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COMPARATIVE STUDY OF PORT BUSINESS CHARACTERISTICS WITH MARITIME LOGISTICS APPROACH IN PORTS: SHANGHAI, SINGAPORE, BUSAN, AND ROTTERDAM

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ABSTRACT

The port is one of the freight transportation business activities locations through the surrounding water area. The approach to port business characteristics can be approached with the concept of maritime logistics. Maritime logistics presents an integrated concept of the process of planning, implementing, and managing the movement of goods and information involved in sea transportation. The three key players that make up the maritime logistics system at a port are shipping, port/terminal operations, and freight forwarding. This article examines several major ports: Shanghai, Singapore, Busan, and Rotterdam, for comparison based on the characteristics of the port business side. Comparative studies are carried out with a benchmarking process against reference ports.

Introduction

Research on port business development has been reviewed by several experts. De Langen and Van der Lugt (2007) conducted a study on the governance of several major port authorities in the Netherlands. Port Authority governance needs to be studied because it will affect the active role of each port to face business competitiveness with surrounding ports. Research conducted by De Langen and Van der Lugt (2007) produced a concept model for organizational description and analysis where there is a link between port governance and the environment, strategy, and resources/capabilities. Denktas-Sakar et al. (2012) researched to obtain a conceptual framework that can integrate organizational relationships between supply chains and stakeholders at the port. This research begins with classifying stakeholders consisting of primary and secondary stakeholders. Nitsenko et al. (2017) assumed that in the port business, the concept of the added value of the port is needed. The concept of added value can take the form of market innovation, product innovation, and process innovation.

The dissertation paper conducted by Deerod (2018) discusses port marketing strategies. Marketing strategies are needed to improve and develop port business services in the right direction and survive in the competitive business created among competing ports. Cancelas et al. (2020) researched the development of port digitalization. Port facilities need to be supported by digitalization or the smart port concept to support port supply chain activities that allow time and processes to be more effective and efficient. De Martino et al. (2020) also produced a port governance analysis model and port value creation. The background of the research is due to a paradigm shift in port

competitiveness, which started from individual ports (terminal vs terminal) to competitiveness between logistics chains. D'Amico et al. (2021) conducted research based on a systematic literature review on smart and sustainable logistics technology. This is supported because there is a demand for needs from city government policymakers, port authorities, local governments, shipping companies, couriers, and so on to deal with advances in digital technology that are integrated into port logistics. Furthermore, Salsas et al. (2022) researched port business model development design. The research in this paper was conducted due to changes in the port business ecosystem along with the port revolution, for which benchmarking was carried out at some of the world's best ports.

Literature Review

The definition of a port has different meanings with different perspectives as the function of the port develops. According to Nijdam and Van der Horst (2018); Ports are transfer point areas in the transportation chain that have other functions as locations for industrial and logistics activities. According to Stopford (2009); A port is a geographical area where ships are positioned along land to load and unload cargo, where the port is in a deep-water area in the form of a bay or river mouth. The Port Working Group of the European Commission (1975) defines a port as an area of land and water for licensing areas, especially, the reception of ships, loading and unloading, storage of goods, receipt and delivery of these goods by land transportation and may also include business activities related to sea transportation.

In their study of maritime logistics, Song et al. (2015) provide a broader view of the relationship between ports and surrounding activities. According to Song et al. (2015), maritime logistics is referred to as the process of planning, implementing, and managing the movement of goods and information involved in maritime transportation business activities.

The concept of maritime logistics studies results in three main key players: shipping, port/terminal operations, and freight forwarding (Table 1).

Table 1 Main and supporting functions of maritime logistics activities (Lee, Nam, & Song, 2015)

	Shipping	**Port/Terminal Operating**	**Freight Forwarding**
Main function	Moving cargoes between ports.	Shipping reception; Loading/unloading cargoes; Stevedoring; Connecting to inland transportation.	Booking vessels; Preparing for requisite documents for ocean carriage and trade, on behalf of shippers.
Supportive logistics activities	Documentation relating to sea trade; Container tracking and information; Intermodal service.	Warehousing; Offering a distribution centre; Testing; Assembly; Repairing; Inland connection.	Inventory management; Packaging; Warehousing.

Another study on ports is based on port functions (Table 2) presented by Nijdam and Van der Horst (2018). According to their study, the port can be seen from its three functions, namely:

1. Port as a transportation node
2. Port as a location for industrial activities
3. Port as a location for logistics activities

Table 2 Differences in port functions (Van Klink (1995); De Langen et al. (2007); Nijdam and Van der Horst (2018))

Characteristics	Port as a transport node	Port as a location for industrial activities	Port as a location for logistics activities
Function of port	- Cargo handling - Storage - Trade	- Cargo handling - Storage - Trade - Industry	- Cargo handling - Storage - Trade - Industry - Distribution and value-added activities
Relevant firms in the port in the provision	- Deep-sea terminal Operators - Providers of nautical services	- Port authority (landlord) - Utility providers (water, heat, energy)	- Forwarders and transport firms
Most important port users	Shipping lines	Port-related manufacturing firms	Shippers
Geographical level of competition	Other ports in proximity	Other 'sites' for industrial activities worldwide	- Other logistics zones, either in neighbouring ports or at inland locations
Important determinants in port competition	- Nautical accessibility - Infrastructure and transport to hinterland - Service to deepsea vessels (port turnaround time)	- Nautical accessibility - Availability/price of land - Proximity to sales market - Investment climate - Quality labour Force	- Infrastructure and transport to hinterland - Availability/price of land - Quality and flexibility of labour force
Underlying developments	Industrialisation, structural economic prosperity		Globalisation, introduction of container, environmental protection

Port performance measurement needs to be done to determine the level of business growth carried out at the port. Port performance measurement is complex because the activities at the port are combined. According to Nijdam and Van der Horst (2018), the performance of a single port terminal can be measured in terms of efficiency (movements per hour), while warehouse performance is measured by the level of storage and output production facilities produced. The size of port performance can certainly be seen from the port function, starting from the port as a transportation node, as well as the port as an

industrial and logistics location. In addition, performance measures can also be seen from investment factors, where investment growth reflects future port opportunities.

Research methods

The preparation carried out in this paper was carried out using the benchmarking method. There are two stages involved in benchmarking, namely the planning stage and the analysis stage. The International Benchmarking Centre (Lema and Price, 1995; Fong et al., 1998) defines benchmarking as a systematic and continuous measurement process; the process of continuously measuring and comparing an organization's business processes against business leaders around the world to obtain information that will help the organization take action to improve performance.

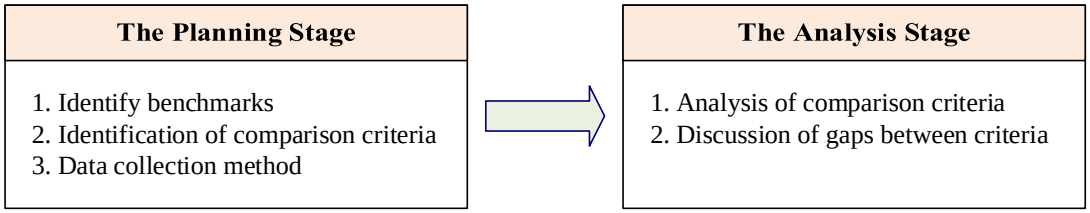

Figure 1 Benchmarking stages of the world's best ports

The planning stage consists of identifying benchmarks, identifying comparison criteria, and data collection methods. Benchmark identification in this study was carried out by identifying the characteristics of the business model of the port obtained from the literature review. Furthermore, the process of identifying comparison criteria is carried out by comparing the object of research, namely the world's best ports. The criteria for the world's best ports were selected from the world's 10 best port rankings based on the busyness assessed by the number of TEUs volumes processed at the port and then selected the best ports that were used as research objects from four different countries. The data collection method in this research is based on secondary data sources that are provided from company annual reports, company online databases, magazines, books, and previous research. The analysis stage consists of the analysis of comparison criteria and discussion of gaps between criteria. Analysis of comparison criteria is carried out by analyzing the business model of each port. The discussion of gaps between criteria is carried out by comparing ports by taking a theoretical approach to the development of maritime logistics business characteristics.

Results and Discussion

1. Benchmarking of Port

Based on the ranking of the world's best ports, ports in Asia are mostly ranked at the top. The countries that occupy the top 10 port positions are China, Singapore, South Korea, and the Netherlands. In this research, benchmarking of ports from four countries is carried out, namely Shanghai Port, Singapore Port, Busan Port, and Rotterdam Port.

Table 3 Best container ports (Source: World Shipping Council, www.worldshipping.org/top-50-ports, accessed April 2023)

Rating	Port	Volume (Million TEU)				
		2021	2020	2019	2018	2017
1	Port of Shanghai	47.03	43.50	43.30	42.01	40.23
2	Port of Singapore	37.49	36.60	37.20	36.60	33.67
6	Port of Busan	22.71	21.59	21.99	21.66	20.49
10	Port of Rotterdam	15.30	14.35	14.82	14.51	13.73

A. Port Of Shanghai

Geographical Location

Shanghai Port is located in the country of China, precisely located in the Shanghai region. Shanghai Port has a strategic place dealing with the East China Sea (east), Hangzhou Bay (south) that can have to get entry to global oceans, and additionally get the right of entry to inland rivers in numerous provinces (Yangtze River basin, Jiangsu, Zhejiang, Anhui, and Taihu Lake basin). Shanghai is the economic locomotive of China, particularly with the development of the Yangtze River Delta. The development of the Shanghai location is likewise supported through the development of port projects, considered one of that is the Shanghai Port as an international port that brings maritime enterprise provider clusters, business partners, logistics, and population.

General Company Structure Description

Shanghai Port is a main port in China that contributes to the economy, competitiveness, resource utilization, and sustainable improvement abilities. Shanghai Global Port (Group) Co., Ltd. (SIPG) is the operator of Shanghai Port. SIPG was established in January 2003 through the restructuring of the Shanghai Port Authority. SIPG became a shareholding business enterprise and became indexed on the Shanghai Stock Exchange on October 26, 2006, resulting in the ownership of the Port of Shanghai being publicly owned. SIPG has 12 branches in Shanghai, 3 internal businesses, 31 2nd-tier subsidiaries (thoroughly owned and at the same time-owned), and 13 organizations that use fairness investments.

Management Model and Structure

SIPG's human resources management version complies with the rule of law according to the requirements of the company law of the People’s Republic of China, the Securities law of the Human Republic of China, the listed enterprise Governance Code, and the applicable legal guidelines and regulations of the China Securities Regulatory Commission (CSRC). SIPG's control team includes executives inclusive of the president director, vice president director, vice president director, secretary to the board of administrators, and deputy finance director. The corporation evaluates management through comprehensive signs which include year-stop performance. Control balance is monitored by way of linking executive salaries to business performance and private overall performance. The selection of the management group is conducted in an open, obvious way, and according to legal guidelines and policies.

SIPG adheres to the ideas of "openness, honesty, fairness", "-way selection, advantage-based totally admission", and "same employment policy without discrimination of ethnicity, race, religion, sex, and gender". In step with the Development Report (2019) as of December 31, 2019, SIPG had 14,650 personnel (together with

branches, inner departments, owned subsidiaries, and holding corporations and joint ventures whose human sources are controlled using SIPG), of which 692 were professional and managerial personnel. The range of executives (from SIPG headquarters and secondary affiliates) controlled and appointed by way of the organization is 206, of which 18 are women.

SIPG manages its groups to guide strength conservation and emission reduction. Key initiatives protected the release of shore-based energy supply development, studies, and alertness of oil-electric hybrid strength train era on 39 tire cranes, and of the entirety of multiplied inexperienced LED lighting applications. According to the end of the 12 months, LNG had been used on 90% of the enterprise's container truck tractors and the share of RTG hybrid power trains reached 87%. SIPG's dedication to the social quarter is performed for charity activities. SIPG contributes to society by way of participating in diverse charitable activities as a volunteer.

Port Performance

The container throughput of Shanghai Port (SIPG's home port) reached 43.303 million TEU in 2019, ranking No. 1 in the world for 10 consecutive years (Shanghai International Port (Group) Co. Ltd., 2023). Based on the Sustainable Development Report (2019), the KPIs of Shanghai Port are presented, which can be seen in Table 4.

Table 4 Major indicators of Shanghai Port (Source: reworked from Sustainable Development Report, 2019)

End of the 13th Five-Year Plan		**2019 Year end**
Major Indicators		
Home port container throughput (million TEUs)	42 million TEUs	43.303 million TEUs
Water-to-water ration of home port containers	47%	48.3%
Assets	150 billion RMB *yuan*	142.177 billion RMB *yuan*
Key indicators of net assets, operating income and EBIT	Ranked among top three most important terminal operators global	Ranked among top three most important terminal operators global
Percentage of full-time heads of grass-root party organizations	Over 90%	85.4%
Number of employees	Around 16,000	14,650
Cash dividends	Cash dividends more than 50% of distributable profits each year	Cash dividends more than 50% of distributable profits each year, 60% for 2016 and 2017
Ratio of establishment of employee congresses, signing ratio, coverage and enforcement ratio of collective bargaining and collective contracts, and ratio of labor contracts signed	Staying at 100%	100%

Port Business

Shanghai Port is inseparable from the delivery function in addition to the main agencies run by way of SIPG which can be port managing operations, integrated logistics services, port-associated offerings, and port investment enterprise. The port logistics

industry chain consists of loading and unloading, warehousing and storage, shipping, inland transportation, and agent services. The enterprise run through SIPG to expand Shanghai Port is an industrial actual estate commercial enterprise positioned as a riverside remarkable complicated integrating green space, modern commercial enterprise, amusement, residences, and helping services for cruise ships. Moreover, there is a cruise delivery enterprise that includes water tourism and spinoff agencies to convey global-class waterfront tourism.

There are several client segmentations identified such as 1) Cooperating groups helping Shanghai Port's assisting businesses (shipping corporations, port operator groups, and logistics organizations); 2) Companies/industries that ship items via Shanghai Port; 3) Passengers or tourists. Shanghai Port makes several efforts to acquire clients via 1) Growing partnership cooperation with inter-port companies (Zhejiang, Jiangsu, and Anhui) with the aim of incorporated development of the Yangtze River Delta; 2) Acquisition of stocks in several terminal agencies along the Yangtze River; 3) Selling home trade-associated business; 4) Promoting strategic cooperation among Shanghai Port and Shanghai Customs; 5) Optimization of go-border change enterprise surroundings.

Shanghai Port has several platforms used for the marketing and distribution of goods. The community-based total carrier platform and blockchain transport drive the improvement of included transportation throughout rivers, seas, highways, and railways to maintain marketplace percentage. SIPG's One-stop Receiving Portal is designed to provide greater handy, green, and coffee-price shipping services for clients. Greater than 97% of service requests can be submitted online, saving 40% of visits to bodily workplaces, 60% of exertions fees, and nearly 90% of carbon emissions (Sustainable Development Report, 2019). The E-EIR platform enables Shanghai Port as a data center that specializes in port logistics and port surroundings. The Yangtze River box Intermodal delivery provider Platform leverages net era and new commercial enterprise fashions to carry together fragmented stakeholders alongside the Yangtze River. Through resource sharing, information sharing, business interplay, and choice-making primarily based on large records and other technologies, the intermodal platform permits green allocation of logistics resources, connects navigation channels, hubs and nodes, rivers, and seas, and facilitates direct customs clearance and access. The E-Truck platform is used to optimize container docking. The core information center for Port Navigation and statistics is a one-prevent information portal for tracking and asking for unfastened statistics approximately ships, containers, and loads in actual time. Furthermore, Shanghai Port has a professional website to provide brand new records on its offerings.

B. Port of Singapore

Geographical Location

The Port of Singapore is a port positioned in Pasir Panjang, Singapore. The Port of Singapore is a key transportation node inside the international delivery chain and a crucial gateway to the supply chain. The Port of Singapore is properly connected to 600 ports in more than 120 nations (Sustainability/Integrated Report - MPA Singapore, 2021). The Port of Singapore's area is a strategic vicinity that is developing as a worldwide commercial enterprise hub. The reality that land and natural assets are confined does not restrict the Port of Singapore from increasing its enterprise. The activity of importing natural assets and then re-exporting goods that have been processed in Singapore is one of the methods the Port of Singapore develop its enterprise and generate delivered price

revenue. Ships passing around Singapore place are ships that cross the Hinda Ocean, and the Pacific Ocean and bypass through the Singapore Strait.

General Company Structure Description

The Port of Singapore is owned by the Maritime and Port Authority of Singapore (MPA Singapore) which was established on 2 February 1996 from the merger of 3 companies specifically the National Maritime Board, Marine Department (below the Ministry of Communications), and PSA's regulatory departments (Anchor of our country - MPA Singapore, 2021). MPA takes on the jobs of Port Authority, Port Regulator, Port Planner, global Maritime Center, and Countrywide Maritime consultant. The Port of Singapore has two business terminal operators, PSA organization restricted and Jurong Port. The Port of Singapore has terminals positioned at Tanjong Pagar, Keppel, Brani, Pasir Panjang, Sembawang, Jurong, and Tuas.

Management Model and Structure

MPA Singapore is an integrated organization formed and established below the Maritime and Port Authority of Singapore Act. The MPA Board, headed by a non-government Chairman, units the strategic direction for the MPA to gain its mission and satisfy its role. Appointed by the Minister of Transport for a three-year term, Board members include the MPA chief executive, senior officials from the public sector, and enterprise representatives (Sustainability/Integrated Report - MPA Singapore, 2021). MPA Singapore has 18 divisions headed by Divisional Directors or Senior Directors, who are liable for dealing with the day-to-day operations in their divisions. The Senior Management Group incorporates the Chief Executive, Assistant Chief Executive, and the divisional Directors and Senior Directors, reporting to the Chairman of the MPA Board and day-to-day to the Secretary of the Ministry of Transport. Sustainability/Integrated Report - MPA Singapore (2021) describes the Port of Singapore as developing 6 materials objects that are aligned with the sustainable development requirements evolved with the aid of the United Countries. The six cloth issues are 1) Safe, Efficient, and sustainable Global Hub Port; 2) Economic Sustainability; three) Environmental Sustainability; 4) International Support and Community Engagement; 5) Financial Sustainability; 6) Culture and Society.

Port Performance

The performance of the Port of Singapore can be seen in Table 5 where several key performance indicators of the Port of Singapore are presented which make the port one of the best ports in the world.

Table 5 Performance indicator of Singapore Port (Source: reworked from Sustainability/Integrated Report – MPA Singapore, 2021)

Performance Indicator	2016	2017	2018	2019	2020	2021
Vessel Arrival Tonnage (billion GT)	2.66	2.80	2.79	2.85	2.90	2.81
Bunker Sales Volume (million tonnes)	48.6	50.6	49.8	47.5	49.8	50.0
Singapore Registry of Ships (million GT)	88.0	88.8	90.9	97.3	95.0	92.3
Container Throughput (million TEUs)	30.9	33.7	36.6	37.2	36.9	37.5
Cargo Throughput (million tonnes)	593.3	627.7	630.1	626.5	590.7	599.0

The Port of Singapore's performance areas are derived from the business model that has been developed. The following are some of the key performance areas generated from the Port of Singapore business model based on the Sustainability/Integrated Report - MPA Singapore (2021):

1. Improve safety and risk management practices
2. Enhance operational resilience and productivity in the Port of Singapore
3. Drive environmental sustainability in the Port of Singapore
4. Lead in setting industry standards
5. Digitalise and improve port infrastructure
6. Develop the next-generation port at Tuas
7. Anchor and grow key players in Singapore's maritime ecosystem
8. Promote a pro-business and conducive environment for maritime businesses
9. Be an active voice on regional and international maritime platforms
10. Strengthen relationships with international counterparts and the maritime community
11. Implement all ratified international regulations and conventions effectively
12. Promote maritime thought leadership
13. Support maritime R&D and nurture a culture of innovation
14. Drive sectoral manpower strategies
15. Promote maritime careers by raising the profile of the industry and its careers
16. Enhance public outreach and engagement to grow awareness of the maritime sector
17. Reinforce Singapore's position as a choice venue for maritime events

Port Business

Based on the six material issues at the Port of Singapore, nine new business value solutions were proposed for the development direction of the Port of Singapore, namely 1) Safe, Efficient & Sustainable Global Hub Port; 2) Vibrant International Maritime Center Ecosystem; 3) Safeguard Strategic Maritime Interest and An Influential Voice; 4) Maritime Knowledge and Innovation Hub; 5) Quality Maritime Workforce; 6) Strong Maritime Singapore Identity; 7) Culture of Excellence; 8) Strong Partnership; 9) Choice Employer.

There are several main business activities owned by the Port of Singapore. Port and marine operations activities consist of operational activities (port infrastructure services, vessel traffic information systems, etc.), marine services (bunkering, guiding and towing vessels, etc.), and port safety and security. Maritime business at the Port of Singapore can be seen from the aspect of a pro-business port environment such as the existence of a conducive business environment, service access to global maritime, and access to major markets. There are port service activities consisting of refrigerated cargo management, dangerous goods handling, depot services, and warehousing services. In addition, there are also cargo solution activities, namely end-to-end transportation solutions, inventory forward-rubbing partnerships, regional distribution centers, cargo flow improvement services, and smart digitization technology.

MPA Singapore conducts several marketing activities such as the promotion of safety, efficiency, and sustainable systems at the Port of Singapore, the promotion of maritime research and development, and building relationships with the international maritime community. Some of the channels used by MPA Singapore consist of a website that provides the latest information on services at the Port of Singapore and there are also several platforms used to improve service and workplace experience (DigitalMPA, TalentMPA, and OneMPA). An information system was also launched called the Port

Operations Control Center to provide vessel traffic information for safe and efficient water navigation.

C. Port of Busan

Geographical Location

Busan Port is located in Busan, South Korea. The Port of Busan is the first and largest trading port managed by the government. The Port of Busan consists of the New Port which is developing into a global transshipment center; the North Port which has played a key role in the development of Korea's port industry and has served as a hub port in Asia; the Gamcheon Port which handles about 50% of Korea's fishery products; and also the Dadae Port, a water-friendly place accessible to citizens. The Busan New Port concept aims to contribute to the national economy by making the Port of Busan a competitive logistics shipping center in Northeast Asia.

General Company Structure Description

Busan Port Authority (BPA) is the first state-run port company in Korea and was established on January 16 2004, in accordance with the Port Authority Act, which was enacted to develop the Port of Busan into a competitive shipping and logistics hub in Northeast Asia. BPA established a joint working strategy with the central government and local governments.

Management Model and Structure

Busan Port Authority's corporate organizational structure includes 5 Divisions, 22 Departments, and 3 workplaces (25 departments in general). BPA set up the ESG (Environment, Social, Governance) department under the direct control of the CEO and the Port Safety & Security department to reinforce safety at Busan Port. The Green Port Department and Smart Engineering Department were established to create a green and high-value-introduced Port of Busan. in addition, there is an Audit Committee, BPA contains transparency and integrity in carrying out policy implementation and promoting corporate environmental, social, and moral values (Busan Port Authority Sustainability Report, 2021).

Busan Port established ESG management to enhance the social value of port management, such as environmental and social responsibility and transparent management, and promoting the sustainable growth of Busan Port. The Port of Busan implements resources based on environmental conservation to reduce pollutant emissions by source, both at sea and on land, from ship arrival to cargo loading, and departure. In addition, the Port of Busan established a technology system focusing on information security, cybersecurity, and public safety. BPA will respond to various cyber threats and protect the Port of Busan from information breaches.

Port Performance

BPA's performance is accomplished by utilizing value creation through the ESG control idea. BPA accomplished a sustainable increase in the Port of Busan. A materiality assessment was performed to perceive key problems and ESG issues from numerous stakeholders, which became the premise for the mission of numerous projects and activities to fulfill environmental and social responsibilities and enhance transparency in governance.

Table 6 Financial status and performance in 2021 (unit: KRW in billion) (Source: reworked from Busan Port Authority Sustainability Report, 2021)

Asset	Sales	Operating Income	Net Income	Gov. dividend
7,037	565	101	41	21

Table 7 Business performance in 2021 (Source: reworked from Busan Port Authority Sustainability Report, 2021)

Cargo Volume	Distripark		Port redevelopment project	
Container	Area	Cargo	Period	Budget
22.7 million TEU	4.2 million m^2	1.94 million TEU	2008 ~ 2030	KRW 6,823 billion

The principle enterprise performance generated through BPA are: 1) Handled the highest cargo quantity record of 22.7 million TEU at Busan Port; 2) Carried out port-oriented safety control by means of recording "zero" cases of serious commercial accidents for 5 consecutive years; 3) Accomplished intensive pollutants management by way of ships, from arrival to departure through decreasing 45% of ultra-fine dust at Busan Port in comparison to the bottom year; 4) Decided on the only operator of fully automated terminals through making the transition from a big quantity of small terminals to a huge terminal machine; 5) Secured an export base for Korean corporations for the first time amongst port authorities via operating a logistics center in Rotterdam; 6) Restored Busan Port to society through the largest port regeneration venture through signing commercial enterprise agreements in the Port Redevelopment project; 7) Developed sourcing technology for shipment managing system, and led the standardization of k-smart Port; 8) Constructed a activity ecosystem through clean port operations by developing 5,907 non-public sector jobs aligned with BPA's middle enterprise; 9) Enhanced the competitiveness of the Port of Busan through ethical management that promotes integrity and transparency through obtaining a high rating in the integrity evaluation and a high-quality rating for 4 consecutive years in the anti-corruption policy assessment.

Port Business

BPA conducts several business activities namely port logistics, port operations, port construction and maintenance, port redevelopment, cruise ship and marine tourism business, and overseas port logistics network. Busan Port Authority facilitates the ancillary logistics services of distriparks, and world-class port-related business clusters, and creates new added value. The Port of Busan consists of three ports, each of which has different functional specialties. Busan New Port is a major transshipment base of the global maritime alliance. Gamcheon Port is a modernized public port for frozen fishery products, miscellaneous goods, and ship repair. The North Port is located along the Asian regional sea and is currently under redevelopment to become a marine tourism base and gateway to Eurasia, where port logistics and maritime culture are harmonized. BPA actively encourages port redevelopment projects aimed at developing a conventional Northern Port. BPA continues to expand its global logistics network to enhance public infrastructure centers and strengthen the global competitiveness of Korean companies. The expansion of this network includes operating logistics centers in Rotterdam, the Netherlands, and in Barcelona, Spain, as well as promoting the construction and operation of warehouses in East Java, Indonesia.

The Government and Port Authority expanded port infrastructure under the regional port development plan set out in the "National Port Master Plan". The creation of comprehensive logistics clusters around ports through the development of logistics complexes in districts and the expansion of land transportation networks, as well as pursuing national and local economic growth by redeveloping obsolete and idle port facilities and revitalizing marine tourism.

D. Port of Rotterdam

Geographical Location

The Port of Rotterdam is located in the Rotterdam region of the Netherlands. The Port of Rotterdam has optimal accessibility thanks to its favorable geographical position, right on the North Sea and at the mouth of the Rhine River. The terminal is directly adjacent to the deep sea and can be accessed from the high seas quickly and safely without the need for a sea lock. This allows ships to be unloaded and loaded in record time, allowing port customers to move on to their next destination quickly. An extensive intermodal network of rail, inland shipping, road, short sea, and pipeline networks provides a wide range of connection options to the rest of Europe (Port of Rotterdam, 2023).

General Company Structure Description

The Port of Rotterdam Authority is an unlisted public company. The governance of the Port of Rotterdam Authority is based on a two-tier board structure where appointments are made by the General Meeting of Shareholders. The Port of Rotterdam is developed by the Port of Rotterdam Authority with two shareholders namely the Municipality of Rotterdam (approximately 70.38%) and the Dutch State (29.17%). The Port of Rotterdam Authority manages, operates, and develops the Port and the industrial area of Rotterdam and is responsible for maintaining the safety and smooth running of all shipping. The Port of Rotterdam Authority aims to strengthen the competitive position of the port of Rotterdam as a world-class logistics center and industrial complex both in terms of size and quality.

Management Model and Structure

The Port of Rotterdam Authority applies the principles and first-rate practices of the Dutch 2022 Corporate Governance Code. In doing so, The Port of Rotterdam Authority applies the ‘comply or explain’ principle. The Port of Rotterdam is creating an environmentally friendly port profile. Long-term contracts with parties using the Port of Rotterdam's services are entered into with discussion of agreements to participate in carrying out environmentally friendly activities. The Port of Rotterdam provides discounts on port fees for ships that have a green index.

Task Force on Climate-related Financial Disclosures (TCFD) has developed several guidelines prepared around 4 issues: governance, strategy, risk control, and indicators and targets. The suggestions are followed through references to the relevant sections. Port authorities and Port Managers remember both types of dangers in operations. Bodily risks from climate alternate affect the infrastructure and assets of the Port of Rotterdam, in addition to patron belongings. Transition risks resulting from the transition to a low-carbon economy can determine the conditions below which the port works (license to perform) and may impact carbon-in-depth activities on the port.

Port Performance

Based on the Highlights Annual Report - Port of Rotterdam Authority (2022), there are performance achievements of the Port of Rotterdam that can be seen in Table 8, which is included with the activities of these performance achievements.

Table 8 Indicator Performance of Rotterdam Port (Source: reworked Highlights Annual Report – Port of Rotterdam Authority, 2022)

Indicator Performance	Number of Performance	Description
Safety and security	1 major incident (2021: 0)	An inland vessel capsized in port, with a fatal casualty as a end result in 2022
Energy transition	Carbon emissions: 23,5 Mtonnes (2020: 22,4 Mtonnes)	Carbon emissions in the port rase for the primary time since 2016, particularly due to the coal-fires power plants at the Maasvlakte. In 2021, emissions have been about 1 Mtonne higher than in 2020, an increase of 4,9%.
Employment	183,004 jobs (2020: 174, 057)	The Rotterdam-Rhine Estuary seaport area hired 183,004 human beings immediately and in a roundabout way in 2021 (the figure lags one year behind)
Goods throughput	467,4 million tones (2021: 468,7 tonnes)	Throughput become 0.3% lower in 2022 than in 2021. There were essential versions, in particular, because of the conflict in Ukraine, sanctions against Russia, and modifications in international strength flow.
Revenue	825.7 million euros (2021: 772.7)	Revenue in 2022 had 6.9% higher than in 2021
Gross investment	257.0 million euros (2021: 226.3)	The principal investments in 2022 were the development of quay partitions in the Amalia Haven and the land reclamation operation on Maasvlakte
Entrepreneurial and effective organization	24 employee Net Promotor Score (Enps)	A completely massive proportion of employees in business enterprises are proud to work for the Port of Rotterdam Authority with a rating of 24 from discerning nationally 12 the score.

Port Business

The Port of Rotterdam Authority manages its business by supporting all seventeen of the Sustainable Development Goals of the United Nations. The Port of Rotterdam Authority's goal is a safe harbor, accelerating sustainability at the port and acting as a smart partner in the logistics chain.

The Port of Rotterdam Authority manages, operates, and develops Rotterdam's port and industrial parks and is accountable for maintaining safe and clean transport. The area of business development undertaken in the Port of Rotterdam is petrochemical (Merk, 2018). The Port of Rotterdam Authority acts as an entrepreneurial developer, matchmaker, facilitator, enabler, director, investor, and initiator. The Port of Rotterdam Authority is energetic inside the Netherlands and some other places through shared participation and consultancy activities.

The three main businesses of the Port of Rotterdam are as follows (Highlights Annual Report - Port of Rotterdam Authority, 2022):

1. Intelligent partner in the logistics chain. By using presenting facts and records, the port can organize shipment management inside the logistics chain as efficaciously and optimally as possible. In this way, the port will make certain that more 'cargo' chooses Rotterdam.
2. Accelerating sustainability at the port. As an accelerator of sustainability in ports, our goal is to contribute to the Netherlands' carbon reduction aim of 55% compared to 2030 in 1990. With a huge portfolio of energy transition tasks, the port transferring toward CO neutrality through 2050, attracting destiny environmentally pleasant cargo flows and operations, and investing in sustainability.
3. An entrepreneurial and effective organization. The port got strict requirements for the effectiveness and consumer focus of our company. suitable internal and outside collaboration, in addition to clean obligations, help make this appear. The direct outcomes consist of similar improvements to organizational agility, management of operating prices and capital fees, and persisted sprucing of customer cognizance.

2. Discussion

The port business comparison in this paper is approached with the concept of maritime logistics. The four reference ports (Shanghai Port, Singapore Port, Busan Port, and Rotterdam Port) that have been analyzed based on the characteristics of port functions (Table 9), it is found that the four ports have fulfilled the concept of port development in the maritime logistics system. The four reference ports carry out maritime logistics business activities, namely shipping activities, terminal/port operations, and shipping goods in an integrated manner through their supporting facilities.

Table 9 Comparison of Characteristics of Shanghai Port, Singapore Port, Busan Port, and Rotterdam Port

*The characteristics of the ports analyzed are based on the updated business model, there is a possibility of developing port characteristics based on the future.

No.	Characteristics	Port of Shanghai	Port of Singapore	Port of Busan	Port of Rotterdam
1.	**Function of port**	**Cargo Handling** - Container Terminal - Non-Container Terminal (bulk cargo, general cargo, special cargo, roll-om/roll-off, cruise ship) - Marine Services (tug services, cargo	**Cargo Handling** - Container Terminal - Non-Container Terminal (bulk cargo, general cargo, special cargo, ro/ro, cement terminal, steel terminal, multipurpose terminal, energy terminal) - Marine Services (bunkering; vessel guiding	**Cargo Handling** - Container Terminal - Non-Container Terminal - Fishery Terminal - Multipurpose Terminal - Passenger Terminal - International Ship Service Center	**Cargo Handling** - Container Terminal - Non-Container Terminal (dry cargo, liquid cargo, LNG, agrofood) - Maritime Services (supply, shipbuilding, maintenance, repair,

No.	Characteristics	Port of Shanghai	Port of Singapore	Port of Busan	Port of Rotterdam
		calculation services) **Storage and Distribution Services** - Integrated Logistics Services **Business Services** - Port Investment Business **Industry** - Integrated Logistics Industry (port logistics, third party logistics, automotive logistics)	and delaying; charts, tide info, AtoN and Hydrography, garbage collection services, voluntary pilotage services) **Storage and Distribution Services** - Reefer Management - Dangerous Goods Handling - Depot Services - Warehousing Services - End-to-end Transportation Solutions - Inventory Forward-Hubbing Partnerships - Regional Distribution Centre Capabilities - Cargo Flow Enhancement Services - Distribution Hub **Business Services** - Maritime Sector Incentive - Withholding Tax Exemption **Industry** - Project Logistics Hub (Onsite yard & warehouse (FTZ), Offsite landing & warehouse (Non-FTZ), Rework and staging	**Storage and Distribution Services** - International Port Logistics Network **Business Services** - Trade/Logistics Area (New Port Distripark) - Cruise Ship and Maritime Tourism Business **Industry** - Fishing Industry - Global Logistics Industry - Industrial Complex (assembly, sorting, packaging and pressing) - Maritime Industry	inspection, ship refueling, and offshore objects) - Marine Services (pilot, tugboat, helmsman) - Transportation and logistics services **Storage and Distribution Services** - Port Logistics **Business Services** - Consulting Services - Investment **Industry** - Industrial Business at Port

No.	Characteristics	Port of Shanghai	Port of Singapore	Port of Busan	Port of Rotterdam
			within the port (FTZ Area)) - Offshore Marine Centre - Cement Industry - Energy Industry		
2.	**Relevant firms in the port in the provision**	**Shanghai Port Authority** (shareholder listed on the Shanghai Stock Exchange) **Terminal Operator:** Shanghai International Port Co. (SIPG) **Other companies** (12 branches in Shanghai, 3 internal organizations, 31 subsidiaries, and 13 equity investment companies)	**Maritime and Port Authority of Singapore** (MPA Singapore) **Terminal Operator:** PSA Terminal Singapore Jurong Port Pte Ltd **Other companies** (start-ups, forwarders, transportation companies, etc.)	**Busan Port Authority (BPA)** **Terminal Operators:** Hutchison Korea Terminals Co., Dongbu Busan Container Terminal Co., Ltd., Busan International Terminal Co., Ltd., CJ Korea Express Busan Container Terminal Co., Ltd., Pusan Newport International Terminal (PNIT), Pusan New Port Company (PNC), Hanjin New Port Company Terminal (HJNC), Hyundai Pusan New-port Terminal (HPNT), Busan Newport Container Terminal Co. Ltd (BNCT) **Other companies** (forwarders, transport companies, etc.)	**Port of Rotterdam Authority** (shareholders: Municipality of Rotterdam (approx. 70%) and Dutch Government (approx. 30%). **Other companies** (forwarders, transport companies, etc.) **Local Partners** (Indonesia, Brazil, Sohar)
3.	**Most important port users**	- Logistics companies (shipping. freight forwarding	- Processing companies - Global and multinational companies	- Supply Company - Industry - Ship Passenger - Shipping Users	- Logistics Company (Terminal and Warehousing) - Industry

No.	Characteristics	Port of Shanghai	Port of Singapore	Port of Busan	Port of Rotterdam
		and shipping, forwarding companies) - Commercial and terminal companies - Large import/export distributors - Multinational and global companies - Passengers and Tourists	- Industry Partners - Passengers and Tourists	- Local residents	- Transportation Company - Shipping Company
3.	**Geographical level of competition**	- T-shaped Water Transport Network - Excellent natural conditions and strong deepening economy	- Industrial parks and business districts - Logistics zones	- Distripark - Free Trade Zone	- Logistics Hub - Industrial Complex
4.	**Underlying developments**	World Class Shipping Hub	Smart and Green Port	Hub Port Logistics, Distripark	New Port Area, Rotterdam Food Hub

Furthermore, the analysis of supporting facilities from maritime logistics business activities is carried out by looking at the characteristics of the port function. The main functions of the four ports have characteristics of business activities ranging from cargo handling, storage, trade, industry, and integrated distribution of goods. The main function of the port illustrates that the Port of Shanghai, Port of Singapore, Port of Busan, and Port of Rotterdam develop their port functions from transportation nodes, industrial activity locations, and logistics activity locations.

Based on the port-related company characteristics, there are differences among the four ports. Shanghai Port has a public ownership profile with the Shanghai International Port (Group) Co., Ltd. (SIPG) listed as the port operator on the Shanghai Stock Exchange. The Port of Singapore is owned by the Maritime and Port Authority of Singapore (MPA Singapore) under the Singapore Ministry of Transportation. The Port of Singapore is operated by commercial terminal operators PSA Corporation Limition and Jurong Port. The Port of Busan is owned by the Busan Port Authority (BPA) under the Government of Busan which conducts its port development plan through the "National Port Master Plan". Busan Port is operated by several commercial terminal operator companies. There are currently 9 terminal operator companies carrying out work at several terminals of the Port of Busan. The Port of Rotterdam is owned by the Port of Rotterdam Authority with two shareholders, the Municipality of Rotterdam (70%) and the Dutch Government (30%). The Port of Rotterdam Authority is also tasked with managing, operating, and developing the port and the Rotterdam Industrial Estate. Port-

related companies that can be identified at the four ports are supporting port logistics activities such as logistics companies, freight forwarders, and transportation companies. The business activities of logistics companies that can be analyzed include warehousing facilities, product processing, packaging, finished goods inventory, distribution planning, order processing, transportation, and customer service.

The port users of the four ports also have the same characteristics. This is because the four ports already have similarities in the characteristics of the main functions. Port users are divided into three segmentations if analyzed as a whole, namely consumers from shipping companies, manufacturing companies located at port locations, and shippers. The difference that can be seen from the three segmentations is in manufacturing companies located in the port industrial area. The Port of Singapore has a special port area for the cement industry, and logistics industry, and also a special port area for the offshore area industry. Likewise, at the Port of Busan, there are differences in industry characteristics, namely the fishing industry, logistics industry, and maritime industry.

Geographical conditions are one of the characteristics of the port development process. The four ports have marine geographical conditions that support the world of shipping. In addition, the natural resources of the hinterland area help the development of the port business. Shanghai Port, Busan Port, and Rotterdam Port have hinterland natural resources that support the development of port business. Meanwhile, the Port of Singapore is different from the other three ports. The Port of Singapore utilizes the hinterland area by creating a processing industry with the support of advanced technology so that it can present many opportunities for other countries to cooperate with the country. Some port characteristics cannot be analyzed specifically such as port characteristics from the aspects of competition and development areas. However the four ports have the direction of competition aspects and development areas to aspects that have been described with the maritime logistics approach. The competition characteristics of each port can be seen from the added value of the facilities provided by the port. The four ports develop their facilities in several aspects such as land availability, proximity to trade access, investment, labor, infrastructure, and transportation to hinterland areas. The four ports are already supported by these value-added activities and continue to develop their ports with various other innovations. Areas of port development can also be identified concerning aspects such as environmental protection, maritime logistics systems, and port digitalization.

Conclusion

The port area is divided into land and water which functions as one of the areas of goods movement. Port activities develop over time due to the revolution of the port business which currently leads to the concept of maritime logistics. The three main port activities are shipping, port/terminal operations, and freight forwarding. Port logistics business can be developed based on the characteristics of port functions, namely ports as transportation nodes, ports as locations for industrial activities, and ports as locations for logistics activities.

This paper benchmarks port business models in several countries, namely Shanghai Port, Singapore Port, Busan Port, and Rotterdam Port. Based on the benchmarking study obtained from analyzing business models and conducting studies based on maritime logistics theory, the four ports have all three port functions, namely as a transportation node, industrial location, and logistics location. The four ports, which are the top 10 best ports in the world, currently focus on developing their business towards

maritime logistics where there is integration between stakeholders in the entire supply chain of shipping goods. The business development of these ports refers to aspects of port logistics development, port digitalization, and environmentally friendly ports. The industries that develop in each port are closely related to the hinterland conditions of each port area. The Port of Singapore utilizes its port to develop the manufacturing industry, while the other three ports have industries related to natural resources produced from the surrounding hinterland areas.

Benchmarking studies of the world's best port business models in several countries can be used as a reference in designing port business development. The continuity between port business models and maritime logistics theory can be used as a comparison with research that can be carried out in the future with a comparative focus on the characteristics of port functions (ports as transportation nodes, ports as locations for industrial activities, and ports as locations for logistics activities).

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