constructed.

### *Findings*

The study's findings suggest that China's port competition and competitiveness are influenced by several cutting-edge trends in the shipping and supply chain industry, such as port supply chain integration, port cooperation, and port sustainability. The results of the data analysis show that the sustainable competitiveness of the port can be classified into four dimensions: resource-based advantages, platform advantages, network advantages, and sustainable advantages. A theoretical framework was accordingly developed to deeply understand the relationships of these four dimensions to a port's sustainable competitiveness. Resource-based advantages represent the traditional strengths that ports possess, typically not easily altered. Achieving sustainable competitiveness requires two major strategic advantages: platform and network advantages, which can be enhanced by establishing appropriate strategies. To maintain a high level of competitiveness in the long term, ports need to consider the potential elements of sustainable advantages.

Moreover, this research discussed seven sustainable port competitiveness strategies, which are: 1) Attracting investment and construction; 2) Establishing port alliance; 3) Attracting shipping companies; 4) Attracting cargo from the hinterland; 5) Optimizing logistics service; 6) Developing innovative technology; 7) Capitalizing on the policy and national strategies.

### *Contributions*

This research significantly advances the theoretical landscape of port and shipping studies. It enhances understanding by conducting a comprehensive literature review, introducing the concept of sustainable port competitiveness, and proposing conceptual frameworks. The study offers fresh perspectives on port competitiveness from port resources, port supply chain, cooperation, and sustainability angles, paving the way for diversified approaches in future research. Additionally, it provides practical implications for both port operators and policy makers, guiding operators to enhance their competitive edge, attract investors, and optimize strategies for long-term competitiveness. Policy makers can leverage insights to design policies that encourage sustainable development, eco-friendly practices, trade facilitation, investment, and skill development, fostering a collaborative approach that contributes to the industry's resilience and positive socio-economic and environmental impact.

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# Research Thesis: Declaration of Authorship

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I declare that this thesis and the work presented in it is my own and has been generated by me as the result of my own original research.

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**Hang Yu, Yu Gong & Jun Liu (2023)** A systematic literature review on port competitiveness, *International Journal of Logistics Research and Applications*, DOI: 10.1080/13675567.2023.2187355

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# Table of contents

<b>Chapter 1. Introduction</b> .....	11
<b>1.1. Background</b> .....	11
<b>1.1.1. Trends of the shipping industry</b> .....	14
<b>1.1.2. Port integration in the supply chain</b> .....	18
<b>1.1.3. Port competition and co-operation</b> .....	19
<b>1.1.4. Port sustainability consideration</b> .....	21
<b>1.2. Ports in China</b> .....	23
<b>1.3. Objectives and contributions</b> .....	28
<b>1.4. Structure of this dissertation</b> .....	30
<b>Chapter 2. Literature review</b> .....	32
<b>2.1. Introduction</b> .....	32
<b>2.2. Existing literature analysis</b> .....	32
<b>2.2.1. Port studies</b> .....	32
<b>2.2.2. Port evolution: port role and ownership change</b> .....	36
<b>2.2.3. Port competition</b> .....	41
<b>2.2.4. Port competitiveness</b> .....	42
<b>2.2.5. Existing literature review on port competitiveness</b> .....	43
<b>2.3. Review methodology</b> .....	47
<b>2.3.1. Question formulation</b> .....	47
<b>2.3.2. Locating studies</b> .....	48
<b>2.3.3. Study selection and evaluation</b> .....	50
<b>2.3.4. Analysis and synthesis</b> .....	51
<b>2.4. Findings</b> .....	51
<b>2.4.1. Descriptive analysis</b> .....	51
<b>2.4.2. Thematic analysis</b> .....	56
<b>2.4.3. Analysis of research perspective</b> .....	59
<b>2.4.4. Clustering analysis</b> .....	61
<b>2.5. Discussion</b> .....	73



<b>2.6. Conclusion</b> .....	79
<b>Chapter 3. Methodology</b> .....	82
<b>3.1. Research philosophy</b> .....	82
<b>3.1.1. The philosophy of management research</b> .....	82
<b>3.1.2. The author' s philosophical position</b> .....	83
<b>3.1.3. Quantitative and qualitative research paradigms</b> .....	85
<b>3.2. Grounded Theory (GT) Method</b> .....	87
<b>3.2.1. Origins and strengths of the GT</b> .....	88
<b>3.2.2. GT in practice</b> .....	90
<b>3.2.3. The criticisms of GT</b> .....	92
<b>3.3. Case study</b> .....	93
<b>3.4. Data gathering</b> .....	93
<b>3.4.1. Research subject setting</b> .....	93
<b>3.4.2. Semi-structured interview</b> .....	94
<b>3.4.3. Use of literature and other secondary sources</b> .....	100
<b>3.5. Data Analysis</b> .....	101
<b>3.5.1. Open and focused coding</b> .....	101
<b>3.5.2. Categorizing and theory building</b> .....	102
<b>3.5.3. Analytic tool and strategy</b> .....	103
<b>3.6. Validity evaluation</b> .....	105
<b>3.7. Ethical issues</b> .....	111
<b>3.8. Summary</b> .....	111
<b>Chapter 4. GT analysis</b> .....	112
<b>4.1. Resource-based advantages</b> .....	112
<b>4.1.1. Geographical location</b> .....	113
<b>4.1.2. Natural conditions</b> .....	116
<b>4.1.3. Hinterland conditions</b> .....	119
<b>4.1.4. Investment and construction</b> .....	123
<b>4.2. Platform advantages (supply chain perspectives)</b> .....	125
<b>4.2.1. Logistics service optimization</b> .....	125
<b>4.2.2. Shipping services</b> .....	129

4.2.3. Market development .....	133
4.3. Network advantages (cooperation perspective) .....	136
4.3.1. Port group merger .....	136
4.3.2. Cooperation between ports .....	139
4.3.3. Cooperation with stakeholders .....	143
4.4. Sustainable advantages .....	145
4.4.1. Green development .....	145
4.4.2. Technology development .....	150
4.4.3. Transformation and upgrading .....	154
4.4.4. Talent attraction and cultivation .....	158
Chapter 5. Conceptual analysis and discussion .....	163
5.1. Dimensional frameworks .....	163
5.1.1. Resource-based advantages .....	164
5.1.2. Port platform advantages .....	168
5.1.3. Network advantages .....	171
5.1.4. Sustainable advantages .....	174
5.2. Sustaining port competitiveness constructs and sailboat model .....	176
5.3. Discussion on sustainable port competitiveness strategies .....	181
5.3.1. Attracting investment and construction .....	188
5.3.2. Establishing port alliance .....	189
5.3.3. Attracting shipping companies .....	190
5.3.4. Attracting cargo from the hinterland .....	192
5.3.5. Optimizing logistics service .....	192
5.3.6. Developing innovative technology .....	193
5.3.7. Capitalizing on the policy and national strategies .....	194
5.4. Summary .....	196
Chapter 6. Conclusion .....	197
6.1. Answer to the research question .....	197
6.2. Theoretical implications .....	199
6.2.1. The contribution to port competition and competitiveness literature .....	199
6.2.2. The contribution to port competitiveness from a supply chain perspective .....	200

6.2.3. The contribution to port competitiveness from a cooperation perspective .....	201
6.3. Practical implications .....	202
6.4. Limitations .....	204
6.5. Future research directions .....	205
References .....	207

## Chapter 1. Introduction

### 1.1. Background

Ports have played a vital role in the global supply chain by serving as interchange points between maritime and inland transport. More than 90% of international trade is achieved through maritime transport (UNCTAD, 2022). Stimulated by economic globalization, both ship capacity and the amount of marine freight carried worldwide have grown significantly (Häberle *et al.*, 2021). At the same time, globalization has transformed the function of ports from infrastructures of transportation to resource allocation hubs of the world market (Gryshchuk *et al.*, 2022). Ports thus play an increasingly important role in both the smooth operation of national economies and international trade.

The swift spread of the COVID-19 pandemic around the world had a huge impact on global economic and trade development, port production activities having been affected by regional policies (Narasimha *et al.*, 2021). Global port congestion, port labour shortages, and other difficulties highlight the port's critical role in the marine supply chain. Similarly, trade conflict between China and the United States poses difficulties to the port industry's normal operations (Guo *et al.*, 2021), emphasizing the significance of ports in the maritime network.

Ports have various positive impacts, most of which are related to economic benefits. First, a port is an irreplaceable part of the global transport chain. As the junction of all kinds of transportation modes and hub of the transportation network, ports create a good transportation foundation for the development of the modern economy. A port relates to the economy of the hinterland through various modes of transportation, connecting the production and consumption of the hinterland, such as industry, agriculture, commerce and foreign trade. Cargo flows throughout the port, improving the local value-added services by bringing material flow, information flow and financial flow (Shan *et al.*, 2014). Its function has also been expanded from traditional transportation to industrial production, commerce, service, etc.

Second, ports play an important role in promoting the economic growth and status of cities in the region (Kong and Liu, 2021). There is a growing trend that the global economy is shifting to port cities. In the recent past, almost all coastal cities had their own port, and every port sustained its city (Kong and Liu, 2021). Focusing on Chinese port clusters, Shan *et al.* (2014) quantitatively investigated the impact of seaports on the host cities' economies and found that every 1% increase in cargo throughput can boost the growth of per capita growth by 0.076%. Furthermore, ports increase urban employment by attracting firms and driving other non-port industries, such as financial and legal services (Bottasso *et al.*, 2014), which generate economic benefits and socioeconomic welfare to the urban economy to some extent (Zhao *et al.*, 2017). Last but not least, maritime transport has been regarded as the most environmentally friendly transportation mode, consuming relatively less fuel per unit of cargo compared to other transportation modes such as road and air (Tamannaie *et al.*, 2021).

Aside from the increasing significance of ports, the environment of port competition has evolved tremendously, influencing the meaning of port competitiveness. In the context of international trade and maritime transport, higher requirements have been put forward to ports. For example, the up-sizing and containerization of vessels pose challenges to the innate berthing conditions and operational efficiency of large ports. As a result, the need for shipping has boosted construction and investment in port infrastructure, particularly in emerging nations, intensifying and complicating competition among ports. In the context of supply chain, the purpose of port competition has evolved from attracting port users to providing value to consumers in the supply chain (Farahani *et al.*, 2014). Ports must attain a greater level of co-ordination and co-operation as supply chain members in order to embody their competitiveness and integrate into the global supply chain (Liu *et al.*, 2019). In the context of regional development, the trend of global economic transfer to port cities is becoming more apparent as a result of the economic benefits provided by ports to cities (Ferrari *et al.*, 2010). Competition between public-owned ports is generally seen as a field of

urban development strategy, with public policy having a significant impact on port strategies (Ma *et al.*, 2021). Port competitiveness is not only of great significance to port development itself, but also an important aspect that can boost urban and national competitiveness. Therefore, port competitiveness has received great attention from governments and business sectors alike.

Huang *et al.* (2003) defined port competitiveness as the ability to create value in the port and its vicinity. An extended view of this definition was provided by Nalebuff *et al.* (1996), who defined port competitiveness as a reflection of a port's ability to grow resources, competencies and capabilities in a cooperative perspective. For the port industry, to meet customers' demands faster and better has become the main goal to enhance competitiveness. Ports with competitive advantages are able to improve customer satisfaction, as well as create profits through low-cost and high-quality services. By integrating their own factors and interacting with the external environment, such ports have comparative advantages over other ports, improving market share, generating value and maintaining sustainable development (Bichou and Gray, 2005). Port competitiveness could hence be understood as a port's effective attraction to the source of goods by virtue of a series of conditions conducive to production and operations, such as container turnover capacity, natural characteristics, policy and technology.

A substantial number of related papers have been published in recent years, showing that port competitiveness is currently a cutting-edge issue in the domain of both maritime studies and supply chain management (e.g. Song and Panayides, 2008; Yeo *et al.*, 2011; Yalcin *et al.*, 2019; Zhang *et al.*, 2014). An advanced Google scholar search identifies eight literature review papers on port competitiveness or port competition in the last ten years from 2009 to 2021. Among them, Pallis *et al.* (2010) reviewed and classified the content of port research and found 74 papers on port competitiveness and competition from 1997 to 2008; Parola *et al.* (2017) found 170 papers on the drivers of port competitiveness from 1983 to 2014, and

Chang and Talley (2019) identified 644 papers examining port competitiveness from the perspective of port efficiency and supply chain perspectives. The increasing number of papers published on the topic demonstrate the hot debate there is on port competitiveness.

In the context of fierce and changing competition between ports, identifying the determinants of competitiveness is crucial to the judgment of competitive strategy and effective action. Most prior studies concentrated on a limited number of factors to test their relevance. However, among the existing research on port competitiveness, most researchers focused their efforts on traditional dimensions such as operational efficiency, inland connectivity and endowment of infra- and supra-structures (Parola *et al.*, 2017). Acosta *et al.* (2011) and Parola *et al.* (2017) argued that the multidimensional nature of port competitiveness derived from a significant number of factors, the importance of each varying in line with the different perceptions of port users. For example, “port cost” was identified as the most important factor when shipping lines were selecting a port, while shippers tended to consider “port location” and “hinterland connections” as priorities (Nugroho, 2015).

With constant changes of the port market environment, shipping background and local policies, factors affecting port competitiveness need to be re-considered and updated. Some factors may be less influential on port competition than previously, while others, which suffered from neglect or lack of in-depth research may potentially help to improve port competitiveness. Thus, it is important to determine possible drivers that affect port competitiveness and identify new drivers that enable a port to gain greater market share. This research argues that the factors of port competitiveness need to be studied periodically due to the fact that port characteristics tend to change. Considering the expanded functions of ports and the current problems they may be facing, some trends may have a growing impact on port competitiveness.

### **1.1.1. Trends of the shipping industry**

It has been emphasized that the changing environment of port competition is inseparable from the context of international transportation, especially the trend of maritime transport. The past half-century has seen a significant growth in the shipping industry as a result of globalization. All countries are involved in global market competition. In this context, the competitive environment of ports has changed, especially the challenges brought by two major development trends in the shipping industry: one is change in the type and size of ships; the other is the restructuring of shipping companies and port operators.

The modern mode of transportation characterized by international containerization has not only promoted major adjustment of the world's industrial structure and economic pattern, but also prompted a new boom in port development around the world (Notteboom *et al.*, 2021). The first container ship, namely the Ideal X, converted under the initiative of Malcom McLean, made her maiden voyage in 1956, marking the prologue of containerization (Bernhofen *et al.*, 2016). Since then, the demand for container shipping services has increased, the economic advantages of container shipping being obvious. In order to reap the economic benefits of transportation, shorten the transportation cycle and improve service quality, the process of large-scale container ships has been significantly accelerated since the 1980s (Mateos-Gonzalez, 2015).

On the one hand, with a significant increase in vessel size, the average container carrying capacity of a container fleet has increased correspondingly; on the other hand, the top liner companies strive to pursue the benefits of scale economics on the basis of reducing the single container transportation cost. Thus, their desire to add new orders for large-scale shipbuilding has been constantly stimulated. As a result, the average capacity of a single container ship increased from 188 twenty-foot equivalent units (TEUs) in 1970 to approximately 15,000 TEUs now.

With large-scale container ships occupying the main shipping market, the comprehensive capacity of ports is also tested by improved international transportation. There are many



natural and operational factors involved in judging whether a port is capable of handling large ships, of which water depth of the channel is the most basic. Port infrastructure is also valued because it directly affects route products planning, based on the efficiency of cargo handling. Although many countries have taken, or are taking measures to strengthen the construction of deep-water berths and improve terminal services to attract large ships, there are relatively few ports available for larger vessels. Many medium-sized ports have gradually taken on the role of feeder ports. Indeed, container ships provide liner services on fixed routes, ports, and time schedules. This means that once the basic routes are formed, they are difficult to change. Therefore, if a port cannot be a hub port or main port, it can only function as a distribution hub or feeder port to other hub ports.

The restructuring between top shipping lines and port operators is the other driving force for change in the competition environment of ports. Due to the global economic downturn in 2008, low freight rate in the shipping market, insufficient shipping demand and excess capacity led to a general loss of shipping enterprises over time. In order to meet such challenges, mergers and acquisitions (M&A), and the establishment of shipping alliances have been widely implemented by shipping companies to consolidate their market share and reduce costs.

The strategy of M&A enables shipping lines to improve internal technology and operational efficiency by introducing a new management mechanism. At the same time, the financial combination increases capacity while avoiding damage to the whole competitive structure (Heaver, 2002). Another formation, strategic alliance, improves the utilization rate of facilities and equipment by sharing vessels and terminals. Overall coverage of routes is expanded and the service offered to customers improved after collaboration.

However, similar to the impact of the upsizing of vessels, M&A alliances have raised the demand for port adaptability. These shipping alliances are able to negotiate with port operators on charges, quality, and conditions of service because they take the initiative in

choosing ports. Competition between ports in a similar region becomes fiercer as the natural and geographical advantages disappear. Hence the trend is for increased competition between container ports, especially for feeder ports to become hub ports and vice versa. Hub ports may have the worry of being replaced by ports with a common inland area. UNCTAD (2018) suggests that the impact is further complicated by the need to redefine terminal franchising, as shipping companies are keen to get involved in port operations.

In addition to shipping lines utilizing the strategy of M&A, the global ports industry has experienced a wave of cross-border M&A since the 1990s (Rodrigue and Notteboom, 2011). Many leading global port operators including Hutch (Hong Kong), PSA corporation (Singapore), DPW (Dubai), AP Moller (Netherlands) and COSCO (Beijing) have expanded their scale extensively beyond ports in their own nations (Mangan *et al.*, 2008). Globalization of port operators has become a trend as a response to pressure from carriers. For example, DWP acquired Unifeeder Group from Nordic Capital in 2018. In the same year, the COSCO shipping group completed the acquisition of OOCL and became the third largest port operator in the world.

Government involvement is another feature of the cross-border port M&A. As an important strategic facility of a country, ports play an important role in national security and military affairs. Hence, they have an important strategic significance, different from general industry. Many governments have set up strict review procedures for foreign investors to acquire domestic ports and terminal enterprises, and even directly intervene when domestic enterprises are threatened by acquisition (Nicolas, 2014). At the same time, it is of great significance for the sustainable development of home countries or regions to acquire port resources through cross-border M&A. Therefore, enterprises engaged in cross-border M&A in the port industry often have a government background and will be supported by the local government in many aspects (Chen *et al.*, 2019). Their purchasing motivation is not purely down to commercial considerations, and their purchase actions may not fully comply with commercial rules.

In the global container terminal operators annual review and forecast published by Drewry (2019), the performance of top global terminal operators is ranked as follows. PSA and Hutch occupy first and second positions, respectively (PSA has a dominant position because it owns 20 % equity of Hutch). After the acquisition of OOCL, COSCO Shipping Group surpassed DPW and Maersk to become the third largest container terminal operator in the world. China not only has one of the largest liner companies in the world, but now is also in the port field. According to Drewry (2019), although there are many uncertainties, the global demand for container ports will still grow moderately in the future, but overall business expansion plans will slow down. This means that terminal utilization will increase in most parts of the world. It is expected that global container port demand will increase by 4.4 % annually in the next five years, and that world container port throughput will increase from 784 million TEU in 2018 to 973 million TEU in 2023, an increase of nearly 190 million TEU (Drewry, 2019).

### **1.1.2. Port integration in the supply chain**

The competition between ports is gradually evolving into competition between port supply chains. With the expansion of modern port functions, the port is no longer just a place for ships to dock and handle passenger and cargo transportation formalities, but a multi-functional area providing value-added services for goods (Olivier and Slack, 2006). In order to maintain the comprehensive competition advantages of port enterprises, it is necessary to further improve the supply chain management mode. By effectively combining all kinds of suppliers and customers into a whole to achieve the optimization of supply chain management costs and maximization of user demand, the competitiveness of ports will be improved. However, the positive role of supply chain management is not fully reflected at present (Notteboom *et al.*, 2020). The main reasons for this include insufficient understanding of port supply chain management, imperfect operational processes of coordination and integration among actual port enterprises, and lack of information sharing between different departments, etc.

It has been well accepted in academia that ports are part of the global supply chain. The concept of supply chain orientation was defined by Mentzer *et al.* (2001, p.11) as "The recognition by an organization of the systemic, strategic, implications of the tactical activities involved in managing the various flows in a supply chain". The purpose of supply chain integration is to realize an effective and efficient dynamic structure integrating information, products, services, resources and funds, so as to provide customers with the maximum service value at the lowest cost and within the shortest time (Frankel *et al.*, 2008). Under the role of an integrated supply chain, the high visibility of enterprise operation and the possibility of cooperation between organizations is completely predictable (Rosenzweig *et al.*, 2003). If the market changes suddenly, an organization can form strategic cooperation with supply chain partners, so as to respond to market changes in a cost-effective way. Supply chain management integration improves the global competition level of enterprises by changing the enterprise value or member strategy of the supply chain (Gunasekaran *et al.*, 2008).

Port integration in the supply chain is a process to improve the operational efficiency of port enterprises by coordinating the operation of transportation, loading and unloading, storage, information and decision-making (Panayides and Song, 2012). It is one of the main trends in the field of management to strengthen the integration of internal enterprises and cooperative enterprises and the external integration process between shipping enterprises and cargo owners. As opposed to the independent nodes of a basic ship's coastal operation system, the port supply chain establishes a link between the procedures related to the distribution port system (Panayides and Song, 2009). The purpose of port supply chain management is to deal with the core businesses among enterprises with vertical dependence, and to build the port group relationship with the same supply chain management (Bichou and Gray, 2004), so that they have competitive advantage over independent ports.

### **1.1.3. Port competition and co-operation**

With the development of regional port cluster research, scholars have found that there is not only a competitive relationship between ports, but also a complementary and cooperative relationship. Simple disordered competition between ports will result in a waste of resources, excessive construction and idle capacity, which will affect the long-term development of the whole regional economy (Guo *et al.*, 2018). In regional port groups, local government and terminal operators should not only improve competitiveness through their own efficient operation and management, but also consider cooperating with neighboring ports to form a transport hub that can compete with the external system (Asgari *et al.*, 2013). This combination of competitive and cooperative relationships is the internal motivation to promote the continuous evolution of a port group system, known as "co-opetition" (Heaver *et al.*, 2001).

Port co-operation was considered a win-win strategy rather than a win-lose one under the environmental force of intense international competition (Song, 2003). The continuous development and expansion of coastal ports has grown the hinterlands of many, and cross-hinterlands have appeared in ports. Researchers realized that the competition between ports was actually competition between neighbouring ports for cross-hinterlands. Notteboom (2010) studied the changes in container throughput of 78 European ports between 1985 and 2008, and found that to some extent, the overlapping hinterlands of modern regional port clusters promoted cooperation between them. Port co-operation generally occurs between ports within a port group by establishing an authority to implement unified planning and management, or by organizing a port association, which does not directly participate in the planning and management of the ports, but restricts port behavior through law or parliament, and guides each port to develop in a direction favorable to the port group (Carlan *et al.*, 2016).

The content of port competition and cooperation within a port group may include the following aspects (Song, 2003): first, in order to plan, construct and operate the port reasonably, port operators make legally binding price clauses to limit price wars and establish a division of roles to prevent resource waste caused by repeated construction. Second,

establishing a common information system platform in order to achieve information sharing. When there is port congestion, ships can be evacuated to other idle ports, which not only makes full use of resources, but also improves operational efficiency. Third, shared investment, especially in technology and equipment, can solve the financial problem of port development, and offers the benefit of risk sharing. In addition, ports in a group build closer connection by coordinating the construction of a land transportation network with the construction of port groups. As a result, resource integration is more efficient, while overall collection and distribution capacity and service quality have improved.

Local government of the ports in a port cluster system can take advantage of geographical advantages to cooperate in the construction of hinterland logistics systems and macro-control. At present, although cooperation and competition between major ports groups has begun, it is far from enough. Studies on how cooperation improves port competitiveness are also somewhat lacking. Therefore, the study of port competition and cooperation will be of great significance to governments' macro decision-making and the operation and management of ports.

#### **1.1.4. Port sustainability consideration**

Increasing concern about green and sustainability concepts in the port industry form the cutting-edge topic of recent years. Sustainability performance has become a non-negligible indicator for assessing port competitiveness (Kim, 2014). Although the environmental impact of ports is generally negative, the adoption of green strategies may improve the competitiveness of port enterprises in the long run.

As the capacity of ports expand and services continue to diversify, the pollutants generated have multiplied at the same time, which has resulted in environmental and ecological problems. Due to the maintenance of ports and ships, cargo handling and storage, sea-based activities and shore-based transport operations (Bailey and Solomon, 2004), pollutants such as drainage, effluent discharge, noise, dust, greenhouse gas emissions (GHG) and dredging

waste disposal are an inevitable byproduct (Starovoytova, 2018; Tsinker, 2004). Both local residents and the fauna and flora near a port could be negatively affected (Lirn *et al.*, 2013). Accordingly, in addition to considering the efficiency and performance of a port, sustainability has also been highlighted as an important issue.

The concept of sustainability was defined at the 1987 Brundtland conference as meeting the needs of the present without preventing future generations from meeting their own needs (WCED, 1987). Lu *et al.* (2016) systematically reviewed the definition of sustainability and summarized it as the strategy of development and acceptability of an environment by rationally utilizing the natural resources of the whole eco-system. In terms of port sustainability, however, each port has unique geographical and hydrological conditions, and the interests and responsibilities of the parties involved vary according to cultural, social, environmental and administrative perspectives (Bichou and Gray, 2005); hence the understanding of port sustainability and sustainable management of ports is complicated.

According to previous studies, the natural features of port sustainability include three dimensions: economic, social and environmental (Glavic and Lukman, 2007; Yap and Lam, 2013). The economic sustainability of a port includes significant return on investment, efficient port operation, adequate facilities to optimize the performance of the company, and ability to compete fairly with other international ports (UNCTAD, 2009); social factors for assessing port sustainability could be issues related to employment, interactivity between ports and cities, safety and security in ports and their surrounding regions (Shiau and Chuang, 2015). In terms of environmental issues, research has put forward diverse factors attributed to the assessment of green ports, including emissions control, waste handling, noise management and ecosystems preservation (Darbra *et al.*, 2005; Chiu *et al.*, 2014). By improving sustainability in all perspectives, namely economic prosperity, environmental quality and social responsibility (Panayides, 2006), ports can maintain economic stability, and be socially responsible within the limits of environmental regulations for a long time (Slack and Pinder, 2004).

In such a context, ports are under greater pressure than ever as international regulations and local policies on environmental protection place greater demands on their operations and management. The concept of the green port was established as part of environmental regulations by related port authorities, policymakers and local communities, aiming to increase net profits as far as possible from available resources through efficient management (Lam and Notteboom, 2014).

In addition to policy and regulations, the significance of improving technology and methods for the purpose of energy efficiency and environmental protection are emphasized (Iris and Lam, 2019). As Lam and Notteboom (2014) noted, while regulations are generally mandatory, improving technology and management makes green strategies more likely to be implemented. While technical and process innovation may solve or alleviate environmental problems, a higher operational requirement has been put forward for ports, as innovation often meets with resistance (Parola *et al.*, 2017). Ports can be at the frontier of green technology because they are able to absorb the green orientation shared by port users (Acciaro *et al.*, 2014). Although highly sustainable ports are likely to attract business investment in the shipping industry as well as support from government and public organizations (UNCTAD, 2015), whether this newly introduced issue becomes a key driver or an evaluation criterion of port competitiveness remains an uncertainty.

## **1.2. Ports in China**

During the mid-1980s, the focus of the world economy began to shift to the Asia Pacific region. Southeast Asia has become a global manufacturing and international shipping center, and container hub ports have gradually transferred to the region (Wang and Slack, 2004). China, the world's largest developing economy, has seen its ports grow rapidly in recent years. The competitiveness of Chinese ports in the world has also increased, as shown in Table 1-1.



Among the rankings provided, 16 Chinese ports have secured positions within the top 20 global ports concerning cargo throughput. Also, nine ports from China have attained positions within the top 20 global ports in terms of container throughput, notably, Ningbo Zhoushan Port and Shanghai Port occupying the top positions, respectively. These Chinese ports also show differentiation between the two rankings. For example, Shenzhen ranked fourth in the container traffic ranking, while its total cargo volume ranking was relatively low (ranked 20), reflecting the different types of cargo that a specific port focuses on. The rankings, however, are only one indicator of the relative scale of transport flow, and not sufficient proof that Chinese ports are competitive in the world market in a situation of increasingly diversified port services.

**Table 1-1** World port rankings by Cargo volume and Container volume in 2021 (Source: Global Port Development Report 2021- Shanghai International Shipping Institute)

Cargo throughput				Container volume			
Rank	Port	Country	Million tons	Rank	Port	Country	Million TEUs
1	Ningbo Zhoushan	China	1224.1	1	Shanghai	China	47.0
2	Shanghai	China	769.7	2	Singapore	Singapore	37.5
3	Tangshan	China	722.4	3	Ningbo Zhoushan	China	31.1
4	Qingdao	China	630.3	4	Shenzhen	China	28.8
5	Guangzhou	China	623.7	5	Guangzhou	China	24.2
6	Singapore	Singapore	599.6	6	Qingdao	China	23.7
7	Suzhou	China	565.9	7	Busan	South Korea	22.7
8	Hedland	Australia	553.3	8	Tianjin	China	20.3
9	Rizhao	China	541.2	9	Hong Kong	China	17.8
10	Tianjin	China	529.5	10	Rotterdam	Netherlands	15.3
11	Rotterdam	Netherlands	468.7	11	Dubai	United Arab Emirates	13.7

12	Busan	Korea	442.5	12	Klang	Malaysia	14.7
13	Yantai	China	423.4	13	Antwerp	Belgium	12.1
14	Taizhou	China	352.9	14	Xiamen	China	12.0
15	Jiangyin	China	337.6	15	Tanjong Pelepas	Malaysia	11.2
16	Dalian	China	315.5	16	Los Angeles	U.S.A	10.7
17	Huanghua	China	311.3	17	Kaohsiung	Taiwan, China	9.9
18	Nantong	China	308.5	18	Long Beach	Germany	9.4
19	Gwangyang	Korea	292.1	19	New York/New Jersey	U.S.A	9.0
20	Shenzhen	China	278.4	20	Hamburg	Germany	8.7

In accordance with the natural characteristics

istics of different regions and the economic structure of hinterlands, coastal ports in China are divided into five port clusters, as in Figure 1-1:

(1) The Bohai Rim ports cluster, located in the Liaodong peninsula and nearby coastal areas, is the largest dry bulk cargo throughput region in China because of its rich energy and mineral production (especially the steel industry). The current spatial distribution of the ports around Bohai Rim can be roughly divided into three sub port clusters: the first is Liaoning coastal port cluster, with Dalian port as the core, Yingkou port as the auxiliary port and Dandong port, Jinzhou port, Huludao port and other ports as the branch ports; the second is Shandong coastal port group, with Qingdao port as the core, Yantai port as the auxiliary port, and Rizhao Port, Weihai port, Longkou port and other ports as feeder ports; the third is Beijing-Tianjin coastal cluster, with Tianjin port as the core, Qinhuangdao port as an auxiliary port, and Jingtang Port, Huanghua port and other ports as feeder ports. The three sub port groups strive for cooperation and complementary advantage, while competing for the position of international shipping center in northern China.

(2) The Yangtze River Delta ports cluster enjoys huge import and export trade volume and foreign trade economy. This region also includes the port of Shanghai, the world's largest container port and also a huge logistics hub. According to the nature of the port, it can be

divided into three parts: seaports (e.g., ports of Shanghai, Ningbo and Lianyungang); ports along the Yangtze River (e.g. ports of Nanjing, Zhenjiang and Changzhou) and inland ports (e.g., ports of Hangzhou, Suzhou, Jiaxing). While there are obvious economic advantages in the construction of a regional international shipping centre, the goal of several ports to become international container hub ports has also put great pressure on Shanghai port.

(3) The Pearl River Delta ports cluster mainly includes Hongkong and Shenzhen as hub ports, in which two major international shipping routes, namely Far East-Europe and Far East-North America meet. The average distance between ports is less than 50 nautical miles, the only case in China where large ports are highly concentrated. The port cluster aims to take advantage of Hong Kong's economy, trade, finance and information, to fully consolidate its position as an international shipping center and to deepen regional cooperation and exchanges. Due to the concentrated port layout in the Pearl River Delta, there is a certain degree of competition in the supply, hinterland, routes and services. Port competitors in the Pearl River Delta include not only the ports in the cluster, such as Guangzhou port, Shenzhen port and Hong Kong port, but also port enterprises in the same port.

(4) The Southeastern region coastal ports cluster is located on the western side of the Taiwan strait and nearby coastal cities with the characteristics of rich coastline resources and many deep-water harbors, including Xiamen and Fuzhou ports.

(5) The Southwestern region coastal ports cluster is located in the coastal areas of Guangxi and Hainan Province, including Zhanjiang and Haikou ports. It serves the development of the West and provides transportation guarantees for the expansion of material exchange outside Hainan Province.

The importance of ports for the development of urban economies has recently been recognized by the government of China, followed by the rapid construction of port infrastructure based on development policies such as "One Belt And One Road" and "Yangtze

river economic belt". At the same time, rules and regulations in terms of operation management and operating charges have been implemented to improve port efficiency and service. In addition, with the continuous development of China's economy, environmental protection requirements have become increasingly stringent. The Chinese government has also issued a series of policies and/or notices related to environmental protection, putting forward higher requirements for the practice of port environmental protection, which has caused a negative impact on the short-term operation status of some ports in China. Accordingly, the port industry in China has a good policy environment, but it is also subject to higher policy regulation in terms of operating charges, and safety and environmental protection (Lam and Notteboom, 2014). Hence the improvement of port competitiveness is facing new challenges.



### **Figure 1-1** Main ports in China

(Source: <https://www.shiphub.co/the-biggest-ports-in-china/>).

In this research, three Chinese ports clusters, namely the Bohai Rim ports cluster, the Yangtze River Delta ports cluster and the Pearl River Delta ports cluster were selected as empirical cases. These three port groups are considered representative of Chinese ports since they serve the majority of China's economic hinterland, although the competitive environment and degree of integration of the port supply chain of the three port groups varies significantly. Data were collected from ports stakeholders in China through a technique of semi-structured interviews. With the help of the China Ports Association, a close relationship with the port companies and relevant academic institutions, the author has been given full access to the data required.

### **1.3. Objectives and contributions**

The above context demonstrates the importance of port competitiveness in the current changing shipping environment, and the significance of improving port competitiveness from several other perspectives. Traditionally, the port has played the role of facilitator, with the aim of providing an infrastructure and superstructure for maritime activities, cargo handling, provisional storage, and other intra-port operations (Song and Panayides, 2008). There has been both quantitative (e.g., Haezendonck and Notteboom, 2002; Yoon *et al.*, 2015) and qualitative (e.g., Gordon *et al.*, 2005; Lu *et al.*, 2016; Satta *et al.*, 2019) research on the drivers and measurement criteria of port competitiveness based on the conditions of specific ports. However, with ports currently playing a critical role as members of supply chains, port performance relies to a large extent on the relevant value-added logistics activities (Bichou and Gray, 2004). Neither can fully explain how a port seeks to improve its capability in the field of logistics through its unique advantage of developing logistics in the context of the integration of supply chain.

Insights are to be gained by drawing from cutting-edge topics of research in port management, namely: port supply chain integration, port collaboration and port sustainability for the investigation of port competitiveness and competition. To the best of my knowledge, there has been little previous research studying port competitiveness through the lenses of port supply chain integration, port collaboration and port sustainability simultaneously. Additionally, little is known about how port stakeholders view the transformation of port roles, or what operating strategies are implemented. Therefore, this research attempts to explore the following research question:

*What issues are important for port competitiveness in Chinese port clusters and how can port competitiveness be improved through supply chain management strategies?*

The contribution of this study to academia and real-world practice is argued in the following ways: First, it is an attempt to investigate port competitiveness in a long-term and ecologically friendly manner, as well as to combine supply chain management with port competitiveness. Due to the trends of port supply chain integration, the strength of port collaboration and increasing awareness on port sustainability, the goal of port competitiveness has gone beyond the preservation of competitive advantage. Considering the lack of a universally accepted definition or well-known theory of port competitiveness in the literature, a new theoretical framework on port competitiveness needs to be developed/proposed. This will help to explain how ports in the real world consider the current competitive environment and develop appropriate strategies; second, it contributes to the enrichment of the port competitiveness literature by conducting a systematic review to synthesize the port competitiveness drivers and strategies from a variety of perspectives. This study conducts a comprehensive review of port competitiveness from multiple stakeholders' perspectives. Limited research has been done in order to conduct such a comprehensive study. Through a systematic literature review on port competition and port competitiveness, some gaps and research directions are summarized and discussed, which may help researchers in the domain to develop new research ideas; third, while port supply chain integration has been well researched and

understood in the past two decades, the literature mainly focuses on the extent and outcome of port integration. This study contributes to enhance port competitiveness performance and coping strategies in the context of port supply chain integration.

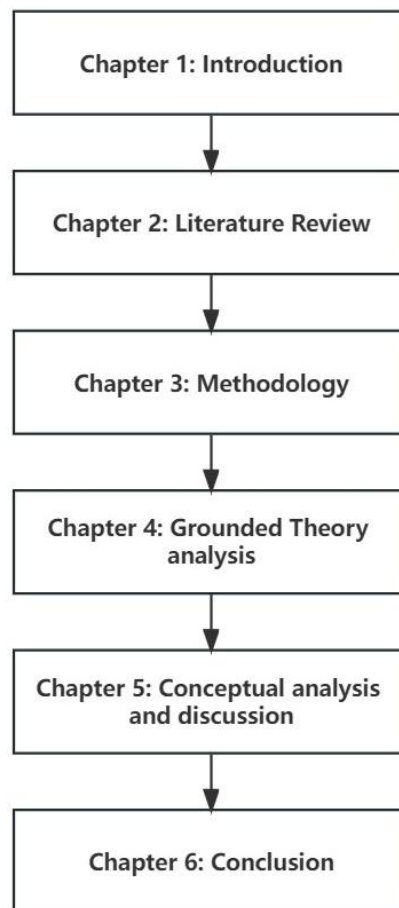
Finally, fueled by the lack of empirical studies concentrating specifically on port competitiveness, this study enriches the empirical study on Chinese port competitiveness through data collection and analysis of a reasonably comprehensive coverage of Chinese port clusters. Although there is some literature on Chinese port competition, these studies, in the form of data comparison, focus on Chinese port competition in a specific region. This study will provide a comprehensive study on Chinese port competitiveness. The depth of the empirical analysis provides rich data for the whole industry chain as well as the comprehensive perspective of stakeholders.

In practice, this research firstly proposes a comparison between the drivers of port competitiveness studied in the previous literature and the new drivers of port competitiveness under a new context and constantly changing competition environment. Second, the research compares the competitive advantages and disadvantages of different Chinese port clusters in their respective market environment. Third, it also provides some 'best practices' of leading global port operators (GPOs) in China, which could be referenced by other port operators to create their own strategies.

#### **1.4. Structure of this dissertation**

Following the Introduction, Chapter 2 provides a literature review of the research that has been done on the key concepts. Chapter 3 contains details of the methodology of the research. Chapter 4 provides the Grounded theory analysis of narratives from port stakeholders and experts on how they consider several issues affecting port competitiveness. Chapter 5 makes conceptual analysis on the main findings, discusses the findings against the reviewed

literature and develops a number of strategies. Finally, Chapter 6 provides a summary of the whole PhD project and its theoretical and practical contributions, acknowledges the limitations of the research and points to future research directions. Figure 1-2 presents the whole structure of this dissertation.



**Figure 1-2** Dissertation structure



## **Chapter 2. Literature review**

### **2.1. Introduction**

The purpose of this chapter is to provide a systematic analysis for the competitiveness of ports by understanding the impacts of operations and management, evaluating the performance of port competitiveness from both the methodological and empirical perspectives. This study differs from previous systematic literature reviews in the field in two respects. First of all, compared to previous studies which mainly focus on the influencing factors of competitiveness, this research aims to review the topic through a complete framework. It also covers port competitiveness from four research areas: port competition, port choice, evaluation and strategies. Second, it identifies potential research questions on the topic of port competitiveness and discusses future directions through a review of the literature.

The remainder of this chapter is organized as follows: Section 2.2 provides the context of relevant concepts on port competition and competitiveness, followed by the research methodology outlined in Section 2.3. Section 2.4 illustrates the key findings of the literature review, covering descriptive analysis and clustering of influencing factors. A discussion on future research directions is provided in Section 2.5, and finally, conclusions are drawn on the contributions and limitations in Section 2.6.

### **2.2. Existing literature analysis**

Based on the existing literature, this section briefly reviews the conceptual context of port competition and competitiveness.

#### **2.2.1. Port studies**

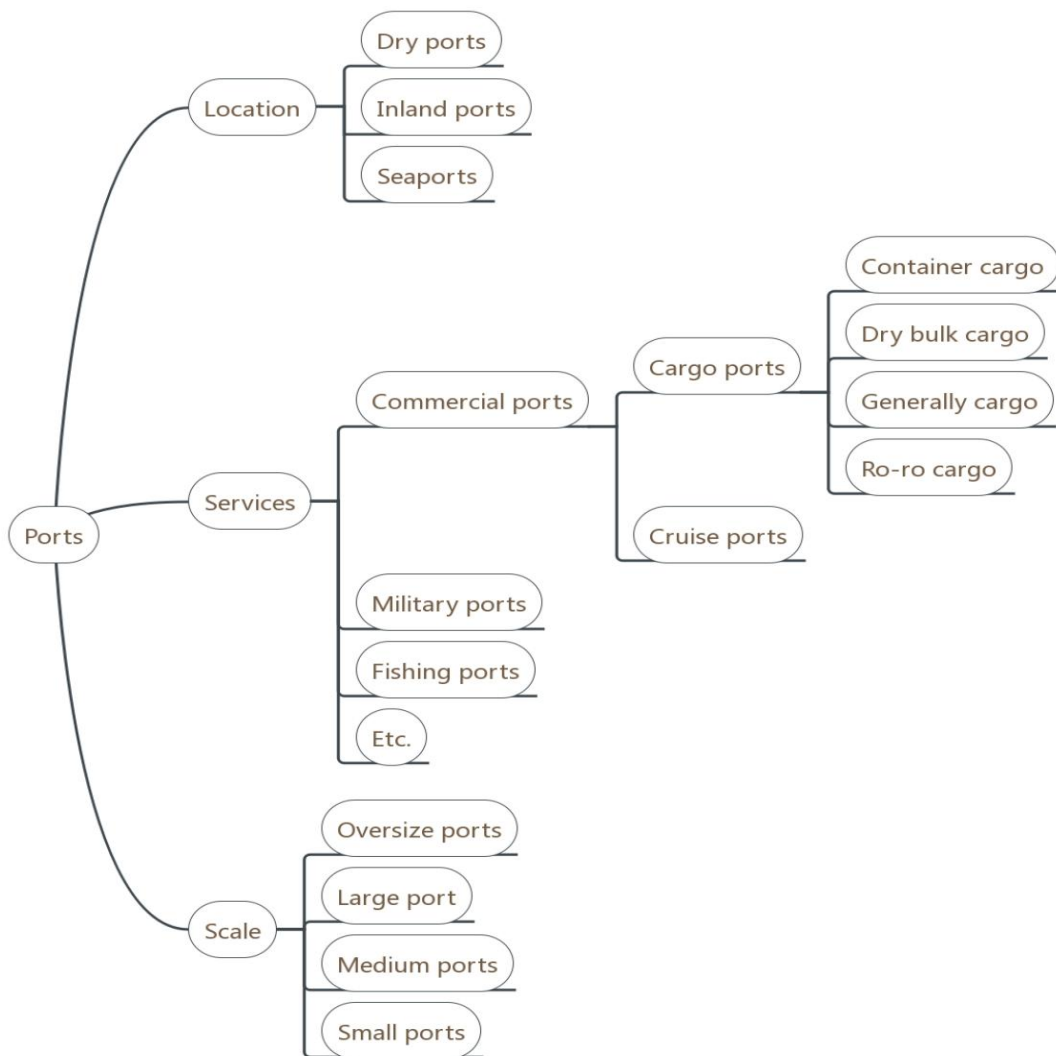
Ports were defined by Stopford (1997, p.29) as " a geographical area where ships are brought alongside land to load and discharge cargo - usually a sheltered deep-water area such as a bay of river mouth." Traditionally, ports are regarded as public goods, which can only be provided

by the government. With the development of technology and change of environment, the operational facilities of ports have gradually become the field of private sector investment and operation. Commercial and shipping developments have left natural ports unable to meet the growing demand for passenger and cargo traffic, followed by continued construction of port infrastructures such as wharfs, breakwaters, and loading and unloading equipment. The role of ports has been extended along with other related services including logistic, industrial, trade and financial activities, which are considered to add value as well as improve competitiveness (Bichou and Gray, 2005). The role of ports needs to be reassessed also because of the technological advances of the shipping industry, including automated ships, unmanned aircraft and blockchain applications, to name but a few. This is an opportunity for ports to improve efficiency, productivity and environmental performance by utilizing these applicable technologies that create added value.

The scale of ports can range from a small quay for the berthing of ships to complex and dynamic entities with many terminals and a variety of industry and service chains. An effective port classification may enable port managers to understand and analyze their potential relationships with other competing and non-competing ports worldwide or with roles outside the port sector. Bichou and Gray (2005) argued that a single taxonomy is not completely valid for port management because ports are no longer considered as separate entities or within isolated markets.

Traditionally, three interrelated dimensions can be fixed to classifying ports: location, service and scale. According to their spatial differences, ports are categorized as a dry ports, inland ports and seaports (Roso *et al.*, 2006). A dry port is an inland intermodal terminal directly connected by road or rail to a seaport and operating as a center for the transshipment of sea cargo to inland destinations; an inland port is a port on a navigable lake, river (fluvial port) or canal with access to a sea or ocean, which allows a ship to sail from the ocean inland to the

port to load or unload its cargo. Ports can be divided, according to the services they offer, into commercial ports, military ports and fishing ports, etc. A commercial port may be further categorized as a cruise port or a cargo port. Additionally, cruise ports are also known as "home port" or "port of call". The cargo port can be further categorized into container, dry bulk, general cargo, or ro-ro cargo. Ports can also be classified according to size. Depending on annual throughput tonnage, they can be divided into oversize ports (more than 30 million tons), large ports (10 to 30 million tons), medium ports (1 to 10 million tons), and small ports (less than 1 million tons). Figure 2-1 provides a detailed classification.



**Figure 2-1** Port categorization (Source: Author's own elaboration)

In order to adequately understand the evolution and trend of ports in recent years, it is necessary to identify several concepts closely related to the port industry.

*Hub port:* A hub port is an area of activity with the function of being a hub for goods transshipment and a gateway for economic and manufacturing sectors through the connection of the inland transport system and ship feeder system (Kavirathna *et al.*, 2018). The importance of transshipment operations and the competitive environment of the shipping industry complicate the decision-making criteria that make up the hub port (Soamiely *et al.*, 2004). First, the location of a port is a basic consideration when building and constituting a hub port. The port must be located in an area along the main shipping route, surrounded by many industrial zones. It must also be in an area with a deep-water level to accommodate mega-sized vessels. Second, the port charges, such as rates and the cost of handling services in the port area, must always be attractive, transparent and specific. Third, a hub port must be fully equipped with modern equipment and additional utility services to coordinate operations and subdivisions within the port (e.g., telecommunication services; ship repair service; provision of water, fuel, crew members and Customs support throughout operations).

*Feeder port:* There is often some distance between the hub port and the industrial hinterland, and it is impossible that all sources of goods are concentrated near the hub port. Therefore, some inland or small coastal ports in the industrial hinterland play the role of feeder port, and transport goods from the industrial hinterland to the hub port continuously through small barges or small and medium-sized sea vessels. Another reason for the existence of the feeder port is that due to the limitation of waterway conditions and cost, it is impossible for an international liner company to ship a 10,000-ton freighter to every small inland or coastal port.

*Port of call:* A port of call is an intermediate stop for a ship on its sailing itinerary. At these ports, cargo ships may take on supplies or fuel, as well as unloading and loading cargo, while cruise liners can let passengers get on or off the ship.

*Port cluster*: the concept of a port cluster derives from the cluster theory, described by Porter (2000) as a group of port enterprises with a relatively concentrated geographic location, competing in the same or related industries (vertical connection with suppliers and buyers; the horizontal connection of alliance, cooperation, resource sharing, etc.). Similarly, Haezendonck (2001) defined port clusters as inter-organizational networks among enterprises in different sectors holding industrial and/or commercial activities situated between water and land. These enterprises include shipping companies, pilotage and towing service enterprises, terminal operators, warehousing enterprises, logistics value-added companies, manufacturers, freight forwarders, shipping agents, distribution companies, porters, railway companies, ship owners, maritime service companies, etc. Port clusters in Chinese research, however, are generally understood as a combination of port regions formed by a group of port enterprises which are geographically adjacent or close to each other and have common or similar businesses and a common economic hinterland (Deng *et al.*, 2013).

*Smart port*: A smart port uses technologies, including the Internet of Things (IoT), artificial intelligence (AI) and blockchain, to be more efficient in handling goods (Liu *et al.*, 2021). Smart ports usually deploy cloud-based software as part of the process of greater automation to help generate the operating flow, which helps the port to work smoothly. At present, most of the world's ports have embedded technology, if not full leadership. However, thanks to global government initiatives and the exponential growth in maritime trade, the number of intelligent ports has gradually increased.

### **2.2.2. Port evolution: port role and ownership change**

Modern ports have undergone a process from general basic industries to multifunctional industries, from dependence on a single hinterland to dependence on common hinterlands around it, and from general urban communities to port-city economic integration regions (Jung, 2011). In the tide of world economic globalization and regional economic integration, the port business of the first generation evolved into a comprehensive service of the fourth

generation port (Verhoeven, 2010). The international transportation of goods has also entered a new era of comprehensive logistics. The trends of the shipping industry discussed above led to more complicated relationships between stakeholders from both the supply and demand sides. In the early 1990s, the United Nations Conference on Trade and Development (UNCTAD, 1992) proposed a three-port generation model to characterize successive processes of port development from the 1960s with a 20-year interval between each generation. After the UNCTAD Generation model, the fourth generation was subsequently supplemented as a technical note to reflect the new function of ports in terms of supply chains (UNCTAD, 1999). The main changes are summarized in Table 2.

**Table 2-1** The UNCTAD Generation Port Model

<b>Generation</b>	<b>Time period</b>	<b>Characters</b>
First generation	Before 1960s	Changing point of transport freight; loading/unloading and storage function; Independent activities and simple individual service
Second generation	After 1960s	Based on 1 with more industrial and commercial activities which added value to service; A closer connection with port users
Third generation	After 1980s	Based on 1 and 2 with the development of united port communication and logistics platform for the purpose of cargo/information distribution; A closer relationship between ports and municipalities
Fourth generation	Since 2000	Based on 1, 2 and 3 with the ports network among distant ports through global port operators

(Source: Author's own elaboration)

The first-generation ports were seen to exist in the pre-1960s, when they played a fundamental role in land and sea transport. Various companies within a port tended to carry out independent activities, with little cooperation between them. The second-generation ports developed from the 1960s to the 1980s, when industrial facilities were built and functions were extended. Ports during that period had a closer relationship with their transport and commercial partners. The third-generation ports, which began in the 1980s, were seen as a product of the rapid development of the shipping industry and global trade. At this stage, the port had become a combination of intermodal center and logistics platform, where modern equipment and information technology brought more specific services.

Beresford *et al.* (2004) criticized the model because it failed to frame a realistic or accurate concept because not all ports had experienced all the processes. Instead, they developed a WORKPORT model showing a clearer transition process allowing a decade's interval to reflect various factors that may change. The WORKPORT project funded by the European Commission aimed to critically examine the UNCTAD model and create a revised model combining the characteristics of the existing model with the development of the next decade. On the one hand, the WORKPORT model shows an increasing trend in private sector involvement, substitution of unitized for break-bulk cargoes, automation & mechanization, proliferation of methods, diversity of port-related activities, and environmental awareness. On the other hand, the model also suggests a decreasing number of workers and accident rates. Similarly, Verhoeven (2010) argued that the fourth generation of the UNCTAD model is limited to the spatial revolution, and developed a 3-D 'fourth generation' model for the multi-purpose gateway port concept. The 3-D model mainly shows shifts in terms of the operations of port activities, spatial networks in different ranges, and societal issues. The rising requirement for operational efficiency and service quality puts pressure on port management. Considering the complex requirements of port users and stakeholders, Flynn and Lee (2011)

and Flynn *et al.* (2011) proposed the concept of a fifth generation of ports concentrating on the next goal of being customer- and community-centric.

Among the changes taking place in ports, port privatization could be summarized as a major trend in port reform and a controversial approach to improve port efficiency and productivity. Since the early 1980s, an increasing number of governments have tended to sell the capital of ports to private companies. This has sparked an abundance of academic works that were carried out based on the forms, types, and empirical studies of port privatization. Considering three factors of port privatization form, namely land ownership, port regulatory functions and cargo handling, Baird (1995) came up with four main models of port administration (Table 2-2).

**Table 2-2** Four models of port administration

	<b>Port functions</b>		
<b>Port models</b>	<b>Port Regulatory Functions</b>	<b>Land ownership</b>	<b>Cargo handling</b>
1 Pure public	public	public	public
2 PUBLIC/private	public	public	private
3 PRIVATE/public	public	private	private
4 Pure private	private	private	private

(Source: Baird, 1995)

The first model, namely the purely public port, is no longer a realistic option for many ports. Currently the largest container port, Shanghai is, nevertheless, an example of a purely public port. Under the model of PUBLIC/private, the government still controls the regulatory functions and land ownership, while leaving port operations to private companies. This type



of port is similar to a landlord port, which is common in Europe and North America and also top container ports such as Rotterdam port, Antwerp port, and New York port. The land and utility of ports in the PRIVATE/public model are controlled by the private sector, with the government acting only as a regulator and policymaker for issues in maritime activities. Under such a model, the most famous example is the port of Hong Kong. Purely private ports are represented by many of the UK's top ports such as the ports of London, Liverpool and Southampton, in which all three rights of control are owned by the private sector.

Arguments for and against port privatization are both in existence. On the one hand, various reasons come from governmental consideration in support of port privatization. When considering the future construction and development of a port, the government attracts the interest of investors in port operations, enabling it to obtain a larger capital base for expansion (Slack and Frémont, 2005). The management approach of the private sector injects fresh blood to improve and upgrade the port because the pursuit of interest will always be motivated by investors. Also, selling ports creates intensified and open competition, which means only firms that offer the best value can survive.

On the other hand, opponents of privatization questioned whether port performance was improved by the approach of privatization. Thomas (1994) pointed out that previous sales of ports show that the revenue of a port mainly comes from the development of real estate rather than the operation of the port itself. Similarly, Baird (1995) attributed the profits of private ports to the rental of port land without port activities and argued that diversification played a more crucial role than privatization in port development. Besides, some arguments even suggest that the motivation of government is to reduce financial burdens rather than improving port efficiency (Cullinane and Song, 2002). Although there is an obvious trend today for the private sector to play an increasingly important role in the worldwide port industry, the role of the public sector remains significant (Baird, 2002).

### 2.2.3. Port competition

Port competition around the world is generally categorized into intra-port competition and inter-port competition (Yuen *et al.*, 2013). Intra-port competition is rivalry between different terminal operators within the same port. The port of Rotterdam is a typical example, where there are three different terminal owners competing with each other: Euromax Container Terminal, which is owned by Hong Kong's Hutchison ports, and handles about two-thirds of Rotterdam's cargo. The other two operators are DP World and AMP terminal (Barnard, 2014). Inter-port competition is believed to be more intensified and is classified into two categories according to the geographical distance between ports: one is neighboring ports competing for the same hinterland shipment or same transshipment. Such competition is exemplified by ports in the UK, with Southampton port competing against Liverpool port to serve the same hinterland shipments from England and transshipment from Ireland and Scotland (Song *et al.*, 2016). Another example is the competition between Shanghai and Ningbo ports, which serve the market in Eastern China.

Another category of inter-port competition is where ports located within different port range compete for cargo throughput and may also compete for the position of a hub port. The concept of port range was defined by Notteboom and Yap (2012) as a district with a number of ports that have similar geographical advantages and hence aim to attract the same customers. There are a number of studies focusing on this type of competition, many of which are between two hub ports or focus ports (Anderson *et al.*, 2008; Ishii *et al.*, 2013; Kavirathna, 2018). It is inevitable that the competitiveness of ports has been examined by empirical analysis in academia. The main challenge faced by many researchers, however, is that ports are dissimilar in their roles, natural conditions, ownership and functions; hence, the study of port competitiveness is based on the analysis of limited regional data (Cullinane *et al.*, 2005; Yeo *et al.*, 2008; Tovar *et al.*, 2015).

Due to the arrival density and service level of ships in ports being important conditions for attracting supplies of goods, competition between ports also means the attraction of ships. The main content of the competition between ports includes the following aspects: first, under the same conditions, there is competition for hinterland resources among the cross-ports. The competition for hinterland cargo flow can occur between ports in the same port cluster, between ports in different port clusters, or between different port enterprises in the same port cluster (Notteboom and Rodrigue, 2005). When the location of two ports is similar or the cost of land transportation is low, the shipper will choose the most advantageous port in terms of total transportation costs and transportation time. Accordingly, the competition between ports is mainly for goods that can be imported or exported through either port, with no significant difference in inland transport costs.

Second, the mainstream trend of container transport leads to many ports competing for transshipment cargos. Goods in transshipment generally pass through a port but are not intended for consumption in the city in which the port is located (Mangan *et al.*, 2008). Hence, the transit port does not depend on the distance between the port and the final consumption place of the goods, but largely on which port can provide the best service for the transit of goods and make the overall transportation cost of goods the lowest.

Third is competition on national investment. In some countries with public ownership of ports, most port investment comes from the government. For the needs of their own development, ports compete for national investment with their neighbouring ports (Hoshino, 2010). In this sense, current port competition is not a 'complete market competition', part of which is shown as 'policy competition'. The policy guidance of local government for port development is also an important aspect of port competitiveness.

#### **2.2.4. Port competitiveness**

The definition of port competitiveness is generally based on the function of ports in the context of maritime logistics and supply chain management. The definition of port competitiveness in research has different expressions according to different perspectives. From a comparative perspective, Chang and Talley (2019) defined port competitiveness as the degree to which one port competes with other ports. A similar definition from Heaver (1995) shows that port competitiveness refers to the ability of ports to gain comparative advantages in terms of products, infrastructure and services, etc. From the perspective of port performance, Huang *et al.* (2003) defined port competitiveness as the ability to create value in the port and its vicinity. An extended view of this definition was provided by Nalebuff *et al.* (1996), who defined port competitiveness as the reflection of a port's ability to grow resources, competencies and capabilities in a cooperative perspective. From the port choice perspective, a competitive port is understood as one that is more likely to be selected than other ports, thus promoting its market share growth (Merk, 2013). For the port industry, meeting customers' demands faster and better has become the main goal to enhance competitiveness. Ports with competitive advantages are able to improve customer satisfaction, and create profit through low-cost and high-quality services (Notteboom and Yap, 2012). By integrating their own factors and interacting with the external environment, some ports have comparative advantage over other ports by improving market share, generating value and maintaining sustainable development (Bichou and Gray, 2005). This study understands port competitiveness as a port's effective attraction to the source of goods and investment by virtue of a series of conditions conducive to production and operation, such as container turnover capacity, natural characteristics, policies and technology.

### **2.2.5. Existing literature review on port competitiveness**

Academic research on port competitiveness has been extensively conducted since the 1990s, a large proportion of articles having been published in recent years (Chang *et al.*, 2018). Pallis *et al.* (2010) presented a full overview and classification of existing port research based on a systematic review of the content of all existing academic journal publications on port economics, policy and management published between 1997 and 2008. Their review

identified the main features of the port research community by utilizing quantitative and qualitative bibliometric techniques. 74 articles were found on port competitiveness and competition, the highest number of articles in the reviewed seven sub-fields. Besides Pallis *et al.* (2010), only three other literature review papers on port competitiveness have been published.

Parola *et al.* (2017) conducted a systematic review of 170 papers published between 1983 and 2014 examining the factors influencing port competitiveness. In their review, five cutting-edge industry trends, namely economies of scale in shipping, governance changes, competition among ports in proximity, inter-firm networks, and green and sustainability challenges were discussed that might reduce traditional drivers' influence and change their relative salient hierarchical positions. Munim and Saeed (2019) identified key universities, journals and articles and their impact on port competitiveness research based on citation analysis of 267 research papers. As a consequence of mixed co-citation and thorough content analysis of the most quoted papers, seven main research streams together with a few sub-streams were disclosed in their review. Chang and Talley (2019) examined port competitiveness from the perspective of port efficiency and supply chains' perspectives by narratively reviewing 644 articles. In their paper, the paucity of literature on port competitiveness from the supply chain viewpoint was summarized and the need for a further literature review was highlighted. Table 2-4 offers a summary and comparison of the previous literature review papers on port competitiveness.

**Table 2-4** Existing literature review on port competitiveness

<b>Reference</b>	<b>Journal</b>	<b>Period covered by the study</b>	<b>Number of reviewed articles</b>	<b>Methodology</b>	<b>Scope of research</b>	<b>Focused aspect of port competitiveness</b>
Parola <i>et al.</i> (2017)	Transport reviews	1983-2014	170	Systematic literature review (SLR)	Drivers of port competitiveness	Economies of scale in shipping; governance changes; cooperation between ports in proximity; inter-firm networks; green and sustainability challenges
Munim and Saeed (2019)	Int. J. Shipping and Transport Logistics	1990-2015	267	Bibliometric citation analysis	Evolution of port competitiveness research	Port competition; port efficiency; institutional transformation; port pricing; port embeddedness; port choice; port cooperation
Chang and Talley (2019)	Transportation Journal	1994-2017	644	Narrative analysis	Methodological issues of the literature in investigating port competitiveness	Technical efficiency perspective and service-based supply chain perspective
Luo <i>et al.</i> (2022)	Transport policy	1970-2019	210	Comparative analysis	Relationships among port competition, cooperation and competitiveness	Key factors in port competitiveness; evaluation of port competitiveness; policies affecting port competitiveness
This review	Int. J. Logistics Research &	2000-2022	81	Systematic literature review	Existing trends; Evaluating factors;	Port competition; evaluation; port choice; strategies

	Application			(SLR)	Improving strategies	
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(Source: Author's own elaboration)

### **2.3. Review methodology**

A systematic literature review (SLR) method was performed to gather and review the relevant research addressing the topic of port competitiveness. SLR method is defined as “a specific methodology that locates existing studies, selects and evaluates contributions, analyses and synthesizes data, and reports the evidence in such a way that allows reasonably clear conclusions to be reached about what is and is not known” (Denyer and Tranfield, 2009, p.671). Fink (2013) regarded SLR in the traditional sense of a literature review locating, selecting and analyzing the existing body of published research conducted by experts and scholars. It is an effective method designed to establish and discuss research questions and to discover future areas of research.

This study adopted a four-stage SLR process according to the new principles proposed by Denyer and Tranfield (2009) in the domain of management. The process included: (1) Question formulation; (2) Locating studies; (3) Study selection and evaluation; (4) Analysis and synthesis. These steps aimed to minimize errors and avoid bias in selecting and analyzing the review.

#### **2.3.1. Question formulation**

Identifying problems and establishing concerns are basics in the initial stages of any research, including the preparation of a review (Light and Pillemar, 1984). In the question formulation stage, appropriate research questions were clearly formulated based on the CIMO (Context, Intervention, Mechanisms and Outcomes) method designed by Denyer and Tranfield (2009) for the establishment of research questions in the domain of business management. In this study, four critical aspects of the literature review were identified by the CIMO as: the importance of port competitiveness (C), approaches of the establishment of port competitiveness criteria (I), which factors and strategies make a port more competitive (M), and how would port and future port studies benefit from the factors and strategies researched (O). In the light of these topics, the research questions were formulated as follows:



RQ1: What existing research lies in the port competitiveness domain?

RQ2: What gaps in this research can be identified and what future directions proposed?

### **2.3.2. Locating studies**

After question formulation, as much literature as possible relevant to the specific research questions had to be located, selected and evaluated in some detail. An exhaustive search of existing papers was necessary in order to ensure that reviews were based on meaningful contributions and that the available evidence was fully considered (Denyer and Tranfield, 2009). Identifying studies generally involves three strategies to confirm the initial scope of research literature: search strings, search databases, and inclusion and exclusion criteria.

#### ***Search strings***

After clarifying the main topics of the study by CIMO and confirming the research questions to be answered, an initial set of keywords was proposed, based on: “port” and “competitiveness”. Considering different expressions for the same term, a set of synonyms was added to each search string for a more accurate and comprehensive search result (Wen *et al.*, 2001). The final structured keywords were: “port” OR “container port” OR “seaport”; “competitiveness” OR “competition advantage” OR “competitive advantage” OR “selection” OR “choice”.

#### ***Database searches***

Two databases were identified: Web of Science (WoS) and Scopus, both of which had wide coverage of the relevant research on port studies. To avoid missing any literature, these two search engines were conducted individually, and the output results summarized and de-duplicated to identify the related literature.

#### ***Inclusion and exclusion criteria***

Inclusion and exclusion criteria were designed mainly for the filtering process. In this research, only articles mainly covering port competitiveness strategies or assessment from business/management perspectives were included, while those concentrating on model optimization were excluded. Only peer-reviewed research articles published in academic journals were selected. In other words, the exclusion criteria involved books, book chapters, conference proceedings, review papers, dissertations, websites, seminars, workshops, technical reports and other ‘grey literature’ (Denyer and Tranfield, 2009). Due to the need for such literary contributions to be available and comprehensible for most researchers, only papers accessible in full-text English were included in the criteria. Also, the included literature was expected to be widely accepted and of high quality in the field of management and organizational studies, so research published in journals not listed in the ABS Academic Journal Quality Guide 2021 were excluded from the study. The ABS Guide was chosen because it was thought to be the most commonly adopted and recognized consistency metric in the academic world (Ghadge *et al.*, 2012). Additionally, the criteria only included research published since 2000 to ensure that discussion on port competitiveness was not out of date (Brooks *et al.*, 2011). Details of the inclusion and exclusion criteria are summarized in Table 2-3.

**Table 2-3** Inclusion and exclusion criteria

<b>Inclusion criteria</b>	<ul style="list-style-type: none"> <li>● Research mainly covering port competitiveness strategies or assessment</li> <li>● Research published in academic journals</li> <li>● Access to full-text</li> <li>● Peer-reviewed research articles</li> <li>● Research published in journals listed in ABS Academic Journal Quality Guide 2018</li> <li>● Research published since 2000</li> </ul>
<b>Exclusion criteria</b>	<ul style="list-style-type: none"> <li>● Research not covering port competitiveness topic or concentrating on model optimization</li> </ul>

- 
- Books, book chapters, conference proceedings, review papers, dissertations, websites, seminars, workshops, technical reports and other ‘grey literature’
  - Non-English
  - Non-ABS 2018 listed journal articles
  - Research published before 2000
- 

(Source: Author’s own elaboration)

### **2.3.3. Study selection and evaluation**

In the study selection stage, a set of explicit selection criteria were established based on the inclusion and exclusion criteria and, more importantly, whether each study actually answered any of the research questions (Tranfield *et al.*, 2003). Three filtering processes were conducted to ensure the reliability and accuracy of the literature list, including a keyword search in identified databases, abstract analysis and full paper analysis (Pittaway *et al.*, 2004).

#### ***Keyword Search in Identified Databases***

Initially, two database search engines were used individually to conduct the advanced search. The structured keywords defined in *Section 3.2.1* are connected by Boolean logic (‘AND’, ‘OR’ and ‘\*’) and input into identified search engines (Gu and Lago, 2009). The article titles, keywords and abstracts were the search target.

#### ***Article Quality and Relevance Assessment***

A comprehensive listing of articles was made, many of which did not adequately meet the inclusion criteria. By checking the title, language, published journal, published time and other information, articles not falling within the criteria were preliminarily filtered. A total of 427 articles screened from WoS database, and 79 articles from Scopus database were exported in the form of titles and abstracts. Since it was unlikely that all the papers’ contents adequately addressed the research questions just from their titles, further analysis of abstracts and full-text scanning were also considered at this stage (Garousi *et al.*, 2019). Analysis of abstracts

aimed to discover whether the research scope of articles covering port competitiveness was met; other irrelevant articles (267 in WoS and 14 in Scopus) were excluded. The remaining articles in the two databases were exported for duplicate article deletion and further full-text scanning. During the citation verification process, five articles were added to the database. Eventually, a total of 74 papers from the two databases were selected as final sample articles.

#### **2.3.4. Analysis and synthesis**

This section provides data analysis and synthesis based on the included studies. On the one hand, the purpose of data analysis is to find and refine the information scattered in individual articles into a description of the overall findings. On the other hand, the purpose of synthesis is to constitute evidence into a different arrangement. Different from mere description, synthesis generally develops knowledge which is not apparent from solely reviewing the individual articles (Denyer and Tranfield, 2009). In this review, sample papers were reviewed by two independent researchers using descriptive analysis, theme analysis and clustering analysis.

### **2.4. Findings**

#### **2.4.1. Descriptive analysis**

##### *General details*

In general, the number of identified papers relating to port competitiveness has been on the rise in the last two decades. The number of identified papers between 2004 and 2010 was relatively small, with no more than five papers published in any one year. However, the following three years witnessed a surge in the number of identified articles, with nine being published in 2011 and eight in 2013. This roughly confirms that, with the change of port roles and the increase in competition intensity, port competitiveness has attracted a gradual rise in academic interest (Notteboom and Yap, 2012). It is worth noting that the number of articles increased again over the next three years, especially in 2018, when the number of published articles peaked at 13. This suggests that the need for research on port competitiveness is

growing, and the review of related fields needs updating. The detailed number of identified articles by year is illustrated in Figure 2-2.

Journals of each publication in the sample have been counted and analyzed in order to have a better grasp of the quality of these articles. The sample included 81 papers published in a total of 25 journals, indicating that the issue of port competitiveness is of wide interest. Among these journals, *Maritime Policy and Management* had the most publications in the sample (18 papers), followed by the *International Journal of Shipping and Transport Logistics* (12 papers) and *Transportation Research Part A-Policy and Practice* (eight papers). Figure 2-3 illustrates the ranking of the number of articles published in each journal. In terms of journal quality, most of these papers were published in ABS 2 (38 papers) and ABS 1 (28 papers) journals, while only one paper was published in ABS 4, and seven papers in ABS 3.

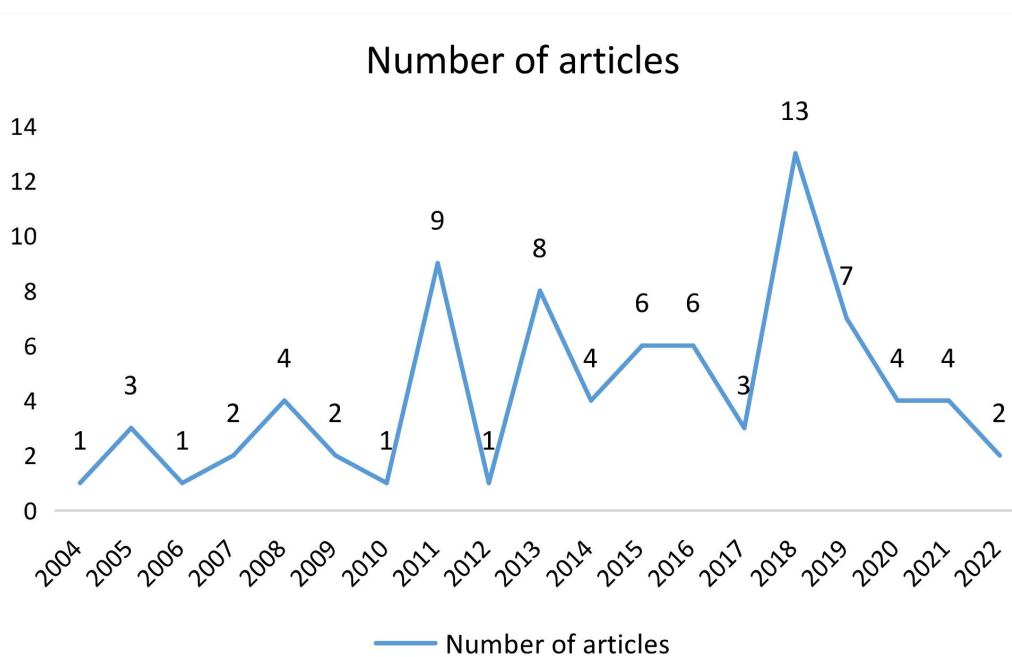
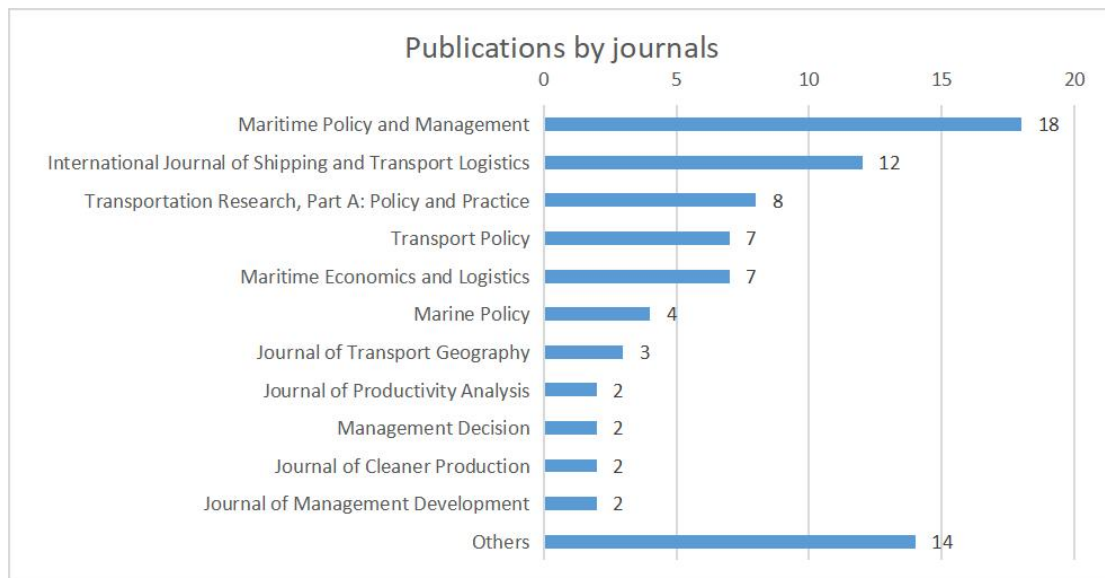


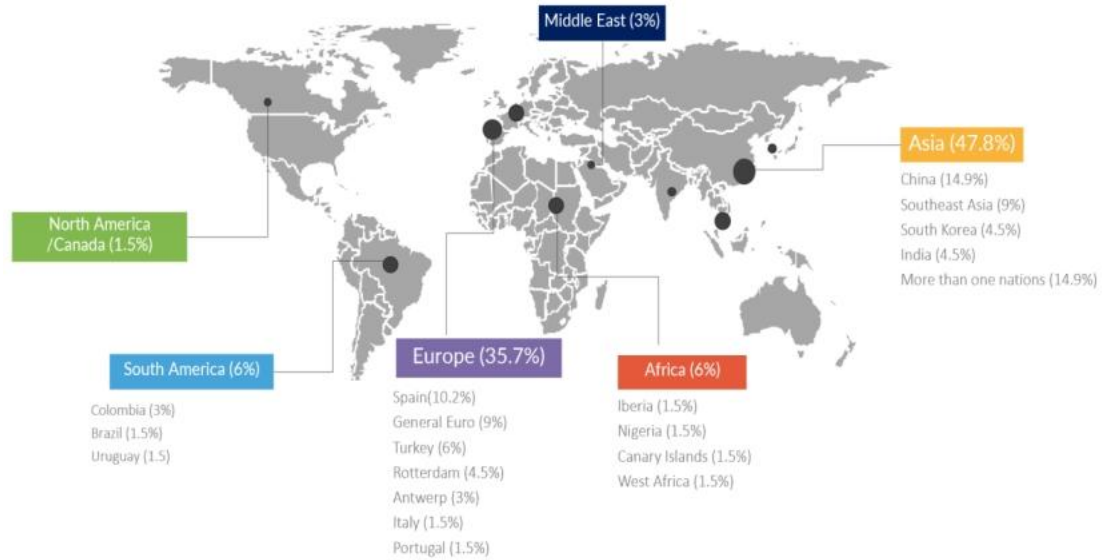
Figure 2-2 Distribution of the reviewed articles (Source: Author's own elaboration)

### ***Geographical scope***

Because each port develops and executes specific operation and management strategies based on geographical location, scale, ownership, policy, management and stakeholders, the research target of port competitiveness is often focused on a specific region (Dinwoodie *et al.*, 2012). Geographical location of ports in 46 empirical studies were hence analyzed in order to understand the distribution of academic concern. Ports in Asia (47.8%) and Europe (35.7%) were regions attracting the most research focus. In terms of nations, ports most frequently studied were in China (14.9%), followed by ports in Spain (10.2%) and in Turkey (6%). Figure 2-4 shows the detailed proportion of port geographical location in academic studies.



**Figure 2-3** Publications by journals (Source: Author's own elaboration)



**Figure 2-4** Distribution of the ports' geographical locations (Source: Author's own elaboration)

### ***Research methods and data***

The research methods of identified articles were classified based on their research type and method. All research papers were split into three major classifications: conceptual research, analytical research and empirical research. To be more specific, analytical research can be further divided into two main categories: mathematical modelling and simulation method to solve pre-set research questions and statistical analysis to deal with descriptive or secondary data. On the other hand, empirical research can be classified into survey and case study according to the scope of the research objects and the different methods of obtaining data. In this study, empirical research (62.2%) was found to be more widely used than analytical research (31%) and conceptual research (6.8%) in the sample articles, which shows that port competitiveness was more concerned with the aspect of practical problems. Case study (32.4%) and survey (29.8%) were two extensively used research methods compared to the other three. Table 2-5 illustrates the proportion of the three research types and five sub-categories of research methods.

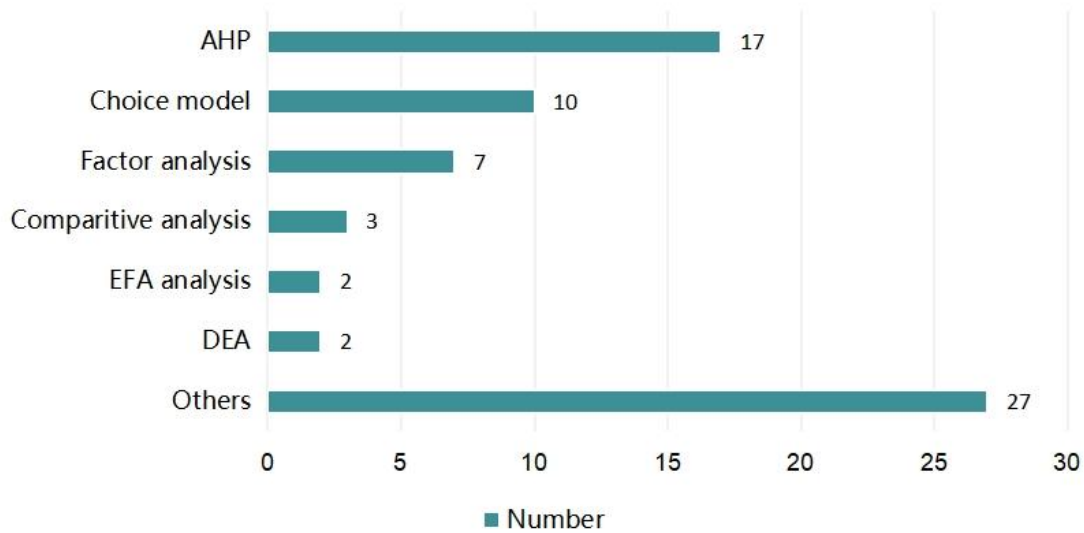
**Table 2-5** Number of articles by research method

<b>Type of research</b>	<b>Proportion</b>	<b>Method</b>	<b>Proportion</b>
Conceptual research	6.8%	Theoretical research	6.8%
Analytical research	31%	Mathematical modelling and Simulation	20.2%
		Statistical analysis	10.8%
Empirical research	62.2%	Survey	29.8%
		Case study	32.4%

(Source: Author's own elaboration)

How collected data in the sample articles were processed was also analyzed. Multiple Criteria Decision Making (MCDM) method and Analytic Hierarchy Process (AHP) were most extensively applied in the sample articles (17 articles) in order to weight the various detriments to port competitiveness. Discrete Choice Modeling (10 articles) and Factor Analysis (9 articles) were also chosen with some frequency. Figure 2-5 shows the detailed number of articles in the data processing techniques.



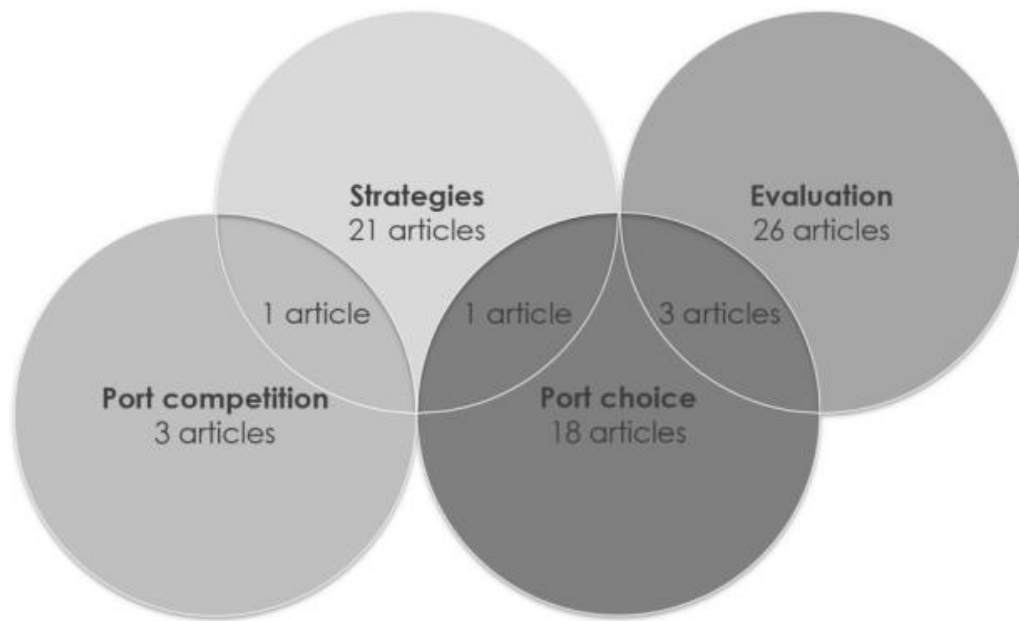


**Figure 2-5** Number of articles by data analysis techniques (Source: Author’s own elaboration)

#### 2.4.2. Thematic analysis

Studies on port competitiveness were previously categorized via various broad methods in academic research (Munim and Saeed, 2019). Through full-text analysis and comparison, this paper divided the research contents of identified articles into four aspects, and considered possible overlaps. Figure 2-6 shows the number of articles in different categories.

One of the most obvious categorizations of articles was to evaluate the competitiveness of ports through different factors (26 articles), followed by 21 articles focused on the strategies used to improve port competitiveness. On the other hand, 18 articles examined port competitiveness through the insight of port choice, and three articles aimed to analyze the competitiveness of ports by comparing the situation of two or more ports with competitive relations. It is worth mentioning that three articles evaluated port competitiveness from the perspective of port choice. Similarly, there was one article each examining the linking port of competitiveness to competition and port choice, respectively.



**Figure 2-6** Number of articles by the category of port competitiveness (Source: Author's own elaboration)

To get a better understanding of their similarities and differences, these four aspects were compared from varied angles. One of the most fundamental differences was how they understood port competitiveness during the research. As discussed in the previous section of the literature review, the concept of port competitiveness varied, the different aims and methods of these categories being mostly influenced to some degree by the definition of port competitiveness. The article on port choice, for example, describes port competitiveness as a port's attractiveness to its customers when the requisite services are offered. The aim of improving port competitiveness is to make a port preferred by port users to a large degree (Tongzon and Heng, 2005). In comparison, the concept of port competitiveness in the evaluation and strategy articles focuses on a port's capability in capital management and operation. In these two groups, the target of port competitiveness improvement was to optimize the utilization of available infrastructure to provide high quality services. The final category, papers on port competition, takes a somewhat unique mindset compared to port

competitiveness: it examines the competitiveness of individual ports when comparing two or more ports with competing relationships. The comparative advantage of ports is reflected in their competitiveness.

In terms of research perspectives on these themes, there were numerous port stakeholders who might influence port competitiveness, such as terminal operators, port administrators, shipping lines, port authorities, forwarders or cargo owners, policymakers, port employees, and academic experts, among many others (Yeo *et al.*, 2011). This paper identified the major research perspectives for each theme category. As significant port service customers, shipping lines offer an obvious research perspective on the theme of port choice. This category primarily collected data through the targeted investigation of related personnel in the shipping lines. Similarly, multiple articles on the evaluation theme gathered data from the viewpoint of shipping lines, some papers including relevant port experts as study participants to gain a more comprehensive understanding. In contrast, the article on strategy and port competition categories focused mostly on the perspective of port operators. The aim of strategy papers was to investigate how a port obtains practicable operation and management strategies by researching the effect of specific variables on port competitiveness. Likewise, port competition articles examined the comparative advantages of a single port as well as the fields that need to be strengthened when competing with peripheral ports.

Furthermore, two clusters were extracted from the three themes, which will be discussed in depth in the following subsection. The clustering includes the influencing factors of port competitiveness extracted from the port choice and evaluation articles as well as the improvement strategies extracted from the strategy theme articles. Table 2-6 shows the characteristics and differences between the four themes.

**Table 2-6** Identified themes from literature review

<b>Themes</b>	<b>Understanding of Port competitiveness</b>	<b>Perspectives</b>	<b>Extracted clustering</b>
<b>Port choice</b>	Attractiveness	Shipping lines	Influencing factors
<b>Evaluation</b>	Capability of resources operation and management	Shipping lines or port expert	
<b>Strategies</b>		Comparative advantages	Port operator
<b>Port competition</b>	Both influencing factors and improvement strategies		

(Source: Author's own elaboration)

### 2.4.3. Analysis of research perspective

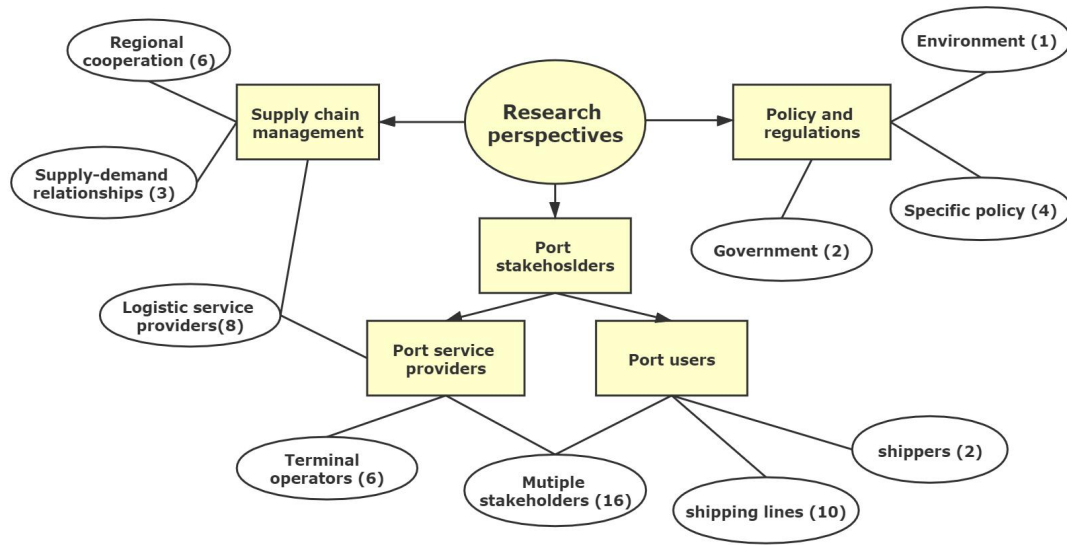
Besides research thematic analysis, another significant finding was that, due to the multifaceted definition of port competitiveness, researchers had varying perspectives in their studies. Research perspective refers to the point of view that researchers observe in any particular research situation from the interests of the stakeholder (Clarke and Davison, 2020). Research perspective is completely different from research object, and has a significant impact on the overall research design. Through analysis of the research perspective in the research sample of this review, a total of 58 articles studied port competitiveness from 10 different research perspectives (Figure 2-7).

The majority of articles were written from the perspective of port stakeholders, including port services providers and port users (42 articles). Under the category of port users, 16 articles studied port competitiveness from the perspective of multi-stakeholders. This classification generally developed from some or all of the following stakeholders: shipping companies,

shippers, freight forwarders, consignees, terminal operators, logistics companies, port managers, etc. Another 26 articles looked at research questions from a single stakeholder's perspective. Shipping lines, as the most direct decision makers of port selection, were most frequently used as a single research perspective in this category (10 articles).

Besides port stakeholders, the concept of supply chain management was argued to be a cutting-edge perspective category in the sample articles. Compared with the perspective of port stakeholders, which aims to examine or improve the overall performance of a port, the supply chain management perspective pays more attention to the whole supply chain service of goods passing through the port (Carbone and Martino, 2003). Although logistic services providers were categorized as port stakeholders, they were also considered an important link in the supply chain management perspective as many competitive strategies aim to improve logistics performance. Regional cooperation was considered an important supply chain management strategy in six articles, including cooperation between ports (dry port and seaport), ports and hinterland transport, or ports and inland services provider. It is worth noting that the perspective of supply-demand relationships in the supply chain was also included, with three articles focusing on the defense of shipping market share.

The third category was summarized as policy and regulation perspective, seven articles emphasizing the inextricable relationship between decision-making and policy when port-related research questions were considered. Three different rule-based perspectives were summarized in this group including the perspective of government (two articles), specific policy (four articles) and environment (one article).



**Figure 2-7** Number of articles by the category of port competitiveness (Source: Author’s own elaboration)

#### 2.4.4. Clustering analysis

##### *Clustering of port competitiveness factors*

As there were various factors pinpointed in the articles, even though the theme was evaluation of port competitiveness or port choice, the study extracted factors on the theme of port choice, evaluating articles to make frequency ranking and analyzing the impact of them. Table 2-7 reports the top 10 (out of 32) factors in descending order of frequency, including: cost, port facilities, operational efficiency, hinterland connectivity, location, services quality, customer issues, hinterland network, human resources and supply chain issues.

The most frequently studied port competitiveness factor was port cost (1), including direct payment to the port and the indirect cost of port berthing. For shippers, forwarders and shipping companies, economic factors are undoubtedly placed at the head of port choice criteria as they constitute an important part of the total cost of freight services (Merk, 2013).

For terminal operators, due to the increasingly fierce competitive environment and pressure from shipping lines, it is necessary to have competitive prices for survival and development (Notteboom and Rodrigue, 2005).

Beside port cost, port facilities (2) and operational efficiency (3) were two fundamental factors that were also extensively cited as affecting port competitiveness. Ports need to have the capability to provide appropriate facilities and use them efficiently to meet the needs of customers (Paixao and Marlow, 2003). The composition of port facilities includes, but is not limited to port infrastructure, superstructure, equipment and inland logistics platform. The impact of different port facilities on competitiveness varies according to different types of ports (Yuen *et al.*, 2012). Among them, research on the importance of infrastructure to port selection was the most extensive (Acosta *et al.*, 2011; Kadaifci *et al.*, 2018). Operational efficiency includes not only the productivity of cargo handling, but the whole wharf operation efficiency, such as warehousing of goods, ship turnover time and ship waiting time due to the port congestion. Therefore, high operational efficiency with adequate port facilities could attract shipping companies to berth.

Hinterland connectivity (4) and hinterland network (8) were two external factors most affecting port competitiveness. On the one hand, hinterland connectivity, including distance from inland hinterland and transport systems can affect the efficiency of shipping logistic services. The strong connection between port and hinterland can increase the cargo resources and improve their competitiveness compared with ports without close hinterlands (Wahyuni *et al.*, 2020). On the other hand, the network formed by port and hinterland is also an important factor in port competitiveness. The scale of cargo through the port is, to a certain extent, affected by some elements of the hinterland network, such as hinterland proximity and economic development of the hinterland.

Furthermore, the geographical location (5) of a port is a nautical factor that has been repeatedly evaluated for its importance to the competitiveness of the port. Ports with excellent geographical location may rely on inherent water area conditions (including sufficient water depth, stable water surface, and large area within ports) to meet the trend of the upsizing of container ships, or because of their strategic position in international trade (Ding *et al.*, 2019). The impact of these factors on the overall efficiency and cost of routes are taken into account by shipping companies when they make route plans.

It is worth noting that service quality (5) and customer-related issues (7) were two customer-focused determinants of port competitiveness attracting increased research attention. Service quality refers to ports' ability to provide both primary activities and other differentiated services that meet the various needs of customers. A number of authors recognized that port services can play an important role in improving port competitiveness (Kim, 2014; Lee *et al.*, 2011). At the same time, a series of customer-related issues, including overall experience and convenience of the service are argued to have a significant impact on maintaining port competitiveness (Caliskan and Esmer, 2019).

Finally, two management and strategies factors, namely human resources (9) and supply chain issues (10) were considered by some researchers to have an impact on port competitiveness (Lee *et al.*, 2011). Human resources management encompasses the management of port labour and the working environment, as well as the acquisition and retention of talent. Supply chain issues are described as the management and coordination of a port's service spatial network (Talley *et al.*, 2014). Despite the fact that many researchers emphasized that ports are an essential part of the supply chain system (Robinson 2002; Bichou and Bell, 2007; Tongzon *et al.*, 2009), enhancing port competitiveness from a supply chain perspective has rarely been theoretically or empirically studied (Chang and Talley, 2019). Since the relationship between these two variables and port competitiveness is



relatively indirect and challenging to measure, they did not rate highly, notwithstanding the fact that their effect on port competitiveness is obviously increasing.

To achieve a deeper understanding of the importance of influencing factors and explore the similarities and difference between them, all factors in this literature review were classified into four groups (Table 2-8): natural conditions, terminal offerings, management and strategies, and external environment factors. First, natural conditions represent the congenital conditions of a port, the influence of which is generally difficult to change. The literature review unveiled 10.2% of factors shaping port competitiveness as belonging to this group. Second, the terminal offerings group refers to relevant factors about what is provided to the customer. This group accounted for the largest proportion of influencing factors, including the top three influencing factors in the ranking of study frequency. Thirdly, the management and strategies group, accounting for 24.5% of factors, was closely related to the operation mode and management strategy of a port. This group consisted of the largest number of factors, many of which had the potential to improve port competitiveness. The final group was external environment factors, referring to the factors outside of port operation and management. Although the factors in this group were not cited frequently (23.1%), articles mentioning these factors were relatively new. Hence many of factors in this group, such as government support, legal framework and green policy have more room for research.

**Table 2-7 Drivers of port competitiveness**

Rank	Key factors	Explanation	Number	References
1	Cost	Tariff; Storage; Transportation;  Expenses incurred for berthing in a port	26	Paixao Casaca, Carvalho, and Oliveira (2013); Kevin Cullinane and Wang (2005); Balci, Cetin, and Esmer (2018); Yoon, Lee, and Dinwoodie (2015); Musso, Piccioni and Van de Voorde (2013); Yang, Wang, and Li (2016); Feng, Mangan, and Lalwani (2012); Tovar, Rubén, and Héctor (2015); Yeo, Roe, and Dinwoodie (2011); Hales <i>et al.</i> (2017); Rosa Pires da Cruz, Ferreira, and Garrido Azevedo(2013); Wang and Yeo (2019); Gohomene <i>et al.</i> (2016); Chang, Lee and Tongzon. (2008); Lau and Li (2015); Khalid and Al-Mamery (2019); Kim (2014); Kadaifci <i>et al.</i> (2019); Onut, Tuzkaya, and Torun (2011); Mueller, Wiegmans, and van Duin (2020); Veldman, Garcia-Alonso, and Vallejo-Pinto (2011); De Icaza, Parnell, and Pohl (2019); Veldman, Garcia-Alonso, and Vallejo-Pinto (2013); Vega, Cantillo, and Arellana (2019); Tongzon and Sawant (2007); Rezaei <i>et al.</i> (2018)
2	Port facilities	Infrastructure; Superstructures;  Enough equipment and back-line land	21	Paixao Casaca, Carvalho, and Oliveira (2013);Acosta, Daniel, and Ma (2011); Yoon, Lee, Dinwoodie (2015); Musso, Piccioni, and Van de Voorde (2013); Hamid (2018); Haezendonck, Van Den, Broeck (2011); Haezendonck and Langenus (2019); Yang and Chen (2016); Feng, Mangan, and Lalwani(2012); Hales <i>et al.</i> (2017); Cabral and Sousa Ramos (2014); Rosa Pires da Cruz, Ferreira, and Garrido Azevedo (2013); Ding <i>et al.</i> (2019); Gohomene <i>et al.</i> (2016); Lau and Li(2015); Khalid and Al-Mamery (2019); Kim(2014); Onwuegbuchunam (2013); Kadaifci <i>et al.</i> (2019); Onut, Tuzkaya, and Torun(2011); De Icaza, Parnell, and Pohl (2019)
3	Operational efficiency	Cargo handling productivity; ship turnaround time; ship waiting times	16	Paixao Casaca, Carvalho, and Oliveira (2013); Balci, Cetin, and Esmer (2018); Wahyuni, Alif, and Felix (2020); Musso and Van de Voorde (2013); Yang and Chen (2016); Feng, Mangan, and Lalwani (2012); Tovar, Rubén, and Héctor (2015); Brooks, Tony, and Athanasios (2011); Jim Wu and Ling (2008); Castillo-Manzano <i>et al.</i> (2009); Ding <i>et al.</i> (2019); Gohomene <i>et al.</i> (2016); Onwuegbuchunam (2013); Kadaifci <i>et al.</i> (2019); Onut, Tuzkaya, and Torun

				(2011); De Icaza, Parnell, and Pohl (2019)
<b>4</b>	<b>Hinterland connectivity</b>	Efficiency and inland transport such as rail and road transport	<b>15</b>	Haezendonck, Van Den, Broeck (2011); Haezendonck and Langenus (2019); Feng, Mangan, and Lalwani (2012); Tovar, Rubén, and Héctor (2015); Yeo, Roe, and Dinwoodie (2011); Brooks, Tony, and Athanasios (2011); Jim Wu and Ling (2008); Castillo-Manzano <i>et al.</i> (2009); Rosa Pires da Cruz, Ferreira, and Garrido Azevedo (2013); Ding <i>et al.</i> (2019); Wang and Yeo (2019); Khalid and Al-Mamery (2019); Mueller, Wiegmans, and van Duin (2020); Veldman, Garcia-Alonso, and VallejoPinto (2013); Yeo <i>et al.</i> (2014)
<b>5</b>	<b>Location</b>	Geographical location of container ports involves economy and geography to attract shipping companies to berth.	<b>14</b>	Paixao Casaca, Carvalho, and Oliveira (2013); Balci, Cetin, and Esmer (2018); Yoon, Lee, and Dinwoodie (2015); Tovar, Rubén, and Héctor (2015); Hales <i>et al.</i> (2017); Ren, Dong, and Sun (2018); Ding <i>et al.</i> (2019); Gohomene <i>et al.</i> (2016); Chang, Lee and Tongzon. (2008); Lau and Li (2015); Kim (2014); Kadaifci <i>et al.</i> (2019); Onut, Tuzkaya, and Torun (2011); De Icaza, Parnell, and Pohl (2019)
<b>6</b>	<b>Service quality</b>	The quality of cargo handling services and other differentiated services such as available storage and dock types	<b>14</b>	Paixao Casaca, Carvalho, and Oliveira (2013); Balci, Cetin, and Esmer (2018); Yoon, Lee, and Dinwoodie (2015); Haezendonck, Van Den, Broeck (2011); Haezendonck and Langenus (2019); Yeo, Roe, and Dinwoodie (2011); Hales <i>et al.</i> (2017); Jim Wu and Ling (2008); Ding <i>et al.</i> (2019); Lau and Li (2015); Kim (2014); Veldman, Garcia-Alonso, and Vallejo-Pinto (2011); Tongzon and Sawant (2007); Yeo <i>et al.</i> (2014)
<b>7</b>	<b>Customer issues</b>	Customer experience, convenience and other requirements	<b>12</b>	Yoon, Lee, and Dinwoodie (2015); Hamid (2018); Haezendonck, Van Den, Broeck (2011); Haezendonck and Langenus (2019); Brooks, Tony, and Athanasios (2011); Cabral and Sousa Ramos (2014); Rosa Pires da Cruz, Ferreira, and Garrido Azevedo (2013); Ding <i>et al.</i> (2019); Wang and Yeo (2019); Kim (2014); Vega, Cantillo, and Arellana (2019); Rezaei <i>et al.</i> (2018)

<b>8</b>	<b>Hinterland network</b>	Hinterland accessibility, hinterland economy	<b>12</b>	Haezendonck and Langenus (2019); Yoon, Lee, and Dinwoodie (2015); Feng, Mangan, and Lalwani (2012); Yeo, Roe, and Dinwoodie (2011); Brooks, Tony, and Athanasios (2011); Rosa Pires da Cruz, Ferreira, and Garrido Azevedo (2013); Ren, Dong, and Sun (2018); Ding <i>et al.</i> (2019); Wang and Yeo (2019); Chang, Lee and Tongzon. (2008); Onut, Tuzkaya, and Torun (2011); Yeo <i>et al.</i> (2014)
<b>9</b>	<b>Human resources</b>	Labor issues; working environment; reserves of talent	<b>9</b>	Paixao Casaca, Carvalho, and Oliveira (2013); Yoon, Lee, and Dinwoodie (2015); Hamid (2018); Haezendonck, Van Den, Broeck (2011); Haezendonck and Langenus (2019); Castillo-Manzano <i>et al.</i> (2009); Ding <i>et al.</i> (2019); Lau and Li (2015); De Icaza, Parnell, and Pohl (2019)
<b>10</b>	<b>Supply chain issues</b>	Supply chain management; port service chain	<b>9</b>	Paixao Casaca, Carvalho, and Oliveira (2013); Haezendonck, Van Den, Broeck (2011); Haezendonck and Langenus (2019); Feng, Mangan, and Lalwani (2012); Yeo, Roe, and Dinwoodie (2011); Lee <i>et al.</i> (2011); Onwuegbuchunam (2013); De Icaza, Parnell, and Pohl (2019); Yeo <i>et al.</i> (2014)
<p><b>Other drivers</b> (in decreasing order of citation number):</p> <p>(11-13) Reputation, Cargo volume, Economic environment, (14) Government support, (15-17) Information technology, Ocean services, Safety/security, (18) Legal framework, (19-21) (Cargo) Damage/loss performance, Port cooperation, Maritime connectivity, (22,23) Information sources, Feeder service, (24-32) Shipment size, Responsiveness of terminal, Innovation, Port risks, Institutional structure, Firm strategy, Flexibility criteria, Coast lines, Green policy.</p>				

(Source: Author's own elaboration)

**Table 2-8** Aspect of port competitiveness.

Aspect of port competitiveness	Nautical conditions (10.2%)	Terminal offerings (42.1%)	Management and strategies (24.5%)	External environment (23.1%)
<p><b>Port competitiveness factors: (numbers of articles)</b></p>	<p>Location (14)</p> <p>Cargo volume (7)</p> <p>Coast lines (1)</p>	<p>Cost (26)</p> <p>Infra and superstructures (21)</p> <p>Operational efficiency (16)</p> <p>Services quality (14)</p> <p>Customer issues (12)</p> <p>Shipment size (1)</p> <p>Responsiveness of terminal (1)</p>	<p>Human resources (9)</p> <p>Supply chain issues (9)</p> <p>Reputation (7)</p> <p>Information technology (5)</p> <p>Ocean services (5)</p> <p>safety/security (5)</p> <p>(Cargo) Damage/loss performance (3)</p> <p>Port cooperation (3)</p> <p>Information sources (2)</p> <p>Innovation (1)</p> <p>Port risks (1)</p> <p>Institutional structure (1)</p> <p>Firm strategy (1)</p> <p>Flexibility criteria (1)</p>	<p>Hinterland connectivity (15)</p> <p>Hinterland network (12)</p> <p>Economic environment (7)</p> <p>Government support (6)</p> <p>Legal framework (4)</p> <p>Maritime connectivity (3)</p> <p>Feeder service (2)</p> <p>Green policy (1)</p>

(Source: Author’s own elaboration)

*Clustering of port competitiveness strategies*

The frequency ranking of port competitiveness strategy is summarized based on the analysis of port strategy papers. Unlike the evaluation and port selection groups, each article can extract several influencing factors, whereas each strategy paper considers the influence of one variable on competitiveness as the research objective and derives the associated strategy. Predicting changes in significant competitive variables in markets and reacting to aspects signifying threats by establishing pre-emptive defense strategies is the most productive approach for defending market share (Jensen and Bergqvist, 2013). In this study, a total of ten strategic elements were extracted from 23 strategic articles, five of them being highlighted twice or more. Table 2-9 reports five main strategic factors in descending order of frequency, including: inland connectivity, cooperation or co-opetition, cost, facility or capacity, and value-added services. In light of these strategic factors, hinterland connectivity and port collaboration are two salient strategic factors that have been studied in the sample articles.

**Table 2-9** Strategic factors leading to port competitiveness

Rank	Strategic factors	Explanation	Potential strategies	Number	References
1	<b>Inland Connectivity</b>	Inland transport such as rail and road transport	Strengthen intermodal system and dry port connection	6	Wilmsmeier, Jason, and Bruce (2011); Jensen and Bergqvist (2013); Tovar, Rubén, and Héctor (2015); Garcia-Alonso, Monios, and Vallejo-Pinto (2019); Jeevan, Chen, and Cahoon (2019); Aksoy and Yalcin (2020);
2	<b>Cooperation/co-opetition</b>	A relationship that combines cooperation and competition between two or more ports	Cooperating with neighbouring seaports or dry ports; clear regional relationship	5	McLaughlin and Colm (2013); Lau and Li (2015); Notteboom <i>et al.</i> (2017); Hintjens (2018); Kramberger <i>et al.</i> (2018)

3	<b>Cost</b>	Tariff; Storage;  Transportation; Expenses incurred for berthing in a port	Cut cost, Cost refined management	3	Lam and Yap (2006); Vanden Bossche and Gujar (2010); Tongzon and Heng (2005)
4	<b>Facility/capacity</b>	Infrastructure;  Superstructures; Enough equipment and back-line land	Properly use facilities, improve capacity	2	Gaur, Pundir, and Sharma (2011); Martínez Pardo, Garcia-Alonso, and Orro (2018)
5	<b>Value-added services</b>	The quality of cargo handling services and other differentiated services such as available storage and dock types	Offer differentiated services, Identifying potential value-added services	2	De Martino and Morvillo (2008); Okorie, Tipi, and Hubbard (2016)
<p><b>Other strategies:</b></p> <p>Human capital; Environment concerns; Operation and information technology; Port privatization; Subsidy policies</p>					

(Source: Author's own elaboration)

The literature on the significant contribution of hinterland connectivity to port competitiveness is extensive (Lee *et al.*, 2014). Notteboom and Rodrigue (2005) argued that the emergence of the “Port regionalization” phase led to inland distribution becoming the most prominent part of port competition. Improving hinterland connectivity has become a strategy to enhance port competitiveness, since ports have been combined with wider and more discontinuous hinterlands. In other words, more importance has been attached to transport costs determined by hinterland connectivity under such situations (De Langen, 2007). Many attempts have been made to propose optimization possibilities for hinterland connectivity from different angles. From the perspective of transport systems, improving dry

port intermodal transport connections could arguably increase the level of port competitiveness in the struggle for hinterland (Aksoy; Wilmsmeier *et al.*, 2011). From the perspective of graph theory, the building of port transport networks is identified in many strategy articles for an understanding of the relationship between each pair of connected ports (Tovar *et al.*, 2015). Although most of these articles focus on specific port regions, the strategy is considered to be a reference for most hinterland dependent ports.

Another group of strategy-related articles focus on cooperative relationships between ports. In order to remain competitive in a rapidly changing world, ports have recognized that there should be increasing levels of cooperation between them rather than direct competition (McLaughlin and Colm, 2013). In fact, developing a mixed combination of cooperation and competition relationships between ports, known as “coopetition”, has long been argued a win-win strategy (Heaver *et al.*, 2001). However, the actual competition for hinterland and investors between many neighboring ports was intense. Based on such, a number of studies have been carried out on what kind of cooperation is appropriate in the actual situation of port cooperation (Lau and Li, 2015). In addition, there are studies focusing on cooperation between seaports and inland ports in order to improve the competitiveness of ports in the region as a whole (Hintjens, 2018; Kramberger *et al.*, 2018).

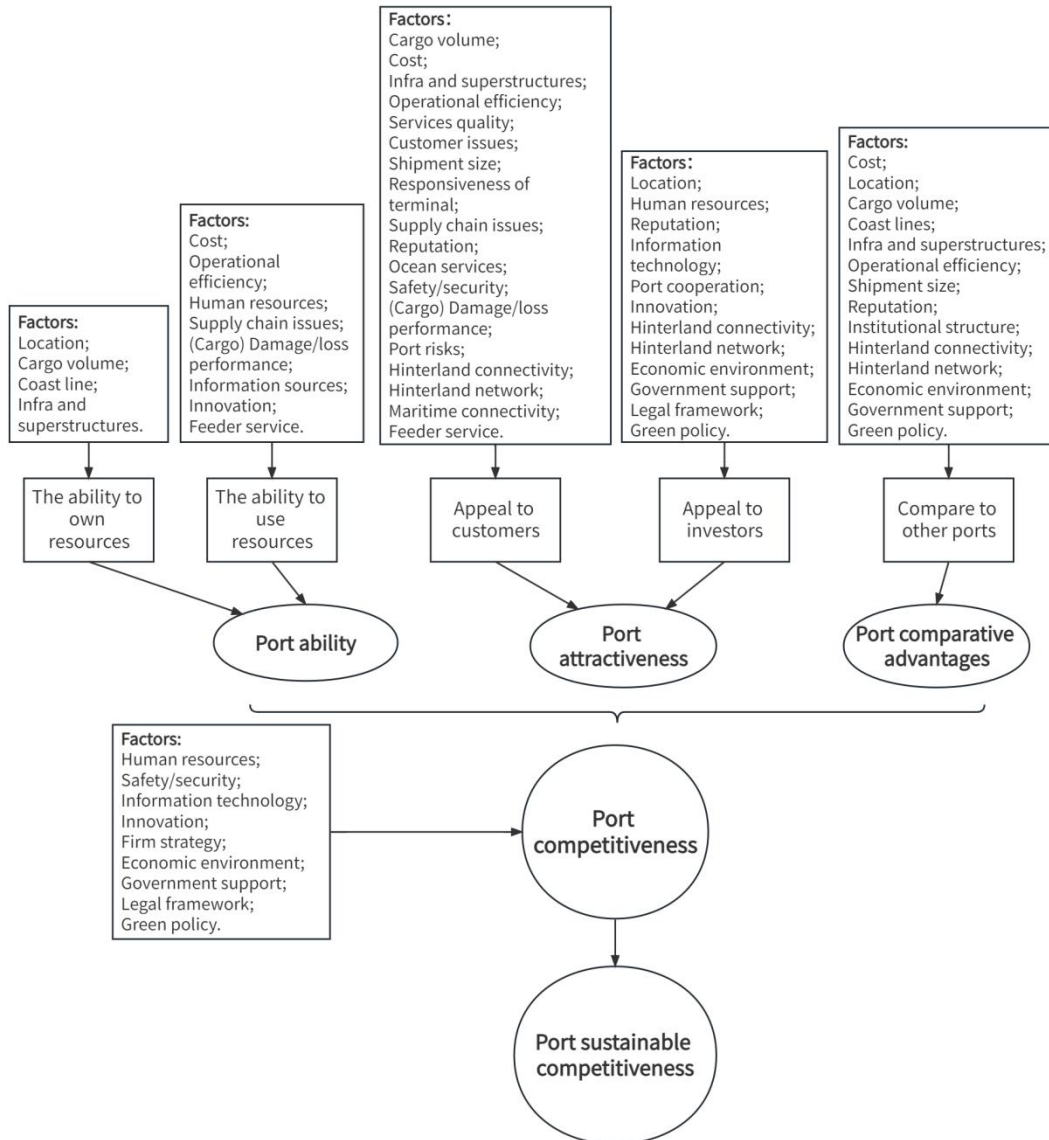
### ***Mechanism analysis***

With the aim of clarifying how port competitiveness is influenced by the different elements in the sample literature, the mechanisms behind port competitiveness and its correlation with certain factors are further analysed. The factors influencing port competitiveness and relevant strategic factors in the first two sections were extracted for a more in-depth analysis and synthesis based on their presentation in the literature. Figure 2-8 illustrates the ways in which different drivers or strategic factors may impact on port competitiveness.

Due to the multi-dimensional nature of port competition and the varying understandings of port competitiveness in the literature, port competitiveness can be divided into three



categories: port ability, port attractiveness and the comparative advantage of a port in the competition. Of these, port ability is divided into a port's ability to own resources, and the ability to use them, while port attractiveness is divided between appeal to customers and appeal to investors. The impact of factors on port competitiveness can occur in six distinct ways based on the objectives, five of which are presented at the top of the diagram as having an impact on each of the five sub-categories of port competitiveness. Some factors, such as cost and port location appear in multiple groups because they can affect port competitiveness in a variety of ways. It is apparent that the number of factors in the group that influence port customer attraction is remarkable. A special set of factors at the bottom of the figure were analyzed as having potential impact on a port's sustainable competitiveness, or a port's ability to maintain competitiveness at a high level over time.



**Figure 2-8** Mechanism of port competitiveness factors' influence (Source: Author's own elaboration)

## 2.5. Discussion

This research has utilized a systematic literature review to examine the structure and content of port competitiveness performance and strategies, providing detailed empirical data to support its findings. In this section, findings regarding the predefined research questions will be discussed in an attempt to provide answers.

*RQ1: What existing research lies in the port competitiveness domain?*

From overall analysis of the research in a number of published articles, it can be seen that research interest on port competitiveness appeared early. However, the number of publications in this field has increased significantly since the last decade, especially in the past three years. The reason for such an increase may be the trend of globalization and intensification of port competition. This result is consistent with the findings of Lagoudis *et al.* (2017), who reviewed and summarized the publications of topics related to competition from 1990 to 2011. The difference with this review is that the timescale (2000 to 2020) and quality (ABS journal) of the publications have been updated.

From a geographical point of view, a major trend in this field is that the research object is gradually tending to regional ports rather than specific ports. Since the author's affiliation strongly influenced the data of the empirical study, most previous studies on port competitiveness were quite localized (Pallis *et al.*, 2010). Among the samples in this review, a large proportion of the empirical studies took specific terminals, specific ports or specific national port systems as their research object, while other research dealt with regional ports in Asia or Europe. However, due to the high flexibility of inland transport and re-routing containers, port competition is being fought out beyond mere physical boundaries (Mueller *et al.*, 2020). As a result, the extent of international and regional collaboration has increased, and so has the relevant research interest.

In the review of the sample articles, the research on port competitiveness was divided into four themes, of which evaluation, port choice and strategies articles accounted for the main proportion. A steady stream of papers aimed at evaluating the factors that contribute to port competitiveness shows the significance and urgency of such an attempt (Miraj *et al.*, 2021). It is clear that key factors of port competitiveness are mainly identified through the analysis of this kind of literature, but there are still difficulties in analyzing the degree of influence of these factors, due to the multidimensional and multifaceted nature of the port (Parola *et al.*, 2017). Compared to evaluation articles, port choice articles have not been published

frequently until the last decade. Articles on this topic were primarily modeled from the customer's perspective, which suggests that understanding the demand of shipping companies has become a new trend in the study of port competitiveness due to the promotion of its strategy position. The research objectives of the strategy papers in the sample are relatively diverse, and it is expected that there will be more such papers in the future because of their guiding significance to practice.

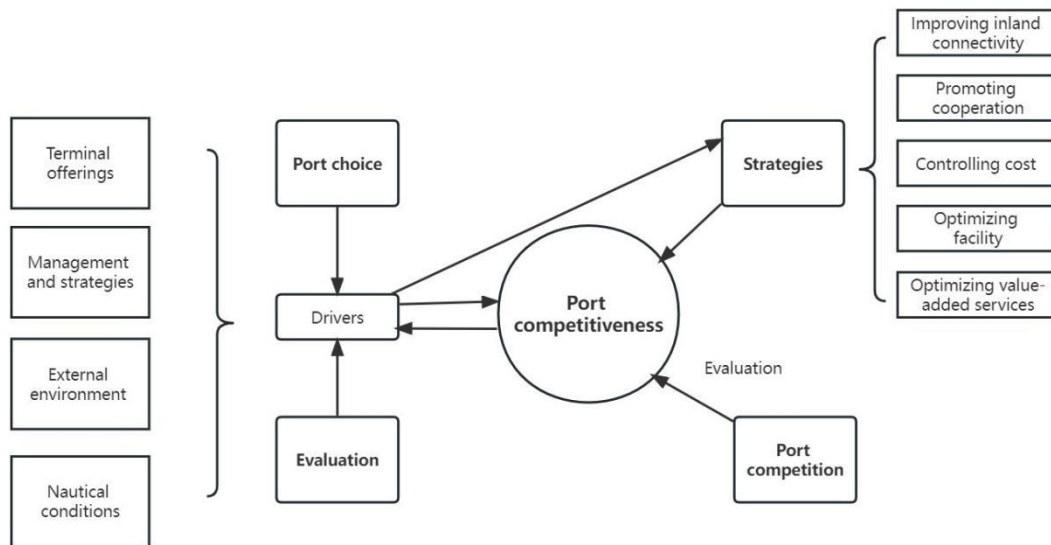
On the whole, quantitative methods for data collection and processing were more popular for port competitiveness evaluation papers when the relevant economic impact factors were considered. A large part of the research on port competitiveness was to carry out empirical research on specific ports or port areas based on the extraction and classification of the influencing factors in the existing literature. Identifying port competitiveness drivers from secondary data is reasonable as the existing literature is sufficient for the initial obtainment. However, the quality of collected data was essential due to the diversity of characteristics and competition environment of ports. Port stakeholders and relevant research scholars were interviewed or surveyed by the researchers in order to collect effective port competitiveness drivers and to measure these drivers.

Port competitiveness evaluation articles are generally designed to measure the influence of a number of factors on the comprehensive competitiveness of ports, or to evaluate and compare the competitive performance of a specific port or port cluster. The difficulty of port competitiveness evaluation lies in the wide diversity of variables whose impact on port competitiveness is difficult to quantify. Based on this, Multiple Criteria Decision Making (MCDM) approaches have been recognized by many researchers as appropriate when dealing with the uncertainty of factors (Yeo *et al.*, 2008). In particular, the AHP method, a fuzzy methodology to measure port competitiveness based on experts' judgement, was the most preferred data analysis technique in the sample articles. Additionally, there were also attempts to utilize Factor Analysis method to explore the relations between influencing factors in

different situations (Lee *et al.*, 2011). Use of this method is more inclined to make theoretical contributions by constructing the conceptual framework and a comparative analysis.

Description of the strategies for improving port competitiveness in the reviewed articles generally focused on a certain influencing factor and port competitiveness to study its relationship with port competitiveness. Synthesis of this kind of research shows that most of the opinions on improving competitiveness are related to the influencing factors in port evaluation, even though some of them are not extensively studied factors. Management strategies regarding strategic factors of inland connectivity and cooperation were extensively proposed in the sample articles. Given the limitations of regional port studies, these specific port strategies were sometimes inapplicable to other areas or types of ports. In this respect, geographical similarity became a prime consideration when practitioners borrowed from these strategies.

As a conclusion, a content framework for port competitiveness was constructed based on the literature sample and the results of data analysis. As depicted in Figure 2-9, the relationship between port competitiveness and its four sub-themes is different, based on their respective objectives. It is apparent that the strategies category seeks to develop a variety of strategies to increase a port's competitiveness, while the port competition group aims to reflect where the port's competitive advantages lie through a comparison of port competition relationships. The assessment and port choice categories are relatively complex, their relationship with port competitiveness being mainly linked through the drivers of port competitiveness. The drivers shown through analysis of the assessment articles not only directly influence port competitiveness, but also stimulate the generation of relevant strategies. The choice considerations of port customers are mainly determined by these drivers and the degree of port competition.



**Figure 2-9** Content framework of port competitiveness (Source: Author’s own elaboration)

*RQ2: What gaps in this research can be identified and what future directions proposed?*

Analysis of the research themes in the reviewed literature show that although articles evaluating port competitiveness are rich, few studies conducted comparative research on port competition by developing and evaluating the indicators of port competitiveness. This implies a lack of convincing evidence in the literature for decision makers on implementing port management and strategy formulation. Indeed, it is challenging to indicate and compare the actual competitiveness of ports due to the multifaceted nature of port competitiveness and the diversity and variability of port governance (Parola *et al.*, 2017). Future research is hence expected to empirically investigate performance of port competitiveness in a specific, highly competitive port or port region.

Prior research perspectives focused mainly on the port customers and decision makers of port activities, including terminal operators, port managers, shipping companies, port authorities, forwarders or cargo owners, policy makers, port employees and academic experts. The two most significant types of research were based on what criteria port customers use to choose

ports, and how port operators improve port service capabilities. However, it should be noted that the position of the port has been extended from maritime activity-related services to inland supply chain support (Bichou and Bell, 2007). There was a lack of literature on port competitiveness from the perspective of partners in the whole service supply chain, apart from a few conceptual framework articles (Lam and Yap, 2011; Talley *et al.*, 2014). In future research on port competitiveness strategy, there should be more possibilities to study the strategy of improving the efficiency and benefits of the whole supply chain from this perspective.

Although the literature on the influencing factors of port competitiveness is relatively abundant at present, the underlying mechanisms of how these factors affect port competitiveness, either positively or negatively, and whether they are interlinked, are not well represented in the sample literature. According to the results of the mechanistic analysis of port competitiveness factors, there are factors that do not necessarily have a direct impact on port competitiveness, but are potentially significant for the long-term maintenance of port competitiveness. Among these, there are still some cutting-edge factors, such as information technology and green policy, whose influence on port competitiveness seems not to have been fully reflected. However, as these factors are receiving increased attention from the port supply chain industry, their potential impact on port competitiveness is arguably likely to be huge in the future. In recent years, the investment of ports in technological innovation has increased significantly in order to comply with the development of science and technology, and high efficiency requirements. With the continuous expansion of ports and increased competition, these emerging technologies are being innovated, researched, and applied to shipping and supply chain activities. In particular, some emerging technologies, such as blockchain technology and terminal automation are still in the initial stages of application (Liu *et al.*, 2021). Therefore, it is worth further investigation on whether these emerging technologies can effectively increase port performance and advantages in competition, and whether massive investment in the early stages of technological innovations is worthwhile (Wang *et al.*, 2021).

Finally, the emergence of the concept of green ports and port sustainability has led to sustainability performance becoming a non-negligible indicator for assessing port competitiveness (Kim and Chiang, 2017). Building green ports and managing the balance between ports and the environment has become a new direction for ports because environmental damage can impede their development process. Although this factor was not frequently recognized in the rankings for this review, it is expected to be a growing influence on port competitiveness in the future. Environmental sustainability puts forward new requirements for port operation management and technological innovation (Yap and Lam, 2013). However, there is still uncertainty about how the restrictions of environmental policy and the implementation of green strategies might affect the competitiveness of ports. Additionally, the understanding of port sustainability in many ports lies in avoiding negative impacts on the environment, while neglecting the economic and social dimensions. The conceptual nexus between economic and social sustainability and port competitiveness is also likely to be discussed in future literature.

## **2.6. Conclusion**

Fueled by a lack of comprehensive literature reviews on the topic of port competitiveness, this chapter conducted a systematic literature review to understand the existing research characteristics of port competitiveness and provide potential insights for future study. To search, select and analyze the literature, this paper adopted a four-stage SLR process, consistent with the new protocol proposed by Denyer and Tranfield (2009) for producing a SLR especially in the domain of management.

In the first stage, four main research questions related to port competitiveness were established based on the acronym CIMO (Context, Intervention, Mechanisms and Outcomes) for the establishment of research questions in the domain of business management. In order to find relevant literature that answered the research questions, search terms, database and inclusion and exclusion criteria were identified during the second stage. The three sample



screening processes, namely abstract analysis, keyword analysis, and full context inspection led to the identification of 74 articles based on the inclusion and exclusion criteria. Obtained papers were further analyzed and synthesized from different angles depending on the information scattered in the text. Finally, research questions were discussed, based on the findings of existing evidence and clustering knowledge.

The value and contributions of this study can be concluded as follows. First, it contributes to the expansion of the overall knowledge on port competitiveness by analyzing and synthesizing the characteristics and evidence of relevant articles. Second, this study has provided a hierarchy of port competitiveness drivers based on their research frequency in the literature, categorizing them into four representative groups. This clustering could be a useful reference for port stakeholders, especially decision makers when implementing port operations and producing strategies. Thirdly, through the discussion of the research questions, the current research trends and existing research contents of port competitiveness were summarized to a certain extent. The outcome could enrich the understanding of port competitiveness evaluation and improving strategies, whether in academia or in practice. Finally, the gaps and challenges in this area were also investigated from different perspectives. The argument on some issues of study provides insight for the future research.

Methodologically, a systematic review is regarded as non-traditional methodology that explores specific research questions derived from policy or practical issues (Denyer and Tranfield, 2009). This paper comprehensively practiced the methodology of SLR to investigate the research questions on port competitiveness through a complete process: locating and selecting literature, evaluating contributions, analyzing and synthesizing data and discussing evidence. The application of a systematic review on port competitiveness implies that SLR can be a scientific approach to appraising research and exploring potential questions not only for researchers and experts, but also for practitioners and policymakers.

Despite the valuable contribution provided in this study, there are some inherent limitations that should be addressed in future research. First, in the literature locating and selecting process, the inclusion criteria were limited to ABS journals, due to the large amount of related literature and the pursuit of high quality articles. This might limit evidence of a comprehensive understanding in the domain of port competitiveness from the reviewed literature, because of the possibility of highly relevant articles appearing in other journals. Second, the locating and selecting stage might contain some subjective bias when a large number of articles are filtered. More scientific and rigorous criteria need to be developed in future literature review studies. Finally, ports vary greatly according to the type of goods and location. This paper focused on the competitiveness of ports generally, as not all the types of port studied were made clear in the articles. It would be challenging, but meaningful if future research could review port competitiveness literature according to port category.

## Chapter 3. Methodology

The methodology chapter is the foundation for the entire research endeavor. In this chapter, we embark on a comprehensive exploration of the methodological framework underpinning this study, delving into the philosophical underpinnings, research paradigms, and methods employed to derive meaningful insights into port competitiveness and sustainable growth. Commencing with the philosophical foundations in Section 3.1, we delve into the philosophy of management research and articulate the author's philosophical stance, which guides the study's direction. In Section 3.2, the GT Method (GT) takes center stage, where its origins, strengths, and practicality are dissected, alongside critical examinations. Transitioning into a Grounded Theory approach in Section 3.3, we set the context for data gathering and analysis. Sections 3.4 and 3.5 delve into the mechanics of data gathering, analysis and ensuring validity. Ethical considerations are expounded in Section 3.6. This methodological journey culminates in Section 3.7, epitomizing the comprehensive framework that underscores the study's pursuit of insights into port competitiveness and sustainability.

### 3.1. Research philosophy

#### 3.1.1. The philosophy of management research

According to Saunders *et al.* (2015, p.124), research philosophy is understood as “a system of beliefs and assumptions about the development of knowledge”. A researcher’s philosophical perspective is non-negligible because it has a profound impact on the research strategy we decide to pursue and the methods we plan to use (Saunders *et al.*, 2015). Distinguishing between the underlying philosophical assumptions guiding the research is also a meaningful way to further classify research methods (Myers, 2013).

Burrell and Morgan (1979) argued that assumptions are made at every stage of research. There are three types of assumptions that are well accepted in the social sciences: ontology, epistemology and axiology. To be specific, **Ontology** is associated with existential and

cognitive questions (Easterby-Smith *et al.*, 2012). The ontological perspective of management science is the essence of management practice (Yulianto, 2021). Ontology could decide how we see the domain of our research and influence our choice of research topic; **Epistemology** refers to the assumptions about knowledge and how it can be obtained (Becker and Niehaves, 2007). The most pertinent philosophical assumptions for management research are those that relate to the underlying epistemology that leads the study (Myers, 2013). Epistemological assumptions enable us to understand the grounds of the knowledge, especially when identifying the validity and scope of the obtained references (Myers, 2013); **Axiology** refers to the role of values during the research process. Collecting data in the form of interviews is a good example, indicating the value of researchers in interacting with participants (Saunders *et al.*, 2015).

### **3.1.2. The author' s philosophical position**

Various researchers have proposed different philosophical perspectives. For example, Guba and Lincoln (1994) delineated four fundamental qualitative research paradigms: positivism, postmodernism, critical theory and constructivism. Additionally, Orlikowski and Baroudi (1991) introduced categories aligned with distinct epistemological foundations, namely positivistic, interpretative and critical perspectives. In the present study, the choice of methodology is informed by the taxonomy presented by Saunders *et al.* (2015), which outlines five pivotal business and management philosophies: positivism, critical realism, interpretivism, postmodernism and pragmatism. Each of these philosophies is based on a unique set of epistemic assumptions. The rationale behind selecting Saunders' classification stems from its comprehensive nature and relevance within the field of business and management. This taxonomy offers a robust foundation for examining the diverse epistemic assumptions that underlie each philosophical outlook.

**Positivism** emphasizes scientific, objective knowledge which can anticipate future occurrences based upon observable, quantifiable facts and assertions (Donaldson, 2003, 2005).

The positivism of the social sciences, including management research, is generally recognized as the currently prevailing philosophy (Burrell and Morgan, 1979). **Critical realism** is connected with “explaining what we see and experience, in terms of the underlying structures of reality that shape the observable events” (Saunders *et al.*, 2015, p. 138). According to **Interpretivism**, “ humans are different from physical phenomena because they create meaning ” (Saunders *et al.*, 2015, p. 140). **Postmodernism**, on the one hand, emphasizes “the role of language and of power relations, seeking to question accepted ways of thinking and give voice to alternative marginalized views” (Saunders *et al.*, 2015, p. 141). **Pragmatism**, on the other hand, seeks practical information that may make actions effective, provide answers to issues, and guide future practices through diverse techniques and combinations thereof (Elkjaer and Simpson, 2011). Pragmatism believes that notions are only significant when they assist action (Kelemen and Rumens, 2008).

Based on the prior discussion and comparison, and in order to represent my research topic, the research philosophy used in this study is pragmatism. The main reason is that firstly, management research is generally rooted in real world practice. As a researcher, it is crucial to make contributions to the theory, but to give better guidance in practice, with the generalization of an author’s knowledge of the real world and real practice. Second, the research question comes firstly from practical considerations, confirmed here as: What issues are important to port competitiveness in Chinese port clusters and how can port competitiveness be improved by supply chain management strategies? The answer to this question is inseparable from the actual operational management mode and competitive environment of the port. Pragmatism employs a variety of approaches to collect trustworthy, well-founded, dependable and relevant evidence that advances the research (Kelemen and Rumens, 2008). Finally, the author believes that learning should help practice with ‘marine technology science’ as an undergraduate subject and ‘maritime policy and shipping management’ as a Master's study. All this stems from the need for practical applications and aims to contribute to the international trade or transportation services.

### **3.1.3. Quantitative and qualitative research paradigms**

Approaches to classify and differentiate research strategies are various, but the obvious and most common one is whether it is a qualitative or quantitative research method. Choy (2014) argued that finding out the advantages and disadvantages of qualitative and quantitative research methods is an appropriate way for researchers to choose research methods according to their own research topics. Therefore, this section will first explore the characteristics of these two types of methods.

Quantitative research can be defined as “research that explains phenomena according to numerical data which are analyzed by means of mathematically-based methods, especially statistics” (Yilmaz, 2013, p. 311). It was also broadly described by Creswell (1994) as a sort of empirical research of a social phenomenon or human problem, testing a theory of variables that are numerically measured and statistically analyzed to determine whether the theory explains or predicts the phenomenon of interest. There is a wide variety of examples of quantitative methods, including survey methods, laboratory experiments, simulation, mathematical modelling, statistical analysis and econometrics, etc.

In contrast, the definition of qualitative research is more controversial because many tend to define the term from a quantitative perspective rather than focus on its own characteristics (e.g. Gay and Airasian, 2000), or they only focus on forms and approaches used to collect and analyze data, neglecting other aspects of the research design (e.g. Strauss and Corbin, 1998). A special case is that of Yilmaz (2013), who summarized and defined it as “an emergent, inductive, interpretive and naturalistic approach to the study of people, cases, phenomena, social situations and processes in their natural settings in order to reveal in descriptive terms the meanings that people attach to their experiences of the world”. Examples of qualitative methods include Descriptive study, Case study, Field research, Ethnography, Participant observation, Grounded Theory and Action research, etc.

When comparing the characteristics of quantitative and qualitative research strategies, Crotty (1998) suggested four aspects, namely epistemology, theoretical perspectives, methodology, and methods that should be considered during the research. Also, Denzin and Lincoln (1994) proposed four fundamental issues of a research design: paradigm, object of study, research strategy and method of collecting and analyzing data. These factors are also worth taking into account when discussing the advantages and disadvantages of both quantitative and qualitative research.

One obvious advantage of the quantitative method is that the preparation time for data collection and analysis is relatively short. Taking the survey method as an example, it need not take long to focus on the organization of data collection, and the data collected can be quickly tabulated. In terms of data analysis, numerically oriented data obtained in this way help us to make objective comparison between groups, and allow us to determine the degree of agreement or disagreement between respondents (Yauch and Steudel, 2003). However, this advantage is limited in some cases. Many of the characteristics associated with people, such as identity, perceptions and beliefs are not properly understood by the numerical data (Dudwick *et al.*, 2006). Another weakness of this strategy is that the demand for sample size is usually large, while available resources are not always sufficient for large-scale studies, especially for groups of developing countries and interest parties.

The main advantage of the qualitative approach is that it can explore the underlying values, beliefs and assumptions in more depth. It emphasizes the significance of people or community as social capital, while information collected by asking different groups of people certain questions is more nuanced compared to data gained from a survey (Yauch and Steudel, 2003). However, this form of data collection is time-consuming, and easily ignores certain

important or detailed questions. Also the results of data can be difficult to examine objectively.

The design of the research method is usually the first step in any research. However, it is arbitrary to say that one method is superior to another, due to existing strengths and weaknesses among both types of research methodology. Hence the aim here was to identify the suitable research strategy for this PhD research topic by exploring a range of possible strategies and philosophical perspectives. In this research project, a qualitative approach was applied (GT method) for several reasons:

First, port competitiveness is a multi-dimensional concept that needs to be considered through different perspectives. Although some existing literature has evaluated port competitiveness by quantitative methods, a qualitative method is more appropriate when considering the perspective of supply chain management, because it is an activity related to people's beliefs. Second, due to the frequently changing environment of port competition and shipping markets, many cutting-edge trends or management strategies cannot be readily acquired from quantitative data. Analysis of qualitative data, by contrast, is closer to the real world. Finally, as this research aimed to build a new theory of port competitiveness, data obtained through interviews were more conducive to the construction of a comprehensive theoretical framework due to the real-time and practicability of respondents' answers.

### **3.2. Grounded Theory (GT) Method**

This research has adopted the Grounded Theory (GT) Method, a qualitative research approach that aims to systematically construct theories grounded in the data itself (Charmaz, 2014). Good GT is defined as a “set of well-developed concepts related through statements of relationship, which together constitute an integrated framework that can be used to explain or predict phenomena” (Strauss and Corbin, 1998, p. 22). This section highlights the origins and



strength of the GT and exhibits the best practices of the method. The rest of the sections in this chapter provide details on the origins and strengths of the method, the detailed practice in GT design, and some criticisms that need to be considered.

### **3.2.1. Origins and strengths of the GT**

In light of the shortcomings of earlier qualitative research approaches, sociologists Barney G. Glaser and Anselm L. Strauss developed GT in the 1960s (Glaser and Strauss, 1965). Their aim was to develop a methodology that enabled researchers to produce theories in a methodical manner from empirical data, without being constrained by pre-existing theoretical frameworks or preconceptions (Glaser, 1967). The original authors made several adjustments to their ground-breaking discoveries throughout the years, and additional GT approaches have evolved over time.

GT has undergone additional refinement and advancement by scholars and researchers across diverse fields since its inception. Glaser and Strauss made significant contributions to the methodology, with Glaser emphasizing the importance of theoretical sensitivity and the constant comparative method (Strauss and Corbin, 1998), and Strauss focusing on the systematic process of data collection and analysis (Locke, 2002). Subsequently, other scholars, including Kathy Charmaz (2014) and Adele E. Clarke (2015), made noteworthy advancements in the theoretical and methodological components of GT.

GT adopts an inductive methodology as opposed to conventional deductive techniques, where researchers begin by setting up hypotheses to examine. Induction in GT refers to “you start with individual cases, incidents or experiences and develop progressively more abstract conceptual categories to synthesize, to explain and to understand your data and to identify patterned relationships within it” (Charmaz, 1995, p. 28). The process permits the emergence of theories from the gathered data, thereby facilitating the discovery of novel insights, patterns, and relationships by the researchers (Hutchison *et al.*, 2010). GT aims at

constructing substantive theories that provide a comprehensive and context-specific explanation of the social processes and phenomena that are being investigated.

A number of traits associated with GT were identified by Glaser and Strauss (1967). These traits include the simultaneous engagement in gathering and analyzing data, the formation of analytic codes and categories, and the production of comparisons between codes, ideas and categories. GT seeks to understand the underlying meanings and actions of individuals, groups, or organizations, and how they interact within their social environments (Khan, 2014). It emphasizes the exploration of social phenomena from the perspectives of the people involved, providing a deeper understanding of their experiences, behaviors and interactions. By adopting a bottom-up approach, GT offers a unique opportunity to capture the complexity and nuances of social phenomena, going beyond surface-level observations, and uncovering deeper insights (Frost, 2021).

Researchers using GT aim to develop theories that are grounded in the data collected, allowing the theories to be closely aligned with participants' experiences and the context in which they occur (Charmaz, 2008). GT recognizes the dynamic nature of social phenomena and acknowledges that theories may evolve and change as new data are collected and analyzed (Charmaz, 2014). It provides a flexible framework that allows researchers to explore and refine theories iteratively throughout the research process.

Through the application of GT, researchers can generate knowledge that is not only relevant within the specific research context, but also has the potential to contribute to broader theoretical understandings (Urquhart, 2010). The theories generated through GT research are often context-specific and offer practical implications for real-world settings. GT has been widely used across various disciplines, including sociology, psychology, nursing, business and education, among others, making it a versatile and valuable research methodology (Glaser and Strauss, 2017).

Researchers in the field of logistics and supply chain management are beginning to recognize the merits of GT as a research tool (Davis-Sramek *et al.*, 2007). Despite the fact that academia has given logistics and supply chain a great deal of recognition, the field's currently accepted theories remain insufficient, the majority being derived from related but distinct fields. Due to the absence of an empirical foundation for logistics and supply chain management, several of these theories may not be appropriate or sufficient for explaining logistics and supply chain facts (Manuj and Pohlen, 2012).

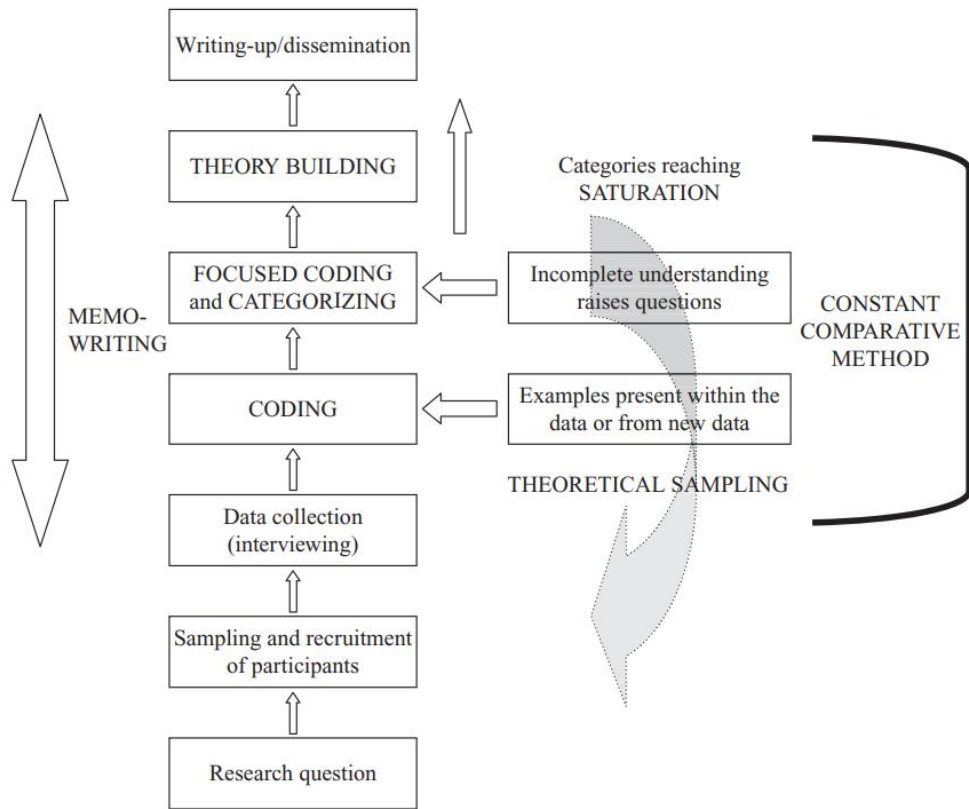
Applications of GT are motivated by the need for theory to create fresh viewpoints, provide insightful knowledge about how people behave and conduct business, and explain novel and well-researched complicated social phenomena (Wiesche *et al.*, 2017). Thus, the research applied this method to bridge the gap in the domain of maritime logistics and supply chain management. By employing GT, the study aims to unearth underlying patterns, relational dynamics and conceptual frameworks that characterize the complexities of logistics and supply chain practices.

### **3.2.2. GT in practice**

The absence of a consistent framework and frequent failure to clearly articulate their research procedure and technique are two major criticisms and challenges of supply chain management (SCM) studies that apply inductive methodologies (Stuart *et al.*, 2002; Seuring, 2008). A review of GT in logistics and supply chain management found that the majority of papers failed to provide sufficient detail about the process of analysis, instead only mentioning that open and selective coding criteria were adhered to, and that frequent comparative analysis was used (Manuj and Pohlen, 2012). While positivist, theory-driven writing standards are meant to boost researcher confidence in analysis by indicating a sufficiently "scientific" and trustworthy approach (Pratt, 2008), grounded theorists in SCM research must oppose these practices (Kaufmann and Denk, 2011). Because of this, there is a pressing need to raise the level of rigor in SCM research by developing an interpretative framework for the presentation of GT investigations.

Kaufmann and Denk (2011) suggested that SCM researchers demand the necessary transparency from GT studies regarding the rationale for the research and the theory construction process. They therefore recommended an editorial format based on the five stages of an inductive research process outlined by Stuart *et al.* (2002). In the first phase, identifying the research subjects, academics provide questions that are explicitly geared at expanding existing theoretical frameworks. Second, researchers who use an interpretative approach build instruments to demonstrate that their chosen technique is acceptable and to generate a study design that aids in answering the research questions. In the third phase, data collection, scientists make sure their samples are relevant to the topic they are studying. Theoretical insights originate from researchers' interpretations of qualitative data in the fourth step, data analysis. Dissemination, the fifth and final step, is when researchers try to persuade others that their inductive reasoning is sound. The last step in disseminating GT studies should, therefore, include a comprehensive account of all preceding steps (Corbin and Strauss, 2008).

A more detailed step-by-step overview of GT process was provided by Tweed and Charmaz (2011). The formation of theory is accomplished by combining labels into categories, and then combining those categories into ideas. This process is assisted by the usage of memos to record the analytical process, which helps to keep track of what is being analyzed. Analysis is a non-linear process that begins with the first piece of data collected and progresses through theoretical sampling (samples chosen to explore aspects of the emerging theory) until theoretical saturation is reached, at which point any additional data merely confirm the categories and concepts already achieved (Tweed and Charmaz, 2011). Figure 3-1 shows the visual representation of the process of developing a GT.



**Figure 3-1** Visual representation of a GT (Source: Tweed and Charmaz, 2011).

### 3.2.3. The criticisms of GT

As with any research method, GT has controversies that must be discussed and handled with care. The interpretative character of GT is its most significant limitation. Interpretive results are constantly at risk of being invalidated by the presence of potential bias, and as a result, such conclusions are open to accusations of researcher bias being made against the researchers (Bryant, 2017).

Participants have a greater degree of influence over the process than they do when using quantitative approaches, since interviews are often open-ended. Because of this openness, the researcher must exercise extreme caution throughout the interview process. Otherwise, the participants may steer the conversation in any way they see fit. The capacity of the researchers to understand the data is likewise subject to certain constraints. It is possible that a

significant issue will go unnoticed if the researchers doing the study do not have theoretical sensitivity on the topic (Glaser, 1978).

Another challenge is the fact that GT is more concerned with theorizing than it is with testing hypotheses. It is not possible for the GT researcher to assert that theoretical notions and linkages have been validated on a wide scale. In order to make such a generalization, empirical research must be conducted using methods that are distinct from GT. The results of a GT research cannot readily be generalized outside the settings and businesses that were the focus of the investigation because of the relatively limited sample size and the selection of participants that are often found in a GT study.

### **3.3. Data Gathering**

#### **3.3.1. Research subject setting**

The selection of an area of inquiry by the researcher and a suitable site for study is the initial stage. The sample being studied in GT needs views from staff members in a variety of organizations operating at a variety of management levels. The purpose of this kind of sampling is to collect information from a variety of sources in order to better understand the phenomenon that is being investigated.

This research employs both convenient and theoretical sampling to investigate how different stakeholders understand port competitiveness in the maritime services supply chain. The competition environment of ports is essential to research the subject selection. In this research, data collection sites were selected from the three main port clusters in China, namely the Bohai rim port clustering, the Yangtze River Delta ports cluster and Pearl River Delta ports cluster. The main reason is that ports in these regions have abundant transportation resources as well as cargo markets. Chinese ports represent some of the busiest and most dynamic port operations worldwide, making them ideal candidates for investigating port competitiveness. The sheer volume of cargo handled by Chinese ports, combined with their diverse range of services and infrastructure, provides a rich and varied context for studying competitive

dynamics in the maritime industry. At the same time, the competition environments in these clusters are distinct due to the different developmental conditions of regional cities and port roles in the region. Therefore, stakeholder research subjects are representative because they cover major Chinese ports, which enables understanding of the current competition modes of the majority of Chinese ports. By focusing on Chinese ports, this study aims to provide insights into the evolving landscape of port competitiveness in one of the world's most significant maritime regions.

### **3.3.2. Semi-structured interview**

The most frequently employed data sources in qualitative data collection are divided into three categories: interviews, observations (such as visits to the site, shadowing and participation at organizational meetings) and archival sources (such as historical documents, annual reports and newsletters) (Langley and Abdallah, 2011). This PhD research decided to use semi-structured interview method as the primary data source. The interview method is a very basic and important data gathering technique in almost all qualitative research (positivist, interpretive, or critical) (Myers, 2013). Interviews are considered an efficient way to collect rich empirical data, especially when the phenomenon of interest is highly contingent and infrequent (Eisenhardt and Graebner, 2007). Semi-structured interviews sit somewhere in between structured and unstructured interviews, using some pre-formulated questions, but there is no strict adherence to them (Myers, 2013). To reduce respondent bias, multiple interviewees with knowledge of the port or shipping management were interviewed from multiple perspectives, including port operators and managers, managers of shipping companies, owners of cargo, shipping agents, cargo agents, government agencies, port researchers and other third parties dealing with ports.

When carrying out quantitative research, a standardized guide is used for each survey or questionnaire in order to enable comparison of the replies. When doing research based on GT, it is beneficial to go into the field with an interview guide that has been generated from

previous investigations or experience; nevertheless, this guide must eventually make way for questions that are based on the emergent ideas. Questions should always be open-ended so that the person being interviewed has the opportunity to provide information that is personally significant to them. According to Strauss and Corbin (1998), the interview procedure ought to provide the researcher with the opportunity to investigate topics as they come up.

An interview protocol was customized for different parties and updated after each interview:

### ***Interview protocol***

#### General port competitiveness

1. What research have you done in the port domain?
2. What factors, in your opinion, can evaluate port competitiveness?
3. How do you think ports compete with each other in the current shipping environment?
4. How do you think emerging technologies affect port competitiveness?
5. From your understanding of the practice, which factors are competitiveness indicators concerning the port administrator?
6. What can the port operator/manager do to improve the competitiveness of the port? What factors will influence a manager's strategy?

#### Integration of port supply chain

7. What role did ports play in the development of history? How has their role changed?
8. Has the port function changed from a simple berthing and loading area to a comprehensive logistics park?
9. Do you agree that competition between ports has gradually evolved into the competition between port supply chains? How do you understand that?
10. Do you think the traditional assessment of port competitiveness will be changed by the



extension of port functions? Why is that?

11. Will the port strategy and management mode be adjusted accordingly in the future? Can you give me some examples?

#### Port competition and cooperation

12. Does the relationship between ports in the regional port group tend to be competition or cooperation? Or both competition and cooperation?
13. In what ways does domestic port cooperation usually take place? Is there room for enhancement in the future?
14. Will cooperation between domestic ports be influenced by regional divisions and local policies?
15. To improve the competitiveness of ports, is it necessary to seek more inter-port cooperation?

#### Port sustainability

16. What is your understanding of port sustainability?
17. Can domestic ports meet the construction and development requirements of green ports?
18. Will the development strategy of green ports bring more pressure or opportunities to port operations?
19. What factors will affect the sustainable development of the port? (policy and regulation/technology/company strategy)
20. Can the sustainability of ports become one of the evaluation indicators of port competitiveness at present/in the future? Why is that?

#### Comparison between China and the international ports

21. What is the current competitive environment of domestic ports?
22. What are the main reasons for the rapid development of China's ports in recent years?

23. What are the advantages and disadvantages of the operation and management mode of domestic ports compared with that of other countries?
24. What are the advantages and disadvantages of China's ports compared with those of other countries and regions when competing for market share? (Geographical location/national policy perspective)
25. What opportunities and challenges may China's ports face in the process of development?
26. Have you ever known about foreign ports before? What aspects are worthy of reference and reference of our country's ports?

Finally

27. What other frontier trends are worthy of attention in port competition?
28. Can you introduce research or management personnel of relevant ports for further interviews?

The interview protocol is an important part of any interview to increase the reliability of case study research (Yin, 2008). It can help researchers to carry out purposeful conversation during the interview, anticipate potential problems which may happen during the collection process and assist the write-up of the findings.

The quality criteria are established because an interview's outcome may not be suitable or qualify for the objectives of the research. Due to the interview protocol here being designed to understand port competitiveness from three perspectives (port supply chain integration, port collaboration and port sustainability), conversations answering questions on any one perspective were considered qualified.

Despite interviews being the primary method of data collection for this study, supplementary sources of data, including corporate documents (e.g., annual reports, newsletters.), field notes, and observations made during site visits, were also utilized. The integration of various data sources is a prevalent practice in longitudinal investigations within the domains of the shipping industry and logistics and supply chain management research. Secondary data provided by interviewees regarding port information may be needed, in that some figures indicating the competitiveness of a port may be considered critical factors by interviewees. Such data will be referred to after the analysis of primary data. The limitation of utilizing such data is that some information may be difficult to obtain in full, while access to such data may also require special consent from the provider.

As the knowledge of the interviewees will be used to formulate the final findings of the study, it is essential to select interviewees with a high level of expertise in purposive sampling. This is because the interviewees' knowledge will be used in the construction of the sample. As a result, interviews were conducted with respondents selected to be representative of the whole (Eisenhardt and Graebner, 2007; Martin and Eisenhardt, 2010).

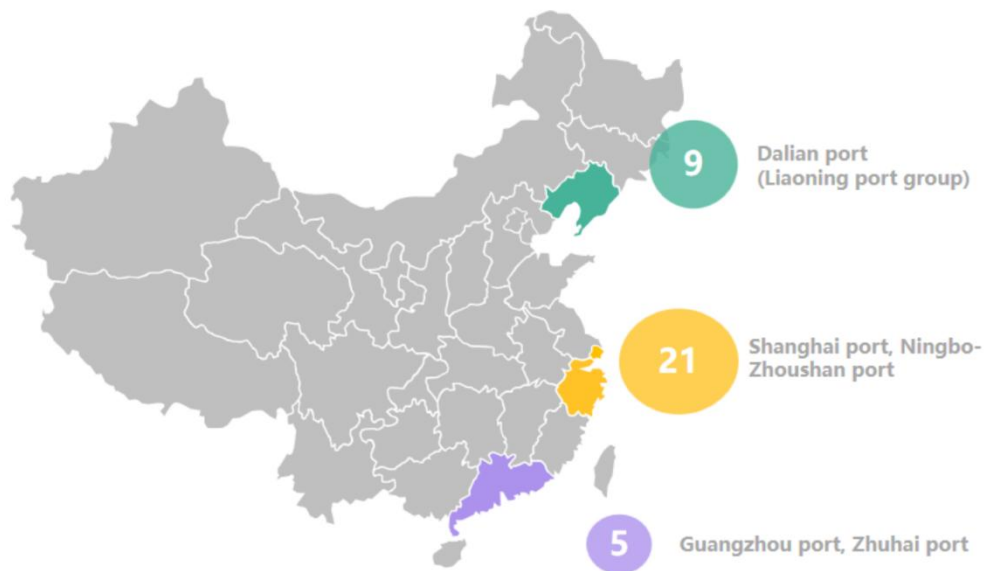
A total of 35 interviews with representatives from 14 different organizations were conducted between October 2021 and January 2022. The duration of each interview varied between 40 and 160 minutes. The participating institutions or companies are listed in Table 3-1, together with the total number of interviews for each of these organizations. In addition, the mean, date and duration of each interview are shown. These interviews were strategically selected to ensure comprehensive coverage of the main port clusters in China, with 9 interviews from Dalian Port (Liaoning Port Group), 21 interviews from Shanghai Port and Ningbo-Zhoushan Port, and 5 interviews from Guangzhou and Zhuhai Port. The participants in these interviews were highly experienced senior management personnel from the maritime industry or scholars with extensive research experience in port operations, ensuring the quality and depth of the data collected. Data saturation was achieved when no new or novel perspectives emerged

during the interviews, indicating a comprehensive understanding of the subject matter and signaling the conclusion of the data collection phase.

Table 3-1 Interview record

No	Organizations	Title	Date	Location
1	Liaoning port	Container terminal manager	11/10/2021	Dalian
2	Liaoning port	Container terminal manager	13/10/2021	Dalian
3	Zhonggu shipping line	Shipping manager	14/10/2021	Online
4	Dalian maritime university	Associate professor	16/10/2021	Dalian
5	COSCO, Maersk (previous)	Shipping manager	19/10/2021	Online
6	Dalian maritime university	Professor	19/10/2021	Dalian
7	Zhuhai port	Terminal manager	20/10/2021	Online
8	Dalian maritime university	Associate professor	21/10/2021	Dalian
9	Dalian maritime university	Professor	21/10/2021	Dalian
10	Dalian maritime university	Professor	27/10/2021	Dalian
11-18	Shanghai maritime university	Lecturer	04/11/2021	Shanghai
19	Shanghai maritime university	Associate professor	12/11/2021	Shanghai
20	Swire shipping	Port captain	13/11/2021	Shanghai
21	Guipu machinery	Technique manager	18/11/2021	Shanghai
22	Shanghai port	Legal manager	22/11/2021	Shanghai
23	Shanghai international shipping institute	Office director	23/11/2021	Shanghai
24	Shanghai international shipping institute	Office director	24/11/2021	Shanghai
25	Shanghai international shipping institute	Office director	24/11/2021	Shanghai

26	Shanghai port	Planning manager	07/12/2021	Shanghai
27	China marine bunker corporation	Manager	08/12/2021	Shanghai
28	Ningbo-zhoushan port	Tanker barge manager	10/12/2021	Ningbo
29	Ningbo-zhoushan port	Terminal manager	14/12/2021	Ningbo
30	Ningbo-zhoushan port	Ship forwarder	16/12/2021	Ningbo
31	Institute of Water Transport Science	Director	20/12/2021	Online
32	Guangzhou port	Terminal manager	23/12/2021	Guangzhou
33	Zhuhai port	Business department manager	24/12/2021	Zhuhai
34	Zhuhai port	Group manager	24/12/2021	Zhuhai
35	Ningbo-zhoushan port	Strategical manager	26/12/2021	Online



**Figure 3-2** Regional distribution of interviewees (Source: Authors).

### 3.3.3. Use of literature and other secondary sources

When carrying out quantitative research, a standardized guide is used for each survey or questionnaire in order to enable comparison of the replies. While doing research based on GT, it is beneficial to go into the field with an interview guide that has been generated from previous investigations or experience; nevertheless, this guide must eventually make way for questions that are based on the emergent ideas. Questions should always be open-ended so that the person being interviewed has the opportunity to provide information that is personally significant to them. According to Strauss and Corbin (1998), the interview procedure ought to provide the researcher with the opportunity to investigate topics as they come up.

### **3.4. Data Analysis**

Interviews and other types of data are obtained following the data gathering stage. According to Jordan et al. (2011), one of the most important concerns for researchers is how to logically organize and analyze the vast amounts of data that are produced by qualitative research. Based on the chosen research strategy (GT) and types of data collection (interview and secondary data), the strategy of coding and comparative analysis will be adopted for analyzing and presenting the data in order to address the research questions.

#### **3.4.1. Open and focused coding**

The interview transcripts and secondary data were coded using an iterative approach according to the coding mechanism proposed by Strauss and Corbin (1990). Miles and Huberman (1994, p. 56) defined codes as: “Codes are tags or labels for assigning units of meaning to the descriptive or inferential information compiled during a study”. Codes are attached to ‘chunks’ of varying size – words, phrases, sentences, or whole paragraphs, connected or unconnected to a specific setting. According to Ryan and Bernard (2000), the coding process involves six basic tasks: sampling, identifying topics, building code books, marking codebooks, building models (relationships between codes), and testing these models based on empirical data. There are various types of codes: descriptive codes (open codes), interpretive codes (axial or selective codes), theoretical codes, pattern codes, etc. (Myers, 2013).

In this research, two rounds of coding process, namely, open coding and focused coding, were carried out in order to make sense of the data (Charmaz, 2014). According to Strauss (1987), open coding, which is also known as initial coding, is a method that separates information into meaningful fragments that are then reassembled into higher-level concepts. Keywords or phrases which connect the informant's account to the experience under investigation were found by doing line-by-line analysis of the transcripts in order to determine what they were (Goulding, 2002). Open coding involves classifying data according to their similarities and contrasts in order to identify overarching themes (Glaser, 2001).

Following the initial coding phase, the research process moved on to the focused coding phase, which allowed for the systematic separation, categorization and synthesis of a substantial volume of initial concepts (Charmaz, 2014). This phase was instrumental in the development of a comprehensive set of initial concepts, as outlined by Gioia *et al.* (2013). During the phase of focused coding, we conducted an extensive search for additional concepts, revised the initial concepts that were provisional in nature, and eliminated the concepts that were observed only once in the data, as per the methodology proposed by Corbin and Strauss (1990). To facilitate comparison between initial concepts that exhibited a high degree of detail, we adopted the practice of assigning identical names to similar initial concepts, as recommended by Corbin and Strauss (1990). Emerging ideas were condensed and organized into classes and features by using focused codes. For example, the initial concepts of “*Inland transport connection*” and “*Sea-railway transport*” were both re-labeled as “*Multimodal transport*”. In this way, the focused coding phase provided a comprehensive set of initial concepts adhering to the original data that was the basis for the subsequent three-level data analysis.

#### **3.4.2. Categorizing and theory building**

The initial concepts were organized into a hierarchical code structure consisting of three levels, each level representing a higher level of theoretical abstraction. This approach is in

line with the framework proposed by Gioia *et al.* (2013). In the initial stage, an investigation for preliminary concepts exhibited comparable content and subsequently organized these into primary categories. According to research conducted by Corbin and Strauss (1990), categories are formed when related ideas are grouped together under one unified term that is both more general and informative than lower-level notions. In the next stage, the goal was to further develop the first-order categories into higher-level categories, enabling us to adopt a theoretical perspective toward the data. According to Gioia *et al.* (2013), the incorporation of second-order categories within the theory is crucial, as it facilitates a deeper understanding of the underlying data at a theoretical level. At the third level of analysis, the second-order categories were consolidated into theoretical dimensions that demonstrated the root theoretical trajectory of the data. The theory-building process was founded upon the three-level code structure that emerged from the analysis of structured data.

In each stage of GT analysis, it is imperative for the researcher to rapidly transition from the process of categorizing and explanation to the endeavor of constructing theoretical frameworks (Holton, 2007). The primary objective in conducting research within a social framework is to incorporate the collected data into a comprehensive theoretical framework (Strauss and Corbin, 1998). The application of GT is argued to be situated within a wider economic and social context, making it potentially challenging to develop a single comprehensive theory. The next chapter entails the presentation of the core structure after the process of analysis. Subsequently, a synthesis of ideas comes to light during the discussion on the research outcomes in Chapter 5, where the ultimate theoretical frameworks are clarified, based on the comprehensive analysis conducted.

### **3.4.3. Analytic tool and strategy**

The coding process was facilitated by the utilization of NVivo, a computer software package for Qualitative Data Analysis (QDA) developed by QSR International. The software effectively minimizes a substantial number of manual tasks, thereby affording the researcher



additional time to identify patterns, discern themes, and draw conclusions (Wong, 2008). Based on Bazeley (2007), NVivo performed four essential duties that facilitated the analysis of qualitative data in this study. These duties comprised: first, manage the information by clearing up the clutter of scattered data files. This encompasses various components such as interview transcripts, codes, and analytical notes. Second is the management of ideas, which is essential for comprehending the conceptual and theoretical complexities that arise during the process of the study. Third, by formulating multiple inquiries based on the dataset and employing appropriate software tools to obtain responses to these queries, the outcomes of queries are stored to facilitate subsequent examination, thereby integrating querying or searching as a component of an ongoing investigative procedure. Finally, the data collected and the findings obtained are utilized to generate transcript reports regarding the conducted study.

Memo writing is a strategy utilized during the coding process. As introduced by Glaser (1978, p. 83): “The writing of theoretical memos is the core stage in the process of generating GT. If the researcher skips this stage by going directly to sorting or writing up, after coding, she is not doing GT”. Memos act as theoretical notes that clarify the underlying data and establish conceptual linkages among different categories (Holton, 2007). The process occurs concurrently with the coding and analysis process in order to capture the researcher's emergent conceptualization of substantive and theoretical codes and categories. The act of writing memos in this research facilitated the elevation of data to a conceptual level and the refinement of the characteristics associated with each category. Memos also serve as a means to direct subsequent actions pertaining to additional data collection, coding and analysis (Charmaz, 2014). All memos are written, systematically stored and subsequently organized to facilitate the synthesis of the overarching theoretical framework.

### **3.5. Validity evaluation**

Charmaz (2014) argued that GT approaches have unrealized versatility and potential, so it is vital to evaluate the use of this method in this research. When considering how the constructed theory interprets the evidence, Glaser's (1978, pp. 4-5) criteria of fit, work, relevance, and modifiability are particularly beneficial. When a model "fits" the data, it signifies that the categories were derived from the data, and that they provide an explanation for the data. According to Corbin and Strauss (1990), before beginning a research project, the researcher has to have at least a general notion of the phenomena that will be explored. This information is then used to identify the persons, communities, or organizations that will be investigated for the study. Despite the fact that all of the codes were analyzed from the data, the original grouping and conceptualization was inspired by the foundational research on port competitiveness, as explained at the outset of Chapter 3. The categories of conceptual structure were altered as the research went on, in order to better reflect and explain the data that were collected.

To be considered valid, a GT has to have both a function and an applicability. It has been suggested that the numerous theories presented above do "provide a useful conceptual rendering and ordering of the data that explains the studied phenomena" (Charmaz, 2000, p. 511). The phenomena relating to the shifting functions and modes of operation of ports have been explained, the significance of the port's resource-based advantages, platform advantages, network advantages and sustainable advantages has been made explicit, and a new theoretical framework has been developed, which may be tested in future work.

The result is relevant because it built a theoretical construct of sustained port competitiveness based on what actually occurred in real ports. This makes the result meaningful. The findings are a complete display of the work experience of the participants, and reflect the depth and breadth of the research processes. The findings also have implications for the administration of regional ports and the development of strategies.

The term "modifiability" refers to the notion that a GT is not absolute and unchangeable (Charmaz, 2014). It is adaptable enough to accommodate changes in situations as well as new information because it possesses sufficient flexibility. Throughout the duration of this research, the numerous ideas that were developed were subjected to revisions at every stage, including the process of writing them up. For instance, after the second round of data analysis, port alliances were suggested as a part of ports' network advantages. This is due to the fact that it was anticipated to become a future trend by several interviewees, despite the fact that it was not popular at the moment. Because ports, no matter how large or small, need to be considered in the long term to improve and preserve competitiveness, the sustainable advantages of ports are the essential and final component presented by the research, while the other results about port sustainability are relevant but easy to overlook. It is a theory that is still being developed and is subject to change. For instance, it is unclear if the market will be affected by other unforeseen trends in the future, or whether the level of port competition would be affected by other kinds of administration. Neither of these questions can be answered with certainty. Despite this, it has reached a point where it is adequately formed for the research to be finished (Glaser and Strauss, 1967). Table 3-2 present the quality evaluation of this Grounded theory research based on the criteria from Charmaz (2014).

Table 3-2. Criteria for evaluating the quality of GT research. Source: Based on Charmaz (2014)

Criteria	Self-check questions	In this research
<b>Credibility</b>	Has your research achieved intimate familiarity with the setting or topic?	A systematic literature review was conducted before collecting data.
	Are the data sufficient to merit your claims? Consider the range, number, and depth of observations contained in the data.	35 semi-structured interviews were conducted with experts and practitioners from or studying major ports in China.
	Have you made systematic comparisons between observations and between categories?	A core structure was tabled with the interview number as reference, and the detailed reasons of categories setting were explained in the main body of the same chapter.
	Do the categories cover a wide range of empirical observations?	Participants of the data including different practitioners related to ports such as port manager, shipping line manager and port service provider, who had lengthy work experience and answered interview questions based on that.
	Are there strong logical links between the gathered data and your argument and analysis?	A complete data analysis process, including various round of coding and summarizing work, was explained in the Methodology chapter.

	Has your research provided enough evidence for your claims to allow the reader to form an independent assessment and agree with your claims?	Following claims in each category, a representative sample of participants' comments to the research findings is provided as a reference and enables the reader to go back to the setting of the "storyteller."
<b>Originality</b>	Are your categories fresh? Do they offer new insights?	The structure of general categories is fresh to the reader and some elements in the categories have rarely been explored in the existing literature.
	Does your analysis provide a new conceptual rendering of the data?	There is a conceptual analysis process in Chapter 5 with each dimensional framework that was developed followed by a general conceptual model that was built.
	What is the social and theoretical significance of this work?	The research result and conceptual frameworks provided can contribute to the understanding of port competitiveness in the new context. The port managerial strategies discussed in Chapter 5 can be a good reference for port managers.
	How does your GT challenge, extend, or refine current ideas, concepts, and practices?	This GT research takes the knowledge from existing literature as basic and reflects the real world differently through the analysis of practitioner interview data.

<b>Resonance</b>	Do the categories portray the fullness of the studied experience?	The categories in the study represent as fully as possible the industry experiences shared by participants.
	Have you revealed both liminal and unstable taken-for-granted meanings?	The term “sustaining competitiveness” in this research is both liminal and unstable.
	Have you drawn links between larger collectivities or institutions and individual lives, when the data so indicate?	The research has drawn links between ports and other stakeholders in the shipping supply chain as data described and has added port platform and port cluster as larger collectivities.
	Does your GT make sense to your participants or people who share their circumstances? Does your analysis offer them deeper insights about their lives and worlds?	Many participants indicated that the process of answering the questions allowed them to sort out their own views on things. The final conceptual framework was also shared with them as feedback to help them in their work or academic perceptions.
<b>Usefulness</b>	Does your analysis offer interpretations that people can use in their everyday worlds?	The interpretations in the study apply to the daily work of people in shipping and logistic industries.
	Do your analytic categories suggest any generic processes?	The theoretical model of sustainable port competitiveness reflects the generic process from general competitiveness to sustainable

		competitiveness.
	If so, have you examined these generic processes for tacit implications?	The outcome has been discussed in Chapter 5.
	Can the analysis spark further research in other substantive areas?	The conceptual framework emphasized many potential research directions that have not been sufficiently researched.
	How does your work contribute to knowledge? How does it contribute to making a better world?	The research contributes to knowledge by enriching the understanding of port competitiveness and contributes to the real world by providing port practitioners with potential port operational and managerial strategies as suggestions.

### **3.6. Ethical issues**

There are some potential ethical issues which need to be considered before conducting data gathering. First, an ethical application needs to be approved by the university faculty ethics committee. Second, a participant's information sheet and a consent form should be designed and prepared for interviewees. Before the interview, the interviewees must be clear about the purpose and needs of the interview, as well as the possible results. Asking for their consent is also necessary before the formal interview starts. Third, risk assessments are important because the interviews will be carried out in different countries. Safety of regions visited, travel safety and travel time all need to be carefully considered before this stage. Finally, the interest sharing with participants should be confirmed. In this research, the results of the study will be shared with the participants, and recorded data from their interviews will be provided if required.

### **3.7. Summary**

This paper has produced a critical evaluation of the research strategies, based on the topic of my PhD. The paper first gave the thesis title and a background to port competitiveness. Then the characteristics of both qualitative and quantitative research were evaluated in order to find the most suitable approach to the PhD topic, given the specific research questions. Pros and cons of the two research categories were analyzed and philosophical concepts were referred to at the same time. Grounded Theory was finally confirmed as the research method, and interviews decided upon as a means of data collection. Finally, the data analysis strategies were also provided and justified.



## Chapter 4. GT analysis

In this chapter, the results of the GT analyses are presented. Briefly, the narratives of the participants can be integrated through a knowledge of four significant aspects of sustained port competitiveness: **resource-based advantages**, **platform advantages**, **network advantages**, and **sustainable advantages**, all embedded in complicated internal-to-the-organization and external-to-the-organization contextual contexts. The implications of each second-order category have been analyzed using GT approach in the following subsections, followed by a discussion of the overall conceptual framework for the aspect of resource-based advantages.

### 4.1. Resource-based advantages

The first dimension summarized from participants' narratives is resource-based advantage, many interviewees emphasizing the importance of a port's own resources as the first priority. Combined with an understanding of port resources, resource-based advantage is defined as the advantage that a port creates or obtains through the rational use of resources. Natural resource advantages, such as geographic position and environmental conditions, and economic resource advantages, such as hinterland conditions and capital construction, are the two categories of resource-based advantages in this study. Table 4-1 summarizes the general concept of second-order categories along with the relevant codes.

**Table 4-1** Core structure of Resource-based advantages (Source: Author's own elaboration)

Second-order categories	Explanation	Relevant codes
Geographical location	The advantage that ports in a given geographic region enjoy in comparison to ports in other regions	<i>Inland connectivity;</i> <i>international network</i>

Natural environment	The basic conditions in which a region has been transformed by natural and non-human factors for millions of years	<i>Weather, water depth and waterway; shoreline</i>
Hinterland conditions	The source of the port's production commodities and the consumption of imported and exported goods	<i>Hinterland economy; hinterland connectivity</i>
Investment and construction	The conditions for a port to manage enormous expenditure on port construction	<i>Investment environment; Infrastructure construction; Capacity and facility</i>

#### 4.1.1. Geographical location

Geographical location was named as a basic characteristic of ports by many port operator participants. Since a port cannot exist by itself (with the exception of ports that are completely devoted to transshipment), the geographical location of a port is a factor that determines its performance, and is perhaps the most essential element (Caldeirinha et al, 2009). An advantageous geopolitical location within a maritime network can frequently provide a port with a significant competitive advantage. The reason behind this was explained as being twofold by a port manager in No. X interview:

*“In reality, a port's advantageous geographical location is comprised of two factors: its proximity to the hinterland and its position in the network of sea routes. Most of the competition between container ports is for hinterland and transshipment sources. If container ports are near economically developed areas and major traffic routes, it is good to compete with other ports for goods coming from the hinterland. If it is close to international routes, it is more likely to be able to compete with other container ports for sources of transshipment.”*

This statement emphasizes the significance of port location in light of the two different types of port competition: regional port competition and international port competition.

#### *Inland accessibility*

In terms of competition between neighboring ports, Notteboom and Rodrigue (2005) claim that inland accessibility has become a cornerstone of port competitiveness, since inland distribution is becoming an increasingly crucial aspect of the paradigm for international freight distribution. Customers are considering the whole logistic cost of carrying containerized products, meaning that the present efficiency advances in logistics, namely for container transportation, are mostly derived from inland distribution. The following quote from a port expert in Interview No.1 exemplifies the competition between Dalian Port and Yingkou Port in terms of inland transport distance:

*“Competition between Dalian and Yingkou is a good example. Due to its proximity to the interior, Yingkou Port conducts a great deal of domestic trade. In terms of the economic hinterland, Dalian and Yingkou are almost entirely dependent on goods from the three northeast provinces, but it is clear that Yingkou port has a significant advantage in that it is around 183 kilometres shorter than Dalian port to the hinterland. Considering the expense of road transport, goods from the port of Yingkou will undoubtedly be cheaper. Due to the relatively low value of domestic goods and the price sensitivity of land transport, this disparity in transport costs often has a substantial impact on decision making.”*

#### *International network*

From the perspective of international competition, due to the strategic advantage of geographical location, the international big port has become an important node on the

international routes of shipping companies, allowing it to acquire a massive amount of international goods and even become an international shipping centre. Numerous participants cited the Port of Singapore as an example of a port with a favorable geographical location when competing for international transit cargo with ports in China (e.g. Shanghai port; Ningbo-Zhoushan port). A typical narrative from X in No. 11 interview was:

*“The location of the Port of Singapore is of great significance: it connects the Pacific Ocean and the Indian Ocean, covering the entire maritime traffic of Europe, Asia, Africa, and Oceania, and it is the best transit point for the shipping routes between Asia and Europe, as well as between Asia and the west coast of the United States. The natural harbor is well protected and provides an extremely large anchorage for over 800 ships. Obviously, the country places an excessive amount of emphasis on port development, and its policy is sound. Therefore, the port enjoys the first-mover advantage. However, it appears that the first-mover advantage is gradually diminishing and is no longer as strong. As a result, when others catch up to him, the nation will be in a state of crisis.”*

A significant implication of this quote is that geographical location is crucial for ports, while clear recognition and timely utilization of advantages are also indispensable. The case of Singapore researched in the literature can be similarly found. According to Gordon *et al.* (2005), Singapore's position is special and favorable, but it is neither unique or irreplaceable, as there are other rival ports in the region, notably in Malaysia. To develop and use its natural resources, Singapore has built up capital, information, and operations technologies, as well as IT management skills. The government has developed housing, roads and quasi-governmental entities to stimulate commerce, while foreign investment has been encouraged to create employment and money.

There is also mounting evidence from the literature showing that the amount of cargo that can be processed at a port has a direct correlation with the port's geographical position, which is almost always fixed. According to the findings of some studies, the proximity to smaller economies has a negative impact on both the total throughput and the performance of a port. These studies also found that the demand for port services is driven by the traffic generation and consumption volumes of the region in which the port is located (Tongzon, 2002). This suggests that the economic performance of the area has an impact on the performance of the port, even though the features of the port might potentially interfere with that connection. Additionally, it has been noted that the proximity to a developed area determines the features of a port, namely the amount of investment in infrastructure, equipment and accessibility, which ultimately has an effect on the performance of the port.

#### **4.1.2. Natural conditions**

Besides geographical location of ports, natural conditions are another natural resource-based factor that is the prerequisite and foundation of port competitiveness. Natural conditions refer to the basic conditions in which a region has been transformed by natural and non-human factors for millions of years. Codes representing natural conditions were analyzed from the data, including *weather*, *water depth*, *waterway*, *shoreline*, etc. Regarding ports, these natural conditions are generally either unchangeable or challenging to change, and are all natural conditions of ports that have a direct impact on port operations and competitiveness.

##### *Weather*

In the process of port operation, the port will inevitably be impacted by adverse weather conditions such as strong winds, fog, heavy haze, blizzards, thunderstorms, typhoons, etc. This will impact vessels entering and exiting the port, as well as cargo activities within the ports, leading to severe congestion and even causing the port to cease operations. These natural elements cause significant economic losses for port businesses and cargo ships. A

relevant example was given by the director of Shanghai Yangshan Port Planning Department in Interview No.28 when comparing Shanghai Port and Ningbo port:

*“There are favourable natural circumstances in both Yangshan Port (Shanghai) and Beilun Port (Ningbo), however the sea surface of Ningbo is prone to fog, and the weather in Shanghai Yangshan port is more suited for ships to enter and depart.”*

For shipping companies, the risk identification of complex weather and its early warning countermeasures also have an impact on port selection because the length of time in port is directly related to the cost of transportation. Literature shows that the impact of weather conditions on port competitiveness is mainly reflected in the elasticity and resilience of ports under extreme conditions (Zhou and Chen, 2020), but the risk concept of complex weather has not been thoroughly investigated, and no comprehensive response concept system has been established.

#### *Water depth and waterway*

Water depth and the conditions of port waterways are widely considered by the shipping industry as indicators of a good natural port as well as a hub port, and this was also confirmed by many respondents in the interviews. Channel safety warning is discussed primarily only from the perspective of channel water depth. The growing importance of effective deep-water ports is attributed in large part to the expansion of ship size, as an expert stated in Interview No. 32:

*“Currently, the trend of ships growing in size has caused significant changes in the international container transport. Ultra-large container ships are becoming increasingly popular on trunk routes, and as a result, the ship's operating conditions for port channels and*

*the depth of the water are becoming increasingly demanding. As a result, the port operator must adapt to a new generation of water depth conditions for containerships in order to maintain a competitive advantage. Most hub ports around the world have favourable natural conditions. Only ports with deep-water berths are expected to win a presence in the extremely competitive international shipping industry as the trend toward larger vessels continues.”*

More evidence of the importance of the water depth was provided in Interview No. 7, when comparing the ports of Shanghai and Ningbo in terms of bulk cargo business:

*“Why does Shanghai not have an advantage in bulk throughput? In fact, the port's water depth in many terminals in Shanghai is inadequate for large bulk carriers. The Ningbo Zhoushan Port can accommodate ships up to 300,000 tonnes, but Shanghai cannot. These enormous ships, which weigh more than 200,000 tonnes each and enter the Jinjiang River from Shanghai, are required to unload their cargo at Majishan Terminal; the cost advantage will be lost after unloading. Therefore, bulk cargo, such as bulk oil, crude oil, and iron ore, must rely on Ningbo rather than Shanghai to be economically cost-effective.”*

In addition to the increasingly obvious influence of water depth of the wharf on the berthing of large ships, the port and its customers attach great importance to whether the waterway conditions can facilitate the entry and exit of ships in the port. The advantage of waterway conditions is also an important indicator of a good natural port, which is often reflected in the construction of port infrastructure. For example, in Interview No. 29, the port manager stated that the infrastructure construction of Ningbo Port had cost advantages due to good waterway conditions:

*“Ningbo Zhoushan port is a natural port, so there are two advantages: the cost of pier construction is generally inexpensive, and the pier approach bridge does not need to be extended. However, in certain locations, such as five miles in front of the shoreline, the bridge must be extended to function.”*

### *Shoreline*

The port shoreline is a strip of space between the sea in front and an isobath of the land behind, where ships berth, and where loading and unloading services are based (Pioch and Souche, 2021). The shoreline of a port is an essential and valuable resource for port development; it is also a finite and non-renewable resource that is crucial to the growth of economies at the national and regional levels. Based on the time-varying nature of port shorelines, the evaluation and development system for such resources in coastal areas has received extensive research in the literature (Zhang *et al.*, 2022; Gopikrishna and Deo, 2018). The importance of valuing port shoreline resources in the context of sustainable development was mentioned by several respondents, such as the following quote from Interview No. 22:

*“The shoreline of the dock determines your future development cap. Maybe you have a small pier now, but if you say there is a lot of room left before you build the port, for example, I may say the shoreline is 3 km at present, but if we think about it in the future, I may have reserved 6 km of shoreline at that time and then go back to build it when needed. This avoids waiting until you don't have enough facilities before planning is too late: submit all those programs to your superiors, including planning options, and you'll have to go through them again for future growth based on your business volume. So, there should be enough shoreline to give the dock enough room for upgrade and modification.”*

#### **4.1.3. Hinterland conditions**



The hinterland of a port is the area that can attract the source of the port's production commodities and the consumption of imported goods (Notteboom and Rodrigue, 2017).

The amount of freight to and from the hinterland was the first and most fundamental indicator of port competitiveness, according to many participants. Generally, ports announce their total volume, but seldom separate it into hinterland and transshipment quantities. Multiple aspects of port hinterland were identified by other interview participants, and two codes were summarized as important economic resource-based factors, namely hinterland economy and hinterland connectivity.

#### *Hinterland economy*

Hinterland economy is one of the main external factors affecting port competitiveness. The existence of a port depends on commodities originating in the hinterland, so there is a direct connection between the economic status of the port hinterland and the demand for port services. If a port's direct and indirect hinterlands are extensive and economically developed, there will be a continual flow of goods transported to the port, enhancing the port's competitive advantages. By contrast, if a port has a very limited radius and the economic status of the hinterland is mediocre, even if the port has advanced and modern facilities, the port may be empty, and it is impossible to compete with other ports that are in a better position. The detailed relationship between hinterland economy and ports was described by an expert in Interview No. 13:

*“When there is a higher level of economic development in the port hinterland, there is also a higher level of regional commodity output. In addition, residents of developed areas have a high level of income and a high demand for commodities with strong purchasing*

*power, both of which stimulate the demand for port transport in the mainland. Developed areas also tend to have a higher population density than less developed areas.”*

A more in-depth point of view in Interview No.6 argued that the growth of a port is inextricably linked to the support of the hinterland businesses that are tied to the port in some way, such as the harbor industry, port logistics, urban tourism, and so on.

*“The hinterland economy is actually very important and core. It determines the real need for the location. Even if the infrastructure at the port is not good, but you have the need here, it has the potential to improve all aspects of your facilities very quickly, right? And now the construction capacity of all kinds of facilities is easily improved, including the introduction of technology. As long as the demand is large enough, it is possible to build a man-made port into the sea. Of course, if you said something about change in the past, maybe this level of infrastructure was the same, because it was relatively slow to improve this before, wasn't it?”*

#### *Access to transportation networks*

Most port and shipping-related literature acknowledges that hinterland connectivity is one of the most essential concerns in port competitiveness and growth (Wang *et al.*, 2016). From the perspective of material flow and exchange, port connectivity can be defined as the ease of reaching other ports or cities via land or sea transport networks to complete the exchange of port materials. Connectivity between ports and hinterland may be broken down into two categories: landward hinterland connectivity, which refers to how easy it is to reach cities in the hinterland through interior transport networks to complete the exchange of coastal port materials, and seaward connectivity, which refers to how easy it is to reach other ports or cities via sea transport networks to complete the exchange. The degree of hinterland

accessibility is more sensitive to differences in the price of land travel than it is to differences in the cost of sea transport. An important criterion for hinterland connectivity is the accessibility between port and hinterland, or accessibility between nodes in a city. Using the inland connectivity of Shanghai's ports as an example, a port researcher explained in Interview No.16 the significance of inland transportation convenience in attracting hinterland, as follows:

*“The accessibility of port and hinterland linkages also plays a significant role in port extension to the interior. For certain inland hinterlands, there may be a suitable port after assessing accessibility, including the accessibility of the city where the port is situated and the sufficiency of the collection and transportation system. If the roads around a port are not in good condition, the hinterland will not choose to contact this port. For example, one of the biggest issues with Shanghai's port in the past was that ships took a long time to cross the Yangtze River. This was not conducive to increasing efficiency on either side. This is why Shanghai has begun to upgrade its transportation network, including roads and railroads, and to make better use of these transportation services, which are critical to the port's effectiveness.”*

In addition to hinterland accessibility, port-hinterland stickiness is indeed a significant component of hinterland connection that should not be disregarded. Although the selection of ports for hinterland customers is primarily based on freight cost as the primary consideration, ports can also maintain a stable relationship with their customers by providing value-added measures that give them a deeper understanding and trust. This helps the ports maintain a positive relationship with their customers. These steps should, of course, be founded on the premise that there is not too significant a gap in accessibility to the hinterland.

#### 4.1.4. Investment and construction

The port transport system is a complex production system that is influenced and constrained by a wide variety of internal and external environmental factors. Some of these factors include the facilities and equipment of a port, general layout of the port, type of cargo, technical performance and operational conditions of incoming transport, quality and management level of the port enterprise, and competition from neighboring ports. The need for enormous expenditure on port construction has become apparent as a natural consequence of the gradual transition that has taken place in ports from being labor-intensive to being capital-intensive. Under such circumstances, the *investment environment* of the port, *construction of infrastructure*, and the port's own *capacity and facilities* are three important factors that are regarded as important for port investment and construction.

##### *Investment environment*

Demand for port investment usually increases due to factors such as growth in regional economies and trade, and shifts in market demand. Due to the irreversible nature of port construction and the enormous investment required, port investors need to correctly grasp the appropriate timing, reasonable scale and level of regional port construction. According to analysis by port experts, investment activity by global terminal operators is on a slowing trend due to the slowdown in terminal business growth and continued financial pressure. Low-risk ports may have an advantage in attracting port investment. In terms of investment markets, global terminal operators are more interested in investing in emerging markets than in mature markets.

The level of support from government, in the form of direct investments and other forms of favorable policy, is another significant factor in determining the environment for port investments. The construction of container ports is a priority development project for governments because they are an essential piece of infrastructure for the growth of the

national economy. However, the construction of port projects requires enormous funds, the majority of which will have relatively obvious spillover effects. It is difficult to meet the funding requirements for port projects if one has to rely solely on financing channels that are based on the markets. As a result, local government is required to make an investment of funds designated for pioneering purposes. It is possible, with the help of government support in this area, to meet the capital needs of port projects that will have obvious spillover effects, and at the same time play a leading role in the process of attracting social capital to participate in the construction of port projects.

### *Infrastructure construction*

The expansion of infrastructure is a necessary precondition for economic expansion in ports. This is true primarily with regard to the reduction of economic costs, promotion of the upgrading of port structures, acceleration of trade development, and improvement of the environment for investment. From the point of view of port competitiveness, the level of quality and perfection of the infrastructure plays an extremely important role in the amount of money that port businesses spend on production and how efficiently they operate. The amount of space occupied by a port's various hard and soft facilities is an important indicator of the size of the port.

### *Capacity and facility*

A port's capacity refers to the highest throughput that it and its terminals are capable of handling at any particular time. Physical limitations or unfavorable economic circumstances that make the marginal cost of greater throughput impractical may both determine this limit. It is important to note that these indicators display relative capacity rather than absolute capacity, and as a result, they do not offer a clear picture of what a thorough capacity analysis comprises in terms of its scope and objectives. For instance, a container port that has longer berths and more cranes than a port with shorter berths and fewer cranes is likely to have a

greater yearly container capacity than the latter port; nevertheless, these characteristics do not assist the computation of the absolute capacity of the two ports.

When selecting a port of service, one of the primary factors that shipping companies and owners of cargo take into consideration is the port's hardware and software facilities. Facilities for hardware include the number of port berths, number of shore handling machines, yard area, storage capacity, and the number of trucks, railways, barges and other forms of transportation. This is a reflection of the capacity of the equipment used for port handling, capacity of the equipment used for storage, efficiency with which machinery is operated, and adequate capacity of the equipment. The participants stated that, in reality, these hardware factors have a direct relationship with the amount of time spent in port, and consequently, the total amount of time spent in transit.

## **4.2. Platform advantages (supply chain perspectives)**

### **4.2.1. Logistics service optimization**

The provision of logistics services is a vital aspect of port competitiveness. Port logistics service can be divided into three levels (Rodrigue *et al.*, 2011): first, the core service of a port is the ordinary cargo handling; second, the auxiliary services of a port are the use of various special loading and unloading machinery transportation tools in a specific yard to complete the cargo handling, transportation, stacking, storage and other services. The third is extended service, which entails providing shippers with impeccable logistics support services in addition to the port's basic logistics service. When selecting a port, it is now crucial for shippers to consider whether or not the port has an integrated logistics industry and excellent logistics support services (Tongzon and Heng, 2005). Customers are more attracted to ports that offer comprehensive logistics services, such as ships, trains, automobiles and warehousing, because these ports have lower freight transportation costs and higher transportation efficiency.

Two main codes, namely *Comprehensive logistics system* and *Multimodal transport* are related to the optimization of port logistics services according to participants' quotes.

#### *Comprehensive logistics system*

With the evolution of a port's role from basic berthing, and loading and unloading service, to an integrated logistics hub (Gordon *et al.*, 2005), optimizing the whole transportation system and reducing freight owners' transportation costs is now a priority for many port managers, according to their quotes. The ability to establish a perfect distribution system to provide customers with comprehensive and diversified services was considered the most important point for ports to improve their attraction through logistics services. In this regard, a representative opinion, expressed by Shanghai port group's legal manager in Interview No. 19 was shown as follows:

*“The growth of contemporary port logistics must satisfy the demands of the globalisation of the economy, and the complete logistics service function exemplifies this necessity. In addition to basic transport and storage, loading and unloading, packing, and other logistics services, it also includes extensive and adaptable service functions. The most distinguishing characteristic of the integrated logistics service function of contemporary port logistics is the transformation of the service economy approach, and the objective of creating individualised demand. Clearly, the competition between port businesses involves not just the rivalry for the resources around ports, but also the whole supply chain network. Modern ports aim to provide more door-to-door service, which means that my service should be given right to your shippers' doors. Consequently, the design, building, and growth of contemporary port logistics must take into account the individualised requirements of integrated logistics services.”*

To be more specific, customers' fundamental requirements include cost savings, safety and convenience of the whole service. Cost savings involve port logistics cost reductions that result in more competitive tenders and time cost reductions due to increased transportation efficiency. Several participants expressed the notion that optimizing storage costs within the supply chain was crucial for cost saving. There are too many storage nodes in the maritime logistics process, from the production enterprise's processing to the freight distribution center, thence to the regional distribution center retailers, and lastly to the customers. Both time and production costs are wasted. In Interview No. 4, an expert quoted another example of logistics system collection and distribution optimization of Shenzhen port logistics:

*“In fact, there are numerous small businesses in the Pearl River Delta region of Shenzhen and many of their products cannot fill an entire container. We therefore refer to the mode of milk collection for optimisation plan: throughout the collection procedure, this box is directly loaded. Otherwise, a merchant's efficiency is quite low if a car is not filled. Therefore, our project not only reduce the cost of transportation, but also the time required for optimization.”*

In addition, many participants emphasized the severe outcome of port congestion including time-wasting and negative social impact. The traffic problems generated by such port congestion are sometimes unimaginable: several truck drivers might block a whole highway while waiting at the highway entry, which not only increases the time cost of logistics and transport, but also has a seriously negative effect on social vehicles as well as on the people of the nearby area.



### *Multimodal transport*

In recent decades, a consensus appears to have arisen defining international multimodal transport as the carriage of goods by at least two different modes of transport on the basis of a multimodal transport contract from a place in one country where the multimodal transport operator takes charge of the goods to a place designated for delivery in another country. A common idea from participants was that the development of multimodal transport with the port as the hub can make full use of port resources so as to improve port competitiveness.

Three benefits of exploring multimodal transport were summarized based on participants' statements. First, the development of multimodal transportation with ports as hubs will significantly improve transportation service efficiency. By continuously improving the deep integration and efficient connection between ports and other modes of transportation, such as railways, highways, civil aviation and pipelines, cargo transit capacity and efficiency can be increased, and combined transportation time and costs can be reduced. Second, by training combined transport operators, the service quality of port logistics and the management level of contemporary logistics businesses may be enhanced. Based on the characteristics of the port, it can carry out different multimodal transport modes, such as hot iron and public water, water and water, and promote the optimization and business coordination of multimodal transport. This can make the middle steps of the whole process easier and reduce cargo damage and cargo difference. Thirdly, the port's ability to make optimal use of its resources while simultaneously lowering its overall consumption is shown by the port's multimodal transport mode and its operating mechanism. Multimodal transport may maximize the comparative advantages of various modes of transportation, such as railway, roadway and waterway. It may also increase the proportion of container and bulk freight rail-water transport, which could minimize energy consumption and pollutants per unit of travel.

One argument is that the major reason multimodal transportation has been struggling is because of the railway's continued prominence in the transportation network. The railway's influence on the port's logistics network will grow in the upcoming years. But progress on rail reform is delayed due to the fact that ports remain at a severe disadvantage when interacting with trains. For the railroad to cooperate, the port would have to make major accommodations. This shift in perspective is largely attributable to the more stringent standards by which businesses are judged on their profitability. This shift has resulted in a marked improvement for the railway, which is now seen to be not just better than before, but also on the upswing.

#### **4.2.2. Shipping services**

Despite the fact that the cargo handling scale of many Chinese ports has reached the top of the world, many participants stated that Chinese ports still need to transition from the world's great ports to the world's strong ports. In order to remain competitive, major ports should provide diversified value-added services related to shipping in addition to basic logistics services. A statement from a Chinese shipping company manager in Interview No. 3 suggested that ports need to make more effort in this regard.

*“I have been in this industry for more than 20 years. To be honest, I feel that the service level of China's ports has not changed much and there is no innovative service. The overall feeling is that their focus is more on the volume of goods, not on the quality of service.”*

Some good cases are traditional shipping centers, such as Singapore, Hong Kong and London, which continue to play the role of international shipping hubs by virtue of their developed shipping markets and perfect shipping services, relying on international economic, trade and financial inertia. Shanghai, Dubai and other new shipping centers also rely on late-mover advantage and cumulative effect to achieve the development of curve overtaking. Therefore,

this section analyzes the influence of shipping services, an additional significant indicator of port comprehensive service capacity, on port competitiveness.

### *Ships services*

Ships services refers to a series of supporting services provided for ships when berthing at port, including supplies of material, ships accessories and fuel oil, ship maintenance, containers repairing and waste collection/washing, etc. The number of ships arriving at port is constantly growing as a result of rising trade demand and development of maritime transportation, and the supply and demand for ships is growing fast. At the same time, due to the development of ports, expansion of port areas, and the development of large-scale and specialized ships, the stay time of ships in port is shortened, which makes it necessary to meet the supply demand of navigation ships, and demands higher requirements from the relevant practitioners. What is not commensurate with this is that, at present, the ship service enterprises in various ports in China have different scales, different management levels, and certain liquidity. It is challenging to offer high-level services due to the lack of large-scale brand management and limited capacity to meet ship service requirements in port.

When it comes to the port, offering comprehensive, high-quality support services to ships can provide safety and convenience for ships' navigation at sea, so as to make more ships call at the port. Therefore, standardizing port supporting services is not only conducive to consolidating and improving the economic benefits of a port, enhancing its competitiveness and influence, but is also conducive to further expanding and strengthening the port industrial chain.

### *Financial services*

The provision of financial services plays a crucial role in enhancing port competitiveness by addressing the financing needs of port customers and streamlining capital flow within the supply chain. Port financial services encompass a series of customized banking service schemes, including financing, settlement, third-party supervision and asset preservation, offered by the port to the core enterprises and upstream and downstream enterprises. The expansion of port financial services can ensure the port's logistics and capital flow in the supply chain. From the perspectives of port customers, they have a large number of production and operational financing needs, and it is difficult to obtain more favorable terms when conducting financing business with banks and other financial institutions by relying solely on customer strength. This was described by a port manager in Interview No. 22:

*“For example, in some cases, the customer needs to obtain the required financing within the shortest possible time. It takes a certain time to go through the standard process of the bank from the time of application to the time of obtaining the loan. Generally, it is impossible for the customer to obtain the bank financing within the specified time. In terms of the composition of customers, a large part of them are small and medium-sized enterprises, and their ability to obtain financing from banks is limited. The main reason why banks have always been cautious in lending to small and medium-sized enterprises is information asymmetry. Banks dare not lend because they do not understand small and medium-sized enterprises. However, if the small or medium-sized business has a stable and close business relationship with the port company, the bank may be able to finance this group of clients based on that relationship's stability and closeness as well as an evaluation of the company's financial standing.”*

Some participants believed that port financial services also benefit banks. Under the conditions of excess liquidity and intense competition, banks are desperate to find customers with financing needs and expand their asset portfolios daily. First, banks' ability to attract

customers in the short term is limited by their own resources; second, building and maintaining customer relationships requires a long-term cost investment. Therefore, if a bank can rely on cooperation with port businesses to bring them a large number of customer resources and a substantial amount of business volume, it is eager to join.

Chinese ports are likely to have enormous development potential in the field of financial services in the future. There is still a lack of integration between the development of financial services and port development, despite the fact that the majority of China's ports are situated in cities with highly developed economies and financial services. The major port enterprises do not fully understand the importance of shipping finance to port development because the use of financial institutions by port enterprises is still limited to the single service of loans. In fact, the great significance of financial institutions for the development of port enterprises lies in combining financial business with port business and financial service demand on the port related industrial chain through innovation, providing multi-dimensional services and creating greater value. Such a marriage of industry and finance is certain to give port enterprises a great deal of life, creating a win-win situation where the growth of the financial sector and the growth of the port services sector are mutually supportive, and boost regional competitiveness.

#### *Transaction services*

Many participants emphasized that the port supply chain is fundamentally driven by the occurrence of transactions rather than merely being an extension of the logistics function of a port. Determining the characteristics of the different types of goods handled by the port and offering services that facilitate the exchange of goods can therefore fundamentally resolve the issue of the source of goods, and enhance the effectiveness and quality of the entire supply chain. The whole oil industry chain built by Ningbo-Zhoushan port in Zhejiang Free Trade Zone is a very good case, according to a ship forwarder in Interview No. 29.

*“To ensure an integrated process, Zhejiang Free Trade Zone has established a complete oil industry chain that includes the import of oil, loading, unloading, stockpiling, processing, and trade of oil products. Building a new highland for the distribution of commodity resources and enhancing China's ability to distribute commodities globally is one of the main tasks of the Zhoushan area. Zhoushan has unique port and location advantages and all the basic conditions for the development of the whole oil industry chain, such as oil storage facilities, refining and chemical projects, and gathering and distribution systems. Exploring the facilitation and liberalisation of bulk commodity investment and trade with the entire oil industry chain as the core is one of the area's top priorities. Growing and strengthening the bonded fuel filling business is a crucial first step in promoting the growth of the entire oil industry chain.”*

Because of its superior location advantages, the successful case of Ningbo Zhoushan port is difficult to replicate, but it is instructive for ports to focus on providing more transaction-related services through industrial integration. The benefits of the port network system and industrial scale can be fully exploited by the simultaneous development of spot trade and comprehensive supporting services. Building a trading service platform in combination with the sector could enhance a port's competitive advantage.

#### **4.2.3. Market development**

##### *Discourse power*

There is a considerable body of work focusing on the competition that occurs between ports; however, the contest occurring between ports, shipping operators and cargo owners is seldom analyzed from the point of view of the supply chain. In point of fact, the central emphasis on competition between container port businesses lies in developing strategies to attract cargo, and providing suitable services associated with freight transportation. Interestingly, when

asked about the contest between ports and service objects dominated by shipping companies, practitioners in different positions gave different answers from their perspectives. Both port workers and shipping company workers, however, believed that their companies had a weak voice in the contest surrounding China's shipping industry.

The port side was of the opinion that the shipping company, which operates in a buyer's market, has an extremely powerful position in the game. Particularly in the last few years, shipping alliances have been the operational trend of large shipping corporations. The existence of a port is closely tied to whether or not the ships of an alliance will be associated with each other. Because of the overlap in their hinterlands, ports frequently compete with each other for business volume and take the initiative to lower prices, which further accelerates the decline in port efficiency. A large number of individual ports that face shipping alliances have no negotiating power, and all ports have vicious competition in order to get the long-term cooperation of super alliances.

However, shipping businesses claimed that despite the significance of Chinese ports to the overall strategy of the country and growth of the region, shipping companies do not have a significant amount of influence in the dialogue with the terminals. When it comes to altering their routes, shipping corporations are also vulnerable to meddling from local governments. The government owns the physical infrastructure of many ports, and there is little awareness of the costs involved, let alone an awareness of the services provided.

### *Marketing strategies*

Marketing initiatives undertaken by port businesses to increase their market share or raise their level of social awareness are referred to as port enterprise marketing. Market research, product design, market positioning, customer services and other business activities related to

marketing performance are all included in port marketing. In the past, ports prioritized production over the market and had weak marketing because of the different industrial characteristics and internal management systems. However, as the demand for port production has expanded, many port enterprises have set up separate trade departments or companies under them, developed marketing staff and actively explored the market to find sources of goods. The port's business strategy has evolved to directly target the market rather than the initial single production, according to the quote of a professor in Interview No. 9:

*“Port marketing typically provided service products directly to enterprise customers, and the marketing channel was short and simple. This was due to the influence of market characteristics and service characteristics. Moreover, because port enterprise customers behave very differently from regular customers, port marketing items frequently have the traits of high purchase volume, small batch sizes, and concentrated geographic location. To build a long-lasting mutually beneficial relationship with customers, the port may choose to use relationship marketing or collaborative marketing strategies. According to the various logistics links that customers participate in, the port can also offer different service contents. For instance, it primarily offers agency, advertising, risk management, and other services to logistics businesses as well as other services to manufacturing businesses.”*

Most significantly, the marketing of port businesses is influenced by the economy and the broader industry environment. Because of state regulation and intervention, the port market features both international competition and regional monopoly. Port businesses need to think about not only where they make money, but where they can grow and what opportunities there are in the port industry. Customers' basic logistics needs can be met with high efficiency and low cost through market segmentation mining; customers' potential logistics needs can be unearthed, and demand can be generated, while customers' own value can be increased, all through market segmentation mining. Additionally, ports need to develop the logistics supply



chain by concentrating their marketing efforts on how port businesses can pool their resources and form marketing alliances with logistics and internet businesses in order to gather customer data.

### **4.3. Network advantages (cooperation perspective)**

#### **4.3.1. Port group merger**

When asked about the competition and cooperation between ports, participants frequently referred to the structural reintegration of ports, which has been a recent trend in Chinese ports. Generally, port group mergers are considered an important means to optimize resource allocation and improve the competitiveness of regional ports (as port clusters rather than individual ports). Three codes, namely *homogeneous competition*, *resource integration and coordinated development* are analyzed separately as the reasons, benefits and future potential of port group merger.

##### *Homogeneous competition*

During the interviews, many market leaders on the port side stated that port competition in China was extremely fierce, because the surrounding ports were seriously homogenized with high overlap of their hinterland. Two typical examples are the competition between Shanghai port and Ningbo-Zhoushan port for the hinterland supply of the Yangtze River Delta, and the competition for the hinterland supply of Guangdong, led by Shenzhen port and Guangzhou port, in the Pearl River Delta port cluster. The passage quoted below by a manager of the port business department in Interview No. 29 reflects the fierce competition in the homogenization of Chinese ports:

*“Because the majority of China's ports are political achievements, we must obtain the goods despite homogeneous competition and even a price war. Local port enterprises make up the majority of port companies in China. Local governments have invested in port*

*expansion in order to achieve political accomplishments. What should we do, if, after the construction of the new port, the cargo volume cannot be reached? The only solution is to develop new markets. Therefore, despite the fact that each port has unique characteristics, for instance the disparate development mentioned by the Guangdong province, they will still make a few slight tweaks and there must be more rivalry.”*

From the perspective of market distribution, identical-sized ports should not be constructed within 200 kilometers of one another. According to another participant, however, China's coastal regions have developed a port system with an average of more than 1,000 tonnes per 50 kilometers, characterized by a shared hinterland. Neighboring ports have similar functional structures and overlapping hinterlands, resulting in severe structural overcapacity and intense competition. Consequently, the primary objective of the merger of port groups is to combine ports with similar functions and overlapping hinterlands in the region. Through administrative and market means, the integration and operation of regional ports can be achieved to varying degrees, and a reasonable division of labor and orderly competition can be established in the layout of the port industry, so that the resources of the port group can be effectively allocated, thereby maximizing its competitive advantages and achieving high-quality, sustainable development. At present, ten provinces in China have already established provincial port groups, while other provinces are actively considering strategies to integrate ports within their provinces.

#### *Resource integration*

In multiple interviews, resource integration was cited as the primary advantage of merging ports into port groups. The objective of the integration of port resources is to continually optimize the allocation of resources between ports, clarifying the functional positioning of ports, and better exploiting the synergistic effects of the division of labor in the port industry through the sharing of resources and complementary advantages. The competitiveness of the

port system can be achieved through strategic cooperation between governments or contractual relationships between businesses to link their respective industrial chains into a collaborative network. A representative statement was made in Interview No. 24 as follows:

*“At present, China's ports still have problems such as weak service capacity, single function, traditional basic services as the main business, and weak service functions such as commerce and logistics. Through port merger, they can build a good regional port industrial structure layout, optimize and improve the port functions, realize the unified planning of port groups and complement each other's advantages, effectively reduce the competition and consumption among ports. Port enterprises can better cultivate their core capabilities, realize the continuous optimization and innovation of the supply chain, so as to achieve the goal of upgrading and transformation.”*

A number of respondents voiced the critical suggestion that the necessity and effectiveness of resource integration should be examined. The first concern is if the integration of resources really avoids repeated investment and reduces transportation costs. The second is whether the new mode of port operation actually benefits the social economy, or whether a "one-province-one-port group" model is consistent with market rules. The port industry itself has some degree of monopoly due to its irreplaceability. Independent port enterprises in the past did not have much influence on ship-owners and cargo owners, but with the integration of port resources to form mega-port groups, the monopoly of enterprises has become possible, while weakening the original competitive market ecology.

#### *Coordinated development*

The integration of port resources continues to advance, effectively coordinating the functional positioning of ports and realizing their sustainable development. On the one hand, port

integration accomplishes efficient preservation and sensible development of limited coastal resources by making the most of these assets, using them intensely, and maximizing their benefits. Port consolidation, on the other hand, improves internal resource allocation. Implementing rules pertaining to the integration of port resources would lessen construction duplication across many ports, standardizing port layouts and port function planning, and saving financial resources. An eco-friendly, people-focused port complex could be built via the use of green transportation methods, intelligent port service systems, and pollution-prevention and emission-reduction technology. Taking Liaoning Province's port merger as an example, one participant expressed concerns and made suggestions in Interview No. 10:

*Liaoning's government is in charge of port integration for the most part. This mode can provide unified planning and management of port layout and construction from a macro perspective and improve the efficiency of port integration. However, it is easy to ignore the development intention of the ports themselves, which affects the synergistic development of ports. As each coastal city in Liaoning has different economic, resource, and industry strengths, port integration needs to improve the operation and management mode of port integration based on the strengths of each port's industry and willingness to join. The Liaoning port cluster also has good location advantages and a large economic hinterland. However, there is no good synergy between the port industry and the development of the city economy, and the link between the port and the city is not close enough. This means that the development mechanism of the port-industry-city linkage still needs to be studied more.*

#### **4.3.2. Cooperation between ports**

Cooperation between ports, which is a part of the co-opetition between ports, is one of the most common occurrences in port practice and was mentioned by most participants. Hintjens (2018) pointed out that port-to-port cooperation increases the competitiveness of ports in the area, increasing their market share. Inter-ports cooperation, according to the views of participants, might be the cooperation between ports providing complementary services (the

cooperation between *hub ports and feed ports*) or different forms of cooperation between ports at the same level, such as *equity cooperation* and *technical cooperation*.

#### *Hub ports and feeder ports*

Since hub ports and feeder ports vary in size, water depth, port specialization, capital and technical capabilities and resources, it is clear that these ports can collaborate together to maximize efficient utilization and to improve their combined strengths. A cluster of ports in a region allows individual ports to pool their resources and offer unique and specialized services to their customers. The overall competitiveness of regional port groups can be boosted by a reasonable division of resources and labor among ports in the maritime supply chain, which attracts more hinterland cargo sources and port ships to call.

The cooperation between seaports and inland ports is one of the most frequent examples of this type. Since seaports in China primarily compete in the inland hinterland, the capacity of hub ports or trunk ports to draw more goods from inland sources is a significant indicator of their competitiveness. The benefits of collaborating with inland ports go beyond simply increasing the volume of goods that pass through them; they also include lower transportation costs, easier access to inland markets, and relief from port congestion. Take, for example, the competition between the ports of Shanghai and Ningbo Zhoushan for inland cargo, as described by a port expert in Interview No. 25:

*“The Shanghai port and the Ningbo Zhoushan port are actually engaged in intense competition on all fronts. In order to transfer the cargoes near the Yangtze River to Ningbo in Taicang port for loading onto larger ships, for instance, Ningbo Zhoushan Port is attempting to increase its market to the Yangtze River area by various ways. Shanghai Port has also discovered ways to acquire more shares or even control the capital of small terminals close to*

*the Yangtze River in order to compete for the cargoes here. There is rivalry in their rail-sea intermodal transportation as well. Since Ningbo's sea-rail system was initially well established, the Shanghai port established a permanent committee to monitor sea-rail transportation as well as to divert inland cargo to the Shanghai port via the railway. As you move further inland, there are more ports available for the transportation of your cargo, which is primarily why this happened.”*

At the same time, small inland ports also want this kind of cooperation, particularly when they encounter bottlenecks or problems in their functions. For example, many small ports on the Yangtze River have to bring in the Shanghai port in order to boost their sales. Hence there will certainly be a variety of cooperation between ports of different sizes.

#### *Equity cooperation*

In contrast to the straightforward cooperation between ports of various sizes, the relationships of cooperation between ports with similar functions are more complicated and frequently driven by interests. When asked about the way a port cooperates, equity cooperation was considered by most participants to be the most effective and secure approach. Capital cooperation between ports can, on the one hand, reduce operational risks. Building and maintaining a port requires a sizeable investment and long-term financial support, making the risks involved greater. On the other hand, capital cooperation can enhance market penetration. In order to achieve significant regional business unification and the growth of foreign business, the long-term development of the port cannot be solely focused on a small area, but must also involve ports and shipping companies outside the area in accordance with their individual strengths and business scope. Using the two biggest ports in the world as an example, experts discuss the cross-shareholding between Shanghai Port and Ningbo Port in Interview No. 23:

*“In 2018, Zhejiang Seaport Group invested RMB 5 billion in Shanghai Shengdong International Container Terminal Co Ltd, a wholly-owned subsidiary of Shanghai Port Group. Following the capital increase, Shengdong's equity was held by Shanghai Port Group and Zhejiang Seaport Group, respectively, at 80% and 20%. In 2020, Shanghai Port paid RMB3.7 billion to subscribe for 5% of Ningbo Zhoushan Port's shares, creating a cross-shareholding between the two parties. This equity partnership improves the asset and liability structures and lowers financial costs. It also introduces strategic cooperation between Shanghai Port Group, optimises the integration of port resources in the Yangtze River Delta region, and realises synergistic development of the port group. It also strengthens the operating strength of the Yangtze River Delta region and solidifies the company's leading market position.”*

Through equity cooperation, port enterprises can further enhance the benefits of integrated and synergistic development between regional ports, allocate resources effectively, reduce internal competition, and receive other benefits that are conducive to enterprise development. For large ports, cooperation with neighboring ports through the acquisition of equity can promote their development into international shipping centers with the ability to allocate global shipping resources and share the development dividends.

#### *Technology cooperation*

Cooperation between ports on a technical level is regarded as a highly promising option. Firstly, the sharing of technology between the two ports enables them to gain advantages from one another without compromising their core interests. Secondly, when it comes to brand new and emerging technologies that call for large financial outlay, ports may share the outcomes of their inputs and the dangers associated with their investments by establishing cooperation agreements with each other. Thirdly, one of the most essential things that can be done to promote green and sustainable growth is for ports to regularly discuss information management and energy technology concerns with one another.

### **4.3.3. Cooperation with stakeholders**

#### *With shipping companies*

Cooperation between shipping companies and ports, two of the most significant issues in maritime logistics, may help integrate the maritime logistics chain to a larger degree and increase maritime efficiency. On the one hand, shipping firms are required to choose a zone in which they will conduct operations. If the port and the shipping industry work together to guarantee that a significant portion of the port's flight frequency is maintained, then the port will be in a position to boost its competitiveness, which is critical. For the shipping company, it can obtain priority in port entry, loading and unloading services at the berth, reduce waiting costs and ensure ship schedules. On the other hand, a cooperative project between ports and shipping businesses may improve the efficiency and stability with which shipping companies move their goods. Additionally, since shipping companies and ports are not in direct competition with each other, it is much simpler to develop vertical collaboration between the two types of businesses.

The primary ways in which shipping companies participate in ports are as follows: first, shipping companies invest in container terminals in ports, which often offer services to the community, but where the shipping company's own ships have priority to call; second, shipping companies invest by purchasing a proportion of the port's shares. Such a mode of cooperation enables port businesses to cut costs associated with investments in fixed assets, which in turn reduces investment risk. At the same time, it enables shipping companies to align their interests more closely with those of the port, creating a community of interest that benefits both parties, and allowing the port to obtain additional sources of goods. Additionally, the shipping firm has the opportunity to gain income from the operation of the terminal and to cut their own operational expenses.



*With cargo owner*

Ports, in addition to cooperating with shipping firms, may also look at the possibility of forming partnerships with the cargo they service, i.e. some of the large businesses. A collaboration of this kind is often regarded as the most efficient way to ensure that productivity is sustained. This is due to the fact that major cargo owners, as compared to shipping corporations, are in a better position to directly select which port serves as the most direct client. As a result, ports may assist in boosting the competitiveness of their networks by giving them access to a wider variety of services in order to foster the development of connections that are sustainable over the long run. A quote from Interview No. 15 provides the following explanation for why collaborations with cargo owners are necessary:

*“The port needs to cooperate with the cargo owner from hinterland, that is, the port is an important node, this node should play a hub role. Large enterprises such as Anshan Iron and Steel in Liaoning and Maanshan Iron and Steel in Anhui, and so on. I think we should form deeper cooperation with the enterprises, that is, at least long-term contracts or long-term alliances. I think the alliance should be developed on a long-term basis, because the inland hinterland enterprises usually have a choice of ports. So, the port has to be established with the larger companies in the region and then form a network of corporate links, not just a hinterland. It is a particularly open and complex network, which is why it is called a hinterland network.”*

*With service provider*

Ports may also aim to build cooperative relationships with key service providers in order to increase the overall quality of the services they offer, while also increasing their own level of

competitiveness. The investigation of different types of collaboration between ports and cross-border e-commerce is one excellent example, as the following quotation states:

*“Cross-border e-commerce is not only an important part of digital trading, but also a new driving force to promote the building of a strong trade nation. In recent years, Beilun Port has taken advantage of its resources to cooperate with cross-border e-commerce service providers to explore new modes of development, such as jointly establishing bonded warehouses to cultivate new advantages in participating in international economic cooperation and competition.”*

As a new trend in foreign trade, cross-border e-commerce business brings certain opportunities for the logistics supply chain market, and also puts forward requirements for the current logistics supply chain market from multiple layers. To increase the overall responsiveness of the logistics supply chain, collaboration and synergistic growth between ports and cross-border e-merchants is essential. It is possible to effectively improve the logistics service experience that customers have when they engage in cross-border online shopping by establishing bonded warehouses and overseas warehouses. This improvement in service experience will also drive the further expansion of the cross-border online shopping market, resulting in a situation in which ports and cross-border e-commerce companies both emerge as winners.

#### **4.4. Sustainable advantages**

##### **4.4.1. Green development**

Most frequently, when responding to questions about port sustainable development, respondents placed priority on whether the port development could be green and avoid negative environmental impacts. As hubs of multimodal transport, ports are also hotspots for

the concentration of energy-intensive fuels, fossil fuels accounting for the largest share of logistics and transportation energy needs at present, resulting in harmful air pollution and greenhouse gas emissions. The environment is also impacted by every activity that occurs in a port, including the sewage, gases, garbage and refuse produced during port operations, as well as the noise and pollutants produced by ships in port (Lirn *et al.*, 2013). Port development is frequently seen as an exchange of economic benefits at the expense of the environment, and the environmental impact of ports has long gone unappreciated. Building green ports and managing the balance between ports and the environment is a new direction for ports, because environmental damage can impede their development process.

The majority of participants concurred that green ports are essential for the ability to remain competitive in the long run. However, neither the attention paid by port managers nor academic research on the environmentally responsible development of ports is obvious at the current time, which may be due to certain resistance or difficulties. The primary focus of this part of the analysis is on the *green criteria* for ports operation and the *power of execution* behind green development in ports.

#### *Green criteria*

As the shipping industry pays greater attention to transport pollution and greenhouse gas emissions, a growing number of policies and regulations, such as the IMO 2020 sulphur limit regulation and national carbon reduction targets pose challenges to port development (Sys *et al.*, 2016). The current green criteria of China's ports are based on the clear requirements of various aspects of green port construction proposed by multiple departments, with the level of port pollution prevention and control as the main indicator. This consists primarily of specific actions to prevent and control pollution from ships and ports, as well as plans and measures to comprehensively and systematically enhance the capacity to prevent and control pollution from ships and ports in terms of transport restructuring, prevention and control of pollution

from mobile sources, use of shore power by ships in port, air pollutants from ships and ports, and treatment of water pollutants.

Participants generally were of the opinion that the influence of the green criteria on port competitiveness cannot be understated. China's green port development is either significantly behind the curve, or has a long way to go before it reaches international standards. A significant quote in Interview No. 26 shows the gap between the green development of Chinese and international ports, and why there are differences in green criteria, as follows:

*“There is a real gap between China's green development and that of international ports, but of course there is also great potential for development. Because our emissions are still mainly controlled in sulphur oxides, our emission requirements have not yet reached the level of similar foreign ports, whether from the perspective of port construction to operation are still in the gap. This is why the highest rating for Chinese ports is 4 stars by China's port associations. We have not seen any ports that have reached 5 stars under the highest 5-star standard, and indeed have not actually reached the standard. On the other hand, it is a serious challenge for Chinese ports to raise the green standard to a certain level. Because of the high port throughput in China, our current emission standards are actually lower than those in Europe and the US. Even if we meet the same level, the general public may still be dissatisfied with us because our total emissions are even higher due to the higher total throughput. With so many people in the city, however, the air can only contain so much particulate matter or nitrogen oxides. As a result, the requirements for China's ports will become even more stringent in the future, and this will be a critical factor in determining whether China can lead the world in the development of first-class ports to a higher level. As a result, China tends to be more diverse in its measures to promote green development: we are involved in shore power, natural gas, and clean energy. Only in this manner can we adapt to the needs of the general public and improve the efficiency of our ports.”*

Moreover, some scholars and experts have expressed the need for a more comprehensive understanding of the mechanisms of green ports, such as the construction of green ports to drive urban development and promote good social effects. However, the perception of green ports by port managers based on policy requirements and related interests remains at the level of energy saving, emission reduction and pollution control. In addition to the requirement to develop a circular economy, ecological construction and protection, and the treatment of pollutants, the more rapidly developing ports have begun to further promote the green ecological construction of their hinterland cities by strengthening their interface and cooperation with industries and cities. It is clear that the criteria for a green port should not only be based on the performance of the port itself, but also on the green operation of the whole industry and the long-term ecological stability of the city.

#### *Power of execution*

Another issue of concern in the development of green ports is whether there is sufficient driving force in the actual operation and development of the port, because many port practitioners in the interviews said that green standards may bring pressure on the port in the short term. Although low-carbon and pollution prevention and other green development goals for ports are significant, short-term actions to achieve these will inevitably lead to higher costs. Therefore, it is concerning that businesses place profit before the willingness to implement green standards in ports. The following statement from a port manager in Interview No. 22 is a good example of the willingness of the port operator:

*“From the standpoint of human development, it is necessary to promote the growth of green ports, but in real life, port businesses are not pushing in time, and the urgency is not great. This is mainly because the government is still not forcing it, but is encouraging it.*

*Major corporations will have a tough time promoting this right now, and the resistance is not on our side. Companies are hesitant to sacrifice their own interests unless the state compels them to do so. This is why investigating green ports is so important: we need to know what it is that ports are missing and how we can fix them.”*

The main driving force for the green development of ports can be summarized as coming from the policy constraints of national and local governments. A further interesting point raised by the participants is that ports may be motivated by how much of an impact they have on the urban environment. The need and motivation for the port to promote green development will be determined by a number of factors, including the level of development of the city in which the port is located, the port's distance from the city center, and the type of goods that the port primarily serves. Here some examples of Chinese ports were provided by the shipping company manager in Interview No. 8 based on his knowledge, as follows:

*“Although Lianyungang and Rizhao are not particularly big ports, the volume of bulk cargo can be very large because of their remote location and minimal impact on major cities. Some of the terminals in the Ningbo Zhoushan port are basically on small islands that don't have any significant urban centres nearby. Shanghai is different: Shanghai, along with many other cities along the Yangtze River, is China's most economically developed area, with higher expectations for pollution control and environmental protection. Similarly, Tianjin Port, Qinhuangdao Port, and other large ports in the north are doing less and less bulk cargo due to environmental protection regulations, especially coal-based ports after the amount of bulk cargo will decrease, so these ports are desperately trying to transition to container development.”*

In addition, technology may be a significant and positive driver of sustainable port development. In the interviews, practitioners from large ports generally felt that the green

development of their ports had reached a relatively stable and favorable stage, meaning that they would not sacrifice efficiency and resources due to government demands for green development. By contrast, they believed that the promotion of green ports through technology may bring new opportunities rather than pressure to ports, as technological advancements will enable the green development of ports to achieve a balance between efficiency and the environment.

#### **4.4.2. Technology development**

With the persistent growth and improvement of information technology, the ports of the world are undergoing a transition toward greater levels of intelligence and digitalization. Ports are paying greater attention to scientific and technical innovation, and they are moving information construction forward more quickly as a direct result of new technologies. The development of new technology has emerged as a critical component in determining the long-term competitiveness of ports. There follows an analysis of *blockchain technology* and *terminal automation*, as representative technologies based on ideas of participants.

##### *Blockchain technology*

Blockchain is a distributed ledger consisting of copies of data organized into blocks utilizing decentralized storage types (Tsiulin *et al.*, 2020). This emerging technology aspires to store and transmit data in a more secure, transparent and decentralized manner. Blockchain technology in the port and shipping industry is currently mainly applied in the business areas of cargo traceability, electronic bill of lading, supply chain upgrading and trade data sharing. Many relevant examples were given by participants, such as the application of blockchain technology having a positive impact on the realization of paperless bills of lading, enhancing cargo traceability, standardizing smart contracts, improving the utilization of shipping data and improving supply chain networks. In Interview 21, a technique manager summarized the

main reasons why blockchain technology fits in with the development of ports and is of high interest, as follows:

*“Despite the fact that the application of big data, the Internet of Things, artificial intelligence, and other technologies can improve the efficiency of container shipping and reduce human costs to some extent. The international trade of container shipping is afflicted by fragmented data, closed information, cumbersome processes, and lengthy cycles. However, the circumstances of blockchain technology's use are consistent with the features of container transportation, such as big scale, time-intensive, multi-party cooperation, and credit dependability. The Internet may serve as the foundation for a blockchain-based system of high-credit, large-scale cooperation. Applying blockchain technology to the container shipping sector may not only address present industry challenges, but also accelerate shipping informationization, optimise the shipping operating environment, and facilitate the sharing of shipping resources.”*

Blockchain technology also helps to integrate data resources and ensure that data is authentic, secure and visualized, according to other participants. The various participating subjects on the blockchain are able to share data and give full play to the commercial value of data. Using blockchain technology can realize full data coverage of information flow, logistics, capital flow and trade transactions, opening up the blockages between information systems, and realizing the unification of underlying technical standards in each information system. Taking advantage of the decentralized shared ledger, each participating entity can enter and query data information, but cannot modify the historical original data on the chain, while the historical data are traceable, ensuring the authenticity and security of the data.

Participants felt that, despite the potential of blockchain technology in ports, its use was still in its infancy, and there were numerous issues to be resolved in the future. A manager of



Dalian Container Port believed that, despite the fact that blockchain technology has already been implemented in Dalian Port (blockchain electronic cargo release platform), the cost of this technology is currently high and, from an economic standpoint, it is only appropriate for the larger stakeholders to implement at this time. In terms of data sharing throughout blockchain technology, an expert from Shanghai International Shipping Institute suggested that if ports want to collaborate on data via blockchain, it is best to bring in a third party as an independent blockchain platform to avoid competing conflicts of interest between collaborating participants.

### *Terminal automation*

Terminal automation refers to the complete or partial replacement of human terminal operations with automated equipment and procedures (Knatz *et al.*, 2022). Container ports often have a high volume of goods to process; therefore, it is crucial to find efficient and cost-effective ways to increase production efficiency and maintain competitiveness. The development of automated technologies is crucial here, even if it is simply to use information technology to monitor terminal assets and support the workforce.

The port automation system is comprised of pertinent intelligent solutions that allow port machinery, automated guided vehicles (AGVs), rubber-tipped gantry (RTG) cranes, closed circuit television (CCTV), optical character recognition (OCR) of container numbers, and other systems to operate continuously and reliably. These systems transmit a large quantity of real-time data to the port control center, allowing operators to quickly and actively identify and resolve real-time issues. In comparison to the conventional terminal, the automatic terminal not only improves loading and unloading efficiency, but also reduces labor costs and promotes environmental sustainability. Many port researchers agreed that the innovation of

automation technology will be a future trend, as an office director mentioned in Interview No. 23:

*“Future expansion is possible for the application of automation technology. In fact, the cost of labour is constantly rising in ports in many nations, including China, Europe, and the United States. Promoting the progression of automation technology, in the eyes of terminal operators, can significantly reduce the future effects of human uncertainties on port operations. As an illustration, in the same two ports in the United States, one terminal is an automated terminal, and the other is not. The automated terminal might experience less human interference. Therefore, I think the application of automation technology will, in the long run, contribute to the improvement of the competitiveness of the port.”*

From the perspective of certain port professionals, however, automation technology may still have some limitations or challenges that prevent its widespread use. Economic costs and return on investment are a major concern for many ports hesitant to use automation technology. Participants working in the ports of Ningbo and Dalian claimed that their ports are currently in a wait-and-see or relatively pragmatic position, taking into account the economic costs. In terms of considering the construction of unmanned terminals, they are already behind in terms of results, but they felt that this has not affected the production results of the ports to any great extent so far. The managers of the shipping company also stated that they have not yet seen any data studies in China demonstrating that the automation of a port can reduce the cost of a single container, and that some related studies are speculative and imprecise, and lack real operational data. In Interview No. 19, the following quote from a port expert reflects his view of the social impact of automated terminals:

*“It is important to think about how to connect with social development after our ports*

*have been automated with unmanned terminals. It is because, along with urban development, the port used to be the most significant source of employment. It is crucial to think about whether technological advancement can reflect the synergy of social and economic development because the number of jobs provided by ports may decline over time, making the development of unmanned terminals not necessarily good for the development of society.”*

The common view from the interviews was that the technological development of ports needs to be synergized with the sustainable development of ports and cities. How to use technology applications to create real value is key to improving the competitiveness of ports. As automated terminal technology matures and may reduce the demand for labor, ports should consider how their contribution to society can be driven by their own demand for skilled personnel. Automated terminals are a means, not an end. Smart ports and sustainable ports are where the future trend of port construction lies, as technologies such as artificial intelligence, 5G, digital twin and driverless vehicles arrive in ports, and applications like smart cargo handling, smart gates and smart security continue to emerge.

#### **4.4.3. Transformation and upgrading**

When it comes to a port's understanding of sustainability, experts claimed that this now only encompasses environmental sustainability. It was also considered crucial to retain sustainable competitiveness in the future for ports to adapt to industry changes, appraise their own characteristics, and take revolutionary action if necessary. As a result of the fast expansion of contemporary logistics businesses, ships are rapidly transitioning toward more specialized configurations, including those capable of carrying big and deep-water containers (Czermański *et al.*, 2021). As port throughput increases and the structure of the port transport cargo category shifts, the direction of port services needs to be constantly expanded and adjusted, while the port development mode and the port industry need to be adjusted significantly. Traditional modes of operation can no longer meet modern needs, and most

ports are considered to be in urgent need of transformation and upgrading. Port transformation and upgrading is also believed to be an important path to achieve high-quality port development. Due to the different sizes of ports, they may need to first consider whether their own transformation goals are to survive or to thrive. Several participants said that the key to transformation and upgrading is to *adapt to the needs of the city and industry* as the development goal, according to their own functional positioning.

### *Different objective*

While large ports have the main objective of serving the international market, the number of small ports that depend on the local economy is often much higher. One argument from a port expert was that small cities are under much more intense pressure to transform due to their limited economy, and it was impossible to reverse such a trend in the near future. An example of an existential crisis in ports due to changing industry trends was cited in Interview No. 19 as follows:

*“For instance, the most significant challenge that Rizhao Port will face in the near future is that its primary source of competitive advantage is in the form of bulk commodities, which can be either dry bulk or liquid bulk. The market for dry bulk commodities, such as coal and iron ore, is almost certainly going to experience a considerable decline in the near future. It is likely that there will be less of a need for oil during the next ten years due to the proliferation of alternative energy sources and the introduction of an increasing number of automobiles that run on alternative fuels. At this moment in time, many of your crude oil terminals are unable to be converted. This is due to the fact that many of the larger investments in pipelines located within the terminals have become abandoned, and it is difficult to maintain sustainability with more abandoned equipment”.*

Therefore, it is necessary for smaller ports to conduct a self-recognition and risk assessment

prior to the process of upgrading and transformation, since it may pose a threat to their continued survival. In fact, small-scale ports do not need to compare or compete with major ports; instead, it is sufficient for them to serve the local economy. The economy of a port is consistent with the growth of GDP of the city in which it is situated. The key to development for small ports is to boost their efficiency in order to have the chance to survive. Small ports must be proficient at their core competitiveness.

In order to preserve a port's ability to remain sustainably competitive over time, large-scale port upgrading and growth plans may need to take into consideration a wider variety of elements. According to the personnel engaged, several ports located in strategically vital places, including Shanghai and Ningbo ports, do not show a significant amount of worry over the sources of their cargo. However, the objectives of these ports and the expectations of the cities in which they are situated sometimes extend beyond straightforward performance improvement and uninterrupted business as usual. Therefore, in order to maintain a high degree of sustained competitiveness, more in-depth planning, as well as multiple transformation and upgrading measures will need to be implemented.

In the not-too-distant future, another survival issue that needs to be taken into consideration is how to reduce the rate at which other modes of transportation can replace sea transport. Despite the fact that air transportation is still considered a specialized service for high-value-added cargo, the fast-paced growth and increasing standardization of the aviation industry indicates that the percentage of freight that is moved via aircraft is likely to increase in the coming years. Ports have to proactively develop their service activities in line with their own positioning and build a service system that is clearly positioned, hierarchical, and coordinated across the board. To further enhance their sustainable competitiveness, hub ports should further improve loading and unloading efficiency, warehousing, collection and distribution systems, and consolidate the strategic layout of waterless ports. Feeder ports should actively explore their own advantages and strengthen their synergy and interaction with hub ports.

*Adapt to the needs of the city and industry*

Because the various ports each have a unique function and possess unique characteristics, the transformation strategies that are appropriate for each port are distinct from one another. However, a fairly consistent view from participants was that rather than concentrating on maximizing short-term earnings, a port must consider its role in serving and integrating with the city as part of its transformation and upgrade. At the same time, it should depend on the impact of "industrial agglomeration" to promote the development of banking, insurance, modern logistics, shipping and other service industries. This will help to fuel economic growth. The business transformation of Shanghai Port was considered a good example. The relevant statements from Interview No. 22 are as follows:

*“The idea of sustainable ports has changed over time. Consider the port of Shanghai, which is currently experiencing a decline in importance. Due to the increased number of large businesses that contribute to Shanghai, the negative effects of traffic congestion and pollution brought on by the port of Shanghai are now more apparent than ever. The integration of the port, industry, and city has received a lot of attention as a result of the port's transformation in Shanghai. Rather than relying solely on the traditional port function, the port has shifted its profitability into real estate and finance and integrated with the city rather than focusing solely on how to increase throughput and expand terminal infrastructure. Because there aren't many sources of cargo, it will be challenging for the port to increase its competitiveness through infrastructure development once the demand is eventually saturated.”*

The port should shift its growth strategy away from a concentration on conventional loading and unloading capacity, and toward a greater emphasis on value-added services. Businesses located in ports need to take an active role in integrating into the global logistics supply chain by aggressively developing professional logistics services such as distribution, processing,

distribution and freight forwarding. According to market demand, it is necessary to carry out diversified management, based on the primary business of the port, strengthening cooperation with related industries, and vigorously promoting the joint operation of the port with shipping, trade, finance, real estate, and other industries, extending the port logistics industry chain, in order to achieve transformation to the fourth generation of ports.

#### **4.4.4. Talent attraction and cultivation**

Participants believed that the sustainable competitiveness of ports is also dependent on the attraction and cultivation of talent, as the competitive dynamics of port companies will continue to escalate in the future. Building world-class ports and seeking high-quality development are the main goals of port enterprises. However, the benefits that port businesses have historically relied on for growth, such as the release of policy bonuses and affordable labor, will gradually disappear. Innovation and creativity will guide port enterprises in the future, increasing the demand for innovative talent. As a result, the demand for high-level talent in ports is increasing, and competition for port talent is becoming more intense. According to participants' key statements in terms of port talent, ports should focus on what *types of talent* were perceived to be in demand and how port enterprises should implement *talent attraction* and *talent cultivation*.

##### *Types of talent*

The development of ports shows diversified characteristics in terms of the demand for talent, so the views on this topic in the interviews were relatively diverse. Three types of talent can be summarized as being in short supply for the port seeking to improve its sustainable competitiveness, including logistics talent, strategic talent and technical talent.

The concept of logistics talent is relatively broad, encompassing distribution personnel, warehousing managers, transport managers, customer relations managers, customs brokers, etc. Logistics personnel must be familiar with the operational characteristics of the logistics industry and apply their expertise in the areas of logistics management and logistics engineering. With the rapid growth of the logistics industry, port logistics companies have a greater need for logistics talent, particularly middle- and upper-level talent. At this time, however, the talent developed through logistics education is deemed insufficient to meet the needs of businesses.

Strategic talent is a term used to describe senior-level personnel who are exceptionally competent and have a clear picture of how the port can be improved through strategic planning for its transformation, upgrading and development. This type of talent is capable of adjusting to the intense competition in both domestic and international markets as well as the demands of industrial development. It can also analyze specific port development strategies in light of each port's positioning and strengths and weaknesses. Furthermore, it has been argued that this talent must have an international perspective, particularly for the major international hub ports that aspire to provide advanced port services such as finance and law in the future.

Technical talent is integrated talent relying on cutting-edge technologies, smart port systems and logistics information service systems. Technical professionals are skilled at applying new technologies and basic theoretical knowledge, particularly in information technology. With the rapid development of the Internet, artificial intelligence and data mining technology, the traditional transport industry is also rapidly becoming intelligent, smart and green. In order to lead the innovative practice of port applications, ports urgently require innovative technical personnel who are aware of, and capable of their own independent innovation.



### *Talent attraction*

Ultimately, the competition in a port will come down to who can attract and retain the most talented staff. The concept of talent today is broader than it was even just a few years ago: it incorporates a global outlook, a flexible mindset, and a solid professional foundation, in addition to being highly skilled. However, the strategic planning of talent management in Chinese port enterprises was deemed lacking, and the management concept of talent was deemed to be at an outdated level, failing to take into account the needs of talent in their own right. This series of flaws prevents the quantity and technical quality of port talent from meeting the requirements of businesses. In Interview No. 28, a port manager mentioned that some major ports have recognized their shortcomings in attracting talent and have increased their commitment to it:

*“Initially, Shanghai did not pay any attention to talent which was willing to move there, but recently, the city has stepped up its efforts to incentivise top professionals. Over the past three years, the Shandong port has fueled innovation and talent by bringing in industry leaders and experts to work on joint projects with businesses, as well as by establishing a hub for port-based technological advancements. It is much easier to introduce new talent when a platform or project is set up in this way, and it also more closely aligns with leading-edge technologies and research hubs, which speeds up the implementation of findings.”*

In addition, a port must have the capability to retain talented employees once they have been recruited. The port will be able to encourage talent to explore difficulties and make breakthroughs in technological innovation by putting into action innovation incentive projects, improving the reward distribution and talent incentive system, and increasing policy and financial support.

### *Talent cultivation*

Improving the overall quality of port personnel requires not only recruiting and retaining a greater number of skilled workers, but also enhancing on-the-job training and continuing education opportunities available to those who are currently employed in order to increase their level of expertise in contemporary forms of logistics. Effective implementation of talent training in terms of building a systematic nurturing mechanism, combining performance incentives, and realizing corporate culture penetration to boost market competitiveness is a key area for port enterprises to study in order to gain a deeper understanding of talent development. The only way for port enterprises to actively update their management practices, improve the overall quality of their talent teams, and better adapt to the development of the times is to adopt a people-centered approach, placing value on the growth of talent resources, and viewing talent cultivation as a strategic issue for their own growth.

The practice of port businesses and schools cultivating talent jointly is widely promoted. A talent pyramid can be created for the port's high-quality development by enhancing the talent team's comprehensive ability, boosting the stock and depth of diverse talents, and cultivating them continuously. According to the comments of X scholars who participated in the training class in Interview Y, however, it was unimaginable for general businesses to conduct such a training class because the trainees must be off duty for several months in order to study in a confined area. The attitude of allowing core staff to take a few months off from work more perfectly describes the port's recognition of the value of talent.

At the same time, it is critical to develop talent with a clear goal in mind, to create a system for talent development that is focused and effective, and to offer talent support for the long-term growth of port enterprises. For instance, since technical and operational skills are the primary strategic resource of port enterprises, attention should be given to their expansion and

development. The port should additionally focus on boosting the quality of its workforce by working to increase internal cohesion, boost employee loyalty, and ultimately boost the organization's core competitiveness. Therefore, it is important for port authorities and companies to have a clear understanding of the strategies that will have a positive impact on the innovation and creativity of port talent. This will provide practical and effective ways of helping port talent to stimulate and enhance their creative and innovative abilities.

## **Chapter 5. Conceptual analysis and discussion**

The results of the previous chapter provide valuable insights into the sustainable competitiveness of ports, highlighting four key categories of competitive advantages. These findings have broad implications for the port industry as a whole, suggesting that certain criteria are universally applicable while also acknowledging the potential for significant variations between individual ports. This chapter seeks to delve deeper into these findings, drawing on data analysis and existing literature to interpret and describe their significance. By synthesizing this information, we aim to uncover new knowledge and novel insights that can inform strategies for enhancing port competitiveness.

To begin, we will explore dimensional frameworks derived from our data analysis, shedding light on the multifaceted nature of port competitiveness. Building upon this foundation, we will then construct a sustainable port competitiveness model that encapsulates the various factors at play in shaping a port's competitive position. Drawing on both our conceptual framework and existing literature, this chapter will culminate in a discussion of seven possible strategies for bolstering port competitiveness. By considering these strategies in light of our research findings, we hope to offer practical guidance for stakeholders within the port industry seeking to enhance their competitive edge.

### **5.1. Dimensional frameworks**

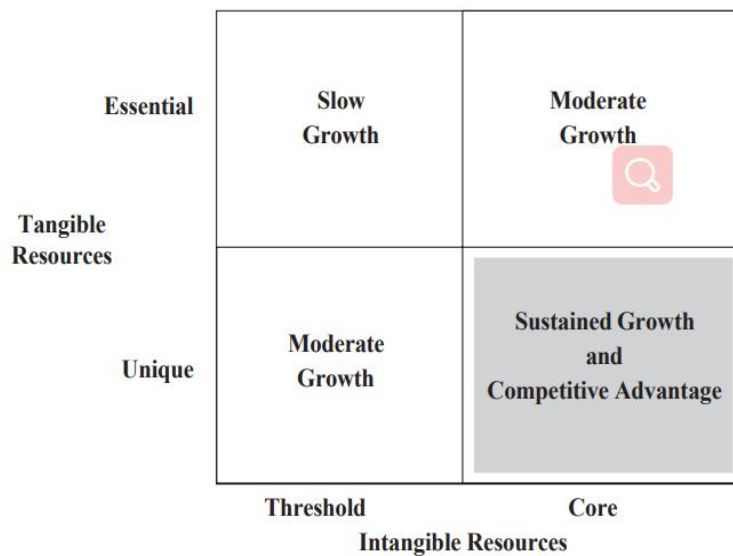
The previous chapter on data analysis presents preliminary findings across four dimensions, each offering insights into the factors influencing port competitiveness. To facilitate a deeper understanding of these findings and their implications, a conceptual framework has been developed for each dimension. These frameworks draw on both the results of the data analysis and existing literature, providing a systematic approach to assessing sustainable port competitiveness.

The conceptual framework serves as a comprehensive guide to understanding how each dimension contributes to port competitiveness and how various components within each dimension interact. By examining these dimensions holistically, stakeholders can gain valuable insights into the multifaceted nature of port competitiveness and identify areas for improvement. Overall, the conceptual framework offers a structured approach to evaluating port competitiveness, allowing for a nuanced analysis of its determinants and facilitating informed decision-making aimed at enhancing sustainability and competitiveness in the port industry.

#### **5.1.1. Resource-based advantages**

Resource-based advantage is recognised as the initial and basic dimension from the research data and is mainly related to a port's own resource conditions. The key rationale for placing it first is that the port's inherent resources are regarded as the fundamental competitiveness element. On the basis of the responses to general questions about participants' understanding of port competitiveness, there are a series of conditions intrinsic to a port that determine, prior to its establishment, if it has corresponding advantages. Such advantages are classified as resource-based because they align with resource-based theory, a developing paradigm that includes notions from mainstream strategy research regarding a firm's distinctive competencies and diverse capacities, thereby giving theoretical propositions with additional value (Mahoney and Pandian, 1992). A further principle of the theory is that in order to provide a competitive advantage, a resource must be unusual, valuable, distinctive and unreplaceable (Otolá *et al.*, 2013). Over time, a competitor may be able to copy or create new strategic resources that provide it with an advantage over the company in question. If a group of resources historically offered a competitive advantage, there is no assurance that they will continue to do so in the future. In an industry, resources that formerly provided a competitive advantage to a business might lose their value if competitors fail to copy them or create new ones.

Port resources may be simply described as any factors (assets) that a port can position as inputs in the production or operation process of the port. This definition applies to both natural and man-made resources. Subhan and Bashawir (2008) classed port resources as internal resources and external resources in a typical corporate setting. The internal resources are those that exist inside the port, while the external resources are those that exist outside the port, but may be handled actively or passively by the port in specific situations, such as via cooperation and partnerships. They constructed a matrix to illustrate the significant part that a port's resources play in gaining a competitive advantage for the port, as well as in contributing to the expansion of the port. As shown in Figure 4-1, a port that is achieving sustainable development and gaining a competitive edge needs to make use of unique tangible resources in combination with core and distinctive intangible resources.



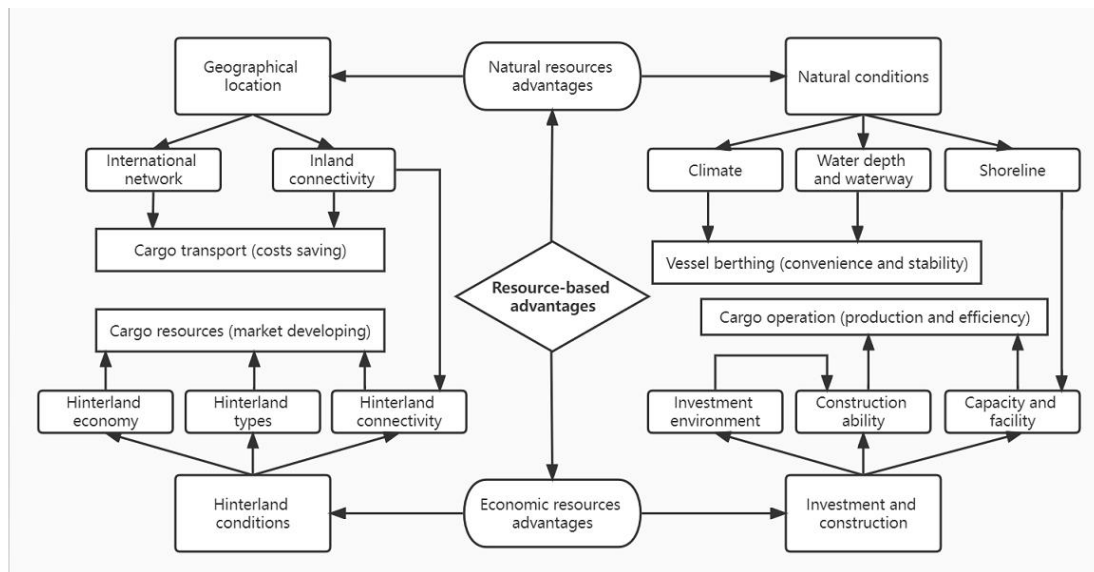
**Figure 5-1** Role of tangible and intangible resources in relation to growth and competitiveness (Source: Author's own elaboration)

Not only did many answers from participants put such factors in first place, but the literature also frequently links port resources with port performance (Talley *et al.*, 2014). From previous port resource studies, it is believed that a port's tangible and intangible resources will play a significant role in the port's performance (Hyuksoo and Sangkyun, 2015). The strategies developed by port firms to rationalize the use of port resources and enhance cargo volume can serve as a significant measure of port competitiveness and survival (Knatz, 2017).

However, the logical connections in the existing literature are predominately based on specialized assessments of various port resource categories, or on the exploration of the variables affecting port competitiveness, while the role of port resources in improving competitiveness has rarely been explored. A notable exception is a study by Hyuksoo and Sangkyun (2015), which investigates three container port resources variables, including infrastructure quality, linear shipping connectivity, and operating efficiency as determinants of container port competitiveness.

It is noted that most previous studies have classified port resources as different determinants of competitiveness using the theoretical foundation of the resource-based view (e.g., Subhan and Bashawir, 2008; Gordon *et al.*, 2005; Beleya *et al.*, 2020). Similarly, the resource-based advantages outlined in this research also align with natural-resource-based theory, an extended form of resource-based view, detailed discussion of which will be presented in the next section. In this research, resource-based advantages are slightly different from port resources. The existing literature classifies port resources as internal and external resources, or as tangible and intangible resources, and subdivides them extensively (Subhan and Bashawir, 2008). Port resource-based advantages, however, are limited to those factors that confer an initial advantage on a port, based on its innate resources. These factors may already exist at the time of the port's construction and may be difficult to alter afterwards.

In addition to analyzing the differences found between the findings and the existing literature, the conceptual framework based on the link between codes within dimensions and sustainable port competitiveness was analyzed. The dimensional framework of resource-based advantages is presented in Figure 5-2, which contains a total of 11 codes in the data and is divided into four groups: geographical location, natural conditions, hinterland conditions, and investment and construction. Of these, geographical location and natural conditions are considered natural resource advantages, and refer to the competitive advantages a port may have due to its natural environment. While the hinterland conditions and investment and construction are categorized as economic resource advantages, the competitive advantage gained by a port is based on the economic context behind it. There are two or three codes within each of these four categories, and they all contribute in their own distinctive manner to the competitiveness of a port.



**Figure 5-2** Dimensional framework of resource-based advantages (Source: Author's own elaboration)

In terms of natural resources advantages, the advantages of a port's geographical location are principally attributable to the port's position in the international route network and its connectivity to interior trade, both of which have a substantial impact on the port's potential to



become a vital cargo traffic node (Peng *et al.*, 2018). This is mainly because the port's primary customers, shipping companies, typically place a high value on the cost of carrying products, and the port's position makes it difficult to alter trip distance. The advantages of natural conditions are mainly manifested in three aspects: climate, water depth, and waterway and shoreline. These elements are closely related to how convenient and stable a vessel's berth is in the port (especially the first two). Port users frequently take this into consideration in order to prevent unnecessary problems, including losses from delays (Elmi *et al.*, 2022).

In terms of economic resources advantages, the competitiveness of a port in relation to the hinterland conditions, which includes elements like the hinterland economy, types and connectivity, can significantly affect the sourcing of cargo to the port. It is worth noting that the degree of connectivity of the hinterland is often linked to the location of the port (inland connectivity) as well, since the ease of access due to distance is the basis for its connection. Another economic resource advantage of a port is its investment and construction context, including the availability of a suitable environment for investment, construction of infrastructure, capacity and equipment. These form the basis for the expansion of the port's operations, while the port's output and efficiency are closely linked to these factors.

In conclusion, the port's resource-based advantages are inherent. While it is challenging for ports to develop strategies to increase competitive advantage in this dimension, it is beneficial for port managers to be aware of the significance of aspects within the framework for port competitiveness and to conduct self-evaluations against the framework.

### **5.1.2. Port platform advantages**

The second dimension of findings, port platform advantages, are the result of data analysis based on the requirements of the various stakeholders in the supply chain. Indeed, ports have

long served as more than just a place for ships to dock and be loaded; they also serve as a complex organization in which many different players and interests coexist, and in which internal and external stakeholders collaborate together to create and distribute wealth or profit while competing based on their own purposes and plans (Song and Parola, 2015). In order to increase their attractiveness to customers, ports must not only focus on providing fundamental services that are effective and of a high quality, but must also place greater emphasis on providing a comprehensive set of logistics supply chain related services through the port platform in order to meet the potential needs of customers throughout the process of transaction. Therefore, ports must boost their value or significance in the supply chain by building their own platform advantages to sustainably improve their competitiveness and forge closer bonds with key stakeholders.

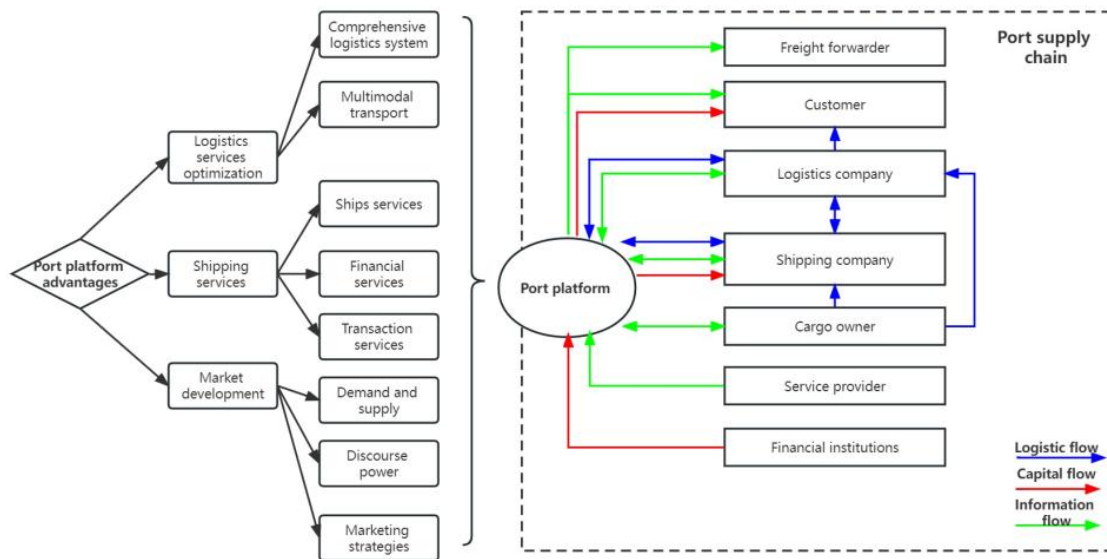
Since the beginning of the twenty-first century, researchers have been examining how ports are increasingly becoming integrated into the supply chain (e.g. Hall and Jacobs, 2010; Yang *et al.*, 2013; Woo *et al.*, 2013). However, most of their attention has been directed toward how the role of ports has evolved and the strategic management of ports. Different from the existing literature, the understanding of port supply chain in this study is not limited to the expansion and extension of port logistics services, but in order to provide comprehensive value-added services to all possible stakeholders, while maintaining a stable collaborative relationship with these roles to enhance the value of the whole chain. Figure 5-3 provides a visual representation of the dimensional framework of port platform advantages.

The left part of the framework interprets the results of data analysis from the previous chapter. There are three groups under this dimension: logistics services optimization, shipping services and market development. These three parts add value to the services provided by ports in the supply chain, and reinforce the interaction with other players in the supply chain in three different ways. Firstly, the optimization of logistics services enables ports to deliver an

increasingly effective service to clients, while maintaining a freight rate that is satisfactory throughout the entire transport. Due to the complexity and diversity of port operation characteristics, there may be many factors and specific strategies related to the optimization of logistics services, but the two most important categories are improvement of the integrated logistics system and multimodal transport, as observed by the participants regarding the future development of ports. Secondly, in addition to providing traditional logistics services, a port is also able to provide a variety of different services linked to shipping in order to satisfy the requirements of clients at every stage of the supply chain. These additional services, which include ships services, financial services and transaction services, are intended to make the port more appealing to clients, and to promote loyalty among clients to the port. The last component is presented as market development, the purpose of which is to support port operators in gaining a better understanding of the situation in the market, as well as the relationship with their market stakeholders and their respective positions, so that they may develop appropriate marketing strategies to attract a greater number of customers.

After accruing the platform advantages discussed above, a port may choose to develop their own platform within the industry. On the right-hand side of the framework model is a representation of the relationship that occurs between the ports and their platform members in the port supply chain network. A port may develop its platform advantage by extending its services provider role, and thus attract more partners apart from customers to join. Platform members include any upstream and downstream port stakeholders who might have a transactional or indirect business relationship with the port, such as shipping companies, logistics firms, customers, cargo owners, freight forwarders, service providers, banks, etc. At least three different flow relationships exist between these roles and the port platform, as shown by the coloured line on the right in Figure 5-3. The comprehensive integration of the port into the supply chain is further demonstrated by coverage of the three fundamental flows of information, capital and logistic flows (Stemmler, 2002).

First, logistics or material flow is the process of transferring goods from the cargo owner's end to the customer through the combined services of port platforms, shipping companies and logistics companies. Capital flow is where the port platform acts as a liaison and guarantor to meet the capital-related needs of customers in shipping services through financial institutions such as banks joining the platform. Finally, all shipping and logistics services provided by the port, including some additional value-added services, can create more efficient information transfer through the connection of all parties to the port platform.



**Figure 5-3** Dimensional framework of port platform advantages (Source: Author's own elaboration)

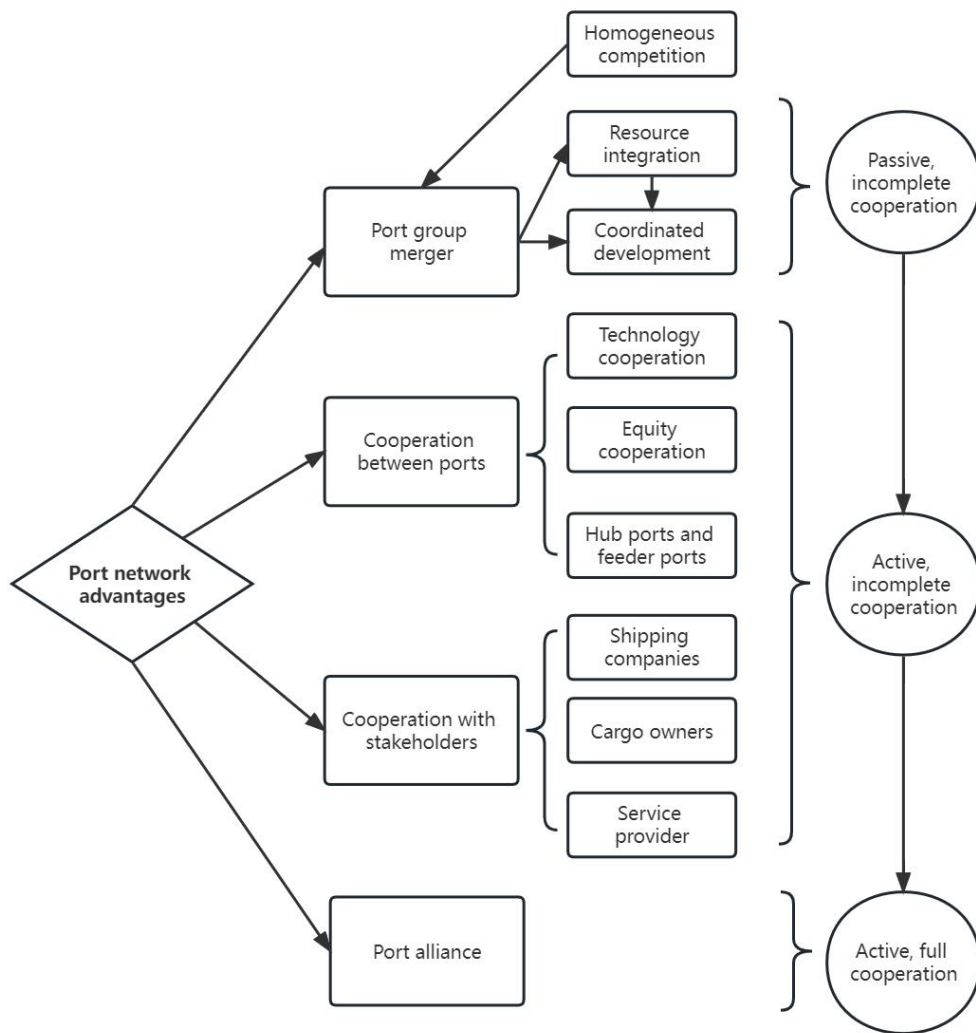
### 5.1.3. Network advantages

The third dimension is port network advantages, which, together with the platform advantage, serves as the port's two strategic advantages. With the development of the study of regional port cluster systems, scholars have gradually discovered that not only are there competing relationships between ports, but that cross hinterlands also facilitate the formation of complementary and cooperative relationships between ports (Wang *et al.*, 2012). Such competitive relationships are an intrinsic motivation for the evolution of port cluster systems (Zhang and Lam, 2017). Therefore, the competitive and cooperative relationship between ports is also considered an important influencing factor for sustainable port competitiveness.

Based on the results of the data analysis in the previous chapter, the possible ways in which ports can collaborate have been sorted into four main different categories: Port group merger, cooperation between ports, cooperation with stakeholders, and port alliance. The network advantages of ports refer to the ports being well-positioned to collaborate and to take advantage of such collaborative relationships (Sheffi, 2012). When asked about the competition and cooperation between ports, participants most frequently referred to the structural reintegration of ports, which has been a recent trend among Chinese ports. Generally, port group merger is considered an important means to optimize resource allocation, improve the competitiveness of regional ports and reduce homogeneous competition (Feng *et al.*, 2012). In this framework (Figure 5-4), however, port consolidation is not the optimal state of port cooperation; rather, it is argued to be a passive and incomplete type of cooperation as an initial attempt. In detail, the trigger for port group mergers was homogeneous port competition while the aim was to achieve resource consolidation and coordinated development. The results of this form of cooperation were questioned by some participants in terms of the extent and effectiveness of integration. Overall group consolidation has, to some extent, avoided unhealthy competition between ports and secured the economic development of the region, but it is doubtful whether a win-win outcome for multiple ports can be achieved.

The other two types of port cooperation in the data analysis chapter are inter-port cooperation and port-stakeholder cooperation. In comparison, these two types require the port to show more initiative in the cooperation process, as the possibilities for cooperation and the ways in which they exist in current examples are more diverse. From the perspective of the literature, these two dimensions of port cooperation capabilities are more generally considered to be what ports need to promote when facilitating cooperative relationships (e.g., Castelein *et al.*, 2019; Shinohara and Saika, 2018; Hall *et al.*, 2013).

The ultimate goal or desired outcome of port cooperation, as expressed by the participants, is to achieve mutual trust between ports and to jointly increase their competitiveness and influence. The framework therefore proposes a fourth type of cooperation to enhance network advantages: port alliances. This proposal is inspired by the alliances of shipping lines to create an alliance in which several ports trust each other and work together for overall benefit (the specific alliance strategy is discussed in Section 5.3.2).



**Figure 5-4** Dimensional framework of port network advantages (Source: Author's own elaboration)

#### **5.1.4. Sustainable advantages**

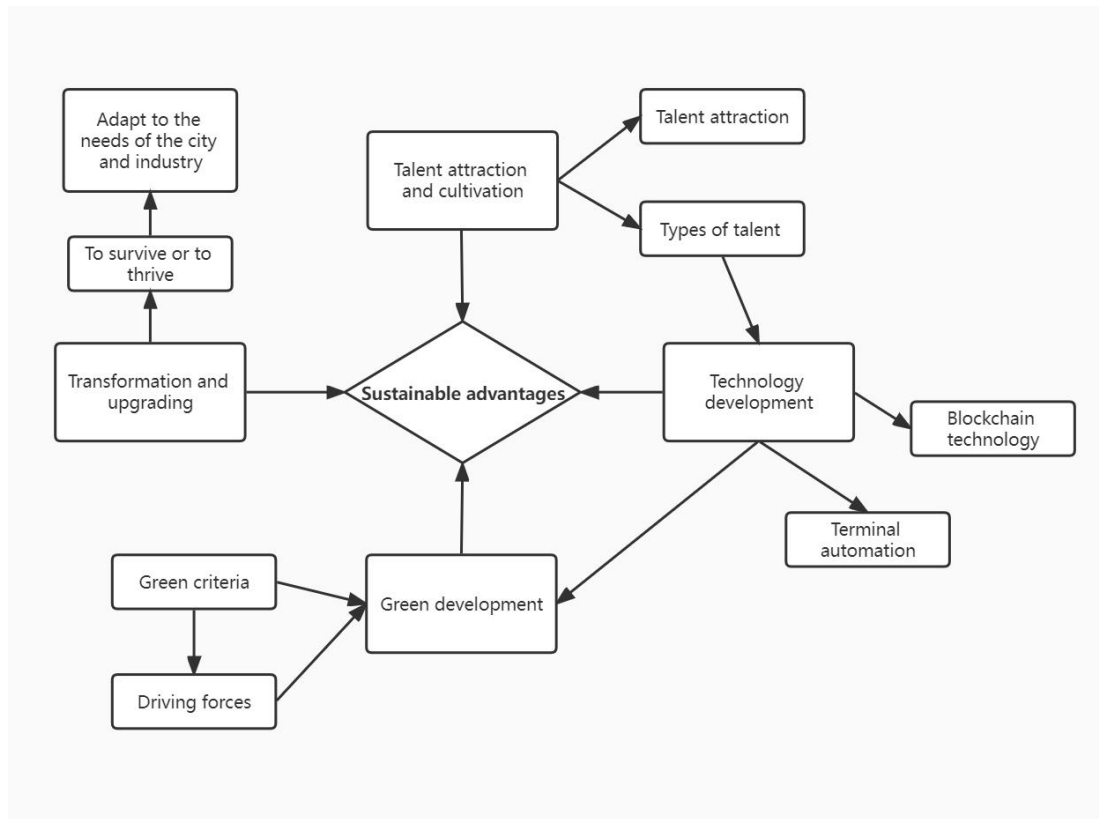
The final dimension, namely sustainable advantages, is a category of elements concerning whether the competitiveness of a port can be preserved in the long run. This dimension (Figure 5-5) is largely based on participants' concerns about the competitiveness and sustainability of ports in the future. The opportunities and challenges for the future development of ports are becoming greater due to the changing industry situation and the demand for sustainable port development from all parties. Smaller ports are at risk of bankruptcy and merger with larger ports, while larger ports need to consider more factors influencing their competitiveness, due to their position in international markets. Thus, four potential factors: green development, transformation and upgrading, technology development, and talent attraction and cultivation combine to constitute the sustainable advantage dimension of a port. These elements collectively embody the essence of sustainable port development, encompassing initiatives aimed at environmental stewardship, organizational innovation, technological integration, and human capital investment. While the immediate impact of sustainable advantages may not be as discernible as primary strategic advantages, they are increasingly recognized as essential components for sustained success in the global market. Crucially, sustainable advantages complement and enhance the effects of primary strategic advantages, forming a synergistic relationship that fortifies a port's competitive positioning amidst evolving industry landscapes.

Most frequently, when responding to questions about port sustainable development, respondents placed priority on whether the port development could be green and avoid negative environmental impacts. The green development of a port was impacted by both the driving force and the green criteria. The adoption of green criteria, in this case, was

considered to have a certain effect on the driving force. Also, port transformation and upgrading, the development of technology, and talent attraction and cultivation have potential to play significant roles in future port competition. It is worth noting that there may be a knock-on effect between these elements. For example, attracting and cultivating innovative technology-based talent directly influences the development of port technology, while some port technology may also contribute to open environmental protection. Therefore, a balance of each component element is key for ports to enhance their competitive advantage in this dimension.

In essence, the sustainable advantage dimension underscores the imperative for ports to embrace holistic and forward-thinking strategies that not only ensure immediate competitiveness but also fortify their resilience and relevance in the long term. By prioritizing green initiatives, embracing technological innovation, fostering organizational transformation, and investing in human capital, ports can proactively address emerging challenges, capitalize on evolving opportunities, and chart a course towards enduring success and sustainability in the global port industry landscape.





**Figure 5-5** Dimensional framework of sustainable advantages (Source: Author’s own elaboration)

## 5.2. Sustaining port competitiveness constructs and sailboat model

Based on the discussion of different dimensions, a theoretical framework for overall sustainable port competitiveness is established as shown in Figure 5-6 below. The port acquires and sustains its long-term competitiveness, as explained by the process from left to right of Figure 5-6. This conceptual model illustrates the trajectory from resource-based advantages to sustainable competitiveness, underscoring the theoretical depth of the findings.

Resource-based advantages are the traditional advantages that ports have and are not usually easy to change. This advantage therefore determines the starting position of a port's competitiveness. The concept of resource-based advantages encompasses the foundational attributes that contribute to a port's competitive edge. Initially, natural conditions serve as the

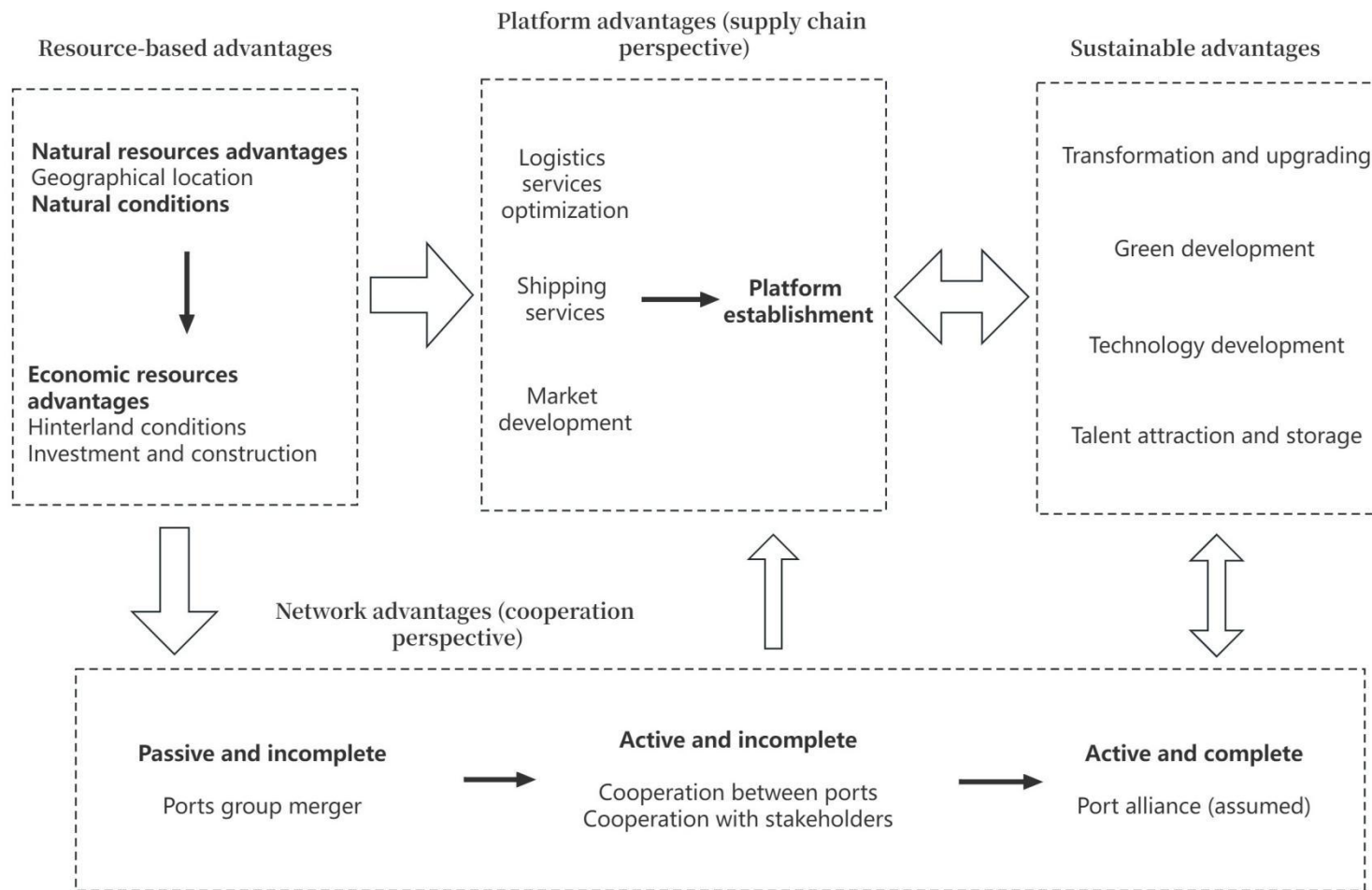
cornerstone of a port's inherent advantages, providing the foundational basis upon which its competitive position is established. These natural conditions, ranging from geographic location to environmental factors, constitute the intrinsic characteristics of a port that are not easily altered, thus exerting a significant influence on its competitive landscape. Furthermore, within the realm of economic resources, ports leverage their natural endowments to cultivate competitive advantages that are conducive to sustained growth and prosperity. Economic resource advantages are shaped by a port's ability to harness and capitalize on its natural conditions, thereby enhancing its capacity to attract investments, develop infrastructure, and foster economic activity within its hinterland.

Achieving sustainable competitiveness requires two major strategic advantages: platform and network advantages, which can be enhanced by establishing appropriate strategies (e.g. Almotairi and Lumsden, 2009; Ascencio *et al.*, 2014; Le *et al.*, 2020). The core essence of platform advantages lies in the establishment of port supply chain platforms, driven by the port's optimization of logistics services, shipping services, and market development. These platforms aim to expand the port's influence in the supply chain, leveraging its capabilities to streamline operations and enhance efficiency. On the other hand, the formation of network advantages is propelled by the port's collaborative efforts at different stages, evolving from passive and incomplete types of cooperation to proactive and comprehensive cooperation models focused on port alliances. The establishment of network advantages also contributes to the development of platform advantages to a certain extent.

These two types of competitive advantage also require the port to have certain foundations, such as the prerequisites to integrate into the supply chain, and potential partners to cooperate with. However, these foundations are not the focus of this component, as they are also influenced by the resource-based advantages of the previous component, such as port location and the relationship between the port and the hinterland. This part of the discussion differs in

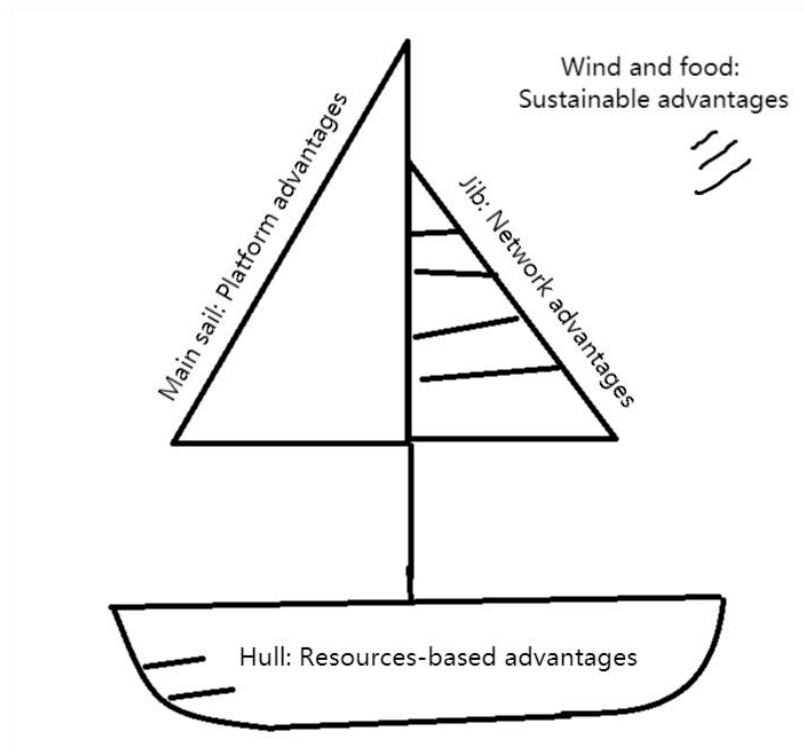
that it focuses on the strategies that ports may develop to enhance these two competitive advantages. It is therefore also considered to be key to the core competitiveness of ports.

Subsequently, in order to maintain a high level of competitiveness in the long term, ports need to consider the potential elements of sustainable advantages. There are four potential factors under sustainable advantages, namely green development, transformation and upgrading, technology development, and talent attraction and storage. These factors are considered to have an increasing impact on port competitiveness in the long term, although their impact is currently not as clear as the two strategic advantages. These sustainable advantages are crucial considerations that come after the establishment of the two primary strategic advantages of ports. While their impact on port competitiveness may not be as immediately clear as the resource-based and economic advantages, they are increasingly recognized as essential components for long-term success in the global market. It is important to note that the dimension of sustainable advantages do not operate in isolation but rather complement and enhance the effects of the primary strategic advantages, forming a synergistic relationship. As ports continue to navigate challenges and opportunities in the maritime industry, these sustainable advantages will play an increasingly significant role in shaping their competitiveness



**Figure 5-6** Sustaining port competitiveness theoretical framework (Source: Author's own elaboration)

In order to effectively visualize the role of the elements within the framework of sustainable port competitiveness, and to present these constructs in detail, this research employs a sailing model to illustrate the four categories of competitive advantage. This model presents a comprehensive and intricate view of the role of each element within the framework, thereby enabling a deeper understanding of the complexities of sustainable port competitiveness. As depicted in Figure 5-7, the sailing of a yacht symbolizes the sustained competitiveness of the port. To sail efficiently, the yacht must have a robust hull, which represents the resource-based advantage of the port. The speed of the sailboat is affected by its two sails, which represent the two strategic advantages of the port: the mainsail symbolizing the platform advantage and the jib symbolizing the network advantage. Finally, the sailboat's ability to journey over a long distance is contingent upon the presence of a consistent wind and ample provisions, which represent the sustainable advantages of the port.



**Figure 5-7** Sailboat model for sustaining port competitiveness (Source: Author's own elaboration)

### **5.3. Discussion on sustainable port competitiveness strategies**

The above sections highlight the importance of several internal factors in maintaining sustainable port competitiveness in a competitive global economy. Besides various other factors, enhancing port strategy is also critical for achieving sustainable competitiveness. However, the current literature lacks a comprehensive understanding of port strategy as a fundamental component of port competitiveness, as supported by the results of the literature review presented in Chapter 2. As a result, this section aims to bridge the gap by providing a comprehensive discussion on a strategy package for ports to enhance and maintain their competitiveness over the long term. This section discusses various strategies for improving and sustaining port competitiveness, which are based on the sustainable port competitiveness constructs and take into consideration the role of the port at different stages of the maritime supply chain of goods, as well as data results and literature knowledge. A systematic process for developing competitive strategies for ports involved in the maritime supply chain is presented.

The first step involves constructing a strategic maritime supply chain map of a port with all activities that occur within the chain being based on the supply chain mapping approaches (Gardner and Cooper, 2003; Mubarik *et al.*, 2023). To accomplish this, the research draws on the existing literature, such as relevant academic publications and industry reports (e.g. Rigot-Muller *et al.*, 2013; Stevens and Vis, 2016; Liu *et al.*, 2021). A maritime supply chain map is then created and illustrated in Figure 5-8, depicting the various stages of port involvement, from the activities of the ship at the anchorage ground of the seaport to the final delivery of cargo to the cargo owner's destination. Subsequently, stakeholders that have a direct association with ports are incorporated into the process, including shipping companies, service providers, feeder ports, and other competitive seaports. This ensures that all the relevant actors are considered in the development of competitive strategies.

Next, the research explores possible competitive strategies for each stage of port involvement and for each stakeholder. These strategies include attracting investment and construction, managing the competition and cooperation between ports, attracting cargo from the hinterland, optimizing logistics services, developing innovative technologies, and capitalizing on policy and national strategies. The objective is to identify opportunities for enhancing port competitiveness through strategic interventions that can improve the efficiency and effectiveness of the maritime supply chain. Table 5-1 shows the possible implementations corresponding to each strategy and the competitive advantage and behavioral objectives targeted. These seven strategies are discussed in the following subsections.

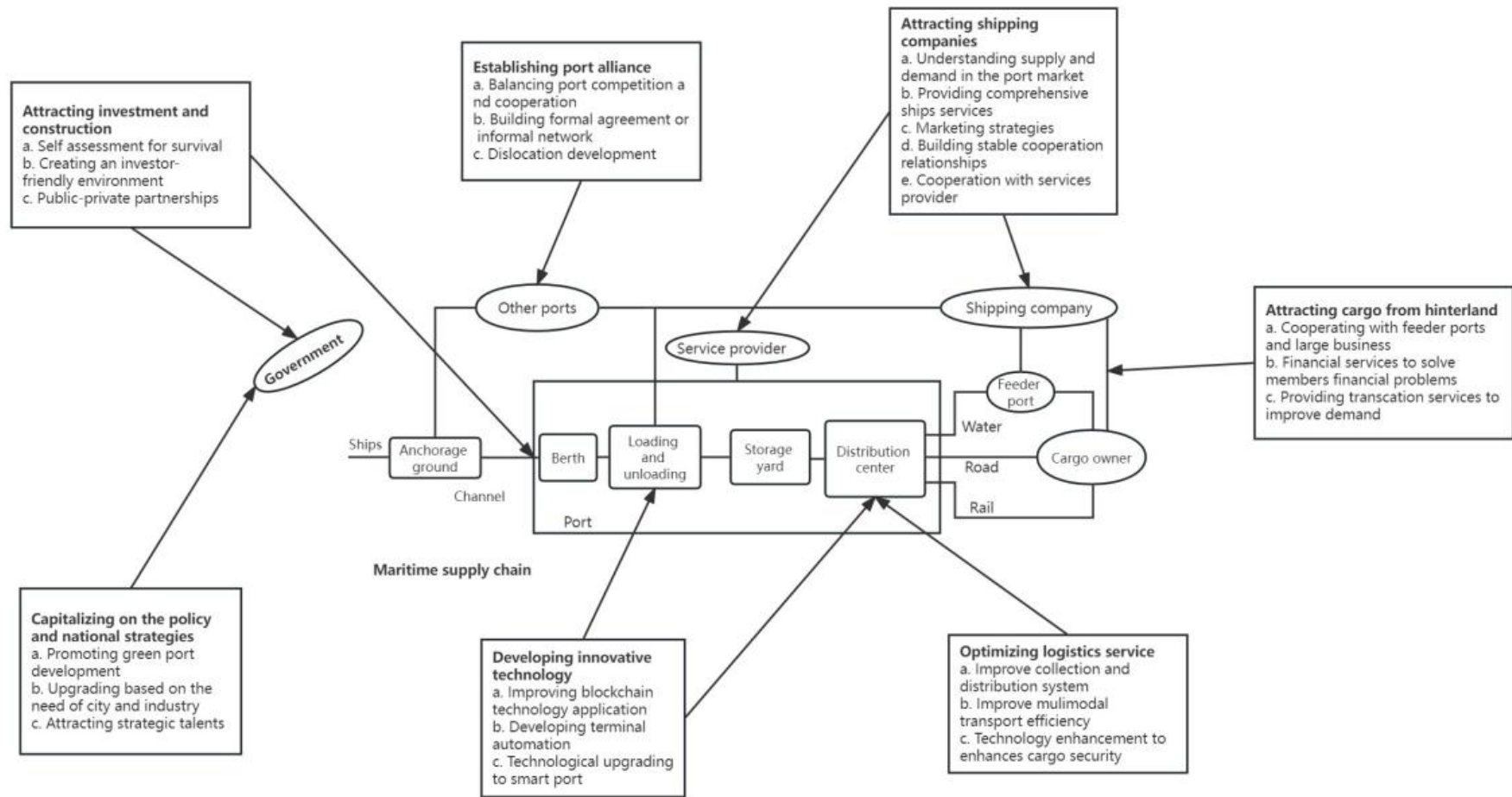


Figure 5-8 Sustainable port competitiveness strategies (Source: Author's own elaboration)



**Table 5-1** Types of sustainable port competitiveness strategies (Source: Author’s own elaboration)

<b>Strategies/ types of strategy</b>	<b>Implementations</b>	<b>Dimensions of improve</b>	<b>Object of action</b>	<b>Evidence from literature</b>
<b>Attracting investment and construction</b>	a. Self-assessment	Resources-based advantages and Sustainable advantages	Port	Argyriou <i>et al.</i> , 2022; Cetin and Cerit, 2010; Lun, 2011; Tanoue et al., 2018
	b. Creating an investor-friendly environment	Sustainable advantages	Government and Port	Alshamlan <i>et al.</i> , 2021; Musso <i>et al.</i> , 2006
	c. Public-private partnerships	Sustainable advantages	Government and Port	Min and Jun, 2014; Panayides <i>et al.</i> , 2015
<b>Establishing port alliance</b>	a. Balancing port competition and cooperation	Network advantages	Port	Ma <i>et al.</i> , 2021
	b. Building formal agreement or informal network	Network advantages	Port	Van der Horst and Van der Lugt, 2011; Zhang, 2020

	c. Dislocation development	Network advantages	Port	Fu and Chen, 2012; Wang <i>et al.</i> , 2017
<b>Attracting shipping companies</b>	a. Understanding supply and demand in the port market	Platform advantages	Port and shipping company	De Langen, 2007; O'Connor <i>et al.</i> , 2023; Yap, 2021
	b. Providing comprehensive ships services	Platform advantages	Service provider and shipping company	Caliskan and Esmer, 2019
	c. Marketing strategies	Platform advantages	Shipping company	West <i>et al.</i> , 2015
	d. Building stable cooperation relationships	Network advantages and Platform advantages	Shipping company	Heaver <i>et al.</i> , 2001.
	e. Cooperation with services provider	Network advantages and Platform advantages	Service provider	Kia <i>et al.</i> , 2000; Nikghadam <i>et al.</i> , 2023
<b>Attracting cargo from hinterland</b>	a. Cooperation with feeder ports and large business	Network advantages and Platform advantages	Port and customer	Caliskan and Esmer, 2019; Sdoukopoulos and Boile, 2020
	b. Financial services to solve members' financial problems	Platform advantages	Customer	Mbarire and Ali, 2014

	c. Providing transaction services to improve demand	Platform advantages	Customer	Song, 2002; Low <i>et al.</i> , 2009; Wang <i>et al.</i> , 2016
<b>Optimizing logistics service</b>	a. Improve collection and distribution system	Platform advantages	Port logistics	Li <i>et al.</i> , 2022; Xu and He, 2022; Lezhnina and Balykina, 2021; Muñuzuri <i>et al.</i> , 2020
	b. Improve multimodal transport efficiency	Platform advantages	Port logistics	Lu <i>et al.</i> , 2023
	c. Technology enhancement to enhance cargo security	Sustainable advantages	Port logistics	Barth and Boriboonsomsin, 2009
<b>Developing innovative technology</b>	a. Improving blockchain technology application	Sustainable advantages	Port handling and logistics	Durán <i>et al.</i> , 2021; Wang <i>et al.</i> , 2019
	b. Developing terminal automation	Sustainable advantages	Port handling	Min <i>et al.</i> , 2022
	c. Technological upgrading to	Sustainable advantages	Port handling and	Molavi <i>et al.</i> , 2020

	smart port		logistics	
<b>Capitalizing on the policy and national strategies</b>	a. Promoting green port development	Sustainable advantages	Port	Alamouh <i>et al.</i> , 2020; Hoang <i>et al.</i> , 2022; Mohanty, 2012
	c. Upgrading based on the need of city and industry	Sustainable advantages	Government and Port	Merk, 2013
	d. Attracting strategic talents	Sustainable advantages	Government and Port	Wobodo <i>et al.</i> , 2020; Safa <i>et al.</i> , 2018

### 5.3.1. Attracting investment and construction

Ports must attract investment in order to maintain their competitiveness in the maritime supply chain (Baştuğ *et al.*, 2022). They require substantial investment to upgrade their infrastructure, modernize their facilities, and acquire cutting-edge equipment and technologies to support their operations. Attracting investment can also assist ports in enhancing their capacity, efficiency and productivity, as well as the quality of their services, thereby making them more attractive to shipping lines and cargo owners. Therefore, developing and implementing strategies that meet the needs of potential investors and respond to the changing needs of the industry is important for attracting investment. This can involve a variety of strategies, such as providing incentives for private investors, leveraging public-private partnerships, and creating a business-friendly environment.

Self-assessment is a critical activity for ports seeking to attract investment and secure their long-term survival, or simply to thrive (Argyriou *et al.*, 2022). By taking a critical look at their current infrastructure, services and market position, ports can identify areas where they need to improve in order to attract new investors and maintain the confidence of existing stakeholders. This self-assessment process includes evaluating the efficiency of operations, the quality of services, and the effectiveness of their marketing strategies (Tanoue *et al.*, 2018). Ports must evaluate their capacity and position in the market (Cetin and Cerit, 2010.). This means understanding the needs and expectations of their customers, as well as identifying potential opportunities for growth and expansion. Ports should also look for ways to differentiate themselves from other ports in the region and offer unique services or features that are not available elsewhere (Lun, 2021). Hence, self-assessment is a critical tool for ports that want to remain competitive and attractive to investors in an increasingly challenging market.

Creating an investor-friendly environment is crucial for attracting investment and promoting growth in ports. Ports need to take into consideration the needs and expectations of potential investors when developing and implementing their investment strategies (Parola *et al.*, 2021). This involves conducting market research to identify the types of investors who are interested in investing in ports, what types of incentives that are likely to attract them, as well as the barriers that need to be overcome (Blomström *et al.*, 2003). This may include tax credits, streamlined regulatory processes and offering attractive lease or concession terms (Musso *et al.*, 2006). In addition, ports need to stay up-to-date with the latest trends and developments in the industry, and be prepared to respond to changing market conditions (Alshamlan *et al.*, 2021). By taking a proactive approach to creating an investor-

friendly environment, ports can attract the right investors and ensure that they are able to contribute to their own long-term success.

It is worth noting that public-private partnerships provide an effective way for ports to leverage the resources and expertise of both the public and private sectors, and to reduce the risks associated with investing in large-scale infrastructure projects (Panayides *et al.*, 2015). By leveraging the resources of both the public and private sectors, ports can benefit from the strengths of each (Min and Jun, 2014). For example, public entities can provide land and infrastructure, while private companies can provide capital and expertise. Additionally, public-private partnerships can help reduce the risk of investing in costly infrastructure projects and make them more attractive to private investors. Ultimately, these partnerships can be a great way to attract investment and construction while ensuring that the port remains competitive in the long term.

### **5.3.2. Establishing port alliance**

The second group of effective port competitiveness strategies lies in establishing an alliance between different ports. To develop effectively and avoid homogeneous competition, it is necessary to understand the appropriate balance between port competition and port cooperation (Ma *et al.*, 2021). Competition can drive innovation, efficiency and better services between ports, while cooperation can encourage knowledge sharing, collaborative activities and improved service efficiency. Based on the result of network advantages, a number of approaches have been followed by ports and government, including port collaboration in terms of technology and capital, and port group merger. Nevertheless, taking a more proactive stance in promoting targeted inter-port cooperation could be a viable strategy for ports to further improve their competitiveness. In light of this, establishing port alliances was proposed as a way to build upon the previous findings and advance the concept of inter-port cooperation as a competitive strategy.

A port alliance can be understood as a formal agreement or an informal network between two or more ports, depending on their needs and preferences. When forming an alliance, it is important to ensure that all partners are in agreement with the goals of the alliance (Sarkar *et al.*, 2009). This means that each port should make sure that the interests of all partners are taken into consideration, and that everyone is willing to contribute in order to achieve the desired results. Additionally, the alliance should be structured in such a way that each port has a role to play and is able to benefit from the alliance (Van der Horst and Van der Lugt, 2011). A number of actions, including the sharing of

information and resources, the collaboration of markets and the borrowing of economies of scale could enhance the competitiveness of ports in the alliance.

Ports in an alliance can share data on vessel schedules, cargo flows, and berth availability to better coordinate their operations and reduce waiting times for ships. They can also share information on the latest technologies, safety protocols and environmental regulations to improve their overall service quality. This can lead to improved services, increased capacity, and a more attractive value proposition for customers. Ports can share data on shipping routes, cargo volumes and vessel schedules. This can help them optimise their operations and improve capacity planning. For example, if there is a sudden spike in cargo demand at one port, it may be able to shift some business to another port in the network.

Ports in an alliance can also leverage port dislocation development as a strategy to avoid homogeneous competition and specify their strategic location (Wang *et al.*, 2017). By strategically allocating cargo flows among ports in an alliance based on each port's strengths and capabilities, ports can differentiate themselves from each other and avoid direct competition (Fu and Chen, 2012). This can enable them to offer unique value propositions to their customers and partners, such as faster transit times, higher service levels, and improved supply chain efficiency. For example, one port in an alliance may specialize in container handling, while another port may focus on bulk cargo handling. By working together and coordinating their services, they can offer customers a wider range of options and more efficient supply chain solutions.

When ports establish alliances with other ports, they can leverage economies of scale, not only within the alliance, but also in their interactions with other stakeholders such as shipping companies and service providers. By pooling their resources and negotiating collectively, ports in an alliance can achieve greater bargaining power and secure better terms and rates from their stakeholders. For example, ports can collaborate with shipping companies to optimize vessel routes and schedules, which can reduce transportation costs and increase efficiency for both parties. This can involve sharing data on cargo flows, port capacities and market demand to identify opportunities for joint optimization.

### **5.3.3. Attracting shipping companies**

Attracting shipping companies is a critical part of port competitiveness, as shipping companies are the primary customers of ports, and their decisions on which port to use can have a significant impact on the success of a port. The attraction of shipping companies can be a boost to the port's reputation and visibility in the global markets (Parola *et al.*, 2017). To attract shipping companies, ports must develop a range of strategies. These strategies include understanding supply and demand dynamics in the port market, providing comprehensive ship services, and developing effective marketing strategies.

With an understanding of the supply and demand in the port market, ports can tailor their services to the specific needs of their customers (O' Connor *et al.*, 2023). They can gather and analyze information on cargo flows, vessel movements and market trends to spot possible business opportunities and find fresh clients (Yap, 2021). They can also meet frequently with shipping firms to enquire about their requirements and find ways to deliver services more effectively (De Langen, 2007). This can aid ports in creating unique solutions to satisfy the particular requirements of each shipping firm, thereby luring in more business.

Providing comprehensive ship services is another key strategy for ports to attract shipping companies. Ports can differentiate themselves from their competitors by offering value-added services such as ship repair and maintenance, cargo inspection and brokerage services. Providing comprehensive ship services can also help build a long-term relationship with shipping companies, leading to repeat business and increased revenue for the port (Caliskan and Esmer, 2020). An important aspect in providing these services is to ensure that the port has an experienced workforce and collaboration with relevant service providers to handle the different types of vessels and cargoes.

Developing marketing strategies refers to ports effectively communicating their unique selling points and competitive advantages to potential customers (West *et al.*, 2015). Along with having a team of people with marketing expertise, ports should also ensure that they meet the needs of their customers. Personalized service that is responsive to customer needs and offers relevant value-added services, such as cargo tracking and information sharing, can differentiate ports from their competitors.

Similarly, ports can work with service providers such as terminal operators, freight forwarders, and customs to streamline operations and reduce costs (Kia *et al.*, 2000). By negotiating collective contracts and standardizing processes, ports can achieve economies of scale and reduce duplication of effort. Moreover, they can use their collective bargaining power to advocate for policies and



regulations that benefit the industry as a whole (Nikghadam *et al.*, 2023). By collaborating with other stakeholders and leveraging economies of scale, ports can improve their competitiveness and enhance the overall efficiency and sustainability of the supply chain. This can benefit not only the ports and their customers, but also the broader economy and society.

#### **5.3.4. Attracting cargo from the hinterland**

Port hinterland was considered the basis for a port's continued existence and growth. Hinterland cargo represents a significant source of revenue for ports, and can provide a stable source of business, even during periods of fluctuating international trade (Caliskan and Esmer, 2019). Hinterland cargo can also help ports to establish and maintain long-term relationships with shippers and logistics service providers (Sdoukopoulos and Boile, 2020).

In order to attract more cargo from the hinterland, ports must have a comprehensive understanding of the various factors that influence the decision-making of cargo owners. This involves understanding the needs and demands of the port's users, and being able to meet their needs in an efficient and cost-effective manner. Three implementations are proposed in this aspect, including cooperation with feeder ports and large business, providing financial services to solve members' financial problems, and providing transaction services to improve demand.

By partnering with feeder ports, a larger port can offer an extended network of services to cargo owners in the hinterland. This can improve the efficiency of the supply chain and help to reduce logistics costs (Wang *et al.*, 2016). Large businesses can also be key partners for ports in attracting cargo from the hinterland. By establishing relationships with large businesses that rely on the port for their logistics needs, the port can ensure a steady flow of cargo and revenue.

As analyzed in the previous chapter, ports can offer financial services to their members to help them overcome financial challenges (Mbarire and Ali, 2014). Also, providing transaction services such as customs clearance, freight forwarding and warehousing can help port users to simplify the logistics process and reduce the burden on cargo owners. Providing these services can also help to improve the overall efficiency of the supply chain, making it more attractive to cargo owners.

#### **5.3.5. Optimizing logistics service**

Optimizing logistics services is essential to port competitiveness strategies because it directly impacts the efficiency and effectiveness of the supply chain (Li *et al.*, 2022). By optimizing logistics services, ports can improve cargo handling, reduce transit times and enhance cargo security, which are all key factors in attracting and retaining customers (Xu and He, 2022). Efficient logistics services can also lead to cost savings for both the port and its customers, which can help to improve overall profitability and competitiveness (Lezhnina and Balykina, 2021). The key components of this strategy include improving collection and distribution systems as well as improving multimodal transport efficiency.

Improving the collection and distribution system is a key aspect of logistics services optimizing strategy. This can be achieved by investing in modern equipment and infrastructure, as well as developing efficient storage facilities such as warehouses and container yards. By doing so, ports can significantly speed up cargo handling and reduce the likelihood of delays or damage to cargo, thereby improving the overall quality of their logistics services. Improving the collection and distribution system can also help to increase the efficiency of the supply chain, as it allows for a smoother and faster flow of cargo from the port to its destination (Muñuzuri *et al.*, 2020). This, in turn, can help to attract more customers and increase cargo volume for the port.

Another key strategy for ports to maintain their competitiveness is by enhancing the efficiency of their multimodal transportation services. To achieve this, ports must collaborate closely with other stakeholders in the transportation sector and leverage innovative solutions to streamline the transportation process. One such innovative solution lies in exploring the use of inland waterways and short sea shipping to optimize the efficiency of multimodal transport (Lu *et al.*, 2023). For instance, ports can establish partnerships with inland waterway operators to transport cargo by barge, or create short sea shipping routes to transport cargo between neighboring ports. These approaches can help reduce road congestion, lower greenhouse gas emissions, and enhance the overall efficiency of the supply chain (Barth and Boriboonsomsin, 2009). By adopting these innovative solutions, ports can improve their logistics services, thereby attracting more customers and remaining competitive in the market.

### **5.3.6. Developing innovative technology**

To remain competitive in the global marketplace, it is vital for ports to continually invest in innovative technology strategies. Ports that overlook investment in innovative technologies risk falling behind their competitors and losing out on business opportunities (Iris and Lam, 2019). By

adopting cutting-edge technologies, ports can improve their operational efficiency, minimize turnaround times and provide a better customer experience. In addition, technology can assist ports in the improvement of cargo security and compliance with regulatory requirements.

The implementation of blockchain technology is an example of innovative technology that could be used to improve the competitiveness of ports (Tsiulin *et al.*, 2020; Liu *et al.*, 2019). Ports are able to track cargo from the place of origin to the ultimate destination through the implementation of blockchain technology to increase the traceability and transparency of cargo movements. Ports can decrease the amount of paperwork and manual processing necessary for transactions by adopting blockchain-based solutions, lowering the risk of mistakes and delays (Durán *et al.*, 2021). By offering secure and transparent financing choices to supply chain partners, ports can also use blockchain technology to improve supply chain financing (Wang *et al.*, 2019). This can assist in lowering financing costs and enhancing small and medium-sized businesses' access to capital, as they might find it challenging to acquire financing through conventional channels.

Another example of innovative technology is terminal automation. This has been developed in many advanced ports and is expected to reduce labor costs, increase efficiency and reduce errors (Min *et al.*, 2022). By reducing the risk of accidents and cargo theft, terminal automation can improve the safety and security of the port environment. This, in turn, can help increase the productivity and throughput of the port, making it more attractive to shipping lines and cargo owners. In addition, the implementation of terminal automation can also contribute to the reduction of greenhouse gas emissions by optimizing energy consumption and reducing fuel consumption.

The use of other advanced technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics to enhance port operations is part of the development of smart port technology. A smart port facilitates the development and sharing of knowledge, optimizes port operations, enhances port resilience, leads sustainable development, and ensures safe and secure operations by bringing together better educated people, a skilled workforce, intelligent infrastructure and automation (Molavi *et al.*, 2020). Upgrading to a smart port, therefore, must ensure that appropriate backup and redundancy systems are in place to prevent system downtime and ensure continuous operation.

### **5.3.7. Capitalizing on the policy and national strategies**

By capitalizing on policies and national strategies that leverage external resources and government support, and align with national development objectives, ports can ultimately sustain their competitiveness. Infrastructure development, trade facilitation and environmental protection are critical elements of port competitiveness, and are often prioritized in government policies and national strategies. Alignment with these policies allows ports to access government funding and resources, and to work with other stakeholders to achieve shared goals. Three key objectives that can assist ports to capitalize on policy and national strategies are the promotion of green port development, upgrading to meet the needs of the city and industry, and attracting strategic talent.

First, as the global focus on environmental sustainability increases, ports are under increasing pressure to minimize their environmental impact. At the same time, they may have opportunities to promote a green development plan and attract government support. To achieve this goal, ports can take several initiatives, such as adopting green practices and technologies, improving energy efficiency and reducing emissions (Alamouh and Ölçer, 2020). One way to promote green port development is to invest in renewable energy sources such as wind, solar and hydro power (Mohanty, 2012). In addition, ports can introduce sustainable transport such as electric, hybrid and alternative fuel vehicles to reduce carbon emissions from port operations (Hoang *et al.*, 2022).

Second, through alignment with city and industry development needs, ports can ensure that their services and facilities are relevant and responsive to changing market demands (Merk, 2013). To achieve this, ports can conduct market research to identify the needs and requirements of their customers and stakeholders. They can then develop and implement strategies to improve their infrastructure and services. Examples include expanding terminal capacity, upgrading cargo handling equipment, and improving inter-modal connections.

Finally, ports can capitalize on policies and national strategies by attracting strategic talent. This might include developing policies and programmes that support the recruitment and retention of skilled and experienced personnel, as well as creating a favourable working environment and offering competitive remuneration packages (Wobodo *et al.*, 2020; Safa *et al.*, 2018). By attracting and retaining strategic talent, ports can increase their competitiveness by improving operational efficiency, innovation and sustainable development.

## 5.4. Summary

This chapter provides a comprehensive analysis and discussion on sustaining port competitiveness theories and strategies. The theoretical framework and strategies presented in the chapter are derived from a combination of data analysis and existing literature, ensuring a comprehensive and well-informed perspective. The chapter began by introducing dimensional frameworks, which were developed by combining the findings of data analysis from the previous chapter and existing relevant literature. These frameworks include resource-based advantages, port platform advantages, network advantages, and sustainable advantages.

The chapter then constructed the "Sustaining Port Competitiveness Constructs" theoretical framework and the sailboat model. The framework serves as a comprehensive guide for port operators to develop and maintain their competitiveness. The constructs visually represent the interconnectedness of these dimensions and emphasize the importance of each part. The sailboat model further built a deeper understanding on the role of each dimension played.

The discussion on sustainable port competitiveness strategies built upon the core categories identified in the research. Strategies were examined in detail, providing practical insights for port operators to enhance their competitiveness in the long term. These strategies include attracting investment and construction, establishing port alliances, attracting shipping companies, attracting cargo from the hinterland, optimizing logistics services, developing innovative technology, and capitalizing on policy and national strategies. Each strategy was discussed in relation to its impact on sustaining port competitiveness and relevant approaches for implementation.

## Chapter 6. Conclusion

This chapter presents a conclusion to the whole body of the PhD research by first answering the research question that was posed in the first chapter, and then discussing both the theoretical and practical contributions, as well as the limitations of the research and potential future research areas.

Overall, this study is divided into six chapters: the first chapter provides an overview of the research background, focusing on the increasing role of port competitiveness in the shipping industry and maritime supply chain with a specific focus on China; the second chapter conducts a systematic literature review (SLR) on the literature of port competition and competitiveness; the third chapter presents and justifies the qualitative research method with a detailed GT Method (GT) design and the description of major steps in the GT process; Chapter 4 presents the GT analysis of the four main sustainable port competitiveness aspects: resource-based advantages, platform advantages, network advantages, and sustainable advantages; Chapter 5 makes a conceptual analysis on the internal mechanisms of the four dimensions and overall sustaining port advantages construct, and discusses the potential strategies. Finally, this chapter draws a conclusion on the whole research project.

### 6.1. Answer to the research question

In the first chapter, the research topic was presented, as follows: "*How do ports and relevant stakeholders realize ports' competitiveness and what can ports do to improve and maintain their competitiveness in the long run?*" In order to answer the research question, the thesis conducted a case study on Chinese ports, conducting semi-structured interviews with 35 industry professionals considered to be experts in the port business. The study sought the points of view of those with a stake in port businesses and discovered that the level of competition between ports is rising to an all-time high, and that there are a variety of elements that contribute to each port's level of competitiveness. Through the application of GT methodology, the study proposed the concept of sustainable port competitiveness and, through the qualitative analysis of interview data, identified four primary aspects of competitive advantage by which ports' sustainable competitiveness can be understood. These aspects include the natural resource-based advantages of a port, the platform advantages emerging from the integration of the port's supply chain, the network advantages resulting from port cooperation, and the ultimate sustainable advantages of the port.

Resource-based advantages are the foundational pillars on which a port's competitiveness is built. These advantages encompass the port's inherent resources, such as its geographical location, natural

conditions, hinterland conditions, and other tangible investment and construction. Evaluating and understanding these advantages is a critical task for port operators, as it forms the basis for their developmental road-map. By comprehensively assessing their resource-based advantages, port operators can identify their strengths and weaknesses, enabling them to strategically leverage these attributes to gain a competitive edge.

In parallel, port platform advantages and network advantages represent essential strategic components that play a pivotal role in the port's continued integration into the supply chain and the restructuring of its resources. Port platform advantages revolve around a port's ability to function as an efficient and seamless hub within the broader supply chain ecosystem. This involves optimizing logistics services, improving shipping services and developing port marketing. The goal of port competitiveness in this dimension is to proactively establish itself at the platform center of the supply chain, strengthening its influence in the service system by reaching out to more stakeholders. This will allow the port to move from being integrated into the supply chain to being at the heart of the supply chain. Port network advantages, on the other hand, emphasize the significance of developing cooperative strategies with external stakeholders. By emphasizing different modes of collaboration and partnerships, including port group mergers, cooperation between ports, and engagement with various stakeholders, ports can create a resilient and synergistic network. Building strong networks fosters mutual benefits, knowledge sharing, and resource pooling, further fortifying the port's competitive position.

The ultimate focus of the port's endeavors must be on attaining sustainable advantages. Sustainability goes beyond short-term gains and profit maximization; it pertains to the port's long-term viability, adaptability and resilience in the face of changing market dynamics and environmental challenges. Sustainable advantages encompass a broad spectrum of aspects, such as environmental development, technology development, port transformation and upgrading, and talent attraction and cultivation. These factors collectively contribute to the port's survival and prosperity, ensuring its relevance in the future landscape of global trade and logistics.

This research also constructed several conceptual frameworks for the purpose of gaining a deeper knowledge of sustainable port competitiveness, and examined seven different types of port competitiveness strategies based on these frameworks as well as the relevant literature. The establishment of four-dimensional frameworks allowed for the investigation of the internal associations of the determinants as well as their direct or indirect influences on the competitiveness of ports. Following that, a framework of sustainable port competitiveness was developed, demonstrating that each dimension of advantage plays a distinct part in the process of achieving and sustaining port competitiveness over the course of time. This study seeks to address port

competitiveness strategies in different operating stages and among different stakeholders with reference to the existing literature. The conceptual framework for sustained port competitiveness served as the basis for this discussion. In the end, this research distilled seven distinct competitive strategies that could provide ports and their stakeholders with some suggestions.

## **6.2. Theoretical implications**

This section summarizes the theoretical contributions of the PhD project to port and shipping studies literature, in particular port competition and competitiveness, port supply chain, port cooperation, port sustainability and GT, respectively.

### **6.2.1. The contribution to port competition and competitiveness literature**

With the rapid development of global trade and the continuous promotion of port construction in various countries, competition among ports is intense, both regionally and globally. As an important component of shipping economics and port research, the literature and industry attention related to port competition and competitiveness has been maintained at a high level. Several articles have performed literature reviews on related topics. For example, a representative one is that of Parola *et al.* (2017), who discussed the frontier concerns of the port industry by systematically reviewing the factors influencing port competitiveness. During the period of this study, Luo *et al.* (2022) conducted a literature review on the relationship between port competition, cooperation and port competitiveness. A detailed comparison of previous reviews on port competitiveness was illustrated in Table 2-4. However, as the existing literature lacks a comprehensive systematic review of recent developments in port competitiveness encompassing various aspects, this study used SLR in Chapter 2 to provide a comprehensive review of the frontier research on port competitiveness in the last two decades, and identified four main research directions in port competitiveness: competitiveness assessment, port competition, port choice and competitive strategies. The chapter concludes with an analysis of the internal mechanisms of port competitiveness and a summary of the content framework of port competitiveness research. It also provides sound recommendations for future research directions in port competitiveness.

Another major contribution to port competition and competitiveness is in the conceptual understanding of port competitiveness. Given the intensification of port competition and the various contexts in which ports are facing development pressures or opportunities (Castelein *et al.*, 2019), this study introduces the new concept of sustainable port competitiveness and proposes a new criterion for the competitive performance of ports, which is the ability to maintain a high level of stability over time. The research has developed a fresh understanding of port competitiveness using a GT approach,



and has proposed a few conceptual frameworks to strengthen the understanding of this topic. The conceptual framework established in this study provides profound insights into the theoretical underpinnings of sustainable port competitiveness, elucidating the intricate dynamics shaping the long-term viability and resilience of ports in the maritime industry. By delineating the trajectory from resource-based advantages to sustainable competitiveness, the framework underscores the foundational role of inherent port attributes in shaping competitive positioning. Subsequent research may be able to diversify the study of port competition and competitiveness based on this concept and different perspectives.

Resource-based advantages, encompassing both natural and economic factors, delineate the fundamental attributes that underpin a port's competitive edge. Moreover, sustainable competitiveness is contingent upon the strategic cultivation of platform and network advantages, which are pivotal in augmenting a port's influence and operational efficiency within the maritime supply chain. Platform advantages pivot on the optimization of logistics services, shipping services, and market development, while network advantages are propelled by collaborative efforts and port alliances. These strategic imperatives necessitate the establishment of foundational prerequisites, such as supply chain integration and strategic partnerships, which are influenced by the resource-based advantages of the preceding components. Furthermore, the incorporation of sustainable advantages, encompassing green development, transformation and upgrading, technology development, and talent attraction and cultivation, underscores the imperative for ports to embrace holistic strategies that ensure long-term competitiveness and resilience.

### **6.2.2. The contribution to port competitiveness from a supply chain perspective**

Research in the field of port management has acknowledged the necessity of placing increased emphasis on the integral role that ports play within supply chain systems (Notteboom and Rodrigue, 2005). Even though the port supply chain is not a new concept in maritime studies and supply chain management research, the concept of port supply chain has not been uniformly defined and understood in the literature. There are also some similar expressions or concepts such as port value chain (e.g., Robinson, 2002; Vitsounis and Pallis, 2012), port-centric logistics (e.g., Mangan, 2008; Haralambides *et al.*, 2011), and port service chain (e.g. Talley *et al.*, 2014). These studies can be summarized as being aimed at examining the "why" and "how" questions: Why ports have already, or need to be further integrated into the supply chain, and how ports can be more tightly integrated into the supply chain? This article expands upon the existing body of literature to formulate questions for interviews, and employs data analysis to demonstrate the primary factors that can enhance the competitive advantage of ports within the context of supply chain management. These factors encompass three distinct dimensions, namely logistics services, shipping services, and market

development. Within all three aspects, there are eight sub-categories (comprehensive logistics system; multimodal transport; ship services; financial services; transaction services; discourse power; and marketing strategies) that are investigated. This comprehensive examination contributes to the existing literature by providing a thorough explanation of the subject matter.

From the literature review section (Chapter 2), some literature has mentioned supply chain issues as an important driver of port competitiveness (e.g., Haezendonck *et al.*, 2011; Yeo *et al.*, 2014; Haezendonck and Langenus, 2018). However, little research has investigated enhancing port competitiveness from a chain perspective. Moreover, this research makes a significant contribution to the field of port supply chain strategies by proposing the establishment of port platforms as a means to enhance operational efficiency and strengthen collaborative relationships within the maritime supply chain. By conceptualizing port platforms as facilitators of three key flows between ports and their partners — logistics services optimization, shipping services, and market development — this study offers a novel framework for ports to proactively engage with stakeholders and optimize their supply chain operations. Unlike existing literature, which often focuses on the passive integration of ports into the supply chain, this research emphasizes the proactive role of ports in orchestrating and optimizing supply chain processes. This shift in perspective underscores the importance of ports as dynamic actors within the broader logistics ecosystem, capable of driving innovation and fostering synergistic partnerships to enhance overall supply chain performance.

### **6.2.3. The contribution to port competitiveness from a cooperation perspective**

This research contributes to the theoretical foundation on different potential modes of port cooperation. As discussed in Chapters 1 and 2, the current state of academic research on port cooperation is characterized by a growing recognition of the importance of cooperation in enhancing port competitiveness (Song, 2003; Luo *et al.*, 2022). However, there remains a dearth of studies specifically focusing on the port group merger and comprehensively comparing different modes of cooperation. This research addresses this gap by shedding light on the implications and challenges associated with the integration of multiple ports within a province.

Moreover, this research distinguishes itself from existing literature by offering a comparative analysis of different modes of cooperation. While previous studies have examined either port group mergers or inter-port cooperation, the current research goes beyond this by encompassing both aspects, and further including collaboration between ports and their stakeholders. By adopting a comprehensive grounded analysis, this study provides a more holistic understanding of cooperative initiatives in the port sector and their potential contributions to port competitiveness.

Furthermore, this research proposes port alliances as a strategic approach to enhance port competitiveness. While existing literature acknowledges the importance of collaboration, the specific strategy of port alliances has received limited attention. This research contributes to the understanding of port cooperation and collaboration theory by categorizing different modes of port cooperation based on the criteria of positivity and completeness. Through this categorization, the research elucidates the varying degrees of cooperation effectiveness and sheds light on the factors that contribute to successful collaborative ventures within the port industry. . By delineating the benefits and potential outcomes of forming strategic partnerships between ports, this study contributes to a nuanced understanding of collaborative frameworks within the port sector. The proposed port alliance strategy offers a structured approach for ports to harness synergies, consolidate resources, and bolster their competitiveness through concerted action and shared objectives.

### **6.3. Practical implications**

#### **6.3.1. Practical implication for port operators**

The practical implications arising from this research present a valuable roadmap for port operators, enabling them to navigate the swiftly evolving market landscape while fostering sustainable competitiveness. In addition to its theoretical significance, this study offers tangible recommendations for port operators, from port company owners to decision-makers, to enhance and uphold their competitive edge in the long term.

A holistic approach to port competitiveness, underpinned by sustainability principles, emerges as a cornerstone of these implications. Port operators are encouraged to transcend short-term gains and consider the lasting impact of their strategies. This involves a comprehensive evaluation of various dimensions crucial to port success: the port supply chain perspective, the port cooperation perspective, and the port sustainability perspective. By addressing these dimensions collectively, port operators can craft dynamic and resilient strategic plans that not only secure immediate advantages but also ensure their port's viability and prosperity well into the future.

By incorporating the practical insights offered in this research, port operators, both on the Chinese front and the international stage, can make informed decisions that amplify their competitiveness. For Chinese port operators, the study's implications offer a contextualized understanding of the national landscape, aligning with China's unique challenges and opportunities. International operators, meanwhile, can derive insights from both the shared implications and China's distinct lessons,

allowing them to adapt and tailor strategies to suit their specific contexts. By adopting these insights into their operational practices, port operators position themselves to successfully navigate the evolving industry dynamics, reinforcing their competitive stance, and contributing to the sustainable growth and development of the global port sector.

Of particular significance, the research delves into seven distinctive strategies that promise to elevate port competitiveness through a sustainable lens. These strategies serve as guiding principles for port operators' strategic initiatives. They encompass a spectrum of pivotal actions, including attracting port users and investors, forging strategic port alliances, harnessing innovative technologies, and optimizing policy and national strategies. Integrating these strategies into their operations empowers port operators to not just maintain, but to also augment their competitive positions, all the while advancing sustainable development goals.

The implications provided by this research resonate with the inherent dynamism of the maritime market. Port operators who thoughtfully implement these strategies are well-poised to navigate the intricate interplay of challenges and opportunities within the industry. By proactively embracing sustainability-oriented strategies, they can forge a pathway to sustained success in the ever-evolving and intensely competitive maritime market. The adoption of these strategies can transform port operators from passive players to proactive leaders, guiding the sector toward an era of sustainable growth, innovative excellence and enduring prosperity.

### **6.3.1. Practical implication for policy makers**

Policy makers hold a pivotal role in shaping the future of the port industry. The practical implications stemming from this research offer invaluable guidance to design policies that foster sustainable port development. By leveraging the insights gained, policy makers can contribute to the creation of an environment that nurtures competitiveness, innovation and environmental responsibility.

Policies focused on sustainable development can incentivize port operators to adopt eco-friendly practices, thereby mitigating the industry's impact on the environment. Collaborative frameworks and alliances between ports and stakeholders can be facilitated through policy initiatives, enabling streamlined operations and enhanced connectivity. Encouraging the adoption of innovative technologies through policy interventions can further catalyze operational efficiency and competitiveness.

Investment-friendly policies, inspired by the study's attraction of port users and investors can accelerate infrastructure development and promote economic growth. Trade facilitation measures can be enhanced through policies that simplify procedures, reduce red tape and optimize customs processes. Additionally, policies that support capacity building and skill development can ensure a skilled workforce equipped to tackle the challenges and complexities of the modern port industry.

Incorporating the practical implications of this research into policy making can lead to a harmonious convergence of efforts between port operators and policy makers. By working in tandem, they can collectively steer the industry toward sustainable growth, environmental stewardship and resilience in an era of rapid change. This collaborative approach, rooted in empirical insights, promises to shape a port sector that not only excels in competitiveness but also contributes positively to the broader socio-economic fabric and environmental well-being.

#### **6.4. Limitations**

This research has the following limitations: the first is the scarcity of data specifically pertaining to Chinese ports. The study predominantly relies on extant literature and a case study on Chinese ports, which may not comprehensively encompass the multifaceted and ever-evolving characteristics of global ports. Consequently, it is imperative to interpret the findings in light of the existing data, recognizing that they may not comprehensively depict the entirety of port operations.

Second, the study employs a port perspective, neglecting to take into account alternative viewpoints held by various port stakeholders. Although the analysis offers an in-depth investigation of sustainable port competitiveness, it may not encompass the nuances and specific challenges encountered by various stakeholders within the port ecosystem. Future research might consider investigating the viewpoints of diverse stakeholders, including shipping lines, cargo owners, terminal operators and government agencies, in order to obtain a comprehensive understanding.

Thirdly, this study adopts a GT approach by examining ports as an integrated case, rather than concentrating merely on individual ports or port clusters. Although this methodology offers a broader point of view on the competitiveness of ports, it runs the risk of disregarding the distinct characteristics, obstacles and tactics employed by individual ports or groups of ports. Further research could explore the context-specific dynamics of individual ports or port clusters in order to gain further insights.

Finally, given the vast amount of literature available on the topic of port competitiveness, it is possible that some relevant studies may have been inadvertently missed during the review process. Despite efforts to conduct a comprehensive literature review, the sheer volume of available literature poses a challenge to ensuring complete coverage.

## **6.5. Future research directions**

The present study has yielded significant findings related to the sustainable competitiveness of ports. Drawing upon the aforementioned findings, the study highlights various potential directions for future research that could contribute to the development of knowledge in this particular field.

First, future research could prioritize the execution of empirical studies in order to substantiate and explore deeper into the strategies identified for sustainable port competitiveness. Quantitative analysis methods, such as statistical modeling and data-driven approaches, offer a more comprehensive and reliable means of assessing the efficacy of various strategies in improving port competitiveness. Furthermore, these studies have the potential to examine the correlation between competitiveness practices and crucial performance indicators, such as market share, profitability and customer satisfaction.

Second, given the size and diversity of China's port industry, future research could delve into the dynamics of regional ports competition. Comparative studies across different regions within China could shed light on the unique challenges, strategies and factors influencing the competitiveness of regional ports.

Third, the investigation of sustainable port development strategies in China is a promising research area due to the nation's ambitious sustainability objectives and growing focus on environmental stewardship (Schipper *et al.*, 2017). Subsequent research endeavors may prioritize the examination of sustainable port development strategies that are custom-designed to suit the unique circumstances prevalent in China. This may encompass the analysis of the creation of renewable energy sources, the adoption of green technology, the implementation of waste management strategies, and the promotion of sustainable transportation initiatives.

Fourth, the port industry has experienced significant repercussions in the wake of the COVID-19 pandemic, leading to substantial transformations in global trade dynamics (Notteboom *et al.*, 2021). Subsequent investigations might delve into the implications of the pandemic on port competitiveness, encompassing the examination of shifts in supply chain dynamics, modifications in trade patterns, and the integration of digital technologies. Examining the approaches employed by ports to adjust to the landscape following the pandemic could yield valuable insights for bolstering resilience and competitiveness in a swiftly changing context.

Fifth, the adoption of industry technology (e.g., Blockchain, IoT, and automation) in the shipping and port industry holds substantial potential for revolutionizing multiple facets, such as enhancing supply chain transparency and security measures, and optimizing operational efficiency (Dutta *et al.*, 2020). Future research might look into the examination of the adoption and implications of these technologies within the context of port operations, the promotion of collaboration among various stakeholders, and the facilitation of trade. Examining the advantages, obstacles and tactics for incorporating innovative technology within the port sector through the analysis of empirical research could provide significant knowledge for port operators and policymakers.

Finally, the competitiveness of ports is not just determined by infrastructure and technological advancements, but also by human factors. Subsequent studies could go deeper into the investigation of talent management, leadership and organizational culture as factors contributing to the enhancement of port competitiveness.

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