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Study on overcapacity of liner shipping: on the transpacific routes

Yuxin Pu

STUDY ON OVERCAPACITY OF LINER SHIPPING:

ON THE TRANSPACIFIC ROUTES

PU YUXIN

A dissertation submitted to the World Maritime University in partial fulfilment of the requirements for the award of the degree of Master of Science in Maritime Affairs

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DECLARATION

I certify that all the material in this dissertation that is not my own work has been identified, and that no material is included for which a degree has previously been conferred on me.

The contents of this dissertation reflect my own personal views, and are not necessarily endorsed by the University.

(Signature): 

(Date): 3 June 2023

Supervised by:* Dr. Wang Xuefeng

Supervisor's affiliation: .....

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Abstract

Title: **Study on Overcapacity of Liner shipping - on the transpacific routes**

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Subject to COVID-19, the international political situation and changes in world trade, the problem of overcapacity in transpacific routes is prominent. Therefore, it is of great practical significance to explore the analysis of the drivers of overcapacity on transpacific routes. In this paper, the current situation of overcapacity of transpacific routes, the motive factors and ISM model are analyzed, and the specific difficulties faced by the transpacific routes are discussed. The motive factors of overcapacity of the routes are: the complicated macro environment of the market will force the container shipping business into the flood of the times; secondly, the characteristics of an oligopoly market make every decision of each liner company crucial; thirdly, the huge trade deficit in the market represented by China and the United States. The problem of overcapacity is analyzed in this paper, including macro-environmental factors, market structure, market supply and demand, and transportation costs. To further investigate the correctness of the drivers of overcapacity, the paper selects the relationship between relevant events and overcapacity on transpacific routes through the ISM model, so that shipping lines and related parties can understand the drivers. After the analysis, a more effective implementation plan is proposed for the problem of overcapacity in the transpacific container market and effective suggestions for risk avoidance are provided.

Keywords: Overcapacity, shipping lines, transpacific routes, ISM model

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List of Abbreviations

ASEAN	- Association of Southeast Asian Nations
EU	- European Union
GRI	- General Rate Increase
SBP	- Structure-Behavior-Performance
SLR	- Systematic Literature Review
TEU	- Twenty-Foot Equivalent Unit
VaR	- Value at Risk

Chapter 1 Introduction

1.1 Background and Problem Statement

The shipping market is an important component and barometer of global trade. In the current turbulent market, the balance between supply and demand for shipping services determines the volatility of freight rates. The liner market, an important branch of the shipping market, peaked in January 2022 (SCFI at 5066.77) and has since declined concerning the epidemic's impact and changes in global fleet decisions. The extreme volatility that freight rates have endured has affected shipping companies' revenues, which will inevitably affect investment decisions in shipping (Michail & Melas, 2023). In addition to internal earnings leading to shipping investments, accidents such as the global political economy, or unexpected events such as COVID-19 and its cyclical combination of changes, the shipping industry is vulnerable to huge external fluctuations (Song et al., 2019; Yang et al., 2021).

It has been estimated that the number of containerships will peak in 2023. The share of containership orderbooks in the global fleet has been increasing and continues to do so, rising from around 10% at the time of the epidemic outbreak all the way to 28.34% (Clarkson data as of January 2023). From January to December 2022, the total number of TEUs under newbuilding contracts reached 2,734,060, representing 10.60% of the available TEUs in the existing fleet. According to Clarkson, newbuilding orders for 2022 are down on previous orders and up on pricing (around 15% on average),

while also seeing more decarbonization investments. In terms of supply and demand equilibrium theory, the boom in the newbuilding market will be nearing its end.

The market situation is not optimistic concerning the container shipbuilding market which is still accelerating investments and three consecutive months of decline around 2023. On the other hand, reduced demand for Chinese exports and ongoing inventory adjustments in the US and Europe has led to more than usual cancellations and "Blank Sailing" on the part of carriers (Gateway, 2023). This shows that from the perspective of each liner company, economies of scale are achieved by obtaining more cargo resources in order to compete against each other on the playing field for market share (Luo et al., 2012). However, at the macro level, the expansion of market supply has created an overall situation of imbalance between supply and demand, leading to lower freight rates and overcapacity in the market (Kou & Luo, 2015). This would exacerbate the conflict between the two levels and create an even worse market environment.

The factors influencing the overcapacity of the fleet can be diverse, namely categorized as (1) market supply and demand; (2) fleet operations; and (3)global external conditions. Matching the volume of cargo imported and exported on both sides of the route with the overall vessel capacity is a state of affairs for a well-functioning market. Fleets are undergoing major changes in the liner shipping industry and the attitude of shipping companies towards shipping alliances, such as MSC Shipping and Maersk, is disintegrating. This is also a major influence on the day-to-day operations of liner sailings. In addition, global external conditions such as port congestion, new IMO regulations, epidemics, economic developments and other events need to be taken into account.

Since the overcapacity trend has become an unchangeable fact for the liner shipping industry, the issue of overcapacity and its corresponding strategy needs to be addressed urgently at this stage. The consequences of a large amount of overcapacity are serious and will result in the dismantling and berthing of containerships, generating further economic losses (Fan & Luo, 2013). The main business strategy of liner shipping companies was to restructure the capacity of the market through mergers and acquisitions as well as shipping alliances in the recession that followed the last boom cycle (before the 2008 financial crisis) (Rondini, 2017). The trend of overcapacity triggered by the booming economic environment is an important segment of the shipping industry. Failure to address this issue will directly impact the changes lines face in their future operations.

1.2 Aim and Objectives

The consequences of a surplus economy are already well documented from the last economic cycle, so avoiding a crisis is a matter of urgent reflection. The research aims to analyze the causes of overcapacity in 2023 and summarize countermeasures through capacity changes and rate movements in the liner market on transpacific routes. The objectives are proposed as follows:

1. To determine the capacity structure and the coordination of supply and demand in the current liner market on Far East-East/West Coast of America routes.
2. To compare the orientation and change in strategy of different lines towards shipbuilding orders on Trans-Pacific routes.
3. To determine the factors influencing the overcapacity situation and to validate their interrelationships.
4. To advise the liner sector on policy regulation, shipping alliances and company

strategy while dealing with overcapacity.

1.3 Scope and Limitation of the Research

This study will be limited to the level of the theoretical derivation of the overcapacity situation on trans-Pacific routes, by examining the logical relationships behind the overcapacity. This is because the main purpose of the cause analysis is to be able to circumvent this long-standing problem to a certain extent. In addition, the research node for the current situation of liner shipping companies will be limited to the period from 2020 to the present, mainly to analyze the reasons behind it with COVID-19 as the research objective.

1.4 Structure of the Research

Search for theoretical books and articles on the study of lines' strategies to deal with future overcapacity situations and learn the basic knowledge and methods in the related field. Chapter 1, Introduction. Firstly, it explains the background of the study and the significance of the study; second, it compares and summarizes the liner market studies by reading a large amount of literature; finally, it identifies the specific content and framework of the study. Chapter 2, Literature Review. Chapter 3, which is a review of the literature, discusses three main aspects: (1) the generation of shipping investment decisions, (2) drivers of overcapacity, and (3) strategies to deal with it. Chapter 3, which describes the current overcapacity situation in the liner market on Trans-Pacific Routes, provides an overview of the overall environment of the liner market and trans-Pacific routes and briefly describes the current state of its segmented vessel trading and shipbreaking markets. Chapter 4, an analysis of the drivers of overcapacity on trans-Pacific routes in the liner market, covers four main areas:

transport cost analysis, analysis of market supply and demand, market structure analysis, and external conditions Analysis. The sections in Chapter 4 will be applied to the ISM model in Chapter 5. Chapter 6 will look at risk avoidance through corporate strategy, shipping alliances and policy regulation.

Chapter 2 Literature Review

2.1 Introduction

This literature review is intended to review and understand the future overcapacity issue of lines in the transpacific routes. As a result of the downward pressure in the shipping market, more attention has been paid to strategic studies on future overcapacity, which is commonly associated with declining earnings (Stopford, 2008; Hermansson, 2016). Recent studies of small but rapid expansion have mainly revealed that overcapacity is based on all ship carriers being able and willing to provide more ship capacity than the market demand for it under all tariff conditions for a given period. Shipping investment decisions are justifiably generated but can create a vicious circle of business competition.

Researchers have focused primarily on three main aspects: (1)generation of shipping investment decisions, (2)drivers of overcapacity, and (3)strategies to deal with it. The current literature on containership overcapacity focuses on the risks that emerged during the last economic cycle, which were controlled through preventive

(forecast freight rates and newbuilding prices) and remedial measures (M&A and shipping alliances).

2.2 Motivation for Shipping Investment Decisions

Changes in freight price volatility are not always cyclical in nature but often disturbed by various factors(Gao et al., 2022; Li et al., 2023; Theodossiou et al., 2020). Why shipping investors still invest in them can be obtained through the market analysis equation that the risk spillover effect is a positive premium (Theodossiou et al., 2020). Evidence from the literature indicates that shipping investors who love high risk, are more prone to get low returns in the short term in exchange for high future returns, so shocks in the short term are less likely to affect shipping decisions. Another consideration is the competition for capacity in ocean shipping, where economies of scale often result in lower operating costs (Li et al., 2023). Kou & Luo (2015) consider that shipping expansion strategies are rational at both peaks and troughs. Conversely, some specialists argued that shipping investment decisions have sometimes been observed to be irrational or influenced by emotion; they may be made out of ignorance, by blindly following competitors, or by over-interpreting market signals(Randers & Göluke, 2007; Z. Yang et al., 2019).

What is more crucial for shipping investments is how to get a sense of proportionality. Binary choice and nested logit models are applied to the actual expansion decision for the choice of whether to invest and the type of vessel. Note that the relationship between ship size, ship length, demand growth rate in the newbuilding market; and the preference for handysize vessels in the selection of second-hand vessels are derived (Fan & Luo, 2013). In order to verify the timing and size of investments, the research distinguishes between two types of capacity models and the

results prove that proactive shipping investment actions will be more likely to gain a competitive advantage and complete an effective capacity competition strategy in three steps (Li et al., 2023).

2.3 Drivers of Overcapacity Issue

2.3.1 Balance of Supply and Demand

A balance between supply and demand is a recognized feature of a healthy functioning shipping market. Excess supply causes freight rates to fall and thus leads to financial underperformance (Hermansson, 2016; Z. Yang et al., 2019). Therefore, the literature can be categorized as freight rate forecasting, newbuilding price forecasting and container ship type selection to obtain optimal solutions.

For freight rate forecasting, While applying Automatic Forecasting and Event Classification (AFEC) to the six main container lines, Prophet's forecasts for "overcapacity" are significantly more in line with actual freight rates (Saeed et al., 2023). This provides forecasts and mitigates the risk of fluctuations in freight rates in shipping that are not influenced by cyclical events. For new building price forecasting, Gao et al. (2022) use an improved PIME for price forecasting for three tanker types of newbuilding, and the price of second-hand vessels was found to have a predictive function. Another research into trading strategies in the dry bulk trading market through the covariance of vessel price and operating earnings ratios and technical trading rules, shown to be more applicable in larger vessels, can be used to assess the appropriate timing of investments in the shipping market (Alizadeh & Nomikos, 2007). For container ship type selection, the attractiveness of larger container ships to carriers, as measured by factors such as net present value and concentration indicators, is

significant but inevitably puts pressure on port and terminal operations (Shi et al., 2019).

2.3.2 Fleet Operation

Fleet operations have a role in enhancing competitiveness in liner shipping. A systematic literature review (SLR) was used to examine the direction of maritime logistics, recognizing the achievements of port and ship operation design solutions, but neglecting the sustainability and marketing aspects (Gülmez et al., 2021). Research by Z. Yang et al. (2019) indicates that the introduction of ship scrapping subsidies into the decision model for the renewal of the dry bulk carrier fleet confirms that ship scrapping subsidies encourage scrapping activity, which in turn increases investment decisions for new orders. Liu et al. (2022) argue that the objective of fleet operations is to minimize costs, and a distribution-free approach can be applied to allow for the analysis of container routing and idle repositioning for new route development. While another research develop a multi-objective model to obtain optimal decisions on cost, sailing time and emissions, which proved to be a practical aid to decision-making on South East Asia - US East route (Ma et al., 2022). There is also a scholarly discussion of the distribution of goods. The analysis of the Liner Shipping Service Scheduling and Cargo Allocation Problem (LSSCAP) concluded that payload is a variable that cannot be counted as an exception in the fuel consumption process and that transshipment and transit times should not be underestimated (Koza, 2019).

2.3.3 External Conditions

The constraints of global external conditions will force shipping companies to make the right choices. A negative example is the bankruptcy of Hanjin Shipping, whose misguided investments and falling oil prices disrupted a virtuous cycle in the

face of global overcapacity. This, coupled with a break in capital flows and government policy inaction, led to the collapse of such a major shipping company (Song et al., 2019).

Of the external conditions, it is particularly crucial to be aware of the port situation. Whether the ports are congested or the supporting infrastructure is efficient will affect the demand for liner shipping. On relieving possible future port congestion, Prokopowicz and Berg-Andreassen (2016) consider the growth of transatlantic trade and the massification of ships as an entry point to discuss the positive impact of deepening horizontal partnerships between ports on the increase in port capacity and overall demand growth. With rising transport demand due to canal expansion and trade agreements, and by this way European ports will have the capacity to handle 143 million TEUs per year within ten years in response to the larger ships on the US-Europe route. While another concern is about the upgrading and improvement of port infrastructure for larger container ships. The Offshore Container Port System (OCPS) was introduced as an efficient solution for ports, and the contribution of operational cost reduction was demonstrated using a container transport network model through the case of 10 North American (West Coast) container ports connected to the Asian market (Kurt et al., 2021).

The external macro environment can also be a driver of overcapacity, independently of the port situation. The most notable shocks, such as the pre- and post-COVID-19 outbreak, presented unanticipated shocks to both the upward and downward movement of freight rates, with shipping companies experiencing, either an increase or a decrease in revenue capacity (Michail & Melas, 2023; Mohanty et al., 2021; Notteboom & Haralambides, 2020; Saeed et al., 2023). Of which a long-horizon equilibrium model is applied to look at unexpected shocks to costs and the macro

environment that affect freight rate fluctuations (Mohanty et al., 2021). The result is a one-year delay in the response of shipping investors to higher freight rates of unknown origin, known as the "inaction period", which has policy implications for the production plans of shipyards and the decisions of shipping investors.

2.4 Overcapacity Strategies

2.4.1 Corporate Strategy

Overcapacity is an issue that every liner shipping company needs to take into consideration. A variety of approaches can be used to solve this problem. Shipping companies can decide how much to invest in capacity based on their market share, and having more assets will trigger investments which, if a lower share is required, may require a greater investment than competitors (Li et al., 2023). While a strategic game-theoretic model of capacity expansion in a competitive market was developed and empirically analyzed, showing that instead of reducing its return on investment, a competitor's expansion strategy would have greater incremental benefits. This leads to a prisoner's dilemma and overcapacity (Kou & Luo, 2015). Paridaens and Notteboom (2022) discussed an integration trend of container shipping companies and indicated that three distinctive logistics integration strategies (Maersk Line, MSC and CMA CGM) offer empirical findings for future integration within shipping companies. In terms of trading strategies, a buy-and-hold strategy is often preferred based on the price-to-earnings ratio (Alizadeh & Nomikos, 2007).

In the case of the maritime transport market, risk management can also be enhanced through freight derivatives. A diversified portfolio of physical and derivative products for containers, tankers and dry bulk markets can reduce freight risk by 48% (Alexandridis et al., 2017). Another research uses VaR to measure risk in the dry bulk

shipping market and compare shipping risk spillovers before and after the financial crisis (Yang et al., 2021). The dry bulk shipping market has had a weak post-crisis spillover effect, playing the role of information receiver.

2.4.2 Shipping Unions

Shipping alliances have a significant role in allocating service structures and can go some way toward avoiding overcapacity. By reviewing research on the management of shipping alliances, the literature suggests research directions for future management concepts and technical support within alliances (Chen et al., 2022). For the allocation of the fleet, Chen et al. (2021) build deployment models by analyzing the various influencing factors and providing recommendations to fully exploit the advantages and resources of the alliance. For comparing mergers and acquisitions and shipping alliances, Rondini (2017) analyses the impact of these issues on the liner market, concluding that they are largely ineffective in terms of profitability. The main purpose is to exercise pricing power and forecast the industry's future direction.

2.4.3 Policy Regulation

In terms of resource allocation, Bai et al.(2023) introduced data-driven static and dynamic resilience assessments to predict the impact of external events or equipment failures on liner shipping networks, making stakeholders aware of the increased need for limited resources to maintain operations in critical ports and canals during disruptions. While Xu et al. (2021) developed a game theoretical model to analyze the game interaction between the two ports to obtain the optimal sharing model, where there is a trade-off between the benefits and losses of cooperative competition, providing a rational use of limited resources in port operations. To investigate whether concentration in the container shipping market hinders healthy competition, the

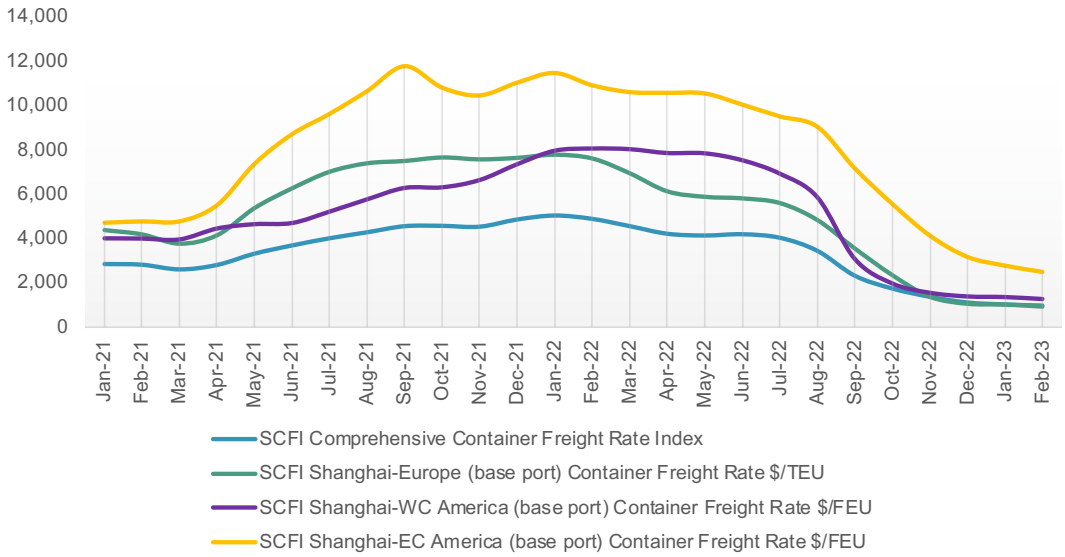
structure-behavior-performance (SCP) framework was used in this thesis, ultimately concluding that market concentration in the hands of the top players ensures relative price stability and that low costs lead to no opportunity to dominate the market (Lam et al., 2007). Similar policy regulation includes data analysis of shipping routes for use in maritime policy-making, where shipping connectivity plays an important role in route setting and port calls (Yap et al., 2023).

2.5 Summary

The works of literature have analyzed the problem of overcapacity mainly in terms of its causes and how to deal with it, with the main research method being game theory models. In the face of the changes in the dissolution of shipping unions, one limitation of the current study is the shifting attitudes toward the market and the creation of a new landscape. Further study is needed to address the liner market with a sustainable management concept by exploring the nature of overcapacity.

Chapter 3 Overcapacity Situation in the Liner Market on Transpacific Routes

3.1 Situation of Overall Overcapacity in the Liner Market



Source: Clarkson Data

Figure 1 SCFI Index (Jan-21/Feb-23)

The SCFI (Shanghai Containerized Freight Index) is used as an indicator of container freight rates, using the timing of the global outbreak as a starting point for tracking to the current stage (**Figure 1**). The SCFI Comprehensive Index (blue line) has experienced fluctuations from low rates - boom - back down to raw levels over a two-year period, which is unprecedented in the container shipping sector. Freight rates within their segmentation follow the same fluctuating variations to some extent, but

with unique variations in the geographical characteristics of the routes. The downward trend starts significantly in August 2022, which is usually the high season of the year for container shipping. This is due to the boom in container manufacturing as a result of the 2021 boom, which saw a shortage of container capacity turn into a surplus as cargo volumes declined.

The Shanghai Container Freight Index (SCFI) rose 33.15 points to 956.93 in April 2023, or 3.59 percent, the first time since July 2022 that the index has risen for two consecutive weeks. In addition, the three ocean routes are also rare across-the-board price increases, including the United States West, United States East line increased by more than $100. In addition, the container shipping giants, including MSC, Maersk, Hapag-Lloyd and CMA CGM have also issued notices of rising of General Rate Increase (GRI). This is partly due to rising demand for Chinese imports and exports, which is still weak. From the perspective of supply, the process of new ship delivery is continuing to advance, and shipping companies are gradually replacing new energy ships under the IMO's new regulations. This move inevitably leads to cost deflation, so the liner companies increase revenue by increasing freight rates. Therefore, the current recovery in freight rates cannot be interpreted as a return to demand for capacity.

In terms of trade between the US and China over the three years, the overall situation was affected by the combination of the trade conflict between the US and China and the epidemic, resulting in dramatic changes in both trade volume and trade structure (Xiao & Hui, 2023). The adjustment of tariff levels on Chinese goods by the United States has had a markedly restrictive effect on Chinese exports to the United States. As a solution to the policy change, the trade area shifting effect of Chinese exports is evident, with a preference for the EU and ASEAN regions. On the other

hand, the comparison of container port throughput between the US and China (**Table 1**) shows that, despite the constraints imposed by external policies, China's container throughput is still increasing year on year, while the US shows a downward trend followed by a slight rebound. The development of automation in ports and the large economic volumes have allowed China to take the lead in container throughput. According to Lloyd's list of the top 100 container ports in the world in 2021, Chinese ports take 28 places, with the Port of Shanghai continuing to top the list and growing by 8.1% compared to last year (2020).

Table 1 Container Port Throughput Comparison between China and U.S.

Year / TEU	CHINA	Selected U.S. Container Ports
2020	264,300,000	54,963,689
2021	282,720,000	50,573,024
2022	295,870,000	50,609,378

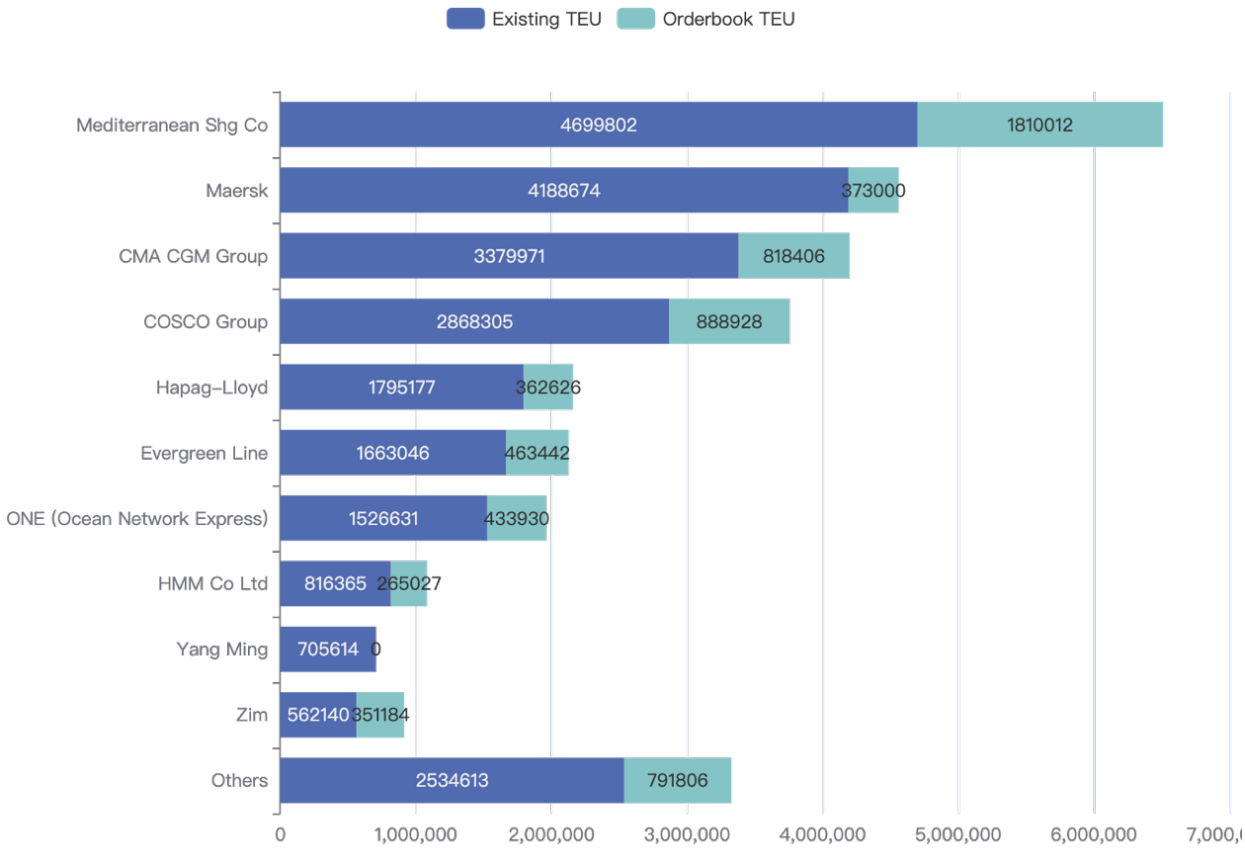
Source: Ministry of Transport of the People's Republic of China; U.S. Department of transportation, Bureau of Transportation

3.2 Situation of the Container Newbuilding Market and the Second-hand Vessel Market

3.2.1 Situation of the Container Newbuilding Market

As the most valuable asset in the shipping industry, ships are often considered to be a measure of competitiveness and market share of lines (Luo et al., 2012). Scholars argue that the higher the shipping rates, the more enthusiastic shipowners will be about investing in new vessels (Hess et al., 2020). The purpose of newbuilding is likely to stem from the impact of decarbonization policies, the current iteration of ship aging,

and the result of competition in vessel availability. Due to the current volatility in the container market, shipping companies are experiencing an unprecedented change in



Source: Alphaliner (March 2023)

Figure 2 Top 10 Operating Fleet by TEU

fleet size. According to the latest top 10 fleet capacity figures compiled from Alphaliner (**Figure 2**), container shipping is an oligopolistic market, accounting for 89.76% of the overall market's capacity. This means shipping investment decisions are controlled by a small number of companies that have the ability to control the market. Different shipping companies have taken other investment decisions. Most of the shipping lines are expanding their capacity according to the current fleet size (MSC, CMA CGM, COSCO). A small number of shipping companies have invested in fewer

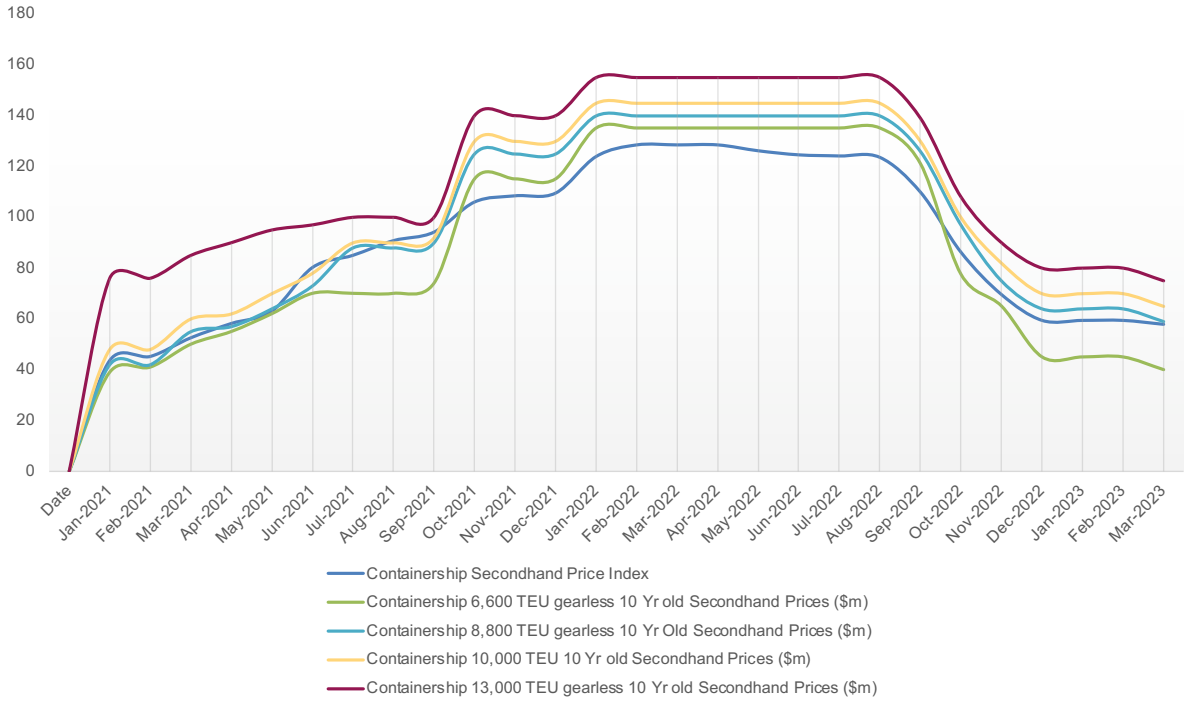
newbuilding orders compared to the current ones (Maersk), while others have focused only on their current capacity without investing in new orders (Yang Ming).

The current ratio of newbuilding orders to capacity operation is 26.51%, which will put pressure on the future for supply to exceed demand. Combined with the shipping rate fluctuations described above, this will certainly intensify the overall trend of overcapacity. Based on the current competition for capacity, MSC has replaced Maersk in the top container capacity position in 2022 and continues to order new containerships. It is not only the top-ranked shipping lines that are competing, most of them are adding capacity in order to capture more market share when profits rise (Fan & Luo, 2013). However, the impact on the actual possible change in market share is not very strong compared to what it was previously.

3.2.2 Situation of the Second-hand Vessel Market

Second-hand vessels are also a means of increasing the capacity of shipping companies in the investment decision for ships. Prices in the second-hand boat market are often used to gauge whether the transaction was formed efficiently and rationally (Alizadeh & Nomikos, 2007). Each line needs to make an informed investment decision based on its own circumstances, considering global economic conditions, the supply and demand in the market, the age and technology level of the vessel and the cost of operating the vessel. During the three years affected by the epidemic, the second-hand vessel market experienced an upward and then downward trend. The

overall trend in the second-hand vessel market has followed the changes in the freight market (**Figure 3**).



Source: Clarkson Data

Figure 3 Prices for Second-hand Vessels of Diverse Containership Types

As can be seen in **Figure 3**, price movements are similar for the different container ship types, advancing normally in proportion to the approved TEU and market changes. But with regard to the gap between the peak and trough, the peak period saw an increase of more than double the price of the trough section. This explains why shipping investors prefer risk, whereby the higher the risk, the greater the payoff (Yang et al., 2021). The current second-hand vessel market as a whole is showing a sluggish trend. Weak demand in the market, which has been affected by global trade tensions, has reduced demand for vessels and contributed to the fall in prices. In addition, the high cost of maintenance and refurbishment of some vessels has led owners to consider selling their vessels.

A typical line active in the second-hand market is MSC, which relies heavily on second-hand transactions to increase its capacity. Statistics show that since August 2020 MSC has purchased more than 290 second-hand vessels (Alphaliner, 2023), which is an unprecedented situation. The family-owned company is taking advantage of the high-yielding benefits to renew its fleet and operate more of its own containerships.

3.3 Situation of the Container Demolition Market

The boom in the newbuilding market is bound to affect orders in the scrap market, which is experiencing a new shift in capacity between the old and the new in the current timespan. According to Drewry's data (Table 2) it can be seen that a boom in the container demolition market is approaching. Shipping lines have launched an offensive to send firewood to older ships amid plummeting rates and an uncertain global economic outlook. Scrapping activity showed signs of recovery from October 2022 and grew gradually from the end of 2022 onwards. In terms of the types of container vessels dismantled, Table 2 showed all the vessels traded in recent months, mainly feeder vessels and one Small neo-Panamax vessel. After not sending any ships for scrapping in four years, MSC has resumed the process. Similarly, Wan Hai Shipping has selected 10 old ships for scrapping out of which six have already been sent for disposal.

As for forecasts for future shipbreaking activity, Simon Heaney (2023) reckons that as many as 600,000 TEU of container ships could be dismantled this year. It was also observed in Drewry's report (March 2023) that container ships over 20 years old accounted for 21.52% of the total capacity. Further to the future delivery of newbuilding orders and the deterioration of the overcapacity situation, scrapping is

inevitably one of the solutions for shipping companies to reduce capacity and control operating costs.

Table 2 Container Demolition Market Volumes and Vessel Types

	Demolitions	Small Feeder (100-2,000 TEU)	Large Feeder (2,000-3,000 TEU)	Small neo-Panamax (5,300-10,000 TEU)
Date	**kTEU**	**kTEU**	**kTEU**	**kTEU**
Feb-2022	0.0	0	0	0
Mar-2022	0.0	0	0	0
Apr-2022	0.0	0	0	0
May-2022	0.0	0	0	0
Jun-2022	0.0	0	0	0
Jul-2022	0.0	0	0	0
Aug-2022	0.0	0	0	0
Sep-2022	0.0	0	0	0
Oct-2022	1.2	1	0	0
Nov-2022	1.1	1	0	0
Dec-2022	12.8	7	0	6
Jan-2023	14.3	14	0	0
Feb-2023	8.4	4	5	0

Source: Drewry Maritime Research (March 2023)

3.4 Situation of Overcapacity on Transpacific Routes in the Liner Market

The transpacific route is a vital part of world trade, carrying goods in and out of North America and Asia. The main features of this route are the long voyage across the Pacific Ocean and the high level of technology and facilities required. Amongst them, containerships are the main vessels on the route, transporting cargo such as consumer goods, industrial goods and manufactured goods (Li et al., 2023). Transpacific routes can be divided into Far East - North American East Coast routes, Far East - North American West Coast routes and Far East - North American Gulf routes based on the regional differences in the ports of call.

The main North American West Coast ports of call include Port of Los Angeles (one of the busiest ports in North America), Port of Long Beach (the second largest port and one of the major Asian trading ports in the U.S.), Port of Seattle, Port of Vancouver (the busiest port in Canada), Port of Prince Rupert (the northernmost port on the WCNA, making it an important gateway for trade with Asia). East Coast ports of call in North America include Port of Savannah (one of the largest ports in the southeastern United States), Port of New York and New Jersey (third largest in the world in terms of container throughput), Port of Boston, Port of Charlestown and Port of Halifax. Ports in the Gulf of Mexico include Port of Houston (the largest port in GoM) and Port of Mobile (a deep-water port).

Trade imbalances on the trans-Pacific route have been a major pain point for a long time. Asia, and China in particular, has assumed the role of exporting powerhouse as the "world's factory". Such a phenomenon is more clearly demonstrated in **Table 3**. A serious discrepancy can be observed between the cargo throughput of the eastbound and westbound routes, with the throughput of the eastbound route being about four times that of the westbound route. The imbalance has remained roughly the same over a two-year period. The vacancy in return collection volumes is another reflection of the overcapacity, which is related to the long-term development of trade relations between North America and Asia. The impact of the COVID-19 outbreak has receded and global demand for North American exports has slowed.

Table 3 Container Throughput between China and U.S.

Year/TEU	CHINA	Selected U.S. Container Ports
2020	264,300,000	54,963,689
2021	282,720,000	50,573,024
2022	295,870,000	50,609,378

Source: Drewry Maritime Research (March 2023)

3.5 Summary

With the previous insane rise in freight rates, assistance to the earnings of container shipping was evident. This has had a boosting effect on the confidence of shipping investors. On the other hand, there is positive price guidance from freight rates to the second-hand vessel market, which is reflected in second-hand vessel prices with a certain lag (around one month). The weakness of the second-hand market and the boom in the newbuilding market can be seen in investors' perception that vessels currently relying on new technologies and energy sources will be more attuned to future changes in policy and prospects. The potential future profitability will also take a long leap forward with the development of sailing technology.

Regarding the overcapacity situation, the main drawbacks are intense competition in the market, increased operating costs and increased risks. Competition between shipping lines in the market will be fierce, which is the opposite result of the expected revenue growth of shipping lines. In an attempt to compete for customers, shipping lines may resort to price wars, bringing down freight rates, which in turn will affect the company's profits. Shipping lines will have to pay higher operating costs, such as vessel maintenance, and fuel costs, as it will be difficult to fully utilize vessels when there is excess capacity, which may result in some vessels being out of service or only operating at low-yielding rates. In addition, it may cause disruptions in the supply chain, such as longer transit times for goods or vulnerability to in-transit losses, making the businesses involved riskier.

The current status will bring opportunities in the container shipping sector. With the completion of the newbuilding orders, a large number of container vessels will be put into service. This means increased competition, and shipping lines will bring about

an improvement in the quality of shipping services as they compete for customers. The excess capacity will have a positive impact on the reduction of the average age of container vessels. Older capacity in the market will be replaced by newbuildings and will finally contribute to the gradual achievement of decarbonization targets.

However, the transpacific container market is also experiencing challenging threats. The United States is facing an intractable economic crisis, with the bankruptcy of Silicon Valley Bank and the US government deficit heralding a financial collapse, and it is not yet clear whether this will be a major blow to the global shipping market. But in any case, a healthy bilateral situation is a necessary prerequisite for the common prosperity of nations. In addition to the threat of the great power game, the decarbonization targets of international organizations are also a yoke for shipping lines. IMO is about to hold the 80th MEPC meeting in July 2023 with a new revision of the decarbonization targets for shipping. It is understood that there will be a higher and earlier revision of the zero-carbon target, meaning a greater decarbonization challenge.

Chapter 4 Analysis of the Drivers of Overcapacity on Transpacific Routes in the Liner Market

4.1 Market Macro Environment (PEST)

4.1.1 Political Factors

The macro-environment has a huge impact on trade, as well as on the container market, which is a subsidiary industry to trade. Political factors in container shipping

transpacific routes are divided into several aspects such as trade policy, geopolitics and security issues, all of which can have an impact on the cargo transportation and route planning of transpacific routes.

In terms of trade policy, the protectionist policies of the US government have a greater impact on the transpacific route. 2018 saw President Trump announce the imposition of tariffs on a large number of products imported from China, leading to increased trade friction between the US and China. This policy directly affected the flow of cargo on the container shipping transpacific route, as some of the cargo needed to be re-routed, and also affected shipping companies and logistics companies on the transpacific route, causing considerable economic losses (Saeed & Cullinane, 2021). On the geopolitical front, the South China Sea issue is a hot topic in the transpacific route. China claims legitimate rights to sovereignty over the South China Sea, but the US opposes this and regularly sends warships and military aircraft to the South China Sea for cruises and reconnaissance, which has sparked tensions between China and the US. This tension may have a negative impact on the safety and stability of shipping routes. The issue of vessel and cargo insurance on the transpacific route is also an aspect of the political factor (Kurt et al., 2021). As the route crosses several countries and regions, coupled with risks such as natural disasters and piracy, shipping lines and cargo owners need to insure their vessels and cargo. In July 2019, the Royal Navy and police seized 1.5 tons of cocaine on a ship off the coast of southern England on one of the key routes on the container shipping transpacific route. The implications of political factors in the context of the growing importance of the transpacific route, therefore, need to be given due attention and studied.

4.1.2 Economic Factors

The transpacific route more specifically is based to a large extent on US-China trade as the basis for supply and demand. In the context of the US-China economic game, the two sides compete in the areas of trade, investment and science and technology. The US has always considered China to be unfairly competing with the US in terms of trade. The US side has taken measures such as increasing tariffs on Chinese goods, restricting Chinese companies from investing in the US and limiting exports of Chinese high-tech products.

4.1.3 Social Factors

The transpacific route is also influenced by social demands, for example, certain social events (pandemic) may lead to tensions in the logistics supply chain. In addition, passing through numerous countries and regions with different cultures, different cultural factors may have an impact on the economy of the route, and market demand, among others, such as the commercial exchanges and cooperation between China and the United States.

4.1.4 Technological Factors

Shipping activities on the transpacific route have an impact on the marine environment, such as ship emissions and wave disturbance. The "IMO 2020" Sulphur limit is in effect worldwide and sets a global limit on the Sulphur content of marine fuels from 3.5% to 0.5%. With the entry into force of the amendments to the International Convention for the Prevention of Pollution from Ships (MARPOL Convention) Annex VI on November 1, 2022, all ships will be required to calculate their EEXI index to measure and rate energy efficiency. The continued advancement of decarbonization targets will further expand the operating costs for shipowners and

create a more urgent requirement to find a more economical and environmentally friendly solution. Since the IMO set decarbonization targets, the conversion of ships' power units has been on the agenda to contribute to the reduction of greenhouse gas emissions, mainly through the use of low sulfur oils or the use of new energy sources or the equipping of desulphurization towers.

4.2 Market Structure Analysis

The structure of the container shipping market is an oligopolistic market, characterized by multiple oligopolies occupying a large proportion of the market. Other companies have a relatively weak position in the market and have found it difficult to create a competitive market (Lam et al., 2007). The main reasons for the oligopolistic market are the large size of ships, route specialization and port competition. With the increasing scale of ships, huge investments are needed to build large ships, so only a few strong enterprises can afford these investments. Route specialization can reduce transport costs and time, making the choice and operation of routes more autonomous and profitable. In addition, ports are an important segment of the container shipping market. By dominating the ports and controlling the port resources, the entry and development of other companies can be limited to a certain extent. Overall, the oligopolistic market structure of the container shipping market makes the market more stable but also makes competition more intense.

In their choice of strategy, lines have chosen different paths to deal with the commercial changes ahead. Some lines are still acquiring vessels, while others are scaling back capacity. The increase in capacity is mainly in the form of new ship orders, second-hand ship transactions, chartering operations and mergers and acquisitions for shipping lines. And the capacity reduction is mainly done by ship dismantling, second-

hand ship trading, chartering operation reduction and enterprise restructuring. MSC, currently the largest shipping company, has scrapped the containership “MSC Floriana” for the first time in four years while continuing to expand its capacity structure (Sofreight, 2023). Wanhai Shipping also scrapped 10 older vessels at the end of last year and requested the buyers to dismantle them at a green shipbreaking yard to meet the high standards of the company's sustainability strategy ESG (Ship Net International, 2022). More often than not, shipping lines' policies to increase and decrease capacity are mutually supportive. They take the opportunity of profitability to renew by a combination of reducing old capacity and adding new technology and new power to the vessel equipment.

4.3 Analysis of Market Supply and Demand

The container shipping market is supplied by the ocean freight services of shipping lines. Liner networks can be divided into end-to-end service, collection-distribution network, hub-and-spoke network and line-bundling network (symmetrical and asymmetrical) according to the route and means of transport. The line-bundling network is a maritime transport method currently used by most shipping lines. Its path is similar to the swing of a pendulum, with the ship moving back and forth between points, changing direction each time it reaches its final port in one area and returning to another. When using a line-bundling network, ships need to depart and arrive frequently (Ducruet & Notteboom, 2011).

The planning of route schedules varies from one shipping line to another according to **Table 4**. It lists the top four liner companies in terms of schedules on transpacific routes (take Shanghai - Los Angeles round trip route as an example). The following features can be found: (1)the time taken to complete a return voyage is

around 40 days, which of course varies depending on market supply and demand. However, CMA CGM has introduced the EXX (Eagle Express X) service (No.5) using a collection-distribution network, which allows the service to have only two points, Shanghai-Los Angeles, thus reducing the one-way transit time to 11 days. The rest of the journey will be completed by feeder vessels, road transport or sea-rail connections for subsequent short hauls. (2) More ports of call are set up in the Far East than on the West Coast of the Americas. Such a situation can be observed in the schedules of MSC, Maersk and CMA CGM. Therefore, when discussing the planning of routes, liner companies have a preliminary understanding and analysis of the volume and distribution of cargo in the region and develop their sailing strategies accordingly. (3) Correspondingly, ships will logically stay longer in the Far East due to the speed of the ship or the ports of call and the loading and discharging of cargo. However, the reality is that the voyage time on the West Coast of the Americas is longer (20-24 days) than in the Far East (around 17 days). Therefore, it can be inferred that this is a schedule tailored by the shipping lines to suit the different needs of regional imports and exports. As an example, Maersk canceled a voyage on the transpacific TP2 service, which reflects the gradual decline in demand in the freight market (Maersk, 2023). The trade surplus between the Far East and the West Coast of North America has made it possible for shipowners to reduce the situation of less return collection and fuel costs only by reducing ship speed.

Table 4 Schedules of Top Shipping Lines

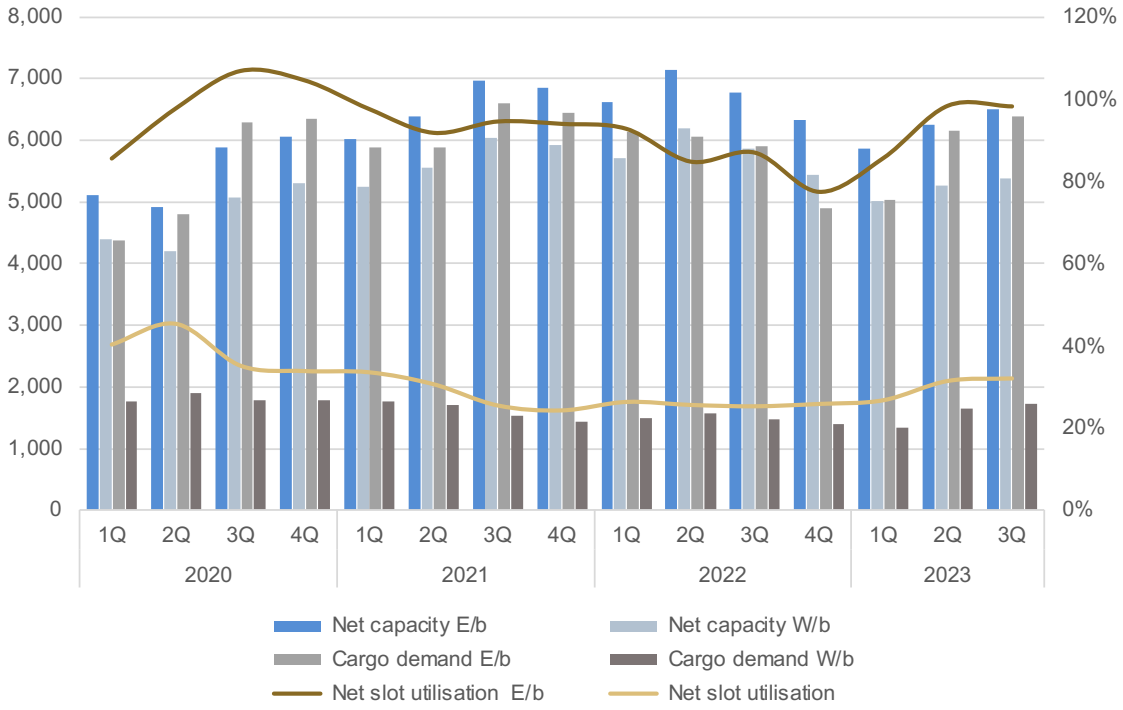
MSC	**E/B**	Qingdao	Shanghai	Ningbo	Busan	Los Angeles
	W/B	Los Angeles	Oakland	Tokyo	Qingdao	
Maersk	**E/B**	Yantian	Ningbo	Shanghai	Los Angeles	
	W/B	Seattle	Los Angeles	Yokohama	Xiamen	Haiphong

Maersk	**E/B**	Vung Tau	Hongkong	Yantian	Xiamen	Shanghai	Los Angeles
	W/B	Los Angeles	Yokohama	Shanghai	Xiamen	Vung Tau	
CMA CGM	**E/B**	Qingdao	Shanghai	Busan	Los Angeles		
	W/B	Los Angeles	Oakland	Yokohama	Naha	Busan	Qingdao
CMA CGM	**E/B**	Shanghai	Los Angeles				
	W/B	Los Angeles	Shanghai				
COSCO	**E/B**	Qingdao	Shanghai	Ningbo	Los Angeles		
	W/B	Los Angeles	(Oakland)	Busan	Qingdao		

Source: Official Website of MSC, Maersk, CMA CGM, COSCO

A chart (**Figure 4**) has been produced based on Drewry's latest quarterly container shipping report to give a better picture of the supply and demand in the transpacific container shipping market. The supply (net capacity allocated by shipping lines on the route) and demand (cargo volumes for shippers) for the eastbound and westbound transpacific routes are presented separately. The following characteristics can be observed: (1) Eastbound routes have significantly more capacity reserves and cargo demand than westbound routes. The blue bars represent net capacity in the east and westbound directions, while the grey bars represent cargo demand in the east and westbound directions. The amount of capacity is a reflection of market demand. (2) Overcapacity abounds. A comparison of the blue and grey bars shows that supply and demand can only be balanced during periods of high freight rates, while the rest of the time there is always excess capacity over cargo demand. (3) Slot utilization on eastbound routes is consistently above 80%, while on westbound routes it is

permanently between 20% and 40%. This is strongly linked to the previously mentioned trade surplus.



Source: Drewry-1Q/2023 Container Forecaster

Figure 4 Transpacific Supply & Demand Position (’000 TEU)

4.4 Transport Cost Analysis

The transportation cost of a maritime transportation business can be divided into vessel capital cost, operation cost and voyage cost according to the operation status. The capital cost of a ship is the most basic cost of acquiring a ship, including financing, tax, depreciation, etc. Operating cost is the operating cost to maintain the ship in seaworthy condition, including crew salary, insurance, maintenance, material cost, maintenance cost, management cost, etc. Voyage cost is the cost required to operate a particular voyage, including fuel, port and canal charges, loading and discharging costs.

In terms of capital costs, the upfront expenses are a huge challenge for shipping lines, whether they choose to operate their shipping business on time charter or through newbuilding or second-hand ship transactions. From a cash flow standpoint, a single spend in an asset-heavy industry can often affect the fleet allocation and decisions in subsequent years. At present, the container's freight rates are under continued downward pressure. The price decline in the transportation market has not greatly impacted the chartering market. Shipping lines are still using the previous two years' gains to upgrade and iterate their assets. In the case of MSC, for example, its acquisition of a number of old vessels in the market that were about to be sent for scrapping, and the expected boom in sending for scrapping at the beginning of the year did not happen (Xinde Marine News, 2023). This inevitably makes the cost of capital continue to rise, but the revenue still remains in the black.

Another factor is voyage cost. As the dominant object in ship operation decisions, voyage costs can be divided into fuel costs, time costs and carbon emission costs (Ma et al., 2022). Among them, it is crucial during the fluctuation time of energy supplements. The cost of sailing will also rise due to the increase in voyage duration. As shipping companies in a similar competitive position in the market, they are cutting costs by way of economies of scale. The sharing of voyage costs appears to be more favorable with larger vessels. However, shipping lines all have their own operational strategies and route layouts to occupy their own markets.

4.5 Summary

Upon analysis of the macro conditions of the ocean-going container market, analysis of the market structure and transportation costs the following conclusions can be drawn: market macro factors are pivotal in determining the overall revenue level of

the market. Good growth of revenue will further pave the way for future development of shipping lines, such as ordering new vessels and expanding new business. In addition, due to the asset-heavy nature of the ocean shipping business, it has long been in more stable oligopolistic market competition. The limited maritime demand is divided by a few companies and there is bound to be excess capacity due to competition. With the new round of new shipbuilding market delivery, the cost of capital will be riskier in the long run due to the supply and demand changing. The interrelationship of these influences and how the degree of influence is identified can be appreciated in the next chapter.

Chapter 5 ISM Analysis of the Overcapacity Problem

4.1 Introduction to Interpretive Structural Modelling

In light of the factors influencing the overcapacity of the transpacific routes described in the previous section, the layers and sequences of their influence can be logically organized and analyzed by building an econometric model. The ISM (Interpretative Structural Modeling Method) model, a more mature set of study methods, is now widely used in studies to give the simplest, hierarchical topology diagram without loss of system functionality. This chapter aims to identify the components or influencing factors to sort out each element's hierarchical relationship through overcapacity.

ISM models are generally made up of two main components: variables and pathways. The variables are the factors that are intended to be studied, while the paths are the relationships of influence between the variables. By studying and modeling the various factors, the most prominent factors contributing to overcapacity in container shipping can be identified and strategies proposed to counter them. The findings of the ISM model will provide a graphical answer to the policy implementation of overcapacity and distil the complex textual relationships into a more precise logical structure. Scholars have used ISM models in the shipping field mainly to analyze a particular event. Song et al. (2019) develop an ISM model to analyze the causes of

Hanjin Shipping's bankruptcy by synthesizing the contents of the literature to explain the intrinsic and extrinsic causes. Therefore, the use of ISM models to study the problem of overcapacity will have a positive effect on container shipping.

4.2 Variables Influencing Overcapacity

Based on the drivers of the overcapacity issue, 12 variables can be summarized to build the model to discover the internal interrelationship between these factors (**Table 5**). From the first to the seventh, the variables can be considered direct factors that influence shipping overcapacity, while the others are considered indirect influencing factors. Factors of which can be analyzed from political, economic, social and technological factors, as well as market structure, supply and demand, and transport cost. These analyses are based on a summary and extension of previous studies that examined the overcapacity situation. The main influencing factors of the previous analysis are listed and refined. If shipping investment is justified in a good or bad market, the possible results are closely related to the cost of fuel due to the investment of competitors or not (Kou & Luo, 2015).

However, the hierarchical relationships and intrinsic links between them should be figured out through the ISM model. Through these, a logical figure of interrelationships between them can be obtained based on these 12 elements.

Table 5 Element Identification

No.	Elements	No.	Elements
Factor 1	Trade demand (S&D)	**Factor 7**	Voyage cycles
Factor 2	Strategies of shipping lines	**Factor 8**	Information asymmetry
Factor 3	Market Competition	**Factor 9**	Green shipping
Factor 4	Container volumes	**Factor 10**	Shipping alliances (VSA)
Factor 5	Liner backhaul volumes	**Factor 11**	Digitalization
Factor 6	Slot utilization	**Factor 12**	Regulations/National policies

4.3 Model Building and Solution

The ISM model will be processed by SPSS software. Matrixing is done first by processing the data. The interrelationships between the influencing factors were derived from previous studies. In the optimized LSSCAP model based on Koza (2019), it is argued that the quantity of container demand directly affects the backhaul volume of lines, voyage cycles and slot utilization of the liner, which has a decisive role in the scheduling service of the liner transportation. The tightening of the backhaul trade is particularly pronounced on transpacific routes. Kou and Luo (2016) used Nash equilibrium to conclude that each decision of a shipping line to expand has the potential to be mutually destructive to market competition. They also argued that different shipping companies can create information inequity in their investment decisions thus affecting the overcapacity situation. In addition, how to make a more rational decision in investing in ships can be selected with the help of binary choice and nested logit models (Fan & Luo, 2013) for new and old ships or ship-type investments. New shipbuilding investment has a catalytic effect on the current digitalization of vessels and green shipping. As the declaration of cargo and ships involves four main areas and branches, the adoption of a unified digital platform will greatly improve the efficiency of cooperation, and the trend towards digitalization provides a boost to market competition for individual shipping companies (Wan, 2021). Conversely, market competition will drive the digitization process faster. Green shipping is considered as having interconnected causes with regulations interacting with each other. Sustainable decision models are used in tactical decision making for slot allocation and voyage cycles in shipping alliances (Parthibaraj et al., 2018). Chen

et al. (2022) argue that with the implementation of a series of IMO anti-pollution treaties, it will redefine the elements of market competition.

A mathematical matrix can be sorted out based on the above interrelationships. The specific steps are as follows: which elements in the matrix are determined by the abstraction of the objectives of the research problem. Determine the two-two causal relationships between elements, such as whether there is an influence of element 1 on element 2, and whether there is an influence of element 2 on element 1 and assign a value of 1 if there is influence. calculate the ultimate reachable matrix and carry out the hierarchical decomposition of the model through the reachable matrix, and finally get the hierarchical situation of the model.

The purpose of performing a matrix is to present abstract judgments in the form of data. For matrix 1, it is used to reflect the interrelationship of the influencing factors (**Table 6**). Influences that are identical by default (e.g. Factor 1 and Factor 1) are not related and are counted as 0 in the matrix. The upper right of the matrix is used as a marker, and if there is no interrelationship between two factors, they are counted as 0 in the matrix. If there is an influence of factor i on factor j (i is the element in the horizontal direction and j is the element in the vertical direction) then it is counted as A in the matrix; if there is an influence of factor j on factor i, then it is counted as B in the matrix. If two factors influence each other, it is counted as X.

Table 6 Matrix Reflecting Interrelationships

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Factor 1	0	0	0	0	A	A	A	0	0	0	0	0
Factor 2	0	0	0	0	0	A	A	A	A	0	0	0
Factor 3	0	0	0	0	B	0	0	0	B	B	X	X
Factor 4	0	0	0	0	0	0	0	B	A	0	0	A
Factor 5	0	0	0	0	0	0	0	0	0	0	0	0

Factor 6	0	0	0	0	0	0	0	0	0	A	0	0
Factor 7	0	0	0	0	0	0	0	0	0	A	0	0
Factor 8	0	0	0	0	0	0	0	0	A	X	0	0
Factor 9	0	0	0	0	0	0	0	0	0	0	0	X
Factor 10	0	0	0	0	0	0	0	0	0	0	0	0
Factor 11	0	0	0	0	0	0	0	0	0	0	0	0
Factor 12	0	0	0	0	0	0	0	0	0	0	0	0

Subsequently, the matrix reflecting the interrelationships can be transformed into an adjacency matrix (**Table 7**). That is, A becomes 1 and B is reflected in the left diagonal to the vacancy in the lower left corner and is also counted as 1in this table.

Table 7 Adjacency Matrix

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Factor 1	0	0	0	0	1	1	1	0	0	0	0	0
Factor 2	0	0	0	0	0	1	1	1	1	0	0	0
Factor 3	0	0	0	0	0	0	0	0	0	0	1	1
Factor 4	0	0	0	0	0	0	0	0	1	0	0	1
Factor 5	0	0	1	0	0	0	0	0	0	0	0	0
Factor 6	0	0	0	0	0	0	0	0	0	1	0	0
Factor 7	0	0	0	0	0	0	0	0	0	1	0	0
Factor 8	0	0	0	1	0	0	0	0	1	1	0	0
Factor 9	0	0	1	0	0	0	0	0	0	0	0	1
Factor 10	0	0	1	0	0	0	0	1	0	0	0	0
Factor 11	0	0	1	0	0	0	0	0	0	0	0	0
Factor 12	0	0	1	0	0	0	0	0	1	0	0	0

Table 8 is presented as an intermediate step to derive the reachable matrix. It is derived by summing the unit matrix and adjacency matrix. The subsequently calculated reachability matrix is shown in Table 9.

Table 8 Sum of Adjacency Matrix and Unit Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
Factor 1	1	0	0	0	1	1	1	0	0	0	0	0
Factor 2	0	1	0	0	0	1	1	1	1	0	0	0
Factor 3	0	0	1	0	0	0	0	0	0	0	1	1
Factor 4	0	0	0	1	0	0	0	0	1	0	0	1
Factor 5	0	0	1	0	1	0	0	0	0	0	0	0
Factor 6	0	0	0	0	0	1	0	0	0	1	0	0
Factor 7	0	0	0	0	0	0	1	0	0	1	0	0
Factor 8	0	0	0	1	0	0	0	1	1	1	0	0
Factor 9	0	0	1	0	0	0	0	0	1	0	0	1
Factor 10	0	0	1	0	0	0	0	1	0	1	0	0
Factor 11	0	0	1	0	0	0	0	0	0	0	1	0
Factor 12	0	0	1	0	0	0	0	0	1	0	0	1

Table 9 Reachability Matrix

	1	2	3	4	5	6	7	8	9	10	11	12
Factor 1	1	0	1	1	1	1	1	1	1	1	1	1
Factor 2	0	1	1	1	0	1	1	1	1	1	1	1
Factor 3	0	0	1	0	0	0	0	0	1	0	1	1
Factor 4	0	0	1	1	0	0	0	0	1	0	1	1
Factor 5	0	0	1	0	1	0	0	0	1	0	1	1
Factor 6	0	0	1	1	0	1	0	1	1	1	1	1
Factor 7	0	0	1	1	0	0	1	1	1	1	1	1
Factor 8	0	0	1	1	0	0	0	1	1	1	1	1
Factor 9	0	0	1	0	0	0	0	0	1	0	1	1
Factor 10	0	0	1	1	0	0	0	1	1	1	1	1
Factor 11	0	0	1	0	0	0	0	0	1	0	1	1
Factor 12	0	0	1	0	0	0	0	0	1	0	1	1

The data obtained by intersecting the reachable set with the prior set can distinguish the hierarchical relationship of each influencing factor (**Table 10**). Set A in the table is the result reflecting the interrelationships between 12 factors. If set A is sorted out it is possible to identify the first level, the second level and so on from the hierarchy.

Table 10 Reachable Sets and Prior Sets and Their Intersections

	Rs	Qs	A=R∩Q
Factor 1	1,3,4,5,6,7,8,9,10,11,12	1	1
Factor 2	2,3,4,6,7,8,9,10,11,12	2	2
Factor 3	3,9,11,12	1,2,3,4,5,6,7,8,9,10,11,12	3,9,11,12
Factor 4	3,4,9,11,12	1,2,4,6,7,8,10	4
Factor 5	3,5,9,11,12	1,5	5
Factor 6	3,4,6,8,9,10,11,12	1,2,6	6
Factor 7	3,4,7,8,9,10,11,12	1,2,7	7
Factor 8	3,4,8,9,10,11,12	1,2,6,7,8,10	8,10
Factor 9	3,9,11,12	1,2,3,4,5,6,7,8,9,10,11,12	3,9,11,12
Factor 10	3,4,8,9,10,11,12	1,2,6,7,8,10	8,10
Factor 11	3,9,11,12	1,2,3,4,5,6,7,8,9,10,11,12	3,9,11,12
Factor 12	3,9,11,12	1,2,3,4,5,6,7,8,9,10,11,12	3,9,11,12

Note: The number represents an element, e.g. 1 for Factor 1

4.4 Results

According to Table 10, it is possible to sort out the basic hierarchy of logic diagrams. The bottom factor, as the initial point cause, is the source of the layers upwards. The factors influencing the fourth tier are summarized in Figure 4 as Factor 3 (Market Competition), Factor 9 (Green shipping), Factor 11 (Digitalization), and Factor 12 (Regulations/National policies). The third tier contains Factor 4 (Container volumes) and Factor 10 (Shipping alliances -VSA), where the fourth tier has impacts on them. Furthermore, the second tier is Factor 5 (Liner backhaul volumes) and Factor 7

(Voyage cycles) and the top tier is Factor 1 (Trade demand -S&D) and Factor 2 (Strategies of shipping lines). The factors at the top tier are the ultimate goal in solving the problem of overcapacity. The fundamental reason for this model is to find the underlying logic and to prevent and improve overcapacity at each level.

The results show that the newer iterations of technology and the competition and regulation of the market are considered to be the underlying logic for functioning properly. Technological innovations such as digitization are often seen as the new benchmark driving the shipping industry forward, which will lead to greater cost reductions and increased efficiency in the long term. Market competition and regulation can, on the one hand, enable capacity supply to grow for greater levels of competition and, on the other hand, discourage disorderly expansion in the face of limited demand. A sensible balance between the two needs to be found in order to alleviate the current situation.

The ISM model can provide solutions to overcapacity from a stakeholder perspective of shipping. In the case of shipping companies, maintaining their competitiveness and future development in the market is in conflict with the current situation of overcapacity. In the case of shipping alliances, the sharing of capacity can help rationalize the planning of capacity, thus requiring more efficient management and reasonable benefit distribution. As for international organizations and governments, they should give feedback and encourage healthy competition for the monopolistic way of enterprises that violate market competition.

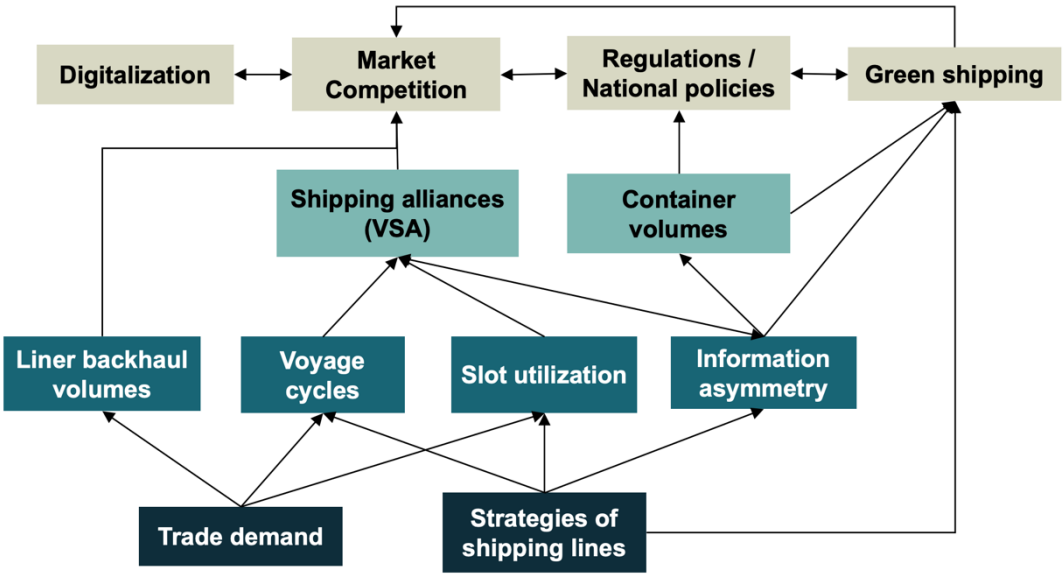


Figure 5 Logic Diagram Based on ISM Model

4.5 Summary

The ISM model forms a matrix of interconnections of elements through data collection, and after the calculation of the matrix, the hierarchy is resolved and the final logic diagram is generated. The bottom layer of the logic diagram is the ultimate goal, which is often considered the crucial element that determines how good the market is and how good the business is individually. In other words, trade demand and the strategies of liner companies set the tone of the transpacific container industry. In the middle are the problems still to be solved and the more mature supporting businesses in container shipping, which means shipping alliances and cargo volumes have more room for improvement in the medium to long term. And the top is the current container shipping industry in the urgent need to promote several major areas, they are currently defined as unknown for the future development of the industry but

have great potential to be able to change the industry landscape. Digitalization and green shipping are the two major directions that represent the future of shipping. And market competition and policies and regulations are the two key aspects to maintaining the stable operation of the container business. Next, we will analyze how to solve the problem of overcapacity from the perspective of shipping stakeholders.

Chapter 6 Risk Avoidance and Recommendations for Overcapacity on Transpacific Routes in the Liner Market

6.1 Timely Corporate Strategy Adjustment

One of the most important steps that shipping lines can take to avoid risks related to overcapacity on transpacific routes is to make timely adjustments to their corporate strategies. Companies need to have a clear understanding of the market conditions and analyze the long-term impact of increasing capacity on the shipping industry. The divorce of the 2M alliance, for example, is considered to be the significant result for the dissolution of the alliance, as Maersk and MSC had quite distinctive strategic objectives, with MSC focusing on expanding its fleet and focusing on container liner business and derivative services (terminals, ocean shipping agency) with a higher degree of expertise. Maersk, on the other hand, has been aiming to become a globally integrated container logistics company in recent years, focusing on end-to-end logistics services across ocean, port, air and land sectors (Maersk Annual Report, 2022). Various corporate strategies require the deployment of different business models that start with the company itself. They should be prepared to adjust their business model and streamline their operations to remain competitive in the market. This could include reducing overcapacity, improving efficiency, and developing new routes.

6.2 Effective Shipping Alliance Management

Shipping alliances can be a useful tool for managing overcapacity on Transpacific routes. By working closely with other liner companies, companies can pool resources and share costs, while also improving capacity utilization. It is important to have effective management of these alliances to ensure that they are operating effectively and efficiently. From a practical point of view, the operation of shipping alliances relies on decision-making, tactical operation and management systems (Chen et al., 2022). For shipping alliances (Ocean Alliance, THE Alliance) that are still in partnership, it is a matter of continuous experience and overall assessment to achieve a fair allocation and maximize benefits through the methods: (1) appropriate route allocation, (2) fleet allocation, (3) slot allocation, (4) cost-sharing and management. The rational allocation of each step reflects the maximum benefit for the shipping companies in the alliance, such as the rational integration of capacity and container volume under their respective advantageous routes. The management of empty containers and the maintenance of ship schedules and slots is carried out within the same management system. Furthermore, shipping lines must make sure that they are working collaboratively towards their goals, and that there is a clear understanding of the roles and responsibilities of each partner. The future of the alliance landscape may flourish more dramatic turmoil with the dissolution of the largest shipping alliance 2M. The share of competition in the maritime market after the challenges each shipping company will re-examine whether their partners and their business strategies are compatible.

6.3 Policy Regulation of the Liner Market

Effective policy regulation of the liner market can help to manage overcapacity on Transpacific routes. Governments can implement policies that encourage liner companies to optimize capacity utilization, improve efficiency, and reduce costs. The government's policy of regulation in view of the overcapacity is on the one hand to control the massive production of a large number of new shipbuilding orders that create a hostile market environment, and on the other hand to actively encourage shipping companies that adopt new energy and equipment in response to decarbonization policies. They can also promote market competition, leading to better prices and services for consumers. Governments should take responsibility for the macro-regulation of the market and face the overcapacity crisis together. In order to balance supply and demand, shipping lines have also increased the suspension of major routes. Maersk decided in April to cancel a particular voyage on the transpacific route, but with little success. This trend is mainly influenced by the continued decline in cargo demand, which requires more stakeholder involvement and market oversight. It is not enough to rely on the strength of individual countries. Adopting the same pace to control the continuous expansion of capacity and providing shipbreaking concessions will better reduce the risk. Such policies can be established through close collaboration with industry stakeholders, including shipping lines, shipping associations, and trade organizations.

6.4 Stakeholders working collaboratively for a positive trend

Finally, it is essential to promote collaboration and positive trends among stakeholders in the liner market. It is worth making clear that the consequences of overcapacity can be very serious, as has been seen in previous cases such as the

bankruptcy of Hanjin Shipping and the impact of the economic crisis on the container shipping market. We can consider overcapacity as a catalyst for a crisis event, which may not be the root cause, but in the future could trigger the business's collapse. At the level of governments and international organizations, measures to jointly negotiate the prosperity of international trade should be actively promoted and the environmental concept of controlling marine pollution should be maintained. At the academic level, shipping experts should analyze the current situation and provide practical responses to the overcapacity. At the operational level, companies should actively seek changes and develop new projects and initiatives that facilitate upstream and downstream linkages under a cooperative and win-win approach. Companies, governments, and other industry stakeholders must work together to develop strategies that minimize the impact of overcapacity on transpacific routes. This could include sharing data and information, exchanging best practices, and developing joint initiatives that can benefit everyone in the market. By working closely together, stakeholders can create a positive environment that promotes sustainable growth and success in the line market.

In summary, companies operating in the liner market can avoid risks related to overcapacity on transpacific routes by making timely corporate strategy adjustments, effective shipping alliance management, policy regulation of the liner market, and stakeholder collaboration for a positive trend. By adopting these strategies, companies can operate successfully in the market and ensure long-term sustainability.

Chapter 7 Conclusions and Future Recommendations

The study on the factors influencing the overcapacity of transpacific routes is proposed based on the current situation. 2023 is in the midst of a turbulent shipping era, with most shipping companies facing decarbonization, capacity allocation, and strategic placement of route configurations. This will certainly affect the general trend of the world fleet in the future. The root cause is the imbalance between supply and demand, and the intrinsic cause of the imbalance can be found.

Using the ISM model to compare and verify most of the influencing factors with each other, and to obtain the results about the problem after reasonable data calculation is the core meaning of the model. This paper considers trade demand and liner company strategies as the bottom-level drivers. The other objectives reflected from them are considered as the upper-level results and ultimately influence the development of the overcapacity problem. Therefore, intensive cooperation between liner companies, shipping alliances and governments can be used to maintain the normal operation of the international container shipping market on the transpacific route.

More quantitative analysis should be done for the future direction of research on the problem of overcapacity. The main aspects are as follows: (1) One of these elements can be selected as the object of study. It can be a data analysis for a certain aspect of influencing factors, such as the impact of trade demand on overcapacity, how exactly it is influenced and to what extent by using decision-making techniques. (2) It

can also be a solution to further deepen the problem of overcapacity on the route and to conduct practical operations and exercises on possible solutions that can effectively alleviate the current situation. This will contribute to how countries and international organizations around the world coordinate. (3) Transpacific routes in actuality have influences that are not linked to the shipping industry but do affect the volatility and ups and downs of freight rates, and this is a direction worth continuing to explore. Factors that may be included are world political conflicts, trade frictions, the impact of epidemics, and so forth.

Reference

Alexandridis, G., Sahoo, S. S., Song, D., & Visvikis, I. D. (2017). Shipping risk management practice revisited: A new portfolio approach. *Transportation Research Part A-Policy and Practice*, *110*, 274–290. https://doi.org/10.1016/j.tra.2017.11.014

Alizadeh, A. H. M., & Nomikos, N. K. (2007). Investment timing and trading strategies in the sale and purchase market for ships. *Transportation Research Part B-Methodological*, *41*(1), 126–143. https://doi.org/10.1016/j.trb.2006.04.002

Bai, X., Ma, Z., & Zhou, Y. (2023). Data-driven static and dynamic resilience assessment of the global liner shipping network. *Transportation Research Part E-Logistics and Transportation Review*, *170*, 103016. https://doi.org/10.1016/j.tre.2023.103016

Chen, J., Ye, J., Zhuang, C., Qin, Q., & Shu, Y. (2022). Liner shipping alliance management: Overview and future research directions. *Ocean &Amp; Coastal Management*, *219*, 106039. https://doi.org/10.1016/j.ocecoaman.2022.106039

Chen, J., Zhuang, C., Yang, C., Wan, Z., Zeng, X., & Yao, J. (2021). Fleet co-deployment for liner shipping alliance: Vessel pool operation with uncertain demand. *Ocean &Amp; Coastal Management*, *214*, 105923. https://doi.org/10.1016/j.ocecoaman.2021.105923

Fan, L., & Luo, M. (2013). Analyzing ship investment behavior in liner shipping. *Maritime Policy &Amp; Management*, *40*(6), 511–533. https://doi.org/10.1080/03088839.2013.776183

Gao, R., Liu, J., Zhou, Q., Duru, O., & Yuen, K. F. (2022). Newbuilding ship price forecasting by parsimonious intelligent model search engine. *Expert Systems With Applications*, *201*, 117119. https://doi.org/10.1016/j.eswa.2022.117119

Gateway, M. (2023, January 25). Shipping hurt by weak demand for Chinese goods - Maritime Gateway. Maritime Gateway - South Asia's Premier Shipping and Logistics News Portal. https://www.maritimegateway.com/shipping-hurt-by-weak-demand-for-chinese-goods/

Gülmez, S., Şakar, G. D., & Baştuğ, S. (2021). AN OVERVIEW OF MARITIME LOGISTICS: TRENDS AND RESEARCH AGENDA. *Maritime Policy & Management*, *50*(1), 97–116. https://doi.org/10.1080/03088839.2021.1962557

Hermansson, F. (2016, March 22). *10 Global Trends Affecting Supply and Demand in the Container Shipping Industry*. Greencarrier. https://blog.greencarrier.com/10-global-trends-affecting-supplyand-demand-in-the-container-shipping-industry

Hess, M., Pavić, I. F., Kos, S., & Brčić, D. (2020). Global shipbuilding activities in the modern maritime market environment. *Pomorstvo*, *34*(2), 270–281. https://doi.org/10.31217/p.34.2.8

Kou, Y., & Luo, M. (2015a). Strategic capacity competition and overcapacity in shipping. *Maritime Policy &Amp; Management*, *43*(4), 389–406. https://doi.org/10.1080/03088839.2015.1105395

Kou, Y., & Luo, M. (2015b). Strategic capacity competition and overcapacity in shipping. *Maritime Policy &Amp; Management*, *43*(4), 389–406. https://doi.org/10.1080/03088839.2015.1105395

Koza, D. F. (2019). Liner shipping service scheduling and cargo allocation. *European*

Journal of Operational Research, *275*(3), 897–915. https://doi.org/10.1016/j.ejor.2018.12.011

Kurt, I., Aymelek, M., Boulougouris, E., & Turan, O. (2021). Operational cost analysis for a container shipping network integrated with offshore container port system: A case study on the West Coast of North America. *Marine Policy*, *126*, 104400. https://doi.org/10.1016/j.marpol.2021.104400

Lam, J. S. L., Yap, W. Y., & Cullinane, K. (2007). Structure, conduct and performance on the major liner shipping route 1. *Maritime Policy &Amp; Management*, *34*(4), 359–381. https://doi.org/10.1080/03088830701539149

Li, X., Zuidwijk, R., & De Koster, M. (2023). Optimal competitive capacity strategies: Evidence from the container shipping market. *Omega*, *115*, 102790. https://doi.org/10.1016/j.omega.2022.102790

Liu, M., Liu, Z., Liu, R., & Sun, L. (2022). Distribution-Free Approaches for an Integrated Cargo Routing and Empty Container Repositioning Problem with Repacking Operations in Liner Shipping Networks. *Sustainability*, *14*(22), 14773. https://doi.org/10.3390/su142214773

Luo, M., Fan, L., & Wilson, W. W. (2012). Firm growth and market concentration in liner shipping. *Journal of Transport Economics and Policy*, *48*(1), 171–187. https://www.researchgate.net/profile/Meifeng_Luo/publication/235702463_Firm_growth_and_market_concentration_in_liner_shipping/links/00b7d51e41edd229e1000000.pdf

Ma, W., Zhang, J., Han, Y., Zheng, H., Ma, D., & Chen, M. (2022). A chaos-coupled multi-objective scheduling decision method for liner shipping based on the

NSGA-III algorithm. *Computers & Industrial Engineering*, *174*, 108732. https://doi.org/10.1016/j.cie.2022.108732

Michail, N. A., & Melas, K. D. (2023). Containership new-building orders and freight rate shocks: A “wait and see” perspective. *The Asian Journal of Shipping and Logistics*. https://doi.org/10.1016/j.ajsl.2023.01.001

Mohanty, S. K., Aadland, R., Westgaard, S., Frydenberg, S., Lillienskiold, H., & Kristensen, C. (2021). Modelling Stock Returns and Risk Management in the Shipping Industry. *Journal of Risk and Financial Management*, *14*(4), 171. https://doi.org/10.3390/jrfm14040171

Notteboom, T. E., & Haralambides, H. E. (2020). Port management and governance in a post-COVID-19 era: quo vadis? *Maritime Economics &Amp; Logistics*, *22*(3), 329–352. https://doi.org/10.1057/s41278-020-00162-7

Paridaens, H., & Notteboom, T. (2022). Logistics integration strategies in container shipping: A multiple case-study on Maersk Line, MSC and CMA CGM. *Research in Transportation Business &Amp; Management*, *45*, 100868. https://doi.org/10.1016/j.rtbm.2022.100868

Prokopowicz, A. K., & Berg-Andreassen, J. (2016). An Evaluation of Current Trends in Container Shipping Industry, Very Large Container Ships (VLCSs), and Port Capacities to Accommodate TTIP Increased Trade. *Transportation Research Procedia*, *14*, 2910–2919. https://doi.org/10.1016/j.trpro.2016.05.409

Randers, J., & Göluke, U. (2007). Forecasting turning points in shipping freight rates: lessons from 30 years of practical effort. *System Dynamics Review*, *23*(2–3), 253–284. https://doi.org/10.1002/sdr.376

Rondini, M. (2017). *Consolidation in times of overcapacity ; strategic alliances vs . mergers and acquisitions in the liner shipping industry | Semantic Scholar*. https://www.semanticscholar.org/paper/Consolidation-in-times-of-overcapacity-;-strategic-Rondini/da52d2a9abf6652b03db1b876efd7770d09502d2

Saeed, N., Nguyen, S., Cullinane, K., Gekara, V., & Chhetri, P. (2023). Forecasting container freight rates using the Prophet forecasting method. *Transport Policy*, *133*, 86–107. https://doi.org/10.1016/j.tranpol.2023.01.012

Shi, W., Li, K. X., Zhu, M., Zhang, Q., & Ge, J. (2019). Carrier profitability influenced by large containerships. *Research in Transportation Business &Amp; Management*, *33*, 100411. https://doi.org/10.1016/j.rtbm.2019.100411

Song, D. W., Seo, Y. J., & Kwak, D. W. (2019). Learning from Hanjin Shipping's failure: A holistic interpretation on its causes and reasons. *Transport Policy*, *82*, 77–87. https://doi.org/10.1016/j.tranpol.2018.12.015

Stopford, M. (2008). *Maritime Economics* [Routledge].

Theodossiou, P., Tsouknidis, D., & Savva, C. (2020). Freight rates in downside and upside markets: pricing of own and spillover risks from other shipping segments. *Journal of the Royal Statistical Society: Series a (Statistics in Society)*, *183*(3), 1097–1119. https://doi.org/10.1111/rssa.12553

Wan, Y. (2021). Improving the information flows and business process in global maritime logistics chains considering digitization and digitalization aspects. Doctoral dissertation. Universit¨at Bremen.

Xu, L., Xie, F., & Wang, C. (2021). Passive or proactive capacity sharing? A

perspective of cooperation and competition between two regional ports. *Maritime Policy &Amp; Management*, *49*(4), 492–509. https://doi.org/10.1080/03088839.2021.1876938

Yang, J., Zhang, X., & Ge, Y. E. (2021). Measuring risk spillover effects on dry bulk shipping market: a value-at-risk approach. *Maritime Policy &Amp; Management*, *49*(4), 558–576. https://doi.org/10.1080/03088839.2021.1889064

Yang, Z., Jiang, Z., Notteboom, T., & Haralambides, H. (2019). The impact of ship scrapping subsidies on fleet renewal decisions in dry bulk shipping. *Transportation Research Part E: Logistics and Transportation Review*, *126*, 177–189. https://doi.org/10.1016/j.tre.2019.04.008

Yap, W. Y., Hsieh, C. H., & Lee, P. T. W. (2023). Shipping connectivity data analytics: Implications for maritime policy. *Transport Policy*, *132*, 112–127. https://doi.org/10.1016/j.tranpol.2022.12.018