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Analysis of Determining Roles for Makassar New Port (MNP) on Indonesian And Global Container Shipping Networks

By

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Abstract

There are two significant issues with Indonesia's current logistics performance: port infrastructure and connectivity with international shipping networks. The purpose of this study is to determine whether the result of Indonesia's port infrastructure, specifically Makassar New Port (MNP) development, has an impact on the connectivity of Indonesian ports, particularly eastern Indonesia, with a global container shipping network. Direct calls for larger container ships from various regions to Indonesian ports, in this case, MNP, are possible. Transshipments can be avoided, and prevent additional costs. However, whether MNP can meet these roles or expectations will be evaluated through this research. Then, to get the answer to this research question, it will be analyzed for transport cost values and compared. Thus, the proper role for MNP in the current condition is obtained based on the lowest transport cost value. the calculation will use the GC model, where eight components are essential variables of the GC model that will be used. The eight components are container volume, base ship model, operational cost, voyage cost, capital cost, port dues & service, Terminal cargo handling, and time value. It was found that from the calculation of the value of the transport cost per TEU for model 1, where Makassar New Port (MNP) acts as a feed port, which is around USD 563 – 577 for ship variations of 600-700 TEU, model 2 where MNP serves as the main port which is around USD 372 – 409 for ship size variations of 2,000 TEU – 3,000 TEU, and finally for model 3 where MNP acts as an intentional hub port, which is around USD 380 – 393 with variations in ship size 4,000 – 5,000 TEU. In general, if based on the value of transport costs, MNP has the potential to perform service models 2 and 3 or play a role as the main port and international hub port. However, after an analysis by reviewing the actual conditions currently with the existing global container volume from/to Makassar, MNP is only suitable to act as a feeder port. Overall, regardless of the transport cost per TEU for each model. One thing that becomes a highlight is the volume size of Indonesia's international containers. Volume is very influential in calculating transport cost per TEU and actual conditions. Based on the calculation results that Makassar New Port (MNP) can play an active role as a minimum main port when the volume of international containers from/to Makassar and eastern Indonesia is around 1,600,000 TEU/year and can play an active role as a global hub port when the volume of international containers from /to Makassar and eastern Indonesia is around 6,000,000 TEU/year.

Keywords; *Makassar New Port, MNP, International Hub Port, Main Port, Feeder Port, Transport cost*

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List of Abbreviations

BBM	Bahan bakar minyak: fossil fuel oils
BPS	Badan Pusat Statistik; Indonesian Central Statistical Agency
DWT	Ship deadweight tonnage
ECA	Emission Control Area
GT	Gross Tonnage
HSD	High-speed diesel
IDR	Indonesian Rupiah
IMO	International Maritime Organisation
MEL	Maritime Economics and Logistics
MFO	Marine fuel oil
MNP	Makassar New Port
MSc	Master of Science
Pertamina	Perusahaan Pertambangan Minyak dan Gas Bumi Negara; Indonesian Oil and Natural Gas Mining Company
PT Pelindo	PT Pelabuhan Indonesia; Indonesia Port Corporations
TEU	Twenty-foot equivalent unit (standard container size)
USD	United States Dollar

Chapter 1 - Introduction

1.1 Background to the Study

Nowadays is an era of international globalization in which free trade occurs and affects the logistics distribution system and capital mobility, resulting in increasingly high competition. Developing technology and implementing an integrated transportation system can improve the efficiency of distribution and logistics systems. Transportation technology advances follow economic and trade developments and vice versa (Triatmojo, 2010). There are two significant issues with Indonesia's current logistics performance. The first is port infrastructure, which receives a score of 2.89 out of 5.0 on the World Bank's Logistics Performance Index. The second issue is connectivity with international shipping networks, for which Indonesia receives 3.15 points out of 5.0, compared to Singapore's 4.00 and Malaysia's 3.25. This issue also has an impact on Indonesia's high logistics costs, which account for approximately 24% of Indonesia's GDP compared to Malaysia's 15% (The World Bank, 2018).

Companies within the shipping industry tend to deploy ships with large capacities to serve international shipments, and this trend is predicted to continue in the future. However, one vital point is that giant ships necessitate improved port infrastructure, like port depth and quay crane capacity. As a result, even when cargo for shipping is enough, many large vessels do not have direct call routes to Indonesian ports. The dearth of this direct call demonstrates that Indonesian ports are prone to international shipping networks, which forced routes from the worldwide shipping network to use one in all of Singapore's or Malaysia's ports as a transshipment point for Indonesia, particularly in the case of container shipping. Furthermore, the absence of this direct call incurs additional costs within the logistics or shipping processes, which made two additional costs. The primary is the extra cost in terms of finance, like the value of handling the container itself. Then there is the time cost, the time it takes to unload/load this container and use the following ship. In Indonesia, all of those costs end in higher transport costs. Higher transport cost is often very actual in Eastern Indonesia, where port infrastructure remains in poor condition. As a result, the transport cost is exceptionally high because transshipment can occur multiple times during shipping activities.

Indonesia has made various improvements to overcome the above problems, such as by creating a national logistics network, where the main focus is the International Hub Port, namely Belawan and Bitung. Until the last one, namely, the Integrated Port Network (IPN), where there are seven main ports, which are expected to become main ports and, in the future, can become International Hub Ports in the global shipping network. One of the ports is Makassar New Port (MNP). Makassar, Indonesia's eastern gateway, is one of the most important cities for shipping goods or containers to and from Eastern Indonesia. So, through the Integrated Port Network (IPN) concept, Indonesia is developing the Makassar New Port (MNP), hoping to reduce transshipment activities for Indonesia, particularly in the eastern part of the country. MNP is expected to become an International Hub port that will be able to make direct calls to international shipping routes in the coming years. Nevertheless, logistics activities, exporters and importers, business players, and local communities in eastern Indonesia will benefit. This service will reduce transport costs for shipments to and from

Makassar while providing direct access to major ports in China, South Korea, Japan, the Philippines, and Australia.

1.2 Research Objective

As mentioned in the background regarding transport cost, the transshipment process in Indonesian shipping activities, the development of Eastern Indonesia, and the development of MNP. The purpose of this study is to determine whether the result of Indonesia's port infrastructure, specifically MNP development, has an impact on the connectivity of Indonesian ports, particularly eastern Indonesia, with a global container shipping network. Direct calls for larger container ships from various regions to Indonesian ports, in this case, MNP, are possible. Transshipments can be avoided, and they can prevent additional costs. However, whether MNP can meet these roles or expectations will be evaluated through this research.

Thus, the research question (RQ) that this study aims to answer is: ***What is the perfect role of Makassar New Port (MNP) in the current condition of Indonesian container shipping?***

To answer the research question sufficiently, in this thesis, several sub-research questions (SQ) need to be addressed:

1. How is the connectivity of Eastern Indonesia, especially for MNP, to the international container shipping network?
2. How many international containers flow from/to eastern Indonesia, especially for MNP?
3. What is the current and future network service model, and what is the role of MNP in this model?
4. What is the transportation cost resulting from the model?

1.3 Research Limitation

There are at least four types of cargo in international trade: container cargo, dry bulk, liquid bulk, and Ro-Ro. Most cargo is transported by sea from the point of origin to the end destination. The type of cargo discussed in this final project is container cargo transportation from/to Makassar New Port (MNP). Still, in terms of cargo, namely containers, in this study, it is assumed that the flow of containers in this study is ideal and does not change in the sense that the annual volume is generally distributed throughout the year. In addition, it is also assumed that the ship will carry cargo in the complete condition in the calculation process.

In addition, it is also assumed that the performance of the ship and port is in ideal conditions. There are no delays, bad weather, or other unexpected events. In actual situations, these unpredictable variables have an unavoidable effect, but for simple calculations, those variables are ruled out in terms of the performance of ships and ports in optimum and ideal conditions. Furthermore, the analysis is based only on the port to port and the destination route, namely Singapore port.

Finally, MNP requires two things in order to serve larger container ships. First, capital investment is necessary to revitalize port infrastructure and superstructure. Second, they must enhance port operational performance. Because our primary goal is to calculate the overall cost of the transport cost based on the roles of MNP, we do not calculate the capital investment required and do not discuss the port's operational performance.

1.4 Thesis Structure

This thesis is divided into six chapters discussing the different parts of the research. The description of each chapter and the general structure of the thesis is shown below;

1. **Introduction** - Chapter 1 explains the general description and background of the research and the research question that serves as the foundation of the study.
2. **Literature Review** - Chapter 2 explains the foundation theory and research-related information.
3. **Research Methodology Framework and Data** - Chapter 3 explain the methodological frame that this thesis will carry out in answering the research question in chapter 2, and supporting this thesis will display data in answering it.
4. **Methodology Approach** - Chapter 4 explains the approach used to answer the questions in this study, using the GC calculation model, then will calculate the transportation costs for three MNP service models.
5. **Result and Analysis** - Chapter 5 explains the results obtained from the previous chapter and analyzes the results to get answers to the research question.
6. **Conclusion & Recommendation** - Chapter 6 summarizes the findings that have been carried out, followed by suggestions and recommendations for further related research in the future.

1.5 Note on Currency Exchange Rate

Most of the data will come from Indonesia, which in terms of data presentation, such as prices and costs, are displayed in units of Indonesian Rupiah (IDR). Thus, to make this thesis accessible and easy to read by various readers, this thesis will convert these values into United States Dollar (USD) values. So that all values in the calculations in this thesis will use USD units. The conversion rate is based on the value in June-July-August, where IDR 1 is equivalent to USD 0.000067.

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Chapter 2 Literature review

2.1 Current Container Shipping Condition of Indonesia

The current pattern of international container shipping in Indonesia is for small ports to act as feeder ports, transporting containers to the main port, which is currently Tanjung Priok (Jakarta) and Tanjuk Perak (Surabaya). Containers are collected in the area and then transported to international hub ports such as Singapore ports and the Malaysian port of Tanjung Pelepas (Iqbal, 2020).

In detail based on (Lazuardi, 2015) it can be described that in general international containers first transshipment at international hubports in Singapore and Malaysia before continuing their journey to domestic shipping. Based on available data, the ports that handle international containers are broadly speaking, or with the largest portion located on the island of Java, namely the Tanjung Priok port, Jakarta and the Tanjung Perak port, Surabaya. Tanjung Priok, Jakarta is a port that handles international containers with the largest volume or portion in Indonesia, this is in accordance with where Jakarta is the capital city of the country, so that most economic activities in terms of trade occur a lot. Meanwhile, Surabaya is a business city and the second largest city after Jakarta.

As explained in the previous chapter, one of the main issues of the current situation is when export commodities from eastern Indonesia have to stop at the main ports (Tanjung Priok and Tanjung Perak) before continuing their journey to their final destination. The problem is, some locations of these commodities are very close to their final destination, if they can go directly to their destination, instead of having to stop at the main port first. This makes it very difficult for local products to compete in the world market due to the high transportation costs. This situation can be described according to the image below;

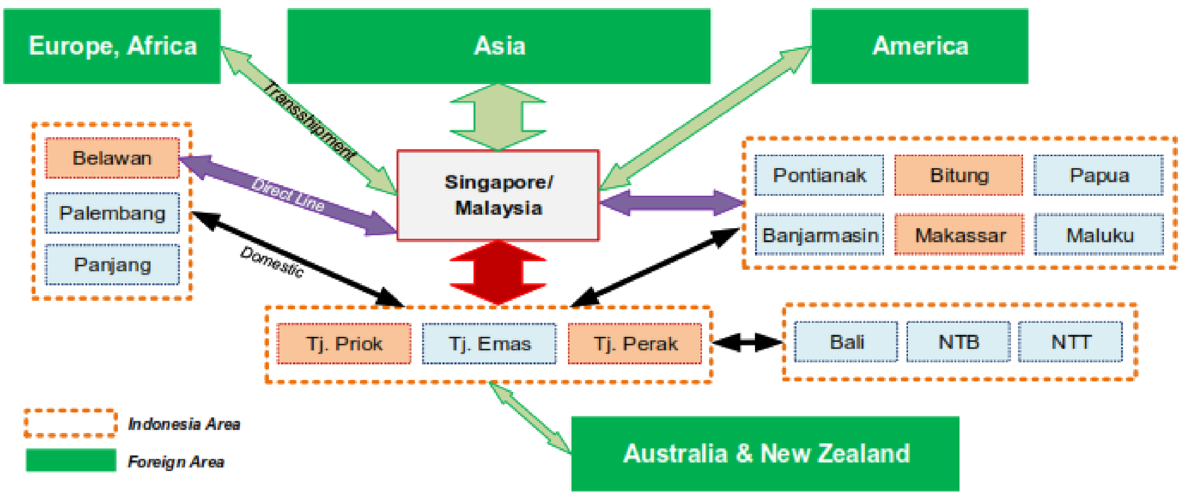

Figure 1 - Current Condition International Container Connectivity

Source: *(Lazuardi, 2015)*

2.2 National Logistics System Concept (Sislognas)

The Indonesian government created the National Logistics System to help with the implementation of the Master Plan for the Acceleration and Expansion of Indonesian Economic Development (MP3EI) 2011-2025. MP3EI has three main goals:

1. Reduce regional inequalities;
2. Accelerate assistance for poverty; and
3. Improve global competitiveness.

One way to achieve these goals is to reduce transportation costs in shipping goods and to improve the accessibility and efficiency of international ports. As a result, the Indonesian government hopes to have its own international hub port in the future, reducing reliance on Singapore's port and Malaysia's Tanjung Pelepas port (Lazuardi, 2015).

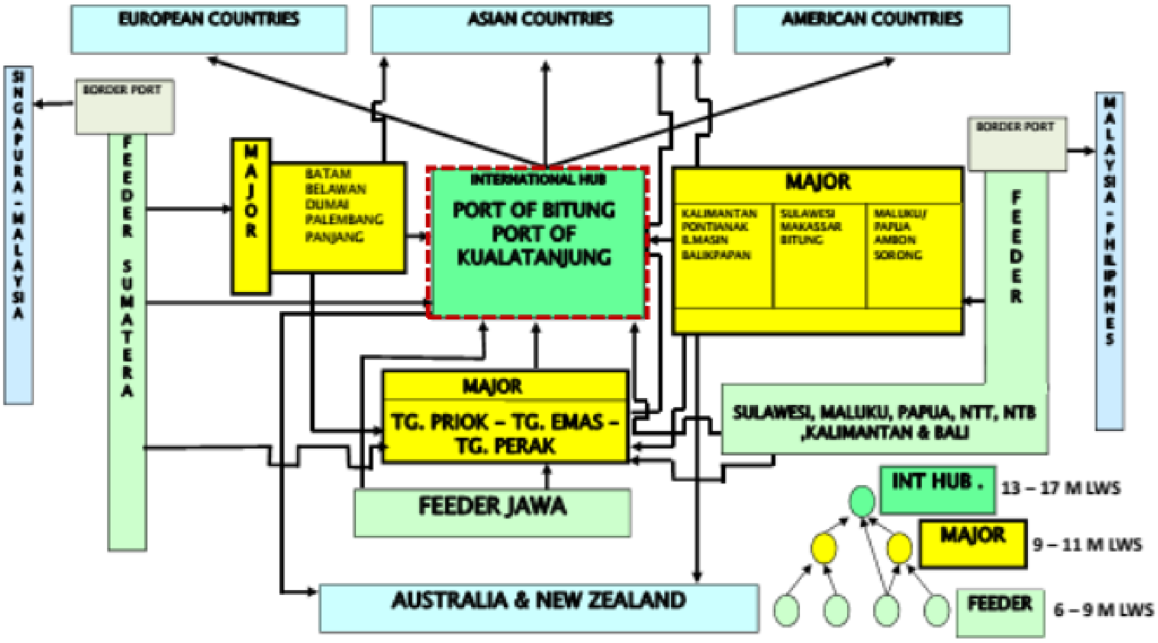

Figure 2 National Logistics System (Sislognas)

Source: *(Lazuardi, 2015)*

The National Logistics System is a system that ensures the continuous distribution of raw materials and finished goods. As a result, distribution from various locations on a national scale can proceed smoothly. Sislognas' success is also influenced by various factors and the participation of various parties in preparing and building adequate infrastructure facilities. Furthermore, Indonesia's abundant natural resources can help the country's people prosper. In addition, the success of Sislognas cannot be separated from the government's readiness and willingness to plan and build adequate infrastructure facilities. Furthermore, Indonesia is an archipelagic country with natural resources scattered from Sumatera to Papua, factory locations close to natural resources, and the distribution process must reach markets and consumers scattered as well. Sislognas cannot be realized unless Indonesia have good infrastructure and can produce competitive, high-quality, and easily accessible products.

2.3 Integrated Port Network (IPN) Concept

The Integrated Port Network (IPN) is one of the Indonesian government's programs aimed at distributing seven ports as the primary hub in terms of standards, facilities, and tariffs. Furthermore, these seven ports will be linked to industrial zones, toll roads, and airports. In line with that, it is hoped that in the future, these seven ports will serve as international hubs for Indonesia, allowing them to participate directly in international trade and eliminate the need for transshipment. According to a study conducted by the Ministry of National Development Planning (Bappenas), the IPN concept will eliminate reliance on transshipment at Singapore's and Malaysia's ports of Tanjung Pelepas (Iqbal, 2020). Kuala Tanjung Port, Batam Port, Tanjung Priok Port, Tanjung Perak Port, Makassar Port, Bitung Port, and Sorong Port are the seven main ports. Each of the main ports is linked to 67 short sea shipping (SSS) ports of various classes, including the main port, collecting port, and feeder port.

Figure 3 Ports of IPN concept
Source: Author

2.4 Port

A port is an area of water that is protected from waves, which equipped with marine terminal facilities including a pier where ships can be moored to loading and unloading, equipped with loading and unloading facilities and storage areas goods can be stored within a certain period of time (Triatmojo, 2010). Ports are places consisting of land and surrounding waters with certain boundaries as a place government activities and economic activities that are used as a place for ships leaning, anchoring, boarding and dropping passengers and/or unloading goods equipped with with shipping safety facilities and port support activities as well as a place intra and intermodal transfers (Ministry of Transportation, 2020).

Seaports are the hierarchy consists of a main port, a collecting port, and a feeder port. The main port is a port whose main function is to serve marine activities domestic and international, domestic and international sea transportation transfers large quantities, and as a destination for passengers and/or goods, as well as transportation crossings with interprovincial service coverage (Ministry of Transportation, 2020). The collecting port has the main function is to serve domestic sea transportation activities, domestic loading and unloading medium amount. while the feeder port has the main function of serving activities domestic sea, and serving sea transportation in limited quantities as well as is a passenger for the main port and the port of collection. In Indonesia there is Ministerial decree Transportation Number KM 53 of 2002 which is define the hierarchy and functions of ports consist of ports international ports, international ports, national ports regional ports and ports local (Ministry of Transportation, 2020).

2.4.1 Port Function

According (Purtiantari, 2015) the definition of the port reflects the functions of the port, including:

1. **Interface**: that the port is a place for two modes/transportation systems, namely sea transportation and land transportation. Thus, the port must provide various facilities and services needed for the movement of goods from ship to land transportation, or vice versa.
2. **Link**: that the port is a link and a transportation system. As a link in the chain, ports both in terms of performance and in terms of cost, will greatly affect the overall transportation activities
3. **Gateway**: that the port serves as an entrance or door leave the country or region. In this case the port holds important role for the economy of a country or a region.
4. **Industry entity**: that the development of industry-oriented exports from a country, the port function is increasingly important for the industry.

2.4.2 Type of Port

Based on (Kapal & Logistik, 2021) the types of ports can be divided as follows;

Type of Port by Function, the port according to its function can be divided into 5 types include:

1. **International Port-Hubs** are Primary Ports that frequently serve international shipping, allowing for the entry and exit of foreign traded goods. International-hub ports are frequently linked to other ports in order to have a large-scale port with adequate facilities for loading and unloading many ships.
2. **International Port** is a type of secondary port that often serves international shipping in the same way that International-hub does. However, the scale of this international port is much smaller than that of the port International-hub, and it serves primarily as a feeder to national ports.
3. **National Ports** are Tertiary Main Ports that provide medium service to national or international shipping. This National Port feeds or distributes goods to regional ports throughout the country.
4. **Regional Port** is a type of Primary Feeding Port that provides medium to low service scales to national shipping. This Regional Port feeds or distributes goods to local ports in the area.

5. **Local Port** is a type of secondary passenger port that serves national shipping on a small scale and receives cargo from national or regional ports.

Here are the differences between the 5 ports above based on several aspects:

Based on its location

1. International Port-Hub: conveniently located near markets and international routes.
2. International Port: conveniently located near international and national shipping lanes
3. National Port: convenient access to national shipping lanes
4. Regional Port: located near shipping lanes connecting regions/islands.
5. Local Port: except for pioneer routes, local ports are rarely used by shipping lanes.

Based on the Service Scale,

1. International Port-Hub: 3,000,000 - 3,500,000 TEUS/Year.
2. International Port: 1,500,000 - 2,000,000 TEUS/Year.
3. National Port: serving the volume of cargo nationally.
4. Regional Port: serving the cargo volume of a province/island.
5. Local Port: serving the volume of cargo in the city/district area.

Based on sea depth

1. International Port-Hub: a minimum depth of 12 m lws is required.
2. International port: a minimum depth of 9 m lws is required.
3. National Harbor: a minimum depth of 7 m lws is required.
4. Regional Port: a minimum depth of 4 m lws is required.
5. Local Port: a minimum depth of 2 m lws is required.

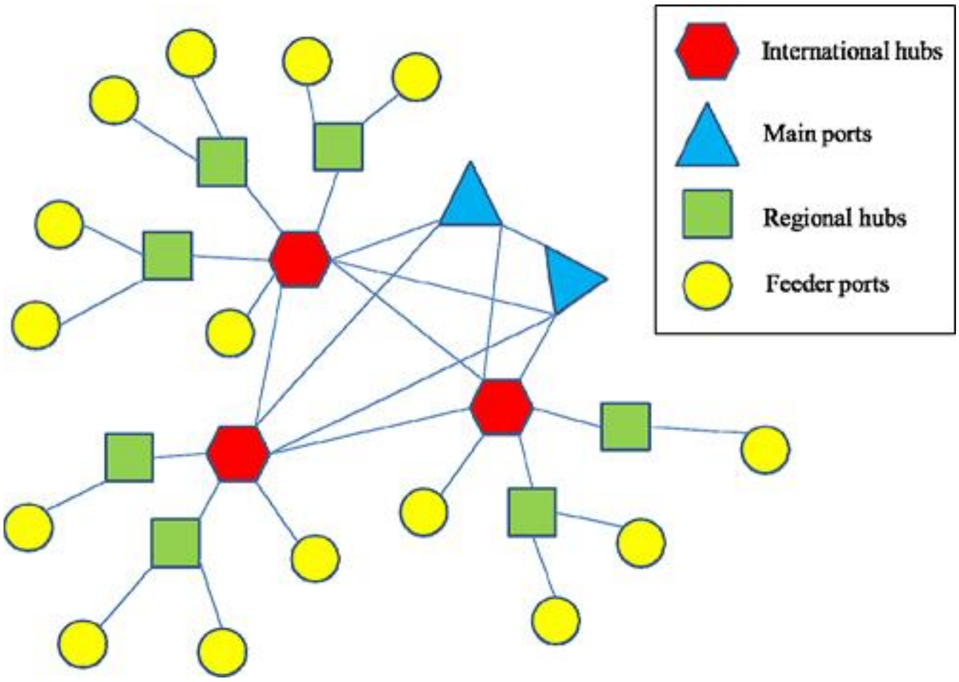

Figure 4 Illustrate of Port by function
Source: *(Kapal & Logistik, 2021)*

Type of port by the cargo distribution hierarchy, the port hierarchy can be divided into three types;

1. **Main port -** A main port is a type of port that handles loading and unloading for both domestic and international trade. This main port has a high traffic density and serves as a crossing point for national and international passenger shipping.
2. **Collect Port** - A collecting port is a type of port that serves as a loading and unloading facility for national/domestic trade cargo. The collecting port has a medium volume of goods traffic density and serves as a crossing point for national/inter-provincial passenger shipping.
3. **Feeder Port** - A feeder port is a type of port that serves as a loading and unloading facility for national/regional trade cargo in the country. The feeder port handles a small volume of goods traffic and serves as a crossing point for passengers traveling between adjacent provinces/inter-island.

Here are the differences between the 3 ports above based on several aspects:

Based on the breadth and depth of services;

1. Main Port: for both national and international traffic
2. Collection Port: for national
3. Feeder Port: for national / interregional – area

Based on load volume;

1. Main Port: large quantity
2. Collecting Port: medium quantity
3. Feeder Port: small quantity

Based on port distance;

1. Main Port: has a considerable distance from other main ports
2. Collecting port: has a certain distance from the main port and close to the feeder port
3. Feeder Port: has a fairly close distance to other feeder ports

2.5 IPN Port

2.5.1 Makassar New Port (MNP)

The Makassar New Port, located on the shores of the Makassar Strait, has been designated as a sea lane for the Indonesian archipelago. Its strategic location, backed up by natural resources and a skilled workforce, enables this region to grow in line with the rest of Indonesia. South Sulawesi's economic growth is very stable, averaging above 7%, and is followed by cargo and passenger traffic at Makassar Port. Makassar Port's cargo and passenger traffic has increased significantly (by more than 10%) over the last five years. This situation will increase the density of cargo flows and ship calls, particularly containers, at Makassar (Sibarani, 2018).

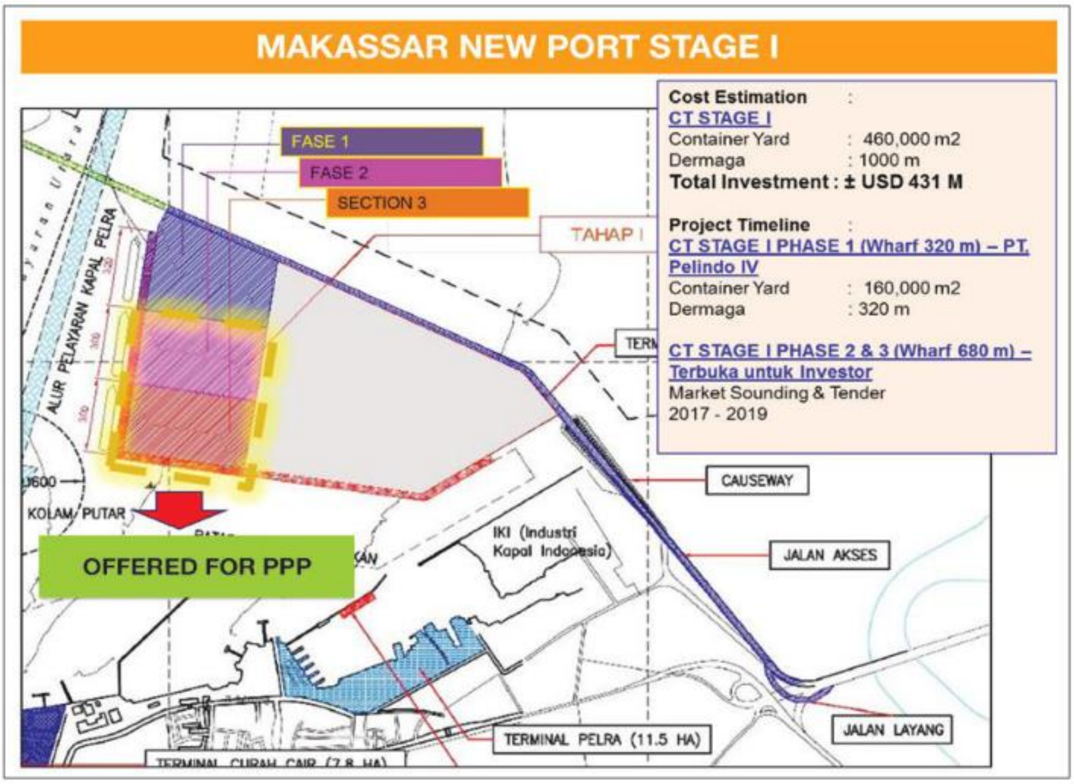

Figure 5 Makassar New Port (MNP)
Source: *(Sibarani, 2018)*

Freight transportation in Makassar, South Sulawesi, continues to grow rapidly from time to time. Given that Makassar is a regional hub for Eastern Indonesia. The development of the Makassar New Port (MNP) is expected to meet the region's transportation needs. Given that Makassar is the hub of eastern Indonesia, it is hoped that MNP will become as busy as the port of Tanjung Perak in Surabaya in the future.

According to (Ministry of Transportation, 2020) Makassar New Port, it is one of Eastern Indonesia's national strategic projects (KTI). Phase 1-A of the Makassar New Port development is nearly complete. The first phase of the project has a pier length of 320 m and an area of 22 Ha. The port project is divided into phases. Makassar New Port is expected to have a total pier length of 2184 meters and a stacking area of 106 hectares by 2032, with a total installed capacity of 8 million TEUs per year. Makassar New Port stages I-B and I-C are ready for construction and are currently awaiting concession permits for stages I-B and I-C, as well as the process of submitting additional dredging and construction plans (Ministry of Transportation, 2020).

2.5.2 Port of Tanjung Priok

Tanjung Priok Port in Jakarta is Indonesia's largest and busiest port. This port handles nearly half of Indonesia's container shipping flows. Furthermore, this port is one of the Indonesian ports with access to the international service network (direct call). This port is currently focused on facility completion and channel deepening to -14mLWS. PT IPC Container Terminal has three Container Terminal Operation Areas at Tanjung Priok Port: Tanjung Priok I Area, Tanjung Priok II Area, and Terminal Support Area (Pelindo, 2022).

Tanjung Priok Port is served by three terminals. Terminal, one serves as the entry and exit point for liquid and dry goods derived from natural resources such as coal, cement, steel, and others. Terminal two serves nearly the same purpose as the first, but now has a wider international reach with a total capacity of more than 600,000 tons. Terminal two also has a crane as an auxiliary tool for moving goods. Terminal three is where necessary goods such as electronics, household appliances, automobiles, and other items enter and exit. This port has 64 large cranes that are operational 24 hours a day, seven days a week (Pelindo, 2022).

2.5.3 Port of Tanjung Perak

Tanjung Perak Port, located in Surabaya, East Java, is Indonesia's largest and second busiest port after Tanjung Priok Port. This port developed into a trading hub for Indonesia's eastern region. Ujung Harbor, located next to Tanjung Perak port, is where ferries bound for Kamal Port, Bangkalan, stop. Tanjung Perak Port collects and distributes goods to and from Eastern Indonesia, including East Java. Tanjung Perak has become the Interinsular Shipping Center for Eastern Indonesia due to its strategic location and potential hinterland. The Tanjung Perak passenger port connects Surabaya to other Indonesian port cities (Pelindo, 2022).

The Tanjung Perak passenger terminal, known as Gapura Surya Nusantara, is Indonesia's most luxurious marine passenger terminal. Ferries on the Surabaya-Banjarmasin and Surabaya-Makassar routes pass through this terminal. Tanjung Perak is Indonesia's primary port for supplying this facility because it has two garbarata facilities for ships. The presence of Teluk Lamong Port Terminal, with advanced technology, aided Tanjung Perak Port activities. In 2015, the world's first container monorail system will connect Tanjung Perak Port and Teluk Lamong Port Terminal. This port also has dock facilities that can serve cruise ships from both within and outside the country (Pelindo, 2022).

2.5.4 Kuala Tanjung Port

This port, built on January 27, 2015 in Batu Bara Regency, North Sumatra, is still under construction. This port will eventually be able to handle 60 million TEUs (twenty-foot equivalent units) per year, making it the largest in Western Indonesia, larger than Tanjung Priok Port in Jakarta. This port was constructed in collaboration with the Port of Rotterdam in the Netherlands and the Port of Dubai at a cost of approximately Rp 34 trillion. Kuala Tanjung will eventually become Indonesia's largest transit hub (Pelindo, 2022).

Kuala Tanjung Port is being prepared to serve as an international hub port. This is in accordance with the plan, with construction beginning in 2016. According to the Indonesian government's initial plan, the Kuala Tanjung Port will be integrated with an industrial area and will be regulated in, where the Kuala Tanjung International Hub Port and Kuala Tanjung Industrial Estate are 2 (two) National Strategic Projects that will be developed in an integrated manner based on the findings of studies (Ministry of Transportation, 2020).

The Kuala Tanjung Port Master Plan, as stipulated by Minister of Transportation, will serve as a guide for port development, development, and operations in the short (2017-2021), medium

(2017-2026), and long term (2017-2036) (Ministry of Transportation, 2020). Furthermore, it serves as a reference for controlling and supervising all port activities, including development, development, and operations, to ensure that they are in accordance with the established plan. The current state of the Kuala Tanjung Port Multipurpose Terminal, which was built, is capable of serving ships up to 60,000 DWT. This port will be developed in accordance with international standards in order to strengthen its position as an international hub (Ministry of Transportation, 2020).

2.5.5 Kijing Port

Kijing Terminal Port, which is one of the National Strategic Projects (PSN) built by PT. Pelindo, has received government concessions. This development is motivated by Pontianak's Dwikora Port, which is becoming increasingly limited due to siltation and is also located in the city center. Kijing Terminal Port is expected to replace Pontianak's Dwikora Port, providing space and opportunities for West Kalimantan Province's growing industries with extraordinary potential, as well as an opportunity for sea highways to stop domestic products to West Kalimantan (Ministry of Transportation, 2020). With the presence of this Kijing Terminal Port, inter-island connectivity will be improved. This port is the largest in Kalimantan, with a capacity of 500 thousand TEUs and 8 million non-containers. The President's call for Rp. 2.9 trillion in investment must be able to strengthen competitiveness and improve connectivity between ports, islands, and countries (Pelindo, 2022).

2.5.6 Bitung Port

Bitung Harbor is a port in Bitung City, North Sulawesi, located on Jalan D.S Sumolang. It is the largest port in North Sulawesi and is visited by passenger ships traveling between major Indonesian cities. Apart from plantation, agricultural, and fishing activities, the existence of Bitung Port is one of the important factors that encourage economic growth and development in North Sulawesi (Pelindo, 2022).

Bitung Port is one of the ports included in the Strategic Priority Project for the Development of an Integrated and Integrated Port Network at Seven Ports in Indonesia. The Bitung Port development concept will center on container loading and unloading operations, as well as logistics geared toward the international market. Bitung Port's transformation into an International Hub Port necessitates port expansion and development. The Integrated Development of the Passenger Port and People's Port on Lembe Island, the Development of a Multipurpose Port in the Bitung SEZ Area, and the Development of the Existing Container Port are some of the investments that can be developed in Bitung Port (Ministry of Investment, 2022).

Bitung City's transportation facilities are adequate for a port city. Bitung's sea transportation facilities connect the mainland to Lembeh Island. Bitung Port has both a passenger and a container port. PT Pelindo, the port management company, has accelerated Bitung City's economic development, particularly by establishing Bitung Port as the International East Gate. Bitung Port is the only port in North Sulawesi visited and anchored by passenger ships traveling between major cities in Indonesia and around the world (Pelindo, 2022).

2.5.7 Port of Sorong

Sorong Port is one of the seaports in West Papua and Papua, serving the flow of passengers and goods from Sorong to Manokwari, Raja Ampat, Wondama, Serui, Nabire, Fak-Fak, Kaimana, Bintuni, Biak, Jayapura, Maluku, Sulawesi, and Java, or vice versa (Pelindo, 2022). The Port of Sorong transports mining products and hinterland commodities to other parts of Indonesia, improving the standard of living for Sorong residents (Pelindo, 2022). It should be noted that Sorong is known as the City of Oil because the Nederlands Nieuw-Guinea Petroleum Maatschappij (NNGPM) has been drilling for oil in Sorong since 1935 (Pelindo, 2022).

Sorong Port is one of the sea transportation gateways in the provinces of West Papua and Papua, serving the flow of passengers and goods from various cities throughout Indonesia. Sorong Port development planning is being pursued in order to boost the development of the manufacturing sector and other economic activities. The Sorong Port development plan has a strategic location because it is at the crossroads of sea and air transportation on the island of Papua. The Port of Sorong plays a significant role in supporting exporters' business activities and the economic growth of the City of Sorong and the Province of West Papua (Ministry of Investment, 2022).

The Sorong Port development concept will focus on container loading and unloading activities as well as logistics, with passenger services available only for large passenger ships and small passenger ships served at the People's Harbor. As a result, this development concept will be followed by the development of an Integrated People's Port with a Tourism Port, which will include the construction of passenger terminals, docks, offices, hotels, and other marine tourism supporting buildings in the Raja Ampat area (Ministry of Investment, 2022).

2.6 Present Connectivity of Makassar’s Ports

Foreign and domestic companies are currently shipping containers from and to Makassar. However, direct call service from Makassar Port is limited to non-existent until the end of 2021. In general, shipping from/to Makassar necessitates transshipment, sometimes multiple times. Starting with transshipment in Tanjung Priok, Jakarta, and continuing with transshipment at the Singapore port. According to the South Sulawesi government's website, direct call delivery from/to Makassar for the European part occurred for the first time in 2018, following the completion of Phase 1 of the Makassar New Port even Maersk Line through Sealand Maersk lines once opened a direct call route for Makassar New Port (MNP) with code IA5. But now the service has been removed.

2.7 Pelabuhan Indonesia (Pelindo)

Pelabuhan Indonesia (Pelindo), is stated owned company of Indonesia that provides integrated services between Indonesian ports. Pelindo is a company that was formed by the merger of four state-owned companies: PT Pelindo I (Persero), PT Pelindo II (Persero), PT Pelindo III (Persero), and PT Pelindo IV (Persero) on October 1, 2021 (Pelindo, 2022).

The established of Pelindo as a company as a result of this merger represents a strategic initiative by the government as a shareholder to achieve a stronger national connectivity and logistics ecosystem network. The number of maritime connections between domestic and foreign ports will increase. Pelindo Integration improves the synergy of Indonesian ports by standardizing operations and streamlining business processes. This, in turn, improves port performance, affecting the country's social and economic well-being (Pelindo, 2022).

2.8 Shipping Network

The shipping network is an important factor in calculating transportation costs because it has strategic, operational, and tactical issues when planning. According to (Wilmsmeier & J.Hoffman, 2008) discovered in their research in the Caribbean region that areas with a variety of routes but the market volume for shipping networks very low, resulting in higher transportation costs. Therefore, transportation costs are closely related to the shipping network.

According to (Yang, 2010) delivery network classified into circular shipping lanes and hub-spoke lanes. Further based on (Imai, et al., 2009) there are two types of standard approaches in container delivery network systems: direct port to port service or multiple port network calls and transshipment or hub and spoke (H&S).

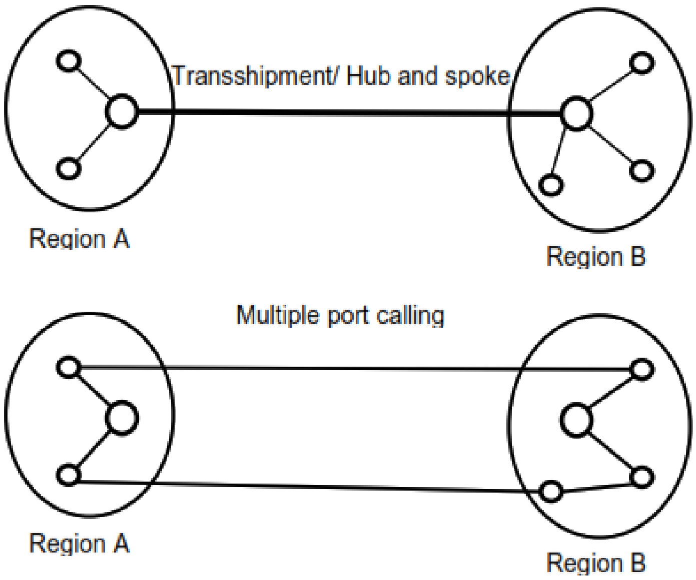

Figure 6 Transhipment & Multi Port Calling

Source: *(Imai, et al., 2009)*

The Hub & Spoke model shipping network was first introduced in 1969 by A.J. Goldman, this model aims to minimize the total cost of transportation by centralizing the transportation center itself. Since then until 2003 about 30% of container shipping using the H&S method. At this time, the concept of transshipment has been expanded in line with the increasingly large economies of scale. Container shipping companies use transshipment relays or interlines, which are connected to their main lines (Tamba, 2017).

2.9 Cost

Costs are expenses, which are a decrease in economic benefits over a period accounting in the form of outflows or asset depletion or the occurrence of liabilities resulting in a decrease in equity that does not involve distribution to investors, cost is also defined as the cash or cash equivalent value sacrificed to obtain goods or services that are expected to provide the organization with current or future benefits (Purtiantari, 2015).

2.10 Transportation Cost

Liner shipping is unique in its characteristics, with operational dynamics and cost component diversity. In this case, operational performance, or quality of delivery, will be a guiding principle in achieving profits. The operational performance of container shipping is also influenced by the size of the ship and the scheduling of ship routes. Liner shipping economies of scale are critical because larger vessels provide a greater shipping range. As a result, the costs of large ships may be lower than those of small ships. However, there are other cost components that can increase costs for large ships, such as the port dues will be higher if the crane productivity is low but the amount of cargo to be loaded/unloaded is very large, resulting in a longer time (Lazuardi, 2015).

2.10.1 GC Model Introduction

The GC model, an econometric model, can be used to calculate the overall transportation costs from the starting point to the end destination. The GC model accounts for all transportation costs, including those incurred in the hinterland, at ports, and at sea. Furthermore, the GC model includes opportunity costs, which are costs based on transportation time and time value (Hassel, 2016).

2.10.2 GC Formula

The GC model, as previously explained, is one method for calculating transportation costs. The GC model can be described in general by the following equation (Grey, 1978):

$$\boldsymbol{GC = \sum_{1}^{m} m_i M_i + \sum_{1}^{t} t_i T_i} \qquad (1)$$

Where:

M_i = Various components actual money costs of the shipping cost.

T_i = Various components of time

Furthermore, there are two cost components in this calculation: maritime or ship costs and port costs, which include both monetary and non-monetary costs. Maritime costs are those incurred as a result of ship operation, whereas port costs are those incurred as a result of cargo services, in this case containers.

According to (Hassel, 2016), the calculation for the maritime cost section in GC model includes three major components: ship operational costs, ship voyage costs, and capital costs. The equation is described below;

$$\boldsymbol{GC_m = \frac{OC_a + VC_a + CapC_a}{N_{TEU}} + \sum_{1}^{m} VoT \,.\, T_m} \qquad (2)$$

Where:

GC_m = GC of Maritime Cost

OC_a = Operational Cost Ship a

VC_a = Voyage Cost Ship a

$CapC_a$ = Capital Cost Ship a

VoT = Value of Time

T_m = Total maritime time of O-D (Origin to Destination)

N_{TEU} = Number of transported containers

As for the port costs in the GC model based on (Tamba, 2017). There are 3 main components, namely pilot service charge, towing service charge and container handling fee. The formulation for the port cost GC model is shown as below:

$$GC_p = \frac{PIL_{ab} + TOW_{ab} + CH_{ab}}{N_{TEU}} + \sum_{1}^{p} VoT \, . \, T_p \qquad (3)$$

Where:

GC_p = GC of Port Cost

PIL_{ab} = Pilot service charge (Port of Origin, Transshipment, and Destination)

TOW_{ab} = Towing service charge ship

CH_{ab} = Container handling cost in port (Port of Origin, Transshipment, and Destination)

VoT = Value of Time

T_p = Total spent time in port (Port of Origin, Transshipment, and Destination)

N_{TEU} = Number of transported containers

2.10.3 Value of Time

The Value of Time (VoT) is one of the factors included in the GC model's calculation of total transportation costs. VoT can be defined as the loss of an opportunity as a result of a longer transportation time; this can include relevant factors such as labor, capital, or storage (Verhaeghe, et al., 2016). Based on (Tamba, 2017) at least there are 3 ways to calculate VoT, First, based on the aggregate value of the commodity sent. The second is based on calculations from existing ships. The last one is based on the cargo owner to pay for the existing costs.

2.10.4 Shipping Cost

In general, the total cost incurred and total revenue earned can be used to assess the ship's operational performance.

The total cost is the sum of the operational and fixed costs of the ship. Meanwhile, total revenue is calculated by multiplying the total cargo shipped by the shipping rate. According to

(Stopford, 2009), there are at least four cost components, plus fixed costs so that there are at least five components;

1. Capital cost

   Capital costs are fixed costs, costs incurred when buying or constructing a new building. This fee appears as a calculation for interest payments and initial return on capital when purchasing or building a ship.

2. Maintenance costs

   Maintenance costs are costs incurred for ship maintenance in accordance with company policies and classification regulations. In some cases, maintenance costs entered into operating costs.

3. Operating cost
   Operating costs are costs that arise when the ship operates daily such as crew salaries, lubricating oil, food ingredients, administration and insurance.

4. Voyage cost
   Voyage costs are costs incurred while traveling from point A to point B such as fuel cost, port dues & services.
   - Fuel cost
     Fuel costs are the main component of voyage costs. This fee depends on the amount of fuel consumed by the ship and the bunkering price.
   - Port dues & service
     Port dues & service is all the fees paid to the port authority in providing its services so that ships can operate around the port. usually consists of mooring fees, tugboat and pilot services, and berthing fees.

5. Cargo handling cost
   Cargo handling cost are costs for the loading process containers at the port of origin and the process of unloading containers at the port of destination.

2.10.5 Shipping Charter

Commonly in the carriage of goods by sea, there are two ways, namely using their own fleet of ships, or ship charters. To carry out ship charter activities, both parties involved, namely the owner ships (shipowners) and ship charters, must reach an agreement (charterers). There are three types of vessel rental agreements: bareboat charter, time charter, and voyage charter. According to (Stopford, 2009) the description of these charters can be explained as follows:

1. Bareboat charter
   Bareboat charter is an arrangement for chartering a ship whereby this ship is in "empty" conditions. All ship operating costs are borne by the charterer, including the cost of repairs and ship surveys carried out periodically, travel costs such as fuel costs, port costs, and loading/ unloading costs are also the responsibility of the charterer.

2. Time charter

Time charter is a ship charter system in which the ship owner allows charterers to use their ships and sail for a set period of time. The rental fee in Time Charter is based on time rather than the number of cargos transported.

3. Voyage charter
   Charterers hire ships for specific voyages from point A to point B, with freight rates charged per unit of cargo carried, which is $30 per ton. In general, the owner is responsible for all costs, including operation, port, and bunker fees, under this arrangement. Just to cargo handling fees that are not covered by the owner's insurance.

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Chapter 3 – Research Methodology Framework & Data

3.1 Methodology Framework

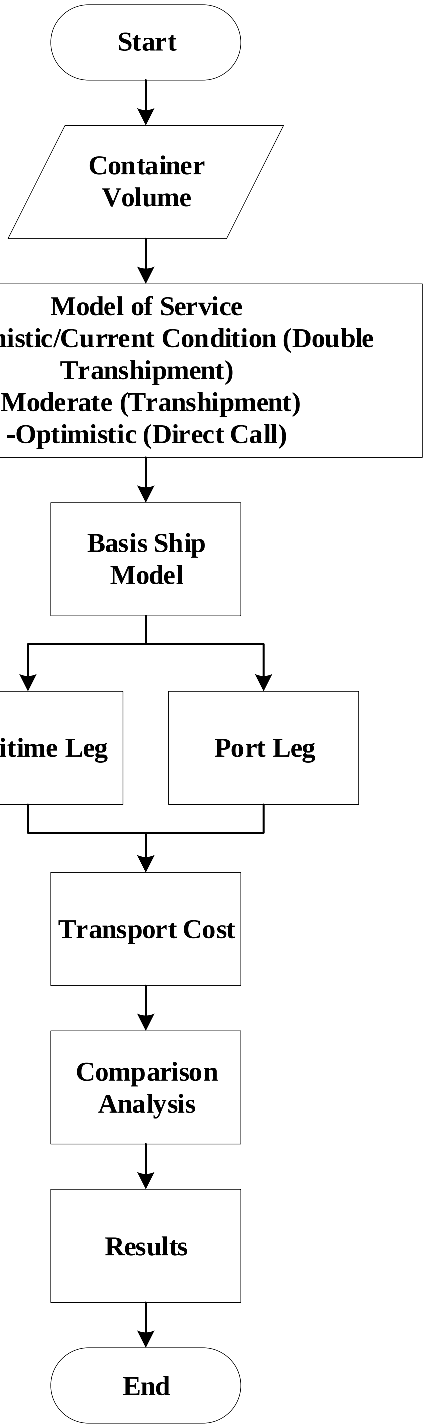

Figure 7 Research Framework
Source: Author

The flow chart above shows the methodological flow followed in conducting this research. As explained above, this study aims to determine the appropriate role for Makassar New Port (MNP) to the current conditions regarding the distribution of international containers in Indonesia. Whether it's MNP as a feeder port, main port, or International Hub Port. To answer this question, according to the flowchart above, the main data that needs to be known is the estimated container volume from/to Makassar or in the sense that MNP will handle it with current conditions.

Next, a service model is made based on the type of container delivery flow and the role that will be performed by the MNP itself. Model 1 is Pessimitic which is considered by MNP as a feeder port for container shipping networks and the type of container shipping is double transshipment. Then, model 2 is moderate which is considered by MNP as the main port for the container shipping network and the type of container shipping is transshipment. Finally, model 3 is optimistic where MNP is considered as an international Hub port for the global container shipping network and the type of container shipping is a direct call. These models will be described in more detail in the next chapter.

Then, to get the answer to this research question, the previously described models will be analyzed for transport cost values and compared. Thus, the right role for MNP in the current condition is obtained based on the lowest transport cost value. To start the calculation of the first transport cost, the first thing to do is to find the base ship model. The base ship model is obtained from existing ships.

After obtaining the base ship model, then proceed with defining the maritime leg and port leg in each model. Moreover, this thesis will use the GC model as described in chapter 2 where there is a maritime leg and a port leg. This division in the future will simplify the calculations in chapter 4, which in that chapter will describe how to get the results, or a more detailed methodology approach to the flow chart above.

After the calculations are carried out, the transport cost values for each model will be obtained. From this transport cost, a comparative analysis was then carried out, to get the answer to the research question for this thesis. Finally, after the results of the analysis are obtained, conclusions and recommendations are drawn for future work.

Furthermore, the data obtained will be described as the basis for calculating transport costs in this thesis. Where there are eight components which are important variables of the GC model that will be used. The eight components are container volume, base ship model, operational cost, voyage cost, capital cost, port dues & service, Terminal cargo handling, and value of time.

3.2 Container Volume

To analyze the container volume for Makassar New Port (MNP) using international container volume data from Indonesia and data from previous studies. To obtain this data, the first step is to look up the Indonesia Container Port Throughput, in this case from 2015 to 2020 according (CEIC, 2022) as shown in the figure 7 below;

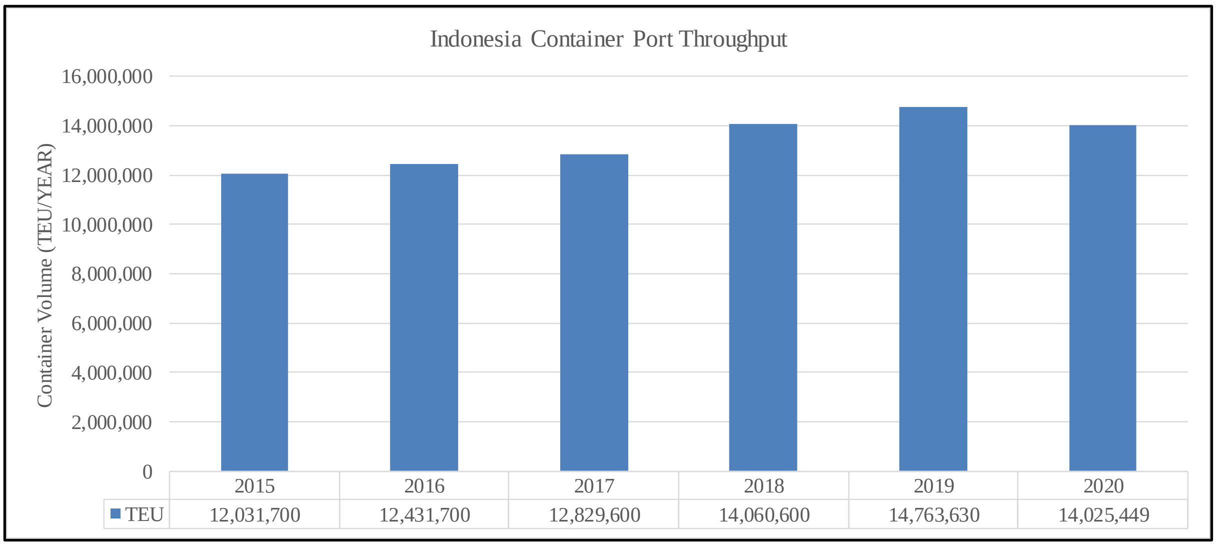

Figure 8 Indonesia Container Port Throughput
Source: Modified from various data

Then, by going through supporting data from the ministry of transportation (Ministry of Transportation, 2020), the national statistics agency (BPS-Statistics Indonesia, 2019), and previous studies (Lazuardi, 2015) and (Iqbal, 2020), it was discovered that about 60% of the total container volume in Indonesia is international containers for every year as shown in the figure below;

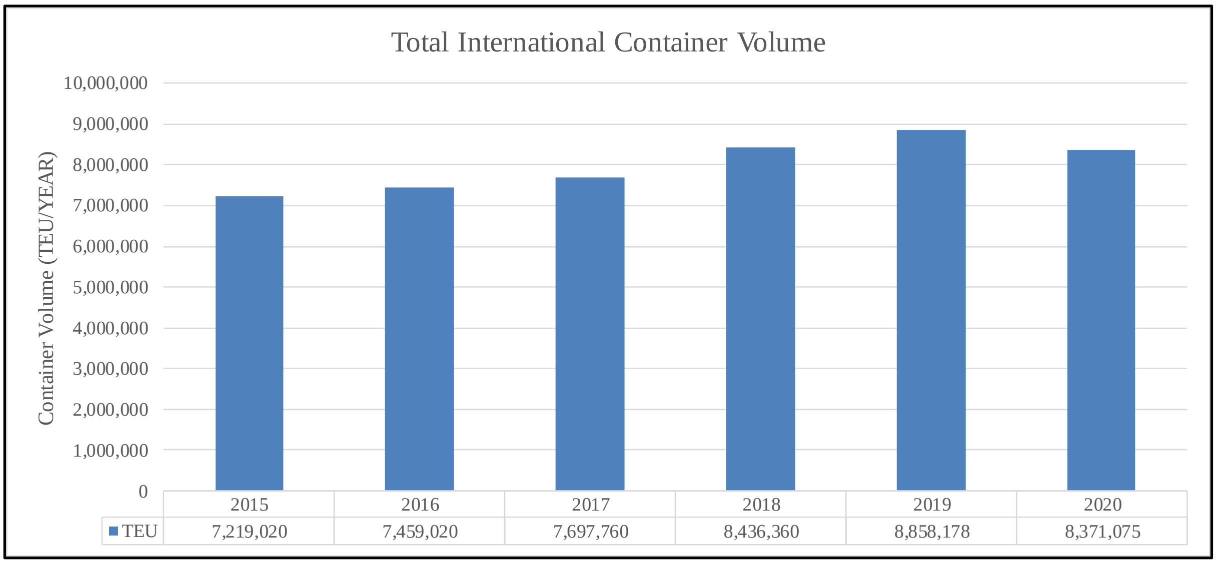

Figure 9 Total International Container Volume
Source: Modified from various data

Then, based on MP3EI, we divide Indonesia into five parts: Sumatra, Java, Kalimantan, Sulawesi, and the Rest of Indonesia (in this case Maluku, Bali, Nusa Tenggara and Papua) as figure below;

Figure 10 Region of Indonesia
Source: *(Lazuardi, 2015)*

The zoning area would be used to easily determining the value volume of international containers currently handled by Makassar New Port (MNP). The following data were obtained, as before, from the Ministry of Transportation (Ministry of Transportation, 2020), the National Statistics Agency (BPS-Statistics Indonesia, 2019), and previous studies (Lazuardi, 2015) and (Iqbal, 2020), as follows:

Table 1 The Total International Container Volume per Region (in TEUs/year)

Region	2015	2016	2017	2018	2019	2020
Sumatera	695,539	718,662	741,664	812,827	853,468	806,537
Java	6,150,279	6,354,748	6,558,144	7,187,398	7,546,768	7,131,778
Kalimantan	266,742	275,610	284,431	311,722	327,308	309,310
Sulawesi	67,425	69,666	71,896	78,795	82,734	78,185
RoI	39,035	40,333	41,624	45,618	47,899	45,265
Total	**7,219,020**	**7,459,020**	**7,697,760**	**8,436,360**	**8,858,178**	**8,371,075**

Source: Modified from various data

Furthermore, based on these data, the number of international container volumes handled by Makassar New Port (MNP) in 2022 can be forecasted. Take into account that Makassar New Port (MNP) is the largest port for Sulawesi, the rest of Indonesia, and parts of Kalimantan at the moment. The following values are obtained using Excel's forecast feature:

Table 2 The Total International Container Volume for MNP (in TEUs/year)

Region	2022
Parts of Kalimantan	169,002
Sulawesi	85,438
RoI	49,464
Total	**303,903**

Source: Author's calculation

3.3 Basis Ship model

The transportation cost of a ship is highly dependent on its size. A small ship, for example, will consume less fuel than a larger ship due to its larger engine capacity. Similarly, the size of the ship, such as length and width, influences the ship's loading and unloading activities as well as the selection of cranes. To obtain a reasonable cost, the ship's size must be balanced with the volume of cargo. The selection of the appropriate ship size demonstrates ship size economy (Veldman, 2012).

In order to calculate this thesis, an optimal ship size based on cargo flow international containers in Indonesia is required, and ship size will also be a factor in calculating transport costs in the future in this thesis. Meanwhile, the data used to calculate ship size came from Pelindo (Pelindo, 2022) and previous studies (Purtiantari, 2015). These are data on international and domestic container ship visits to the port of Tanjung Perak (Surabaya), which can be found in the appendix A, based on these data, the most frequent visits were chosen as a baseline for this study as shown in the table below.

Table 3 Domestic Vessels

Ship Size (TEUs)	**No. Vessel**
100 - <200	5
200 - <300	16
300 - <400	32
400 - <500	12
500 - <600	**86**
600 - <700	**41**
700 - <800	9
800 - <900	4
900 - <1000	1
≥1000	21
Total	227

Source: Modified from (Pelindo, 2022) (Purtiantari, 2015)

Table 4 International Vessels

Ship Size (TEUs)	No. Vessel
<1000	18
1000 - <2000	**129**
2000 - <3000	**85**
3000 - <4000	4
≥4000	2

Total	235

Source: Modified from (Pelindo, 2022) (Purtiantari, 2015)

Based on the data presented above and supported by statistics from the Indonesian Ministry of Transportation, the largest container ship sizes for international trade are in the 4000 TEU, while the largest container ship sizes for domestic trade are in the 1000 TEU. Thus, in this study for the domestic route will use ships with a size of 100-1000 TEUs and International will use ships with a size of 2000-3000 TEUs and intra-asia will be 3000-4000 TEUs. Then, categorize it with assumption of Makassar (MNP) roles has, which are as a feeder port, main port, and International Hub Port. Based on the study (Sudjaka, 2018) results, by using the equation of the relationship between TEU and the basic parameters of the ship, in this case, the GT. The equation that defines the basic ship parameters relationship as a function of GT is shown below;

$$\boldsymbol{GT = 843 + 10.2662\ TEU} \quad (4)$$

Thus, the ship data for the base ship model is obtained as follows:

Table 5 Model Ship Size – GT

Ship Size (TEUs)	GT
MNP - Feeder Port	
100	1,870
200	2,896
300	3,923
400	4,949
500	5,976
600	7,003
700	8,029
800	9,056
900	10,083
1,000	11,109
MNP - Main Port	
2,000	21,375
3,000	31,642
MNP - International Hub	
4,000	41,908
5,000	52,174

Source: Author Calculation

3.4 Operational Cost

The operational costs discussed in this study include all costs associated with the ship's operation, such as maintenance, crew salaries, lubricating oil, food on board, administration, insurance, and other ship operational overhead costs. According to (Veldman, 2012) research and (Culliane & Khanna, 1999) literature for ships of 6,000 – 20,000 TEU size, ship repair and maintenance costs, administration costs, and insurance range from 3.5% of the price of new or used vessels and vary depending on ship size. Meanwhile, overhead costs, food, and crew costs are assumed to be fixed costs to the ship's operational costs, with an annual value of around USD 400,000 regardless of ship size. Based on (Veldman, 2012) research on ship operating costs as a function of ship size in TEU and (Sudjaka, 2018) research to the validity of this relation, with the assumption of 350 operational days per year, the following equation is obtained:

$$\textbf{Annual Operational Costs} = \mathbf{1,281,369 + 428.417\ TEU - 0.0036607\ TEU^2} \tag{5}$$

The operational costs of the ships that will be used in this study can be calculated using the above equation; the operational costs are shown in the table below;

Table 6 Model Ship Annual Operational Costs

Ship Size (TEUs)	Annual Operational Costs (USD)
Feeder Port	
100	1,324,174
200	1,366,906
300	1,409,565
400	1,452,150
500	1,494,662
600	1,537,101
700	1,579,467
800	1,621,760
900	1,663,979
1,000	1,706,125
Main Port	
2,000	2,123,560
3,000	2,533,674
International Hub	
4,000	2,936,466
5,000	3,331,937

Source: Author Calculation

3.5 Voyage Cost

Voyage costs are costs incurred while traveling from point A to point B such as fuel costs, port dues & services. When operating, the main component of the voyage cost is the cost of fuel or bunkering. Is the most important component because it accounts for a large and significant portion of total transportation costs.

3.5.1 Service Speed and Fuel Consumption

For the purposes of this study, service speed was determined by reviewing the ship database and travel records from existing ships with the same TEU capacity as the base ship model in this study. (Clarkson, 2022) and (Marinetraffic, 2022) are the databases used in this case. As a result, the average service speed for the ship model studied in this study is obtained, as shown table below;

Table 7 Model Ship Service Speed

Ship Size (TEUs)	Service Speed (Knot)
Feeder Port	
100 – 1000	8.5
Main Port	
2000 - 3000	12.5
International Hub	
≥4000	15.5

Source: Modified from (Clarkson, 2022) and (Marinetraffic, 2022)

After determining the service speed, the next step is to compute the fuel consumption focusing on the ship model. The equation below shows the relationship between ship speed and fuel consumption based on (Bialystocki & Dimitris Konovessis, 2016);

$$\boldsymbol{F(Cons) = 0.2525\ x\ V^2 - 1.6307\ x\ V} \quad (6)$$

Where:

V = Speed in knots

3.5.2 Fuels & Bunkering Prices

In Indonesia, fuels can only be sold by PT Pertamina, while in the bunkering process, shipping company usually use the services of an agent. Two types of fuel that are usually sold in Indonesia are high speed diesel (HSD) and the more common ones are Marine fuel oil (MFO) or known as low sulfur fuel oil (LSFO) and high sulfur fuel oil (HSFO). Because Indonesia is currently not included in the Emission Control Area (ECA) by the International Maritime Organization (IMO) and current considerations of policy are towards the use of low sulfur levels. So, in this thesis use the low sulfur fuel oil (LFSO) price as a reference for fuel and bunkering prices.

In general, fuel and bunkering prices in Indonesia are displayed in units of IDR per liter or USD per liter, but in the world of shipping fuel and bunkering, they are usually shown in ton. Therefore, it must be converted from liters to tons, with LSFO density in general around 0.91 kg/l, so it can be assumed that 1 ton of LSFO is equal to 1,098 liters of LSFO. Based on information from the website of one of the fuels and bunkering agents in Indonesia, it was found that the selling price of LSFO per liter is around USD 1.45 per liter, or around USD 1,592 per ton.

3.6 Capital Cost

According to (Veldman, 2012) presents a methodology in his study to predict the annual capital cost of ships ranging in size from 6,000 to 20,000 TEUs, using a capital recovery factor of 10.19%, an interest rate of 8%, and a ship's economic lifetime of 20 years. Based on (Veldman,

2012) research on ship annual costs as a function of ship size in TEU and (Sudjaka, 2018) research on the validity of this relation, with the assumption of 350 operational days per year, the following equation is obtained;

$$\boldsymbol{Annual\ Capital\ Costs = 3,446,548 + 1,675.05\ TEU - 0.0143065\ TEU^2} \quad (7)$$

The capital costs of the ships that will be used in this study can be calculated using the above equation; the operational costs are shown in the table below;

Table 8 Model Ship Annual Capital Costs

Ship Size (TEUs)	Annual Capital Costs (USD)
Feeder Port	
100	3,613,910
200	3,780,986
300	3,947,775
400	4,114,279
500	4,280,496
600	4,446,428
700	4,612,073
800	4,777,432
900	4,942,505
1,000	5,107,292
Main Port	
2,000	6,739,422
3,000	8,342,940
International Hub	
4,000	9,917,844
5,000	11,464,136

Source: Author Calculation

3.7 Port Dues & Service

Port dues & service is all the fees paid to the port authority in providing its services so that ships can operate around the port. usually consists of mooring fees, tugboat and pilot services, and berthing fees. As explained in Chapter 2, maritime services at ports are generally provided through correspondence with state-owned port authorities, in this case Pelindo. Pelindo's operations in various parts of Indonesia have now been consolidated into a single unit. As a result, Pelindo is currently setting prices for maritime services in one-unit price. Pelindo's tariffs for port dues and services are shown below;

Table 9 Port Dues & Services - Pelindo

Charges	Tariff (USD)	Unit
Port Dues	0.10	per GT / visit
Pilotage Service		
Fix	96.72	per ship / movement
Variable	0.04	per GT / movement
Towage Service		
Vessel up to 2000 GT	177.47	per unit / hour

Vessel GT 2001 to GT 3500	205.87	per unit / hour
Vessel GT 3501 to GT 8000	497.92	per unit / hour
Vessel GT 8001 to GT 14000	752.62	per unit / hour
Vessel GT 14001 to GT 18000	1,011.75	per unit / hour
Vessel GT 18001 to GT 26000	1,544.16	per unit / hour
Vessel GT 26001 to GT 40000	1,640.56	per unit / hour
Vessel GT 40001 to GT 75000	1,726.35	per unit / hour
Vessel above GT 75000	2,072.15	per unit / hour
Berthing Service	0.10	per GT/ visit

Source: (Pelindo, 2022)

Furthermore, for this thesis, it is necessary to understand the port dues and services at the Singapore port. This is because the port of Singapore is assumed in the study to be the port of transshipment or the final destination of the service network in the MNP service model. The table below shows the port dues costs for the Singapore port;

Table 10 Port Dues - Port of Singapore

Period of Stay (Days)	Rates per 100 GT (USD)
1	5.4
2	6.12
3	6.48
4	6.84
5	9
6	11.16
7	13.32
8	15.48
9	17.64
10	19.8

Source: (MPA Singapore, 2022)

The tariff for port services such as pilotage and tug service are handled by the private sector in Singapore, in this case PSA Marine Pte Ltd. According to their website, the pilotage and tug tariff as shown table below;

Table 11 Pilot and Tug service rates – Port of Singapore

GT	Rates (USD)
Up to 6,000 GT	162.35
Above 6,000 GT and up to 12,000 GT	181.08
Above 12,000 GT and up to 20,000 GT	199.44
Above 20,000 GT up to 30,000 GT	226.8
Above 30,000 GT up to 40,000 GT	253.8

Source: (MPA Singapore, 2022)

3.8 Terminal Cargo Handling

Because of the numerous variables, it is extremely difficult to determine precisely how much terminal cargo handle costs. As a result, the average tariff value obtained from previous studies will be used in this study. According to (Sudjaka, 2018), the tariff for Pelindo is USD 120/TEU, while the tariff for the port of Singapore according to (Tamba, 2017) is USD 170/TEU.

3.9 Value of Time

In this thesis, the VoT value is taken based on the results of the study by (Tamba, 2017), where it is assumed that the value for VoT is USD 27.4/TEU/day.

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Chapter 4 Methodology Approach

In this chapter 4 after the literature review and framework of this research have been explained in chapters 2 and 3. In addition, to understanding the state of Indonesia's container shipping network and the current role of the Makassar New Port (MNP). Besides, in order to discover and answer the research question posed by this study, it is necessary to understand the shipping network model or service that MNP may be able to provide in the future. Moreover, understanding how to calculate transportation costs for service models that are likely to occur, which will then be compared and analyzed to provide results and answers to research questions from this study.

4.1 Model of Service

First and foremost, an assumption is made in the service model that will be implemented by Makassar New Port (MNP). In this study, it is assumed that MNP will or can provide three different service models. The first is the current state (pessimistic); in this model, the MNP only serves as a feeder port for further transshipment to the main port and then to the international hub port for global shipping networks. The second model is (moderate), with the MNP serving as the primary port for transshipment to the international hub port. The third model is the (optimistic) model, in which MNP can make direct calls to the global container shipping network, or in which MNP is a point port in the global container shipping network.

4.1.1 Model 1 Pessimistic (Double Transshipment) / MNP – Feeder Port

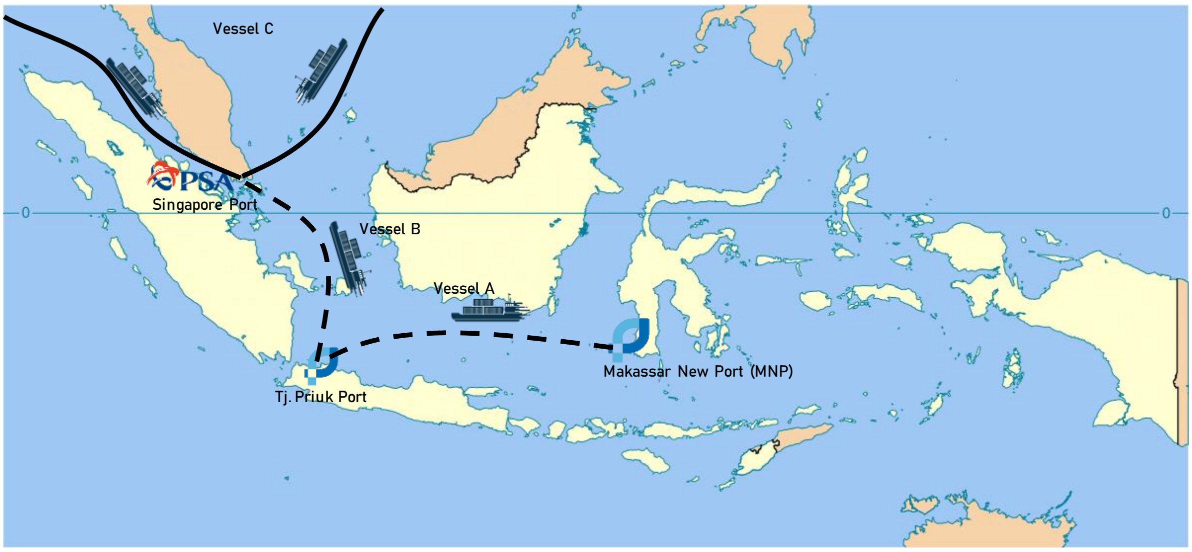

Figure 11 Model 1 – Pessimistic (Double Transhipment)

The above image depicts the current state of the shipping network for shipping containers from/to Makassar to international shipping routes. As can be seen, the MNP service in this case serves as a feeder port in order to make direct service calls is pessimistic. Containers from/to Makassar are brought via domestic vessel A to Indonesia's main port, in this case TJ. Priok Port (Jakarta) for transshipment, and then brought again by domestic vessel B to Singapore port for transshipment again, for global shipping network routes; thus, this model can be described as a model with double transshipment. Furthermore, from this model will be detailed regarding the maritime leg and port leg model, which in the future will assist the calculation according to the GC model used in this thesis. And also from this model can help the calculation of time cost which is one of the variables in the calculation of transport costs that you want to find for each model.

4.1.2 Model 2 Moderate (Transshipment) / MNP - Main Port

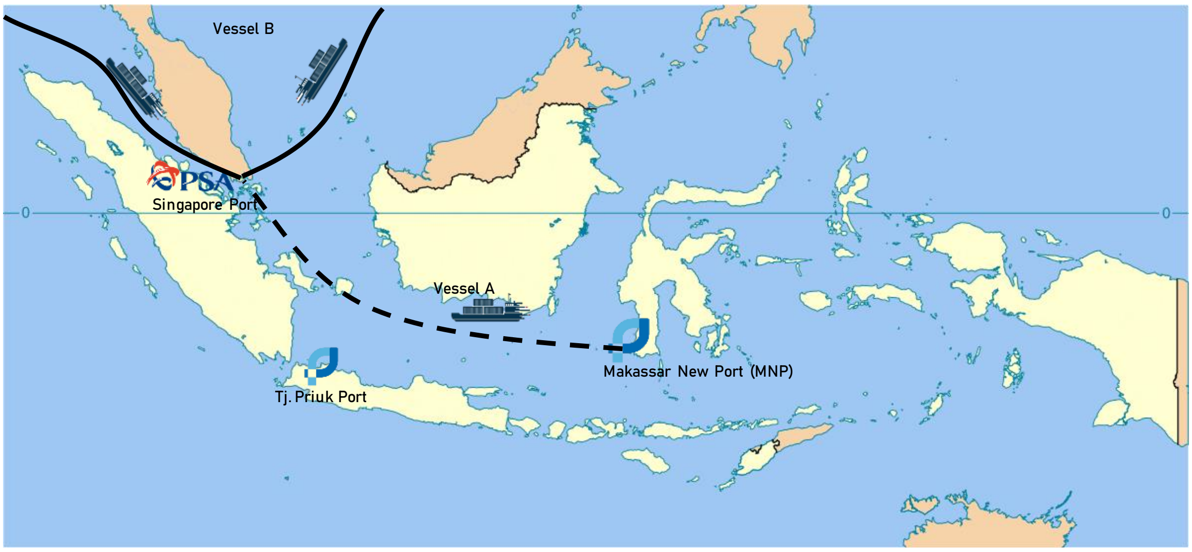

Figure 12 Model 2 – Moderate (Transshipment)

The above image depicts the state of the shipping network for shipping containers from/to Makassar to international shipping routes if MNP as a main port. It can be seen that the MNP service is the main port in this case in a moderate sense for carrying out direct service calls. This model is a transshipment model because the container from/to Makassar is carried by domestic vessel A to transshipment at the Singapore port for global shipping network routes. Furthermore, from this model will be detailed regarding the maritime leg and port leg model, which in the future will assist the calculation according to the GC model used in this thesis. And also from this model can help the calculation of time cost which is one of the variables in the calculation of transport costs that you want to find for each model.

4.1.3 Model 3 Optimistic (Direct Call) / MNP – International Hub Port

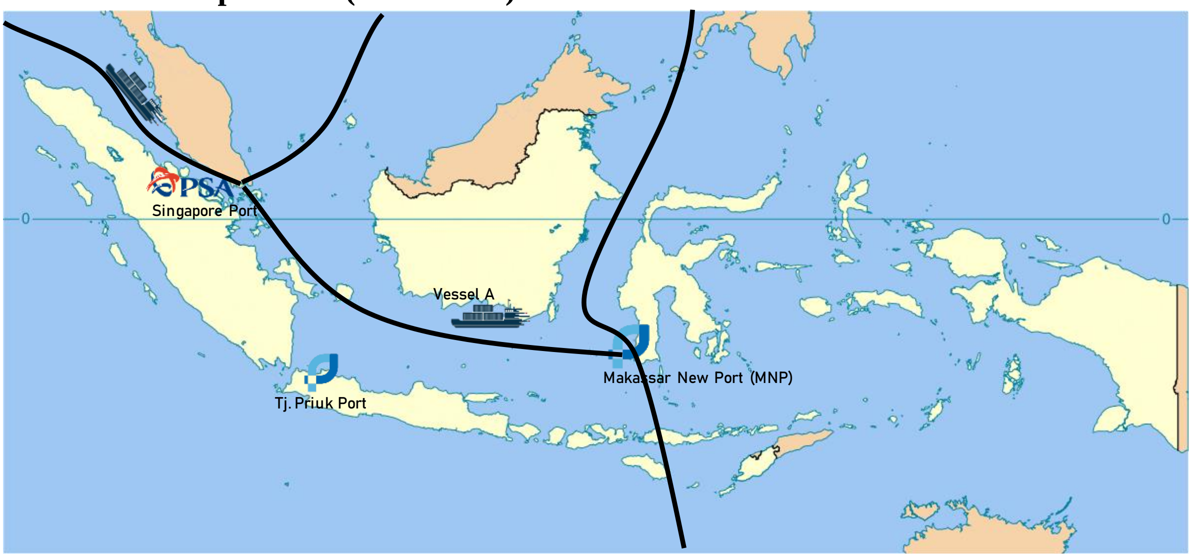

Figure 13 Model 3 - Optimistic (Direct Call)

The condition of the shipping network for shipping containers from/to Makassar to international shipping routes, as shown in the image above, was when MNP became one of the international hub ports. It can be seen that the MNP service in this case is an international hub port in the sense that direct service calls can be made. Containers from/to Makassar are carried directly by international vessels to point ports on global shipping network routes in this model, which is known as a direct call model. Furthermore, from this model will be detailed regarding the maritime leg and port leg model, which in the future will assist the calculation according to the GC model used in this thesis. And also from this model can help the calculation of time cost which is one of the variables in the calculation of transport costs that you want to find for each model.

4.2 Calculation of Transport Cost

The GC model is used in this study to calculate transportation costs. As explained in Chapter 2 of this study, transportation costs are divided into two categories: monetary and non-monetary, with each category containing two costs: maritime costs (also known as shipping costs) and port costs as shown on equation (1). With the above explanation, the GC model will be obtained for transportation calculations in this study by combining equation (2) and (3). The combination formula is shown below;

$$GC_{TC} = GC_m + GC_p \tag{8}$$

$$GC_{TC} = \frac{OC_a + VC_a + CapC_a}{N_{TEU}} + \sum_{1}^{m} VoT \,.\, T_m + \frac{PIL_{ab} + TOW_{ab} + CH_{ab}}{N_{TEU}} + \sum_{1}^{p} VoT \,.\, T_p \tag{9}$$

$$GC_{TC} = \frac{OC_j + VC_j + CapC_j + PIL_{ij} + TOW_{ij} + CH_{ij}}{N_{TEU}} + \sum_{1}^{m} VoT \,.\, T_m + \, + \sum_{1}^{p} VoT \,.\, T_p \tag{10}$$

Where:

GC_m = GC of Maritime Cost

OC_a = Operational Cost Ship a

VC_a = Voyage Cost Ship a

$CapC_a$ = Capital Cost Ship a

VoT = Value of Time

T_m = Total time voyage of O-D (Origin to Destination) / Total time of maritime leg

N_{TEU} = Number of transported containers

GC_p = GC of Port Cost

PIL_{ab} = Pilot service charge (Port of Origin, Transshipment, and Destination)

TOW_{ab} = Towing service charge ship

CH_{ab} = Container handling cost in port (Port of Origin, Transshipment, and Destination)

T_p = Total spent time in port (Port of Origin, Transshipment, and Destination) / Total time of port leg

The above equation can be dividing into two parts: the shipping cost obtained from the summation (operational cost, voyage cost, capital cost, pilot service, towing service, container handling cost) and the time cost obtained from the summation (total maritime time and total spent time in port). There will be a port leg and a maritime leg based on freight and time costs, with the port leg occurring when the container is at the port and the maritime leg occurring when the container is on the ship. Based on that, it can be stated generally;

$$\textbf{Shipping cost per TEU} = \frac{OC_a + VC_a + CapC_a + PIL_{ab} + TOW_{ab} + CH_{ab}}{N_{TEU}} \tag{11}$$

$$\textbf{Time cost} = \sum_{1}^{m} VoT\ .\ T_m + + \sum_{1}^{p} VoT\ .\ T_p \tag{12}$$

Where:

OC_a = Operational Cost Ship j

VC_a = Voyage Cost Ship j

$CapC_a$ = Capital Cost Ship j

VoT = Value of Time

T_m = Total time voyage of O-D (Origin to Destination) / Total time of maritime leg

N_{TEU} = Number of transported containers

PIL_{ab} = Pilot service charge (Port of Origin, Transshipment, and Destination)

TOW_{ab} = Towing service charge ship

CH_{ab} = Container handling cost in port (Port of Origin, Transshipment, and Destination)

T_p = Total spent time in port (Port of Origin, Transshipment, and Destination) / Total time of port leg

$$\textbf{Transport Cost per TEU} = \textbf{Shipping cost per TEU} + \textbf{Time cost} \tag{13}$$

Normally, transport cost is obtained based on the round trip of a ship, but in this study, we focus on transportation costs from Makassar New Port (MNP) to the Port of Singapore so that the calculation is only done with a one-way trip.

4.2.1 Model 1 Pessimistic (Double Transshipment) / MNP – Feeder Port

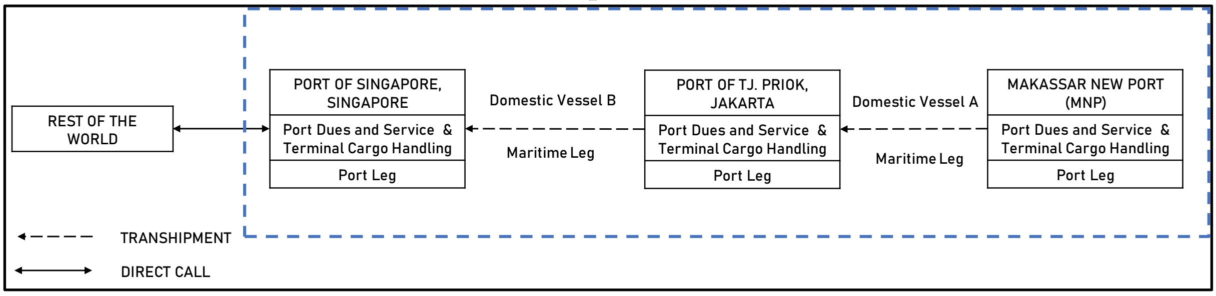

Figure 14 Maritime & Port Leg Model 1

As previously stated, this study only looks at one-way trips between Makassar New Port (MNP) and Singapore Port, as depicted above. The formula (10) is then used to calculate the one-way transport cost, and it can be seen that there are 3 port legs and 2 maritime legs, then calculations are performed to obtain all of the variables contained in the formula (11) & (12).

Calculating Operational Costs

Following that, we will calculate the value of the freight cost, with the first component being operational cost. The annual operational cost is calculated using the methods described in Chapter 3 and the data that has been obtained as shown in table 6. Just a reminder that the equation (5) obtained from the (Veldman, 2012) and (Sudjaka, 2018) study is based on the assumption of 350 operational days. The following formula approach is used to calculate the operational cost value in the maritime leg;

$$\textit{Operational Cost} = \textit{Annual Operational Cost } x \ \frac{\textit{Voyage Duration}}{350 \ \textit{days}} \qquad (14)$$

The voyage duration in this case is determined by the time it takes the ship to make a round trip from the port of origin to the port of destination. According to the Meratus shipping company's website (Meratus, 2022), the Makassar-Jakarta route takes 7 days, and the Jakarta-Singapore route takes 7 days as well. so that the total value of operational costs can be summarized in the table below;

Table 12 Operational Cost - Model 1

Ship Size (TEU)	Makassar-Jakarta		Jakarta - Singapore		Total Operational Cost (USD)
	Voyage Duration (Days)	Operational Cost (USD)	Voyage Duration (Days)	Operational Cost (USD)	
100	7	26,483	7	26,483	**52,967**
200	7	27,338	7	27,338	**54,676**
300	7	28,191	7	28,191	**56,383**

400	7	29,043	7	29,043	**58,086**
500	7	29,893	7	29,893	**59,786**
600	7	30,742	7	30,742	**61,484**
700	7	31,589	7	31,589	**63,179**
800	7	32,435	7	32,435	**64,870**
900	7	33,280	7	33,280	**66,559**
1,000	7	34,123	7	34,123	**68,245**

Calculating Voyage Cost

Following that, we will calculate the value of the freight cost, with the second component being voyage cost. Fuel costs, port dues and port services are typically included in voyage costs. However, the port service will be calculated independently in this study. As a result, the components of voyage costs are fuel costs and port dues. First, we calculate the fuel cost consumption based on equation (6) then multiply by voyage duration and fuel price which have been mentioned in chapter 3,

$$\boldsymbol{Fuel\ Cost = Fuel\ Consumption\ x\ Voyage\ Duration\ x\ Fuel\ Price} \qquad (15)$$

below is a summary of the fuel cost calculation for model 1 as shown in the table below;

Table 13 Total Fuel Cost – Model 1

Ship Size (TEUs)	Fuel Consumption (Tonnes/day)	Makassar – Jakarta		Jakarta – Singapore		Total Fuel Cost (USD)
		Voyage Duration (Days)	Fuel Costs (USD)	Voyage Duration (Days)	Fuel Costs (USD)	
100	4.38	7	48,835	7	48,835	97,670
200	4.38	7	48,835	7	48,835	97,670
300	4.38	7	48,835	7	48,835	97,670
400	4.38	7	48,835	7	48,835	97,670
500	4.38	7	48,835	7	48,835	97,670
600	4.38	7	48,835	7	48,835	97,670
700	4.38	7	48,835	7	48,835	97,670
800	4.38	7	48,835	7	48,835	97,670
900	4.38	7	48,835	7	48,835	97,670
1,000	4.38	7	48,835	7	48,835	97,670

Then calculate port dues, Model 1 contains three ports: MNP, Tanjung Priok Jakarta, and the Port of Singapore. The calculations are summarized in the table below;

Table 14 Total Port due – Model 1

Ship Size (TEUs)	GT	Makassar Port due (USD)	Jakarta Port due (USD)	Singapore Port due (USD)	Total Port due (USD)
100	1,870	186.96	186.96	100.96	474.88
200	2,896	289.62	289.62	156.40	735.64
300	3,923	392.29	392.29	211.83	996.41

400	4,949	494.95	494.95	267.27	1,257.17
500	5,976	597.61	597.61	322.71	1,517.93
600	7,003	700.27	700.27	378.15	1,778.69
700	8,029	802.93	802.93	433.58	2,039.45
800	9,056	905.60	905.60	489.02	2,300.21
900	10,083	1,008.26	1,008.26	544.46	2,560.98
1,000	11,109	1,110.92	1,110.92	599.90	2,821.74

After obtaining the two values, the calculation of the voyage cost in this study can be determined, and the summary of the voyage cost for model 1 can be seen in the table below;

$$\boldsymbol{Voyage\ Cost = Fuel\ Cost + Port\ Due} \tag{16}$$

Table 15 Voyage Cost - Model 1

Ship Size (TEUs)	Total Fuel Cost (USD)	Total Port due (USD)	Total Voyage Cost (USD)
100	97,670	475	98,145
200	97,670	736	98,406
300	97,670	996	98,666
400	97,670	1,257	98,927
500	97,670	1,518	99,188
600	97,670	1,779	99,449
700	97,670	2,039	99,709
800	97,670	2,300	99,970
900	97,670	2,561	100,231
1,000	97,670	2,822	100,492

Calculating Capital Cost

Following that, we will calculate the value of the freight cost, with the first component being operational cost. The annual capital cost is calculated using the methods described in Chapter 3 and the data that has been obtained as shown in table 9. Just a reminder that the equation (7) obtained from the (Veldman, 2012) and (Sudjaka, 2018) study is based on the assumption of 350 operational days. The following formula approach is used to calculate the operational cost value in the maritime leg;

$$\boldsymbol{Capital\ Cost = Annual\ Capital\ Cost\ x\ \frac{Voyage\ Duration}{350\ days}} \tag{17}$$

The voyage duration in this case is determined by the time it takes the ship to make a round trip from the port of origin to the port of destination. According to the Meratus shipping company's website (Meratus, 2022), the Makassar-Jakarta frequency route is once per week or takes 7 days, and the Jakarta-Singapore frequency route is once per week or takes 7 days as well. so that the total value of capital costs can be summarized in the table below;

Table 16 Capital Cost - Model 1

Ship Size (TEU)	Makassar-Jakarta		Jakarta - Singapore		Total Capital Cost (USD)
	Voyage Duration (Days)	Capital Cost (USD)	Voyage Duration (Days)	Capital Cost (USD)	
100	7	72,278	7	72,278	144,556
200	7	75,620	7	75,620	151,239
300	7	78,956	7	78,956	157,911
400	7	82,286	7	82,286	164,571
500	7	85,610	7	85,610	171,220
600	7	88,929	7	88,929	177,857
700	7	92,241	7	92,241	184,483
800	7	95,549	7	95,549	191,097
900	7	98,850	7	98,850	197,700
1,000	7	102,146	7	102,146	204,292

Calculating pilot service cost

The following step is to compute the pilot service. The cost of pilot service can be calculated using Model 1 with three ports and two times of movement for each port and assuming minimal charge will be 4 hours. The table below summarizes the results of the pilot service cost calculation for model 1;

Table 17 Pilot service cost - Model 1

Ship Size (TEUs)	GT	Pilot service cost (USD)			Total Pilot Service Cost (USD)
		Makassar Port	Jakarta Port	Singapore Port	
100	1,870	343.01	343.01	649.40	1,335
200	2,896	425.14	425.14	649.40	1,500
300	3,923	507.27	507.27	649.40	1,664
400	4,949	589.40	589.40	649.40	1,828
500	5,976	671.53	671.53	649.40	1,992
600	7,003	753.66	753.66	649.40	2,157
700	8,029	835.79	835.79	649.40	2,321
800	9,056	917.92	917.92	649.40	2,485
900	10,083	1,000.05	1,000.05	649.40	2,649
1,000	11,109	1,082.18	1,082.18	649.40	2,814

Calculating tug service cost

The following step is to compute the pilot service. The cost of pilot service can be calculated using Model 1 with three ports and assuming tug service for each port is 6 hours. The table below summarizes the results of the tug service cost calculation for model 1;

Table 18 Tug service cost – Model 1

Ship Size (TEUs)	GT	Tug service cost (USD)			Total Tug Service Cost (USD)
		Makassar Port	Jakarta Port	Singapore Port	
100	1,870	1,065	1,065	974.10	3,104
200	2,896	1,235	1,235	974.10	3,445
300	3,923	2,988	2,988	974.10	6,949
400	4,949	2,988	2,988	974.10	6,949
500	5,976	2,988	2,988	974.10	6,949
600	7,003	2,988	2,988	1,086.48	7,061
700	8,029	4,516	4,516	1,086.48	10,118
800	9,056	4,516	4,516	1,086.48	10,118
900	10,083	4,516	4,516	1,086.48	10,118
1,000	11,109	4,516	4,516	1,086.48	10,118

Calculating terminal handling

The following step is to compute terminal handling costs. The number of TEUs per round trip is required to calculate this cost. Assuming that the cargo flow from/to Makassar is constant, based on the ship's utility, which generally transports 80% of the ship's capacity and the terminal handling price for each port, the total value of terminal handling for model 1 can be calculated. The calculation's summary is shown below;

Table 19 Terminal Handling Cost – Model 1

Ship Size (TEUs)	Terminal Handling Cost (USD)			Total Terminal Handling Cost (USD)
	Makassar Port	Jakarta Port	Singapore Port	
100	9,600	9,600	13,600	32,800
200	19,200	19,200	27,200	65,600
300	28,800	28,800	40,800	98,400
400	38,400	38,400	54,400	131,200
500	48,000	48,000	68,000	164,000
600	57,600	57,600	81,600	196,800
700	67,200	67,200	95,200	229,600
800	76,800	76,800	108,800	262,400
900	86,400	86,400	122,400	295,200
1,000	96,000	96,000	136,000	328,000

Calculating time cost

Time data for the maritime leg and port leg are required to calculate the time cost. Assuming that the port leg time in Indonesia is 3.5 days and the port leg time in Singapore is 2 days. and the total time will be obtained by using the website searoute.com to determine the duration of the voyage in the maritime leg. The total time is then multiplied by the VoT described in chapter three. Thereby, the time cost value shown in the table below is obtained;

Table 20 Total time cost - Model 1

Ship Size (TEUs)	Total maritime + port leg time (days)	Total time cost
100 - 1000	14	**384**

4.2.2 Model 2 Moderate (Transshipment) / MNP - Main Port

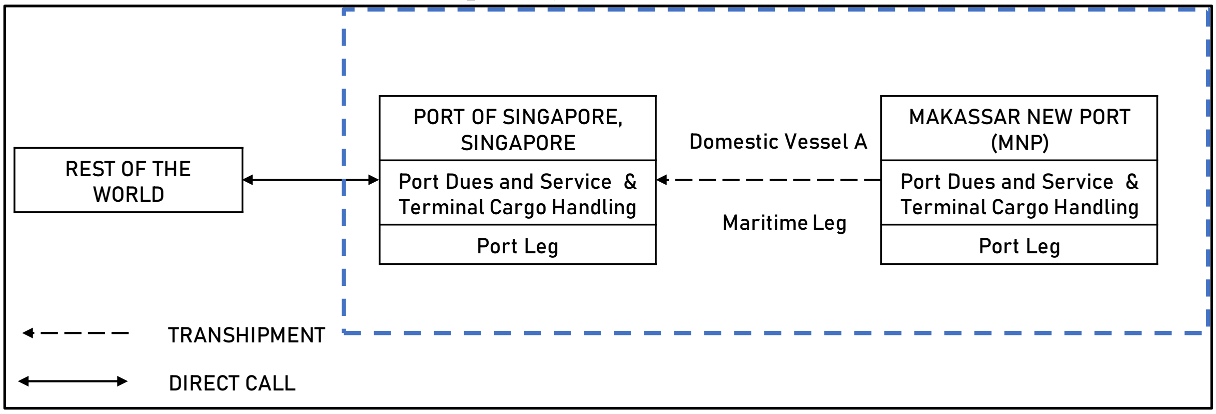

Figure 15 Maritime & Port Leg Model 2

As previously stated, this study only looks at one-way trips between Makassar New Port (MNP) and Singapore Port, as depicted above. The formula (10) is then used to calculate the one-way transport cost, and it can be seen that there are 2 port legs and 1 maritime leg, then calculations are performed to obtain all of the variables contained in the formula (11) & (12).

Calculating Operational Costs

Following that, we will calculate the value of the freight cost, with the first component being operational cost. The annual operational cost is calculated using the methods described in Chapter 3 and the data that has been obtained as shown in table 6. Just a reminder that the equation (5) obtained from the (Veldman, 2012) and (Sudjaka, 2018) study is based on the assumption of 350 operational days. The following formula approach is used to calculate the operational cost value in the maritime leg;

$$\textit{Operational Cost} = \textit{Annual Operational Cost } x \ \frac{\textit{Voyage Duration}}{350 \ \textit{days}} \qquad (18)$$

The voyage duration in this case is determined by the time it takes the ship to make a round trip from the port of origin to the port of destination. According to the Meratus shipping company's website (Meratus, 2022), the Makassar-Singapore route takes 9 days. so that the total value of operational costs can be summarized in the table below;

Table 21 Operational Cost - Model 2

Ship Size	Makassar-Singapore

(TEU)	Voyage Duration (Days)	Operational Cost (USD)
2,000	9	54,606
3,000	9	65,152

Calculating Voyage Cost

Following that, we will calculate the value of the freight cost, with the second component being voyage cost. Fuel costs, port dues and port services are typically included in voyage costs. However, the port service will be calculated independently in this study. As a result, the components of voyage costs are fuel costs and port dues. First, we calculate the fuel cost consumption based on equation (6) then multiply by voyage duration and fuel price which have been mentioned in chapter 3,

$$\boldsymbol{Fuel\ Cost = Fuel\ Consumption\ x\ Voyage\ Duration\ x\ Fuel\ Price} \qquad (19)$$

below is a summary of the fuel cost calculation for model 2 as shown in the table below;

Table 22 Total Fuel Cost – Model 2

Ship Size (TEUs)	Fuel Consumption (Tonnes/day)	Makassar - Singapore	
		Voyage Duration (Days)	Fuel Costs (USD)
2,000	19.07	9	273,226
3,000	19.07	9	273,226

Then calculate port dues, Model 2 contains two ports: MNP, and the Port of Singapore. The calculations are summarized in the table below;

Table 23 Total Port due – Model 2

Ship Size (TEUs)	GT	Makassar Port due (USD)	Singapore Port due (USD)	Total Port due (USD)
2,000	21,375	2,138	1,154	3,292
3,000	31,642	3,164	1,709	4,873

After obtaining the two values, the calculation of the voyage cost in this study can be determined, and the summary of the voyage cost for model 2 can be seen in the table below;

$$\boldsymbol{Voyage\ Cost = Fuel\ Cost + Port\ Due} \qquad (20)$$

Table 24 Voyage Cost - Model 2

Ship Size (TEUs)	Total Fuel Cost (USD)	Total Port due (USD)	Voyage Cost (USD)

2,000	273,226	3,292	276,518
3,000	273,226	4,873	278,099

Calculating Capital Cost

Following that, we will calculate the value of the freight cost, with the first component being operational cost. The annual capital cost is calculated using the methods described in Chapter 3 and the data that has been obtained as shown in table 9. Just a reminder that the equation (7) obtained from the (Veldman, 2012) and (Sudjaka, 2018) study is based on the assumption of 350 operational days. The following formula approach is used to calculate the operational cost value in the maritime leg;

$$\boldsymbol{Capital\ Cost = Annual\ Capital\ Cost\ x\ \frac{Voyage\ Duration}{350\ days}} \quad (21)$$

The voyage duration in this case is determined by the time it takes the ship to make a round trip from the port of origin to the port of destination. According to the Meratus shipping company's website (Meratus, 2022), the Makassar-Singapore route takes 9 days. so that the total value of capital costs can be summarized in the table below;

Table 25 Capital Cost - Model 2

Ship Size (TEU)	**Makassar-Singapore**	
	Voyage Duration (Days)	**Capital Cost (USD)**
2,000	9	173,299
3,000	9	214,533

Calculating pilot service cost

The following step is to compute the pilot service. The cost of pilot service can be calculated using Model 1 with three ports and two times of movement for each port and assuming minimal charge will be 4 hours. The table below summarizes the results of the pilot service cost calculation for model 2;

Table 26 Pilot service cost - Model 2

Ship Size (TEUs)	**GT**	**Pilot service cost (USD)**		**Total Pilot Service Cost (USD)**
		Makassar Port	**Singapore Port**	
2,000	21,375	1,903	907	2,811
3,000	31,642	2,725	1,015	3,740

Calculating tug service cost

The following step is to compute the pilot service. The cost of pilot service can be calculated using Model 1 with three ports and assuming tug service for each port is 6 hours. The table below summarizes the results of the tug service cost calculation for model 2;

Table 27 Tug service cost – Model 2

Ship Size (TEUs)	**GT**	**Tug service cost (USD)**		**Total Tug Service Cost (USD)**
		Makassar Port	**Singapore Port**	
2,000	21,375	9,265	1,361	10,626
3,000	31,642	9,843	1,523	11,366

Calculating terminal handling

The following step is to compute terminal handling costs. The number of TEUs per round trip is required to calculate this cost. Assuming that the cargo flow from/to Makassar is constant, based on the ship's utility, which generally transports 80% of the ship's capacity and the terminal handling price for each port, the total value of terminal handling for model 1 can be calculated. The calculation's summary is shown below;

Table 28 Terminal Handling Cost – Model 2

Ship Size (TEUs)	**Terminal Handling Cost (USD)**		**Total Terminal Handling Cost (USD)**
	Makassar Port	Singapore Port	
2,000	192,000	272,000	464,000
3,000	288,000	408,000	696,000

Calculating time cost

Time data for the maritime leg and port leg are required to calculate the time cost. Assuming that the port leg time in Indonesia is 3.5 days and the port leg time in Singapore is 2 days. and the total time will be obtained by using the website searoute.com to determine the duration of the voyage in the maritime leg. The total time is then multiplied by the VoT described in chapter three. thereby ensuring that the time cost value shown in the table below is obtained;

Table 29 Total time cost - Model 2

Ship Size (TEUs)	**Total maritime + port leg time (days)**	**Total time cost (USD)**
2,000 – 3,000	9	**247**

4.2.3 Model 3 Optimistic (Direct Call) / MNP – International Hub Port

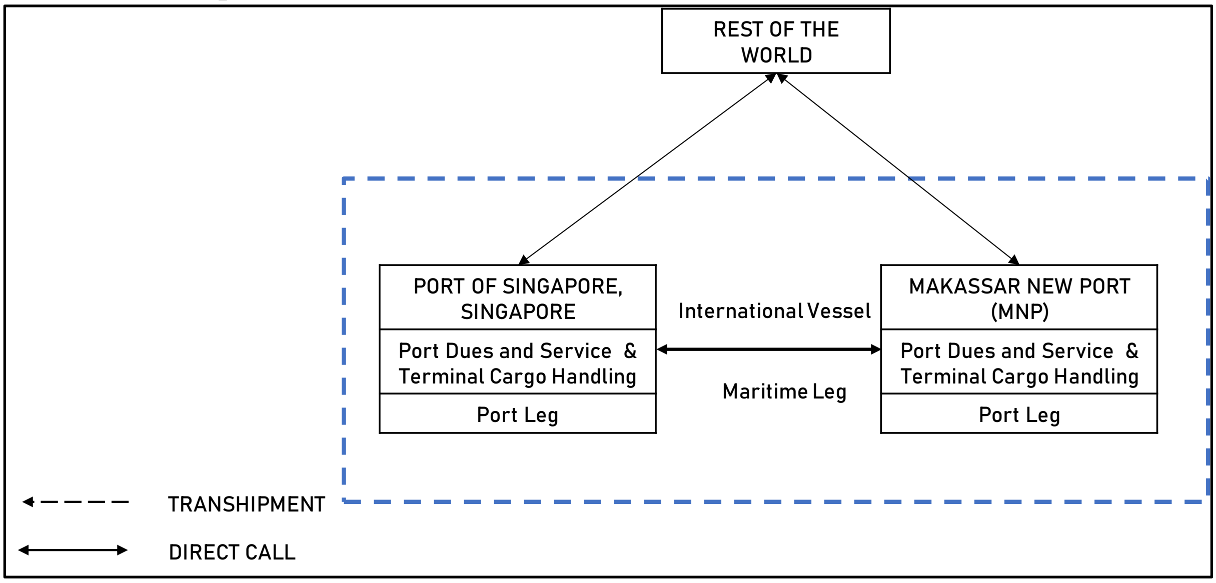

Figure 16 Maritime & Port Leg Model 3

As previously stated, this study only looks at one-way trips between Makassar New Port (MNP) and Singapore Port, as depicted above. The formula (10) is then used to calculate the one-way transport cost, and it can be seen that there are 2 port legs and 1 maritime leg with international vessel, then calculations are performed to obtain all of the variables contained in the formula (11) & (12).

Calculating Operational Costs

Following that, we will calculate the value of the freight cost, with the first component being operational cost. The annual operational cost is calculated using the methods described in Chapter 3 and the data that has been obtained as shown in table 6. Just a reminder that the equation (5) obtained from the (Veldman, 2012) and (Sudjaka, 2018) study is based on the assumption of 350 operational days. The following formula approach is used to calculate the operational cost value in the maritime leg;

$$\boldsymbol{Operational\ Cost} = \boldsymbol{Annual\ Operational\ Cost\ x\ \frac{Voyage\ Duration}{350\ days}} \quad (22)$$

The voyage duration in this case is determined by the time it takes the ship to make a round trip from the port of origin to the port of destination. According to the Sealand Maersk shipping company's website, the route IA5 has chosen to be the routes for model 3 round-trips, it takes 42 days. so that the total value of operational costs can be summarized in the table below;

Table 30 Operational Cost - Model 3

Ship Size (TEU)	**Makassar-Singapore**	
	Voyage Duration (Days)	Operational Cost (USD)
4,000	42	352,376

5,000	42	399,832

Calculating Voyage Cost

Following that, we will calculate the value of the freight cost, with the second component being voyage cost. Fuel costs, port dues and port services are typically included in voyage costs. However, the port service will be calculated independently in this study. As a result, the components of voyage costs are fuel costs and port dues. First, we calculate the fuel cost consumption based on equation (6) then multiply by voyage duration and fuel price which have been mentioned in chapter 3,

$$\boldsymbol{Fuel\ Cost = Fuel\ Consumption\ x\ Voyage\ Duration\ x\ Fuel\ Price} \quad (23)$$

below is a summary of the fuel cost calculation for model 3 as shown in the table below;

Table 31 Total Fuel Cost – Model 3

Ship Size (TEUs)	Fuel Consumption (Tonnes/day)	Makassar - Singapore	
		Voyage Duration (Days)	Fuel Costs (USD)
4,000	35.39	42	2,366,135
5,000	35.39	42	2,366,135

Then calculate port dues, Model 3 contains two ports: MNP, and the Port of Singapore. The calculations are summarized in the table below;

Table 32 Total Port due – Model 3

Ship Size (TEUs)	GT	Makassar Port due (USD)	Singapore Port due (USD)	Total Port due (USD)
4,000	41,908	4,191	2,263	6,454
5,000	52,174	5,217	2,817	8,035

After obtaining the two values, the calculation of the voyage cost in this study can be determined, and the summary of the voyage cost for model 3 can be seen in the table below;

$$\boldsymbol{Voyage\ Cost = Fuel\ Cost + Port\ Due} \quad (24)$$

Table 33 Voyage Cost - Model 3

Ship Size (TEUs)	Total Fuel Cost (USD)	Total Port due (USD)	Voyage Cost (USD)
4,000	2,366,135	6,454	2,372,589
5,000	2,366,135	8,035	2,374,170

Calculating Capital Cost

Following that, we will calculate the value of the freight cost, with the first component being operational cost. The annual capital cost is calculated using the methods described in Chapter 3 and the data that has been obtained as shown in table 9. Just a reminder that the equation (7) obtained from the (Veldman, 2012) and (Sudjaka, 2018) study is based on the assumption of 350 operational days. The following formula approach is used to calculate the operational cost value in the maritime leg;

$$\boldsymbol{Capital\ Cost = Annual\ Capital\ Cost\ x\ \frac{Voyage\ Duration}{350\ days}} \qquad (25)$$

The voyage duration in this case is determined by the time it takes the ship to make a round trip from the port of origin to the port of destination. According to the Sealand Maersk shipping company's website, the route IA5 has chosen to be the routes for model 3 round-trips, it takes 42 days. so that the total value of capital costs can be summarized in the table below;

Table 34 Capital Cost - Model 3

Ship Size (TEU)	Makassar-Singapore	
	Voyage Duration (Days)	Capital Cost (USD)
4,000	42	1,190,141
5,000	42	1,375,696

Calculating pilot service cost

The following step is to compute the pilot service. The cost of pilot service can be calculated using Model 1 with three ports and two times of movement for each port and assuming minimal charge will be 4 hours. The table below summarizes the results of the pilot service cost calculation for model 3;

Table 35 Pilot service cost - Model 3

Ship Size (TEUs)	**GT**	**Pilot service cost (USD)**		**Total Pilot Service Cost (USD)**
		Makassar Port	Singapore Port	
4,000	41,908	3,546	1,015	4,561
5,000	52,174	4,367	1,015	5,383

Calculating tug service cost

The following step is to compute the pilot service. The cost of pilot service can be calculated using Model 1 with three ports and assuming tug service for each port is 6 hours. The table below summarizes the results of the tug service cost calculation for model 3;

Table 36 Tug service cost – Model 3

Ship Size	**GT**	**Tug service cost (USD)**	**Total Tug**

(TEUs)		Makassar Port	Singapore Port	**Service Cost (USD)**
4,000	41,908	9,843	1,523	11,366
5,000	52,174	10,358	1,523	11,881

Calculating terminal handling

The following step is to compute terminal handling costs. The number of TEUs per round trip is required to calculate this cost. Assuming that the cargo flow from/to Makassar is constant, based on the ship's utility, which generally transports 80% of the ship's capacity and the terminal handling price for each port, the total value of terminal handling for model 3 can be calculated. The calculation's summary is shown below;

Table 37 Terminal Handling Cost – Model 3

Ship Size (TEUs)	**Terminal Handling Cost (USD)**		**Total Terminal Handling Cost (USD)**
	Makassar Port	Singapore Port	
4,000	384,000	544,000	928,000
5,000	480,000	680,000	1,160,000

Calculating time cost

Time data for the maritime leg and port leg are required to calculate the time cost. Assuming that the port leg time in Indonesia is 3.5 days and the port leg time in Singapore is 2 days. and the total time will be obtained by using the website searoute.com to determine the duration of the voyage in the maritime leg. The total time is then multiplied by the VoT described in chapter three. thereby ensuring that the time cost value shown in the table below is obtained;

Table 38 Total time cost - Model 3

Ship Size (TEUs)	**Total maritime + port leg time (days)**	**Total time cost (USD)**
4,000 – 5,000	9	**247**

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Chapter 5 – Results and Analysis

As a follow-up to the previous chapter, results can be found to answer the research question of this study. It should be remembered that the basis for calculating the estimate is for the annual volume of containers from/to Makassar, the explanation of which can be seen again in chapter 3. In this chapter, we will first determine the transport cost for Makassar New Port (MNP) according to the annual volume of containers for each. each model, then a comparative analysis is carried out between the 3 models. And the last stage is what about the practice in the field and the current and future conditions.

5.1 Model 1 Pessimistic (Double Transshipment) / MNP – Feeder Port

As explained in chapter 4, model 1 positions Makassar New Port (MNP) as a feeder port for international container shipping in Indonesia. Where based on the data presented in chapter 3 that the average Indonesian domestic ship is in the range of 100 TEU - 1000 TEU, in addition that the average ship size for feeder ports operates in the range of 100 TEU -1000 TEU in Indonesia. Therefore, for model 1, the range for the base ship used is calculated at the same ship size range.

Furthermore, as explained in the previous chapter through equation (13) that at least the value of transport costs consists of two components of shipping cost and time cost. It should be reminded that the calculation results in this model do not take into account factors beyond control or this calculation is based on ideal conditions. First, we calculate the first component of the transport cost, namely the shipping cost.

Calculating Shipping Cost

The table below shows the values obtained by component for shipping costs. It should be underlined that this calculation is based on the ship range of domestic ships in Indonesia according to the previous explanation.

Table 39 Shipping Cost - Model 1

Ship Size (TEU)	**100**	**200**	**300**	**400**	**500**
Operational Cost (USD)	52,967	54,676	56,383	58,086	59,786
Voyage Cost (USD)	98,145	98,406	98,666	98,927	99,188
Capital Cost (USD)	144,556	151,239	157,911	164,571	171,220
Pilot Service Cost (USD)	1,335	1,500	1,664	1,828	1,992
Tug Service Cost (USD)	3,104	3,445	6,949	6,949	6,949
Terminal Handling Cost (USD)	32,800	65,600	98,400	131,200	164,000
Shipping Cost (USD)	**332,907**	**374,865**	**419,973**	**461,562**	**503,136**
Ship Size (TEU)	**600**	**700**	**800**	**900**	**1000**
Operational Cost (USD)	61,484	63,179	64,870	66,559	68,245
Voyage Cost (USD)	99,449	99,709	99,970	100,231	100,492

Capital Cost (USD)	177,857	184,483	191,097	197,700	204,292
Pilot Service Cost (USD)	2,157	2,321	2,485	2,649	2,814
Tug Service Cost (USD)	7,061	10,118	10,118	10,118	10,118
Terminal Handling Cost (USD)	196,800	229,600	262,400	295,200	328,000
Shipping Cost (USD)	**544,808**	**589,410**	**630,941**	**672,458**	**713,960**

From the table above, we calculate the shipping cost per TEU. To go to the next step, we need to know what the container volume is for model 1. Again, to underline that this research focuses on the cost for one-way, namely Makassar to Singapore, so the result of transportation costs is in the form of cost in one-way Makassar to Singapore.

Calculating Transport Cost per TEU

Annual Volume Container = 303.903 TEU

Container volume per day = 303.903/350 = 869 TEU

Service time = 7 days

Thus, Volume TEU per for model 1 = 869 TEU x 7 = 6,083 TEU

Below is shown the value of transportation costs for model 1, with ship sizes from 100 TEU – 1,000 TEU

Table 40 Transport Cost per TEU – Model 1

Ship Size (TEU)	**100**	**200**	**300**	**400**	**500**
Shipping Cost	332,907	374,865	419,973	461,562	503,136
NTEU	6,083	6,083	6,083	6,083	6,083
Number of Leg	2	2	2	2	2
Shipping Cost	109	123	138	152	165
Time Cost	384	384	384	384	384
Total Transportation Cost (USD)	**493**	**507**	**522**	**535**	**549**
Ship Size (TEU)	**600**	**700**	**800**	**900**	**1000**
Shipping Cost	544,808	589,410	630,941	672,458	713,960
NTEU	6,083	6,083	6,083	6,083	6,083
Number of Leg	2	2	2	2	2
Shipping Cost	179	194	207	221	235
Time Cost	384	384	384	384	384
Total Transportation Cost (USD)	**563**	**577**	**591**	**605**	**618**

Based on the table above, it can be concluded that the results for the transport cost per TEU in model – 1 are when MNP is the feeder, with ship sizes from 100-1000 TEU around USD 493 – 618 per TEU.

5.2 Model 2 Moderate (Transshipment) / MNP - Main Port

As explained in chapter 4, model 2 positions Makassar New Port (MNP) as a main port for international container shipping in Indonesia. Where based on the data presented in chapter 3 that the average Indonesian for international ship is in the range of 2000 TEU - 3000 TEU, in addition that the average ship size for main ports operates in the range of 1000 TEU - 3000 TEU in Indonesia. Therefore, for model 2, the range for the base ship used is calculated at the same ship size range.

Furthermore, as explained in the previous chapter through equation (13) that at least the value of transport costs consists of two components of shipping cost and time cost. It should be reminded that the calculation results in this model do not take into account factors beyond control or this calculation is based on ideal conditions. First, we calculate the first component of the transport cost, namely the shipping cost.

Calculating Shipping Cost

The table below shows the values obtained by component for shipping costs. It should be underlined that this calculation is based on the ship range of domestic ships in Indonesia according to the previous explanation.

Table 41 Shipping Cost - Model 2

Ship Size (TEU)	**2,000**	**3,000**
Operational Cost (USD)	54,606	65,152
Voyage Cost (USD)	276,518	278,099
Capital Cost (USD)	173,299	214,533
Pilot Service Cost (USD)	2,811	3,740
Tug Service Cost (USD)	10,626	11,366
Terminal Handling Cost (USD)	464,000	696,000
Shipping Cost (USD)	**981,860**	**1,268,889**

From the table above, we calculate the shipping cost per TEU. To go to the next step, we need to know what the container volume is for model 2. Again, to underline that this research focuses on the cost for one-way, namely Makassar to Singapore, so the result of transportation costs is in the form of cost in one-way Makassar to Singapore.

Calculating Transport Cost per TEU

Annual Volume Container = 303.903 TEU

Container volume per day = 303.903/350 = 869 TEU

Service time = 9 days

Thus, Volume TEU for model 2 = 869 TEU x 9 = 7,821 TEU

Below is shown the value of transportation costs for model 2, with ship sizes from 2,000 TEU – 3,000 TEU

Table 42 Transport Cost per TEU – Model 2

Ship Size (TEU)	**2,000**	**3,000**
Shipping Cost	981,860	1,268,889
NTEU	7,821	7,821
Number of Leg	1	1
Shipping Cost	126	162
Time Cost	247	247
Total Transportation Cost (USD)	**372**	**409**

Based on the table above, it can be concluded that the results for the transport cost per TEU in model – 2 are when MNP is the main port, with ship sizes from 2,000-3,000 TEU around USD 372 – 409 per TEU.

5.3 Model 3 Optimistic (Direct Call) / MNP – International Hub Port

As explained in chapter 4, model 3 positions Makassar New Port (MNP) as an international hub port port for international container shipping in Indonesia. Where based on the data presented in chapter 3 that the average intra-asia ship is in the range above 4,000 TEU. Therefore, for model 3, the range for the base ship used is calculated at the same ship size range.

Furthermore, as explained in the previous chapter through equation (13) that at least the value of transport costs consists of two components of shipping cost and time cost. It should be reminded that the calculation results in this model do not take into account factors beyond control or this calculation is based on ideal conditions. First, we calculate the first component of the transport cost, namely the shipping cost.

Calculating Shipping Cost

The table below shows the values obtained by component for shipping costs. It should be underlined that this calculation is based on the ship range of domestic ships in Indonesia according to the previous explanation.

Table 43 Shipping Cost - Model 3

Ship Size (TEU)	**4,000**	**5,000**
Operational Cost (USD)	352,376	399,832
Voyage Cost (USD)	2,372,589	2,374,170
Capital Cost (USD)	1,190,141	1,375,696
Pilot Service Cost (USD)	4,561	5,383
Tug Service Cost (USD)	11,366	11,881
Terminal Handling Cost (USD)	928,000	1,160,000
Shipping Cost (USD)	**4,859,033**	**5,326,962**

From the table above, we calculate the shipping cost per TEU. To go to the next step, we need to know what the container volume is for model 2. Again, to underline that this research focuses on the cost for one-way, namely Makassar to Singapore, so the result of transportation costs is in the form of cost in one-way Makassar to Singapore.

Calculating Transport Cost per TEU

Annual Volume Container = 303.903 TEU

Container volume per day = 303.903/350 = 869 TEU

Service time = 9 days

Thus, Volume TEU for model 3 = 869 TEU x 42 = 36,498 TEU

Below is shown the value of transportation costs for model 3, with ship sizes from 2,000 TEU – 3,000 TEU

Table 44 Transport Cost per TEU – Model 3

Ship Size (TEU)	4,000	5,000
Shipping Cost	4,859,033	5,326,962
NTEU	36,498	36,498
Number of Leg	1	1
Shipping Cost	133	146
Time Cost	247	247
Total Transportation Cost (USD)	**380**	**393**

Based on the table above, it can be concluded that the results for the transport cost per TEU in model – 3 are when MNP is an international hub port, with ship sizes above 4000 TEU around USD 380 – 393 per TEU.

5.4 Comparison Analysis

After we get the value of transport cost per TEU for each model, then the next thing to do is a comparative analysis between the results for each model. To make a comparison, for model 1, the results of 600 TEU and 700 TEU were chosen with the consideration that these two ship sizes are the largest based on the explanation in chapter 3. Therefore, from there we get two values for each model, thus interpolation calculations for certain ship sizes it will be easier. Below is a summary of the results of each model with two ship sizes, which have been determined;

Table 45 Summary Calculation Transport Cost per TEU

Model	1		2		3	
Service Time (Days)	7	7	9	9	42	42
Ship Size (TEU)	600	700	2,000	3,000	4,000	5,000

Volume (TEU)	6,083	6,083	7,821	7,821	36,498	36,498
Operational Cost (USD)	61,484	63,179	54,606	65,152	352,376	399,832
Voyage Cost (USD)	99,449	99,709	276,518	278,099	2,372,589	2,374,170
Capital Cost (USD)	177,857	184,483	173,299	214,533	1,190,141	1,375,696
Pilot Service Cost (USD)	2,157	2,321	2,811	3,740	4,561	5,383
Tug Service Cost (USD)	7,061	10,118	10,626	11,366	11,366	11,881
Terminal Handling Cost (USD)	196,800	229,600	464,000	696,000	928,000	1,160,000
Total Shipping Cost (USD)	**544,808**	**589,410**	**981,860**	**1,268,889**	**4,859,033**	**5,326,962**
N_{TEU} (TEU)	6,083	6,083	7,821	7,821	36,498	36,498
Number of Leg	2	2	1	1	1	1
Shipping Cost (USD)	179	194	126	162	133	146
Time Cost (USD)	384	384	247	247	247	247
Total Transportation Cost (USD)	**563**	**577**	**372**	**409**	**380**	**393**

Comparison Shipping Cost

First, we can see that the value of shipping costs is increasing with respect to the size of the ship, this is in accordance with the principle that ships with large sizes are more willing to incur large costs. To be able to compare in detail about shipping costs, see the image below;

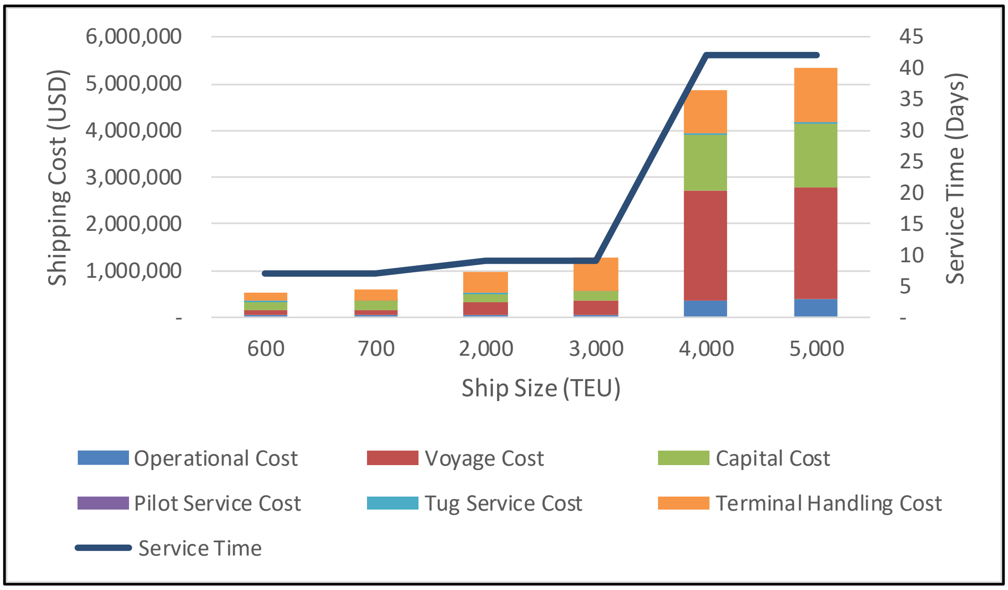

Figure 17 Shipping Cost - Ship Size

From the picture above, it can be seen that the value of shipping cost is in line with the size of the vessel and the service time/voyage duration of the vessel. Large ships tend to take longer journeys than small ships, so the component of the shipping cost value also increases in line with the service time and size of the ship. For example, if a 600 TEU ship performs the same service time as a 4,000 TEU ship, the shipping cost will be higher than when the ship only performs a lower service time, but the shipping cost is still lower than 4,000 TEU. To see further description of the components in shipping cost, the figure below shows the proportion of each component in shipping cost to ship size and service time.

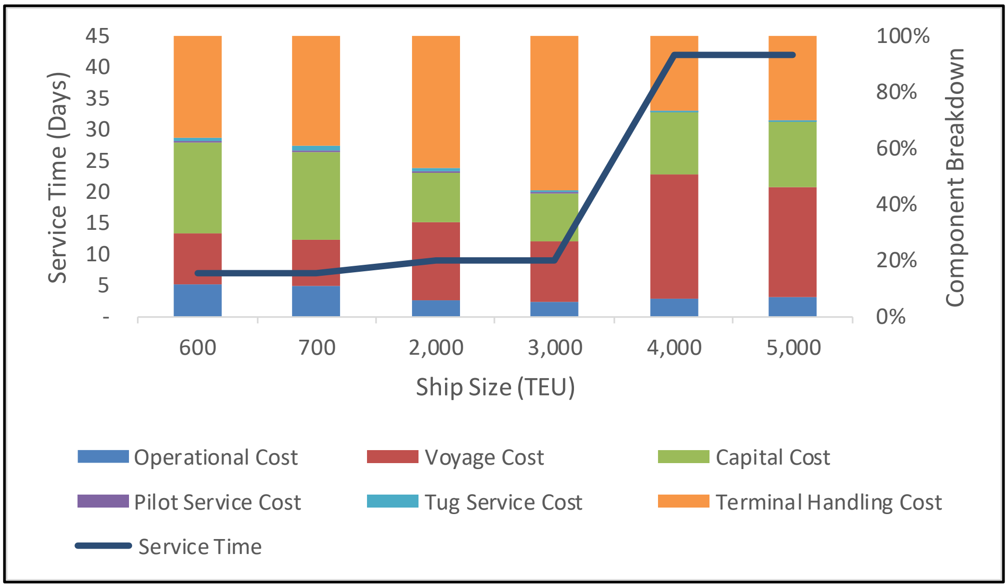

Figure 18 Proportionally of Component to Shipping Cost

From the picture above, our first concern is the voyage cost, which is proportionally increasing in line with the increase in ship size and service time, this is appropriate where larger ships at this time focus on decreasing ship speed, this is done to suppress fuel cost which is one of the critical components in calculating voyage cost. The next thing to pay attention to is the terminal handling cost where when a ship with a large size and long service time does not become the component with the largest proportion, it is inversely proportional to when the ship is small and the service time is fast. This is appropriate where ships with small sizes will have a higher frequency of trips, if the ship's capacity is lower than the available cargo volume, causing high terminal handling costs.

Comparison Transport Cost per TEU

Furthermore, after calculating the shipping cost for each model, the next analysis is the transport cost per TEU for each model. We can see the value of transport costs in table 45. In outline it can be seen that the value of transport costs in model 1 is in accordance with the statement that transport costs in Indonesia, especially for the eastern part of Indonesia, are very large, this is due to the occurrence of double transshipment, as happened in the model 1 in this study.

For a more detailed picture, regarding the transport cost per TEU, we will look at the proportion of each component of the shipping cost to the value of the transport cost per TEU. The image below will show this;

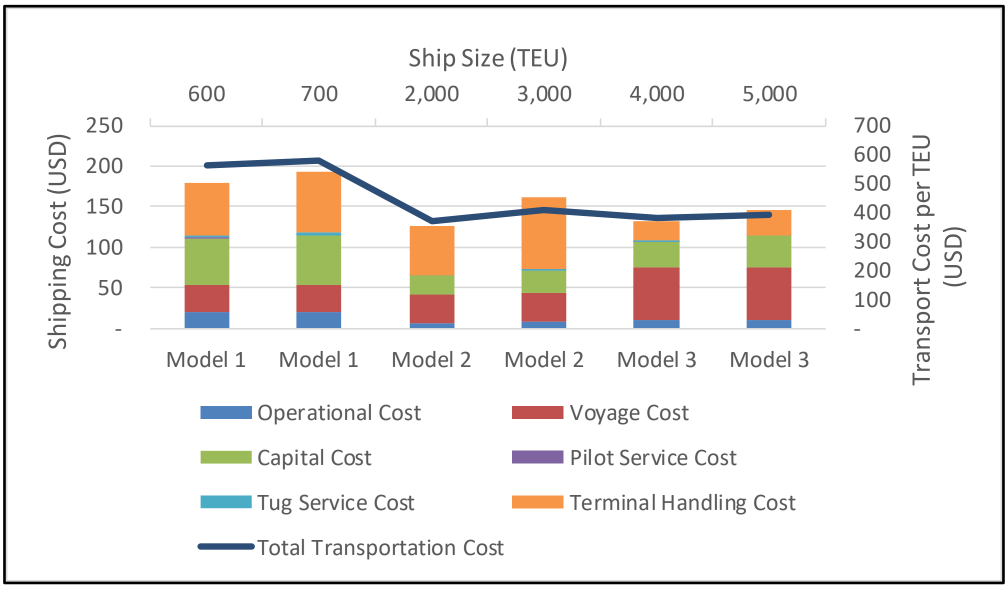

Figure 19 Transport Cost per TEU

Contrast with the graph of shipping cost where the value of shipping cost is getting bigger in line with the size of the ship and service time, on the contrary the value of the transport cost per TEU, the smaller the size of the ship, the greater the value of the transport cost per TEU and the larger the size of the ship, the smaller it is. value of transportation cost per TEU. This indicates that the nature or characteristics of economies of scale can be applied, where increasing the size of the ship will automatically reduce the transport cost per TEU.

From the values above, we can then analyze the suitable role for the Makassar New Port (MNP), whether it is model 1, model 2, and model 3. It should be remembered that in this study the transport cost per TEU is based on the Makassar-Singapore route, where Singapore port is considered to represent the role of an international hub port in container flow in Indonesia, especially for containers from/to Makassar.

5.5 Makassar New Port (MNP) Role

In accordance with the research question in this study, with the results described above, it is very possible for MNP to act as a Main Port or International Hub Port. When Makassar New Port (MNP) is played as the Main Port, at least there is a decrease in the value of transport cost per TEU by 30%. It can be seen that the development of the MNP in the future can reach vessels with a size of 4,000 TEU or intra-Asian vessels. This is also in line with government programs going forward through the concept of the National Logistics System and IPN, in which the Makassar New Port (MNP) will act as one of the Main Ports and in the future can act as an international hub port. Even in 2020 Maersk in its subsidiary launched a new route for direct calls from/to Makassar with the code IA5 (Sealand Maersk, 2020) this is in line with the construction of the Makassar New Port (MNP) for phase 1 which was completed around that year. This shows the potential of Makassar New Port (MNP) to become an international hub port in global container shipping routes.

However, based on a recent visit to the website of the Sealand company Maersk, the IA5 route changed the shipping route and removed the Makassar New Port (MNP) as one of the point ports of the route. In addition, even with the Makassar New Port (MNP), local shipping companies are also more inclined to make MNP act as a feeder port on their routes. We can explain this incident further in the next section.

5.6 Actual Condition

As previously explained, Makassar New Port (MNP) when it becomes a main port can reduce the value of transport costs by up to 30% when compared to being a feeder port. This will certainly be good news for all parties, including the government, shipping companies, exporters and importers, especially for the eastern part of Indonesia.

However, in practice in the field, until now Makassar New Port (MNP) is still more often considered as a feeder port by shipping companies despite the decrease in transport cost per TEU by up to 30% obtained from the calculations in this study. This incident can be explained through the table below;

Table 46 Total Cost - Practical Condition

	Ship Size (TEU)	Volume Container (TEU)	Cost per TEU (USD)	Total Cost (USD)
Model 1	600	869	563	**489,008**
	700	869	577	501,751
Model 2	2,000	869	372	**744,283**
	3,000	869	409	1,226,524
Model 3	4,000	869	380	1,518,926
	5,000	869	393	1,962,761

The explanation for the table above is as follows, in practical conditions in the field the volume of containers to be transported will not always be ideal or in accordance with the calculations in chapter 4 where each model for the volume of transported containers is an ideal value, in the sense that the available containers will remain until transported by ship to the port of destination.

But in practical, real conditions in the field this is very difficult to happen. So, in this section we assume that the container volume is the volume of containers that exist at least in a day, in accordance with the previous calculation that the container volume per day in this study is 869 TEU / day. This is done with the assumption that in each model at least when the ship that will come to transport the container, will transport the container as large as a container per day regardless of the size of the ship, service day, and the service model or role of the port of transport.

Furthermore, in table 46 above, the calculation to get the total cost is in the form of multiplication of container volume and container cost per TEU. Furthermore, if the size of the ship is smaller than the total volume of the container, then to get the total transport cost, that is by multiplying the value of the volume of the container by the cost per TEU. On the other hand, if the size of the ship is larger than the volume of the existing container, then to get the total transport cost, that is by multiplying the size of the ship by the cost per TEU.

So, it can be said that in field practice with international container volumes from/to Makassar, the company will condemn it more when Makassar New Port (MNP) acts as a feeder port. It can be seen from the total cost when MNP becomes the main port as is the policy of the Indonesian government, the total cost obtained is around USD 744,283, whereas when MNP becomes a feeder port as was done by Indonesian shipping companies, the total cost obtained is around USD 489,008, there is a decrease cost of about 50% when MNP becomes a feeder port.

The explanation above is the reason why Makassar New Port (MNP) is very difficult to become a main port in current conditions or in terms of international container volume conditions from/to Makassar and Eastern Indonesia.

5.7 Hypothecial Scenarios

In addition to the calculations in the research and as a supporting explanation to add when the time is right or the conditions are right for Makassar New Port (MNP) and the Government of Indonesia, so that MNP can become a Main Port and International Hub Port. In the first scenario, it is assumed that the volume of international containers for the eastern and western parts of Indonesia is equal. From the calculations in chapter 3, the international container volume value is 1,600,000 TEU. Then for the second scenario, it is based on the value of the international container volume handled by the main port in terms of the international container volume in the Java region, which is 7,000,000 TEU. Therefore, from these two scenarios it will be concluded that when is the right time for MNP to act as the Main Port on the Indonesian container shipping network and the International Hub Port on the Global container shipping network.

5.7.1 Volume International Container 1,600,000 TEU

The results for the following hypothecial scenario are based on the calculations that have been done previously, without changing the related elements. Changes only occur in the volume of the international container. So below is a summary of the calculations so that the total transport cost per TEU is obtained for each model with an annual container volume of 1,600,000 TEU;

Table 47 Summary Transport Cost per TEU - 1,600,000 TEU

Model	**1**		**2**		**3**	
Service Time (Days)	7	7	9	9	42	42
Ship Size (TEU)	600	700	2,000	3,000	4,000	5,000
Volume (TEU)	32,004	32,004	41,148	41,148	192,024	192,024
Operational Cost (USD)	61,484	63,179	54,606	65,152	352,376	399,832
Voyage Cost (USD)	99,449	99,709	276,518	278,099	2,372,589	2,374,170
Capital Cost (USD)	177,857	184,483	173,299	214,533	1,190,141	1,375,696
Pilot Service Cost (USD)	2,157	2,321	2,811	3,740	4,561	5,383
Tug Service Cost (USD)	7,061	10,118	10,626	11,366	11,366	11,881
Terminal Handling Cost (USD)	196,800	229,600	464,000	696,000	928,000	1,160,000
Total Shipping Cost (USD)	**544,808**	**589,410**	**981,860**	**1,268,889**	**4,859,033**	**5,326,962**
N_{TEU} (TEU)	32,004	32,004	41,148	41,148	192,024	192,024
Number of Leg	2	2	1	1	1	1
Shipping Cost (USD)	34	37	24	31	25	28
Time Cost (USD)	384	384	247	247	247	247
Total Transportation Cost (USD)	**418**	**420**	**270**	**277**	**272**	**274**

As in the previous section, then analyze the shipping cost and transport cost per TEU, for more details, see the graphic image below;

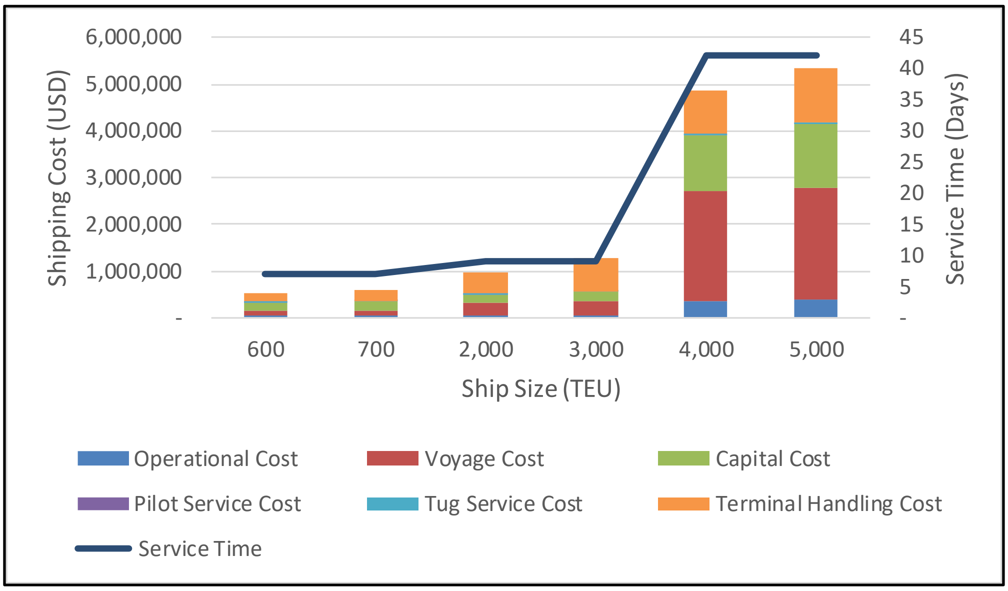

Figure 20 Shipping Cost - Ship Size (1,600,000 TEU)

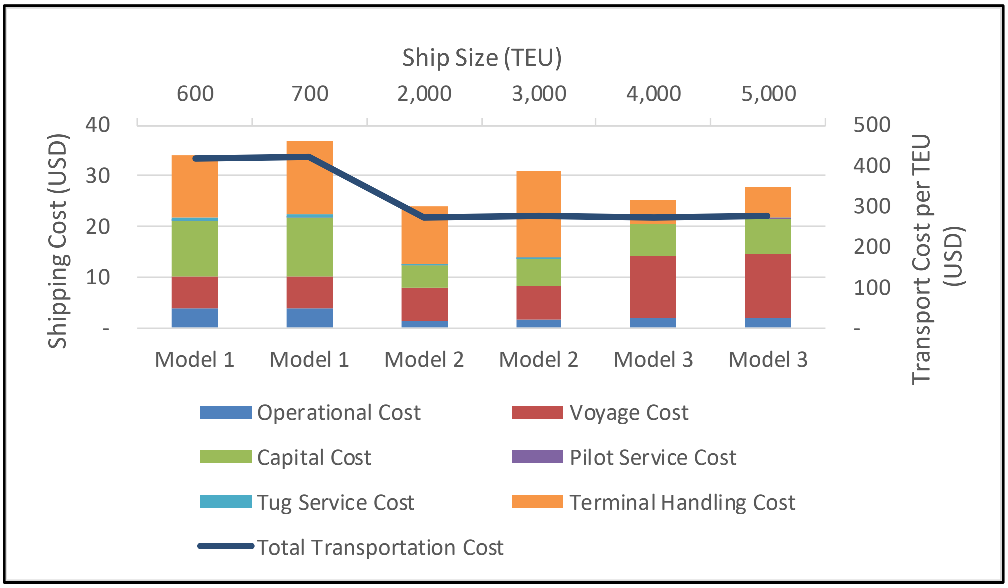

Figure 21 Transport Cost per TEU (1,600,000)

From the two figures above, it can be said that the number of container volumes will not change the basic principles of shipping cost and transport cost per TEU. Where the shipping cost will continue to increase in line with the size of the vessel, and the transport cost per TEU will decrease in line with the larger vessel size. However, the difference will be seen more clearly in practical conditions, which can be seen in the table below;

Table 48 Total Cost - Practical Condition (1,600,000 TEU)

	Ship Size (TEU)	Volume Container (TEU)	Cost per TEU (USD)	Total Cost (USD)
Model 1	600	4,572	418	1,909,479
	700	4,572	420	1,922,222
Model 2	2,000	4,572	270	1,236,551
	3,000	4,572	277	1,268,443
Model 3	4,000	4,572	272	1,243,146
	5,000	4,572	274	1,371,706

Same as the previous explanation in calculating the total cost where the calculation to get the total cost is in the form of multiplication of container volume and container cost per TEU. Furthermore, if the size of the ship is smaller than the total volume of the container, then to get the total transport cost, that is by multiplying the value of the volume of the container by the cost per TEU. On the other hand, if the size of the ship is larger than the volume of the existing container, then to get the total transport cost, that is by multiplying the size of the ship by the cost per TEU.

It was found that the total cost value when Makassar New Port (MNP) became the feeder port or model 1 became the highest value among the other two models. Although there is a slight difference between model 2 and model 3, from the table above, model 2 gets the smallest value. So, it can be said that in this scenario, MNP is suitable to be the main port for container networks in Indonesia, and can also be an International Hub Port for global container networks.

5.7.2 Volume International Container 6,000,000 TEU

The results for the following hypothecial scenario are based on the calculations that have been done previously, without changing the related elements. Changes only occur in the volume of the international container. So below is a summary of the calculations so that the total transport cost per TEU is obtained for each model with an annual container volume of 6,000,000 TEU;

Table 49 Summary Transport Cost per TEU – 6,000,000 TEU

Model	1		2		3	
Service Time (Days)	7	7	9	9	42	42
Ship Size (TEU)	600	700	2,000	3,000	4,000	5,000
Volume (TEU)	120,001	120,001	154,287	154,287	720,006	720,006

Operational Cost (USD)	61,484	63,179	54,606	65,152	352,376	399,832
Voyage Cost (USD)	99,449	99,709	276,518	278,099	2,372,589	2,374,170
Capital Cost (USD)	177,857	184,483	173,299	214,533	1,190,141	1,375,696
Pilot Service Cost (USD)	2,157	2,321	2,811	3,740	4,561	5,383
Tug Service Cost (USD)	7,061	10,118	10,626	11,366	11,366	11,881
Terminal Handling Cost (USD)	196,800	229,600	464,000	696,000	928,000	1,160,000
Total Shipping Cost (USD)	**544,808**	**589,410**	**981,860**	**1,268,889**	**4,859,033**	**5,326,962**
N_{TEU} (TEU)	120,001	120,001	154,287	154,287	720,006	720,006
Number of Leg	2	2	1	1	1	1
Shipping Cost (USD)	9	10	6	8	7	7
Time Cost (USD)	384	384	247	247	247	247
Total Transportation Cost (USD)	**393**	**393**	**253**	**255**	**253**	**254**

As in the previous section, we then analyze the shipping cost and transport cost per TEU, for more details, see the graphic image below;

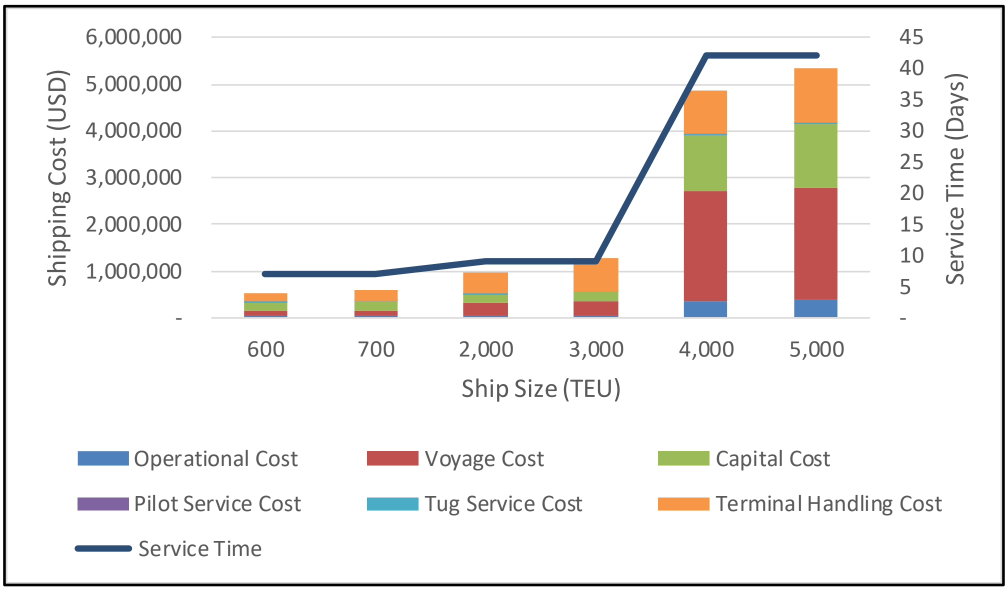

Figure 22 Shipping Cost - Ship Size (6,000,000 TEU)

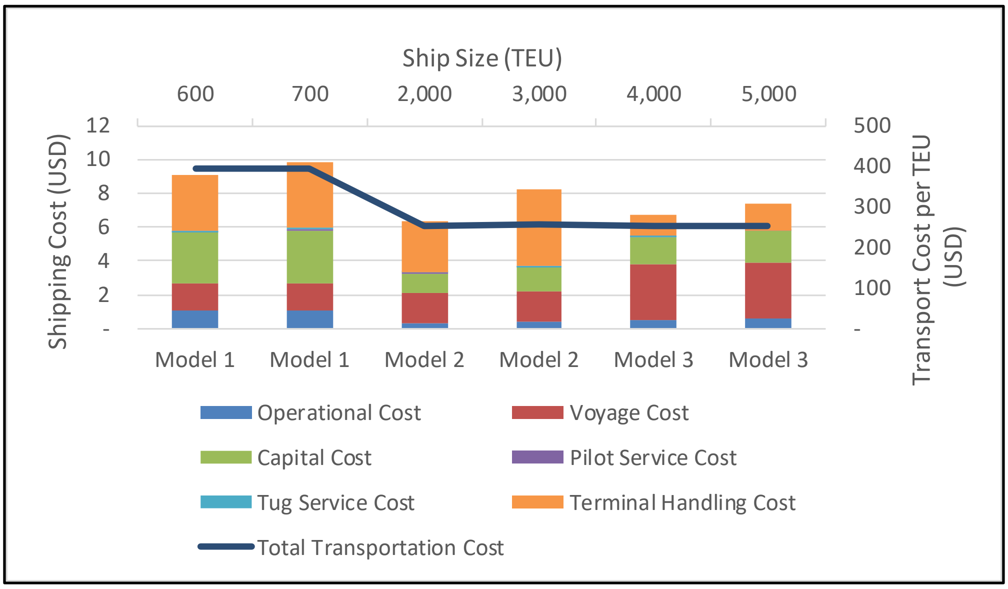

Figure 23 Transport Cost per TEU (6,000,000)

From the two figures above, it can be said that the number of container volumes will not change the basic principles of shipping cost and transport cost per TEU. Where the shipping cost will continue to increase in line with the size of the vessel, and the transport cost per TEU will decrease in line with the larger vessel size. However, the difference will be seen more clearly in practical conditions, which can be seen in the table below;

Table 50 Total Cost - Practical Condition (6,000,000 TEU)

	Ship Size (TEU)	Volume Container (TEU)	Cost per TEU (USD)	Total Cost (USD)
Model 1	600	17,143	393	6,731,714
	700	17,143	393	6,744,458
Model 2	2,000	17,143	253	4,336,559
	3,000	17,143	255	4,368,451
Model 3	4,000	17,143	253	4,343,155
	5,000	17,143	254	4,354,296

Same as the previous explanation in calculating the total cost where the calculation to get the total cost is in the form of multiplication of container volume and container cost per TEU. Furthermore, if the size of the ship is smaller than the total volume of the container, then to get the total transport cost, that is by multiplying the value of the volume of the container by the cost per TEU. On the other hand, if the size of the ship is larger than the volume of the existing container, then to get the total transport cost, that is by multiplying the size of the ship by the cost per TEU.

It was found that the total cost value when Makassar New Port (MNP) became the feeder port or model 1 became the highest value among the other two models. it can be seen that the difference between model 2 and model 3 is only USD 1, this occurs due to the rounded value of the numbers after the comma, but it can be said that the value of transport cost per TEU for model 2 and model 3 in this scenario is the same. So it can be said that in this scenario, MNP is suitable to act as an International Hub Port for global container networks, and can also act as a Main port in Indonesia's national container network.

Chapter 6 Conclusion and Recommendation

6.1 Conclusion

In conclusion, Makassar New port (MNP) for the global container shipping network and Indonesia's national shipping network. Based on the Indonesian government's program through the national logistics channel and IPN, Makassar New Port (MNP) in the future is prepared to become a Main Port and International Hub Port in the national shipping network. Therefore, by going through the thesis, looking for roles, services and roles that are suitable for MNP to the current conditions in terms of international container volumes from/to Makassar, especially Eastern Indonesia.

Then in this thesis, Makassar New Port (MNP) is assumed to have 3 service models, namely pessimistic, moderate and optimistic. Which in the pessimist MNP is considered or acts as a feeder port in the sense of the shipping network mode being double transshipment, moderate as the main port in the sense of the sailing network mode being transshipment, and optimistic as an international hub port in the sense of direct call shipping mode. In this thesis the main focus is the Makassar-Singapore route, where the Singapore port is considered as one of the international hub ports for Indonesia in the global container network.

By going through the data obtained from various sources, it was found that the estimated value for the volume of international containers to be handled by Makassar New Port (MNP) is 303.903 TEU/year. This figure is obtained through forecasting results from the volume value obtained from the total container throughput in Indonesia and based on the international container distribution of the data to regions in Indonesia. In this case, Sumatra, Java, Kalimantan, Sulawesi, and the rest of Indonesia. After that, it was found that the average ship size for domestic shipping ranges from 100 to 1,000 TEU or ships operating on MNP as feeder ports. Then, for international shipping, the average ship size is between 2,000 – 3,000 TEU or ships operating at MNP as the main port. Then, for intra-Asian shipping or when MNP acts as one of the international hub ports, or port points in a global container network, the operating vessel size is above or equal to 4,000 TEU.

It was found that from the calculation of the value of the transport cost per TEU for model 1 where Makassar New Port (MNP) acts as a feed port, which is around USD 563 – 577 for ship variations of 600-700 TEU, model 2 where MNP acts as the main port which is around USD 372 – 409 for ship size variations of 2,000 TEU – 3,000 TEU, and finally for model 3 where MNP acts as an intentional hub port, which is around USD 380 – 393 with variations in ship size 4,000 – 5,000 TEU. In general, if based on the value of transport costs, MNP has the potential to perform service models 2 and 3 or play a role as main port and international hub port. However, after an analysis by reviewing the practical conditions that currently with the existing international container volume from/to Makassar, making MNP only suitable to act as a feeder port.

Overall, regardless of the transport cost per TEU for each model. One thing that becomes a highlight is the volume size of Indonesia's international containers. Volume is very influential on the calculation of transport cost per TEU as well as practical conditions. Based on the calculation results that Makassar New Port (MNP) can play an active role as a minimum main port when the volume of international containers from/to Makassar and eastern Indonesia is around 1,600,000 TEU/year, and can play an active role as an international hub port when the volume of international containers from /to Makassar and eastern Indonesia is around 6,000,000 TEU/year.

6.2 Recommendation

The final result of the research methodology in this research is a suitable role for Makassar New Port (MNP) in the national shipping network and the global shipping network in this case containers. The determination of this role is based on the value of the transport cost of each model which is assumed to be based on the role that will be carried out by the MNP. From this transport cost, it can be a start for the Indonesian government in determining policies for each port in Indonesia and especially for MNP in the future.

From the perspective of the operator or provider, in this case the shipping company. These results can be a starting point in conducting in-depth calculations for determining prices and optimal shipping routes. With an optimal methodology, the maximum price and route can be determined to get a high freight rate or price so that it becomes a benefit for shipping companies in increasing their revenue.

In this thesis, there are various analytical calculations performed based on the equations obtained from the regression results from previous studies. In real conditions the calculations in this thesis may not be in accordance with real conditions, where there are various variables that can change a value. However, this research can again be a reference or starting point for the Indonesian government and shipping companies in carrying out detailed calculations. For example, in the calculation of terminal handling, a detailed analysis of the outgoing costs can be carried out so that the calculation output will be more accurate and realistic

In the case of cargo handling terminals, calculations can be made based on different types of containers, currently the type of container is 40', one of the popular types or in one unit, namely FEU. Furthermore, one of the variables in the cargo handling terminal is time. Time is dynamic and uncertain in terms of cargo handling and port due and service, and time is crucial for both. In this study, it is assumed that all existing jobs or treatments work in ideal conditions, or only based on the average value obtained. Therefore, it can also be a starting point in analyzing the relationship between cargo handling terminals and service models for a port.

Furthermore, this calculation is only based on service ports, further research can be done by looking for door-door values, where various variables can appear. Especially in the IPN concept, the Makassar New Port (MNP) will be integrated with the railway, toll road, and airport. Thus, it is possible to do a multimodal transport cost or door-door analysis

In this study the scope of research is only limited to MNP ports, while in the IPN program there are seven main ports in Indonesia, which are prepared to become main ports and international hub ports in the future. In addition, the research is also limited to the Makassar-Singapore route in terms of determining the service model and MNP role, in further research, calculations can be made with different routes, or in more detail based on the destination of the International container.

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Appendix A – Ship Data

List of ship for International Services

No	Nama Kapal	Home Port	LOA	DRAFT	GRT	DWT	TEU's
1	APL BANGKOK	HONGKONG	231	12	35.991	42,201	1,300
2	AS CATALANIA	LIBERIA	223	12	28.592	39,418	1,993
3	AEGEAN EXPRES	SINGAPORE	168	0	15.095	18,581	1,500
4	AKERDIJK	MONROVIA	168	10	17.368	21,274	1,500
5	ALTAVIA	KOREA	183	11.5	23.691	23,840	2,063
6	ANTJE WULFF	HAMBURG	211	9	32.284	39,291	2,000
7	ARICA	LIBERIA	225	12	32.901	35,358	2,872
8	AREOPOLIS	MONROVIA	208	12	25.630	33,767	2,474
9	ARUNA IPSA	MARSHALL ISLAND	197	11	21.932	24,279	1,858
10	AMUNDSEN	SINGAPORE	175	10.87	18.334	23,417	1,736
11	ASIA IPSA	MARSHALL ISLAND	197	11	21.932	27,744	1,858
12	APL TOPAZ	PANAMA	275	8	47.893	53,822	4,000
13	BALEARES	MARSHALL ISLAND	209	12	26.374	34,022	2,546
14	BAHAMIAN EXPRESS	SINGAPORE	179	10	21.018	25,899	1,312
15	BALTIC STRAIT	MONROVIA	183	9	18.102	23,840	1,702
16	BARO	MARSHALL ISLAND	175	9	18.334	23,400	1,740
17	BLUE MOON	ANTIGUA AND BAR	148	9	9.954	13,663	1,022
18	BONAVIA	MONROVIA	188	11	23.691	30,518	1,643
19	BOX VOYAGER	LIBERIA	230	12	36.087	42,598	2,430
20	BUSAN TRADER	MALTA	210	11	27.051	34,566	2,664
21	BUXMELODY	MONROVIA	215	10	28.050	38,069	2,702
22	CAPE FARO	SINGAPORE	170	9	15.995	20,250	1,440
23	CAPE FLINT	MANILA	170	9.5	15.995	20,250	2,400
24	CAPE NEGRO	SINGAPORE	183	9.53	17.609	24,116	1,510
25	CAPE	CYPRUS	196	11	29.022	34,907	1,000
26	CAPE NABIL	SINGAPORE	175	10.09	18.257	23,550	1,740

27	CMA CGM KAILAS	PANAMA	197	11	21.971	24,161	1,854
28	CMA CGM MIMOSA	AARHUS	222	12.02	28.927	39,163	1,958
29	KUO HUNG	ANTIGUA AND BAR	213	12.5	35.878	41,425	2,792
30	KMTC PORTKELANG	GERMANY	213	12.5	35.878	41,425	2,792
31	KOTA RAJIN	BEDBURG	156	9	14.308	16,584	1,200
32	COUGAR	TAIWAN	186	9.53	17.156	22,210	1,308
33	WESTERDIEK	ANTIGUA AND BAR	188	11.5	23.897	30,407	2,080
34	CHILOE ISLAND	MALTA	222	12	28.911	39,228	2,824
35	CAPE MORETON	ANTIGUA AND BAR	222	12	27.786	37,882	2,741
36	CAPE NORVIEGA	SINGAPORE	183	95	17.609	24,116	1,510
37	CHINDWIN STAR	MONROVIA	167	10	15.859	20,058	1,514
38	DIMITRIS Y	ITALIA	210	12	31.131	38,500	2,672
39	DAHLIA	HONGKONG	223	13	28.927	39,276	2,824
40	DS ABILITY	MONROVIA	148	8	9.940	13,760	1,098
41	EVER PEARL	PANAMA	182	9	17.887	19,309	2,000
42	ELENA	ANTIGUA AND BAR	139	8.8	9.981	11,834	600
43	ELLEN S	ANTIGUA AND BAR	148	9	9.957	13,760	1,118
44	E.R MARTINIQUE	MONROVIA	222	10	28.927	39,159	2,500
45	E.R. MALMO	MONROVIA	222	9	28.927	39,187	2,728
46	EVER APEX	KAOHSIUNG	165	8.5	14.807	15,605	1,618
47	EVER POWER	KAOHSIUNG	182	9	17.887	19,309	2,000
48	FAR COLOMBO	SINGAPORE	183	9.5	17.613	24,134	1,200
49	FESCO TRADER	SINGAPORE	147	8.96	12.471	15,213	1,060
50	FRISIA GOTEBORG	GOTEBORG	223	12	27.779	39,345	2,824
51	FRISIA NUERNBERG	LIBERIA	189	11	21.842	28,520	1,970
52	FRISIAN PIONER	ANTIGUA AND BAR	148	9	9.966	13,700	1,118
53	E. R. FREMANTLE	FREMANTLE	202	12	30.280	35,848	2,500
54	HANSA CALYPSO	MONROVIA	168	9	17.495	21,636	1,645
55	HANSA CENTURY	HAMBURG	192	11	31.730	27,700	2,810
56	HANJIN CHITTAGONG	KAOHSIUNG	200	11	27.104	11,856	2,553

57	HANSA CONSTITUTION	GERMANY	192	12	31.73	27,706	2,810
58	HANJIN DALIAN	TAIWAN	200	11	27.061	33,381	2,457
59	HAMMONIA GALLICUM	MONROVIA	196	11	29.383	34,671	2,404
60	HAMMONIA INTERNUM	MONROVIA	185	11	29.383	34,710	2,959
61	HANSA PAPENBURG	MONROVIA	176	9	18.327	23,464	1,740
62	HAMMONIA THRACIUM	MONROVIA	196	11	29.383	34,704	1,726
63	HANSA AUGUSTENBURG	LIBERIA	175	11	18.335	23,578	1,700
64	HAI WANG XING	CHINA	122	7.2	7.460	9,105	415
65	SFL HAWK	MONROVIA	222	12	28.592	39,266	2,000
66	HELENA SCHULTE	CYPRUS	231	12	35.975	42,106	3,534
67	HERMANN WULFF	HAMBURG	211	10	32.200	38,975	2,732
68	HANSA FRESENBURG	MONROVIA	176	9.5	18.296	23,454	1,696
69	H FYN	MALTA	172	10	16.145	20,367	1,500
70	HS MASTER	LIBERIA	188	10	23.897	30,416	1,200
71	HS OCEANO	MONROVIA	213	12	32.968	38,250	2,789
72	HS ONORE	MONROVIA	213	12	32.968	38,608	2,867
73	HANJIN VERACRUZ	SINGAPORE	172	952	17.211	21,933	1,708
74	HS WAGNER	MONROVIA	231	12	36.007	41,000	2,353
75	ITHA BHUM	SINGAPORE	171	9.8	15.533	21,813	1,324
76	ITAL OCEANO	MONROVIA	213	11	32.968	38,250	2,650
77	ITAL ONESTA	MONROVIA	212	10	32.968	38,250	2,650
78	JAN RITSCHER	MONROVIA	209	11	25.705	33,843	2,526
79	JAKARTA TOWER	MONROVIA	212	11	26.638	34,325	2,564
80	JRS BRISBANE	CYPRUS	141	8	9.983	10,700	889
81	JIN YUN HE	AMERICA	183	10.3	16.737	24,244	2,200
82	JOSEPHINE MAERSK	DENMARK	219	10	30.166	37,300	3,003
83	KAPITAN MASLOV	CYPRUS	184	9	16.575	23,372	1,726
84	KALLIROE	MONROVIA	175	10.9	18.321	10,202	1,740
85	KATHARINA	MONROVIA	200	11	25.535	33,900	2,452
86	KESTREL	LIBERIA	172	19	16.770	21,500	1,500
87	KOTA HADIAH	SINGAPORE	160	14	13.272	19,234	1,000

88	KAMALA	PUSAN	200	8	24.724	29,277	2,011
89	KOTA ANGGUN	SINGAPORE	183	9.53	17.652	23,842	1,454
90	KOTA HARMUNI	SINGAPORE	160	9.5	13.272	19,858	1,088
91	KOTA HENING	SINGAPORE	160	94	13.497	18,871	1,080
92	KUO HUNG	AARHUS	169	8.4	15.075	18,585	1,750
93	KOTA RAKAN	SINGAPORE	146	9	9.725	13,447	907
94	KOTA NALURI	SINGAPORE	180	10	20.902	25,985	1,810
95	KOTA RATU	SINGAPORE	135	8.12	9.422	9,000	500
96	KANWAY GLORY	SINGAPORE	193	10	18.602	24,376	1,613
97	KOTA NAZAR	SINGAPORE	180	10	20.902	25,985	1,810
98	KMTC PORTKELANG	AARHUS	187	11.04	20.815	28,499	1,860
99	KOTA RAJIN	AARHUS	146	8.2	9.678	13,212	907
100	KOTA RAKYAT	SINGAPORE	146	8.5	9.725	13,017	907
101	KOTA RANCAK	SINGAPORE	146	8.09	9.678	10,280	938
102	KARIN	LIBERIA	180	10.7	20.569	25,723	1,702
103	KMTC SHANGHAI	HONGKONG	187	0	20.815	28,499	1,860
104	KOTA HASIL	SINGAPORE	160	9.4	13.272	19,859	1,088
105	KOTA TEGUH	SINGAPORE	131	7.9	7.683	10,712	500
106	KOTA WISATA	SINGAPORE	183	9.5	17.125	24,155	1,510
107	LARENTIA	KAOHSIUNG	216	11.5	27.915	37,900	2,702
108	LEO AUTHORITY	SINGAPORE	184	10.1	16.705	24,336	2,000
109	LEO MONO	PANAMA	191	5	24.724	29,304	1,599
110	LINDAUNIS	LIBERIA	152	8.5	10.585	12,782	1,036
111	LOBIVIA	MONROVIA	188	10	23.652	30,300	2,082
112	LOUDS ISLAND	SINGAPORE	215	11.6	27.915	38,103	2,702
113	LEO PERDANA	KAOHSIUNG	200	10	27.104	33,423	2,553
114	MAERSK ATLANTIC	HONGKONG	155	9	14.063	17,733	1,122
115	MAERSK ABERDEEN	HONGKONG	155	9.7	14.063	-	1,400
116	MAERSK JURONG	PANAMA	223	12	27.910	39,479	2,063
117	MANUELA	MONROVIA	181	10	16.233	25,243	1,661
118	MAASHOLM	MONROVIA	152	9	10.585	12,782	1,036
119	MARE BRITANNICUM	BREMEN	260	12	40.306	52,182	4,038
120	MAERSK RONNEBY	HONGKONG	148	9	9.957	13,769	1,118
121	MSC ASTRID	PANAMA	230	10	35.954	42,119	1,500
122	MATHILDE SCHULTE	HONGKONG	189	105	27.279	30,337	2,345

123	MAGNAVIA	MOROCCO	188	11	23.828	30,820	2,078
124	MAERSK WOLGAST	HONGKONG	175	9.72	18.123	23,116	1,713
125	MCC KYOTO	MONROVIA	176	95	18.123	22,314	1,713
126	MEDCORAL	CYPRUS	181	9.5	17.068	21,200	1,496
127	MERKUR TIDE	LIBERIA	168	0	15.929	22,066	1,500
128	MEDPEARL	CYPRUS	181	9	17.068	21,200	1,496
129	MSC HOBART	AARHUS	188	11.1	22.738	33,522	1,965
130	MIAMI TRADER	MALTA	201	11.5	25.587	33,940	2,460
131	MOL HORIZON	SINGAPORE	172	13.8	17.702	21,957	1,596
132	MOL SPARKLE	PANAMA	200	11	27.104	33,100	1,900
133	MOL KOMATI	PANAMA	180	9.5	21.018	25,746	2,000
134	MADELEINE RICKMERS	KAOHSIUNG	184	9.9	16.801	23,000	2,000
135	MSC SENTOSA	HONGKONG	211	9.9	32.313	32,841	2,000
136	MEDFRISIA	CYPRUS	180	9.5	17.068	21,409	1,000
137	MV.OCEAN MERMAID	SINGAPORE	175	9	18.123	22,314	1,370
138	NADIR	GERMANY	172	10	21.199	25,039	1,200
139	NEW LIGHT	INDONESIA	97	7	3.810	5,400	300
140	NEWYORKER	GREECE	207	9	25.294	32,299	2,506
141	NICOLAI MAERSK	DENMARK	199	10	27.733	30,936	2,274
142	NOBLE ANTARES	CHINA	176	90	18.326	23,359	1,740
143	NORTHERN DEFENDER	MONROVIA	231	12	35.975	42,166	3,534
144	NOBLE MATAR	CYPRUS	229	12	39.824	46,150	2,466
145	NOBLE REGOR	CYPRUS	213	12	35.887	42,690	2,782
146	OCEAN MERMAID	SINGAPORE	175	9	18.123	22,314	1,370
147	OLIVIA	GERMANY	216	11	28.050	38,096	2,702
148	OOCL TAICHUNG	HONGKONG	183	10	16.705	24,376	1,560
149	OS MARMARIS	BAHRAIN	175	10	18.326	23,359	2,000
150	OTTO	LIBERIA	179	10	20.624	26,027	1,200
151	PELICAN	LIBERIA	172	9.5	16.770	21,500	1,809
152	PISTI	PANAMA	209	12	31.207	38,400	2,000
153	PRINCESS OF LUCK	TAIWAN	183	10.01	16.705	24,346	1,560
154	PONTRESINA	MONROVIA	213	11.5	28.270	38,127	2,646
155	PROTOSTAR N	CYPRUS	222	11	28.007	37,867	2,134

156	RHL ASTRUM	MONROVIA	177	8	18.480	23,640	1,730
157	RACHA BHUM	THAILAND	211	10	32.060	40,120	2,732
158	RHL AUDACIA	MONROVIA	177	9	18.480	23,630	1,732
159	RED ROCK	INDONESIA	100	6.7	4.391	5,097	350
160	RED ROVER	AUSTRALIA	105	7	4.559	6,300	350
161	RUBINA SCHULTE	MONROVIA	223	12	28.927	39,276	2,824
162	SANTA BELINA	MONROVIA	222	12	28.616	39,360	2,824
163	STADT GOTHA	ANTIGUA AND BAR	166	9.5	15.375	18,700	1,500
164	SANTA BRUNELLA	MONROVIA	222	12	28.616	39,337	2,400
165	SARAH SCHULTE	CYPRUS	223	12	28.592	39,383	2,824
166	SANYA	SINGAPORE	183	10	16.705	24,327	1,560
167	SILVER BAY	LIBERIA	175	9	17.295	22,286	1,500
168	SINAR BITUNG	SINGAPORE	162	9.25	13.596	17,800	1,150
169	SCIO SUN	LIBERIA	178	10	18.000	26,288	1,752
170	SCL AKWABA	SINGAPORE	140	0	9.938	12,584	750
171	STADT DRESDEN	ANTIGUA AND BAR	222	12	27.971	37,929	2,741
172	SEOUL TRADER	MALTA	210	11	27.051	34,528	2,664
173	SEVILLIA	LIBERIA	180	95	21.018	26,830	1,794
174	SFL FALCON	MONROVIA	222	11	28.927	37,850	1,200
175	SFL HUNTER	LIBERIA	222	12	28.592	39,266	2,824
176	SIMA SINGAPORE	SPAIN	197	9	29.195	45,867	2,000
177	SINAR SOLO	SINGAPORE	147	8	12.531	15,218	1,060
178	SOUTHERN LILY 3	SINGAPORE	144	8	9.422	13,058	777
179	SOUTHERN MOANA	SINGAPORE	144	8	9.422	13,064	750
180	SOUL OF LUCK	SINGAPORE	168	13.8	16.915	21,520	1,645
181	SOUTHERN TRADER	SINGAPORE	146	8	9.725	12,985	907
182	SPAARNE TRADER	NETHERLANDS	181	9	17.068	21,146	1,496
183	STADT AACHEN	GERMANY	222	10.8	35.573	36,896	3,398
184	SFL TIGER	MONROVIA	222	10	28.592	39,266	2,000
185	STEINTOR	ANTIGUA AND BAR	168	9.2	16.85	21,548	1,679
186	SZCZECIN TRADER	TACOMA	186	1	16.803	23,014	2,000
187	STADT ROSTOCK	ANTIGUA AND BAR	222	10.01	27.971	37,929	2,741

188	TATIANA SCHULTE	SINGAPORE	222	8.6	28.592	40,500	2,000
189	THANA BHUM	LAEM CHABANG	197	9	21.932	22,133	1,300
190	THORSCAPE	NORWAY	196	11.5	29.022	34,907	2,908
191	THORSWAVE	CYPRUS	196	11	29.022	34,900	1,000
192	TPSVESSEL	SINGAPORE	150	10	1.500	15,000	1,500
193	UNI AHEAD	TAIWAN	165	8.5	14.796	15,477	1,164
194	UNI PRUDENT	TAIWAN	182	9	17.887	19,308	1,618
195	UNI AMPLE	TAIWAN	165	85	14.796	15,477	1,164
196	UNI-ANGEL	MALAYSIA	165	85	14.796	15,477	1,296
197	UNI ARISE	JAPAN	165	85	14.796	15,477	1,296
198	UNI ASSENT	TAIWAN	165	8	14.807	15,511	1,164
199	UNI PACIFIC	KAOHSIUNG	182	9	17.887	19,308	1,618
200	UNI PATRIOT	KAOHSIUNG	182	9	17.887	19,308	1,618
201	UNI PERFECT	KAOHSIUNG	182	9	17.887	19,308	1,618
202	UNI PROBITY	KAOHSIUNG	182	9	17.887	19,308	1,618
203	UNI POPULAR	TAIWAN	182	9	17.887	19,309	1,618
204	UNI PREMIER	KAOHSIUNG	182	9	17.887	19,308	2,000
205	UNI PROSPER	TAIWAN	182	9	17.887	19,308	1,618
206	URU BHUM	THAILAND	195	11	24.955	31,805	2,598
207	VEGA FYNEN	ANTIGUA AND BAR	148	8.5	9.957	13,826	1,114
208	VEGA KAPPA	MONROVIA	148	9	9.940	14,342	900
209	VEGA LUNA	LIBERIA	148	9	9.940	13,760	1,118
210	VEGA LUPUS	LIBERIA	148	9	9.940	13,760	1,118
211	VIRA BHUM	THAILAND	195	11	24.955	31,805	2,598
212	WAN HAI 211	TAIWAN	174	8	17.138	23,826	1,500
213	WAN HAI 212	SINGAPORE	175	98	17.138	23,877	1,325
214	WAN HAI 266	SINGAPORE	198	95	18.872	23,648	1,662
215	WAN HAI 281	TAIWAN	183	9.5	17.609	24,116	1,510
216	WARNOW CHIEF	CYPRUS	181	10	17.068	21,146	1,496
217	WARNOW CARP	SINGAPORE	140	8	9.946	11,968	752
218	WARNOW MATE	SINGAPORE	180	9	17.068	21,200	1,120
219	WAVE	CYPRUS	196	11	29.022	34,900	1,000
220	WESTERDIEK	AARHUS	211	10	32.060	39,083	2,000
221	WESERWOLF	MONROVIA	211	12	32.322	39,127	2,732

222	X-PRESS INDUS	SINGAPORE	184	9	21.339	23,691	1,713
223	XUTRA BHUM	THAILAND	195	11	23.922	30,832	1,162
224	YANG MING EARTH	VIGO	171	9.52	17.153	22,077	2,200
225	YELLOW MOON	ANTIGUA AND BAR	148	9	9.954	13,760	1,022
226	YANG MING GLORY	MONROVIA	211	11.5	29.873	31,209	2,300
227	YM INAUGURATION	LIBERIA	173	9.5	16.488	22,070	1,500
228	YM MING IMAGE	KAOHSIUNG	173	13.5	16.488	22,027	1,500
229	YM IMMENSE	MONROVIA	173	9.5	16.488	22,027	1,805
230	YM INITIATIVE	KAOHSIUNG	173	9.5	16.488	22,027	1,900
231	YM INTELLIGENT	MONROVIA	173	9.5	16.488	22,027	2,500
232	YM INSTRUCTION	MONROVIA	173	9.5	16.488	22,070	2,300
233	YM INTERACTION	ZHENJIANG	173	9.5	16.488	22,027	2,500
234	YM INVENTIVE	MONROVIA	173	9	16.488	22,027	1,000
235	ZENIT	PUSAN	178	11	21.199	25,107	1,617

List of ship for Domestic Service

No	Nama Kapal	LOA	DRAFT	GRT	DWT	TEU's
1	KM. ACHILLES	107	6.61	4	6	500
2	KM. ADINDA IZORA	68	5	2	2	106
3	KM. ASIAN FRIENSHIP	106	636	4	6	250
4	KM. AKASHIA	96	5.6	3	4	300
5	KM. AMAZON	157	8.62	12	14	1158
6	KM. ARMADA SEGARA	120	6	5	8	453
7	KM. ARMADA PAPUA	149	8.7	10	13	500
8	KM. ARMADA PERMATA	129	8.2	9	13	1000
9	KM. ARMADA PURNAMA	150	0	10	13	300
10	KM. ARMADA SENTANI	121	6.49	5	8	600
11	KM. ARMADA SERASI	121	5	5	8	500
12	KM. ARMADA SEJATI	115	8.15	6	9	700
13	KM. ARMADA PERSADA	150	8.26	10	13	500
14	KM. ARMADA SETIA	114	5	6	8	600
15	KM. ACX SWAN	129	7	7	10	347
16	KM. ALFA TRANS SATU	60	4	2	2	300
17	KM. AYER MAS	95	5.83	3	4	120
18	KM. BARITO BORNEO	84	5	3	4	500

19	KM. BALI GIANYAR	97	5.95	3	5	600
20	KM. BALI KUTA	97	5.95	3	5	300
21	KM. BALI AYU	97	5.95	3	5	296
22	KM. BALI SANUR	97	5.95	3	5	500
23	KM. BALI TABANAN	97	5.95	3	5	500
24	KM. BELIK MAS	120	8	6	9	500
25	KM. CARAKA JAYA NIAGA III-8	98	5	3	123	500
26	KM. CARAKA 17	98	5	3	4	600
27	KM. CARAKA JAYA NIAGA III-23	98	5.4	3	4	500
28	KM. CARAKA JAYA NIAGA III-24	98	4	3	5	500
29	KM. CARAKA NIAGA III-26	98	5.5	3	4	450
30	KM. CARAKA JN III - 30	98	5.4	3	4	500
31	KM. CARAKA NIAGA III-31	98	5.4	3	4	500
32	KM. SEMARANG CJN III-35	98	5.62	3	4	500
33	KM. CJN III - MULI ANIM	98	5.5	3	4	300
34	KM. DAMAI BAHAGIA	115	6,571.00	4	6	430
35	KM. DAMAI SEJAHTERA 1	130	8.3	8	11	500
36	KM. DAMAI SEJAHTERA-II	130	0	8	11	1000
37	KM. INTAN DAYA	90	4	3	5	300
38	KM. DERAJAT	95	5	3	4	288
39	KM. ESTUARI MAS	120	7	7	8	500
40	KM. FORTUNE	96	5.6	3	5	600
41	KM. GLADYS	177	10	18	21	1200
42	KM. GLOBAL SAMUDERA	108	5	4	7	500
43	KM. GUHI MAS	97	7.4	3	5	500
44	KM. HIJAU SEJUK	129	7.8	8	10	802
45	KM. HIJAU MUDA	132	8	7	10	600
46	KM. HIJAU SEMANGAT	132	8.15	7	11	500
47	KM. HIJAU TERANG	133	5	7	11	746
48	KM. HIJAU SEGAR	133	7	8	10	797
49	KM. INTAN DAYA 2	83	3.5	2	3	234
50	KM. INTAN DAYA 6	83	3.5	2	3	234
51	KM. INTAN DAYA 9	90	5	3	5	208
52	KM.INTAN DAYA 4	79	5	3	4	500
53	KM. ISA CLARITY	97	4	4	2	500

54	KM. JAVELIN	85	7.3	3	4	350
55	KM. JALES MAS	120	5	7	8	537
56	KM. JOURNEY	85	5.5	3	3	600
57	KM. KANAL MAS	120	730	7	8	558
58	KM. KANON BARU	96	4	3	5	600
59	KM. KALI MAS	120	5.17	7	8	600
60	KM. KAWA MAS	147	8.26	9	13	1000
61	KM. KEDUNG MAS	120	6.22	6	7	600
62	KM. KISIK MAS	145	8.29	9	13	650
63	KM. KUALA MAS	120	6	6	9	538
64	KM. LAGUN MAS	97	740	5	9	500
65	KM. LAGOA MAS	128	6.2	6	9	1000
66	KM. LCT.JNW	68	2	998	2	128
67	KM. LUZON	157	4	12	15	1000
68	KM. MATARAM EXPRESS	98	5.77	4	5	300
69	KM. MAGELAN	96	5	3	5	300
70	KM. MARIGOLD STAR	119	6.7	5	8	500
71	KM. MERATUS AMBON	124	6	7	8	500
72	KM. MAHAKAM RIVER	116	6	5	6	426
73	KM. MARINDO BARU	120	9	5	5	300
74	KM. MERATUS BATAM	139	8	10	13	910
75	KM. MERATUS BONTANG	107	4.3	4	5	368
76	KM. MERATUS DILI	119	6.4	5	685	430
77	KM. MERATUS BALIKPAPAN 1	122	5	6	8	750
78	KM. MERATUS KALABAHI	129	7.8	8	11	700
79	KM. MERATUS MEDAN 1	162	8	14	17	1000
80	KM. MERATUS PALU	106	6.59	4	6	500
81	KM. MERATUS BARITO	107	4.2	4	5	600
82	KM. MERATUS PALEMBANG	117	6	5	8	618
83	KM. MERATUS SUMBAWA 1	98	5.6	3	4	600
84	KM. MENTARI SEJAHTERA	85	4	3	4	300
85	KM. MENTARI SUCCESS	86	7.3	3	3	300
86	KM. MILLENIUM BARU	88	6.3	2	3	750
87	KM. MERATUS MINAHASA	149	8	10	11	1117
88	KM. MERATUS KELIMUTU	129	7.8	8	10	600

89	KM. MERATUS KENDARI	120	0	6	7	603
90	KM. MERATUS KUPANG	129	7.8	8	4	831
91	KM. LUMOSO GEMBIRA	106	0	4	5	500
92	KM. MERATUS PADANG	101	6.6	4	6	600
93	KM. MENTARI PERKASA	85	5	3	3	300
94	KM. MERATUS PROGRESS 1	106	6	4	2	1000
95	KM. MERATUS PROJECT 1	100	6	4	5	514
96	KM. MENTAYA RIVER	101	6	4	5	326
97	KM. MADISON	157	8	12	14	1158
98	KM. MERATUS SPIRIT 2	148	8	10	13	712
99	KM. MERATUS TANGGUH I	115	8	6	9	500
100	KM. MERATUS TANGGUH 2	119	7.85	7	9	500
101	KM. MULTI GUNA	80	5.18	2	3	500
102	KM. MERATUS ULTIMA 1	107	6	5	6	455
103	KM. MERATUS ULTIMA 2	107	7	5	6	500
104	KM. MUSI RIVER	116	5.36	5	5	500
105	KM. NEW LIGHT DOM	97	7	4	5	350
106	KM. NRS 2	67	0	1	2	500
107	KM. ORIENTAL SAMUDERA	128	6.2	6	9	400
108	KM. PAHALA	95	5	3	5	288
109	KM. PEMUDI	102	6	4	5	232
110	KM. PERMAI I	146	9	9	12	600
111	KM. PEKAN RIAU	80	5	3	5	1000
112	KM. PEKAN FAJAR	114	5	4	7	530
113	KM. PORT NUMBAY	128	6.58	6	8	500
114	KM. PRATIWI RAYA	97	7.4	3	5	400
115	KM. PRATIWI SATU	97	5.8	3	5	500
116	KM. PULAU HOKI	121	6.1	6	9	484
117	KM. PULAU LAYANG	120	6.1	6	9	484
118	KM. PULAU WETAR	120	5	6	9	600
119	KM. SAMUDERA MAS	97	7.4	3	5	300
120	KM. SINAR DEMAK	87	4.38	3	4	203
121	KM. SELILI BARU	118	0	6	8	500
122	KM. SEGORO MAS	97	5.95	3	5	375
123	KM. SELAT MAS	164	11	1	12	500

124	KM. SENDANG MAS	113	6.2	4	6	1200
125	KM. SINAR AMBON	97	5.8	3	5	287
126	KM. SINAR ARROW	103	5	4	4	600
127	KM. SINAR PAPUA	110	5.29	4	7	350
128	KM. SINAR JAMBI	86	4	3	4	400
129	KM. SINAR JEPARA	119	6	5	7	256
130	KM. SINAR JIMBARAN	118	4	6	66	600
131	KM. SINAR PADANG	87	4	3	4	500
132	KM. SPRING MAS	183	8.5	17	24	156
133	KM. SINAR SALJU	110	5	5	10	500
134	KM. SINAR SONA	80	4	2	3	200
135	KM. STRAIT MAS	164	8	14	18	1500
136	KM. TANTO BERKAT	122	5.67	5	7	500
137	KM. TANTO CAHAYA	148	7.9	10	13	1000
138	KM. TANTO CERIA	99	5.7	3	4	500
139	KM. TANTO ABADI	94	5	4	4	500
140	KM. TANTO HAWARI	98	4	4	5	600
141	KM. TANTO HORAS	98	5.24	4	5	312
142	KM. TANTO SEPAKAT	106	5	4	6	600
143	KM. TANTO KITA	118	6.5	5	7	500
144	KM. TANTO LESTARI	127	5	123	123	500
145	KM. TANTO LUMOSO	138	6	8	12	700
146	KM. TANTO TERANG	145	5	9	12	800
147	KM. TANTO REJEKI	84	6	3	4	500
148	KM. TANTO EXPRESS	135	5	9	11	600
149	KM. TANTO STAR	148	7.9	9	13	1000
150	KM. TANTO SEHATI	122	5.67	5	7	500
151	KM. TANTO SEKAWAN	101	5.5	4	6	500
152	KM. TANTO SURYA	128	4	8	9	600
153	KM. TELUK BINTUNI	114	6	4	7	500
154	KM. TELUK BERAU	114	6	4	123	500
155	KM. TELAGA MAS	120	730	7	8	558
156	KM. TELUK FLAMINGO	114	6	4	68	388
157	KM. TANTO FAJAR 1	98	4	4	5	300
158	KM. TANTO FAJAR 2	98	6	4	5	500

159	KM. TANTO FAJAR 3	98	6	4	5	500
160	KM. TANTO HARI	126	8.7	6	8	500
161	KM. TANTO HANDAL	98	5	4	5	600
162	KM. TANTO HARMONI	98	5.4	4	5	312
163	KM. TITANIUM	118	615	6	8	628
164	KM. TASIK MAS	120	5	7	8	558
165	KM. TANTO PERMAI	145	6	9	11	500
166	KM. TANTO RAYA	121	7.5	7	9	558
167	KM. TANTO SAKTI I	126	6.5	6	7	600
168	KM. TANTO SAKTI II	126	6.5	6	7	600
169	KM. TANTO SATRIA	127	6.8	6	8	500
170	KM. TWADIKA	107	8.8	4	7	500
171	KM. UMBUL MAS	120	8.32	9	13	600
172	KM. VERTIKAL	118	6.15	6	8	300
173	KM. WARIH MAS	120	7	7	8	558
174	KM. SINAR DEMAK	87	4.38	3	4	203
175	KM. SELILI BARU	118	0	6	8	500
176	KM. SEGORO MAS	97	5.95	3	5	375
177	KM. SELAT MAS	164	11	1	12	1500
178	KM. SENDANG MAS	113	6.2	4	6	1200
179	KM. SINAR AMBON	97	5.8	3	5	287
180	KM. SINAR ARROW	103	5	4	4	600
181	KM. SINAR PAPUA	110	5.29	4	7	350
182	KM. SINAR JAMBI	86	4	3	4	400
183	KM. SINAR JEPARA	119	6	5	7	256
184	KM. SINAR JIMBARAN	118	4	6	66	600
185	KM. SINAR PADANG	87	4	3	4	500
186	KM. SPRING MAS	183	8.5	17	24	156
187	KM. SINAR SALJU	110	5	5	10	500
188	KM. SINAR SONA	80	4	2	3	200
189	KM. STRAIT MAS	164	8	14	18	1500
190	KM. TANTO BERKAT	122	5.67	5	7	500
191	KM. TANTO CAHAYA	148	7.9	10	13	1000
192	KM. TANTO CERIA	99	5.7	3	4	500
193	KM. TANTO ABADI	94	5	4	4	500

194	KM. TANTO HAWARI	98	4	4	5	600
195	KM.TANTO HORAS	98	5.24	4	5	312
196	KM. TANTO SEPAKAT	106	5	4	6	600
197	KM. TANTO KITA	118	6.5	5	7	500
198	KM. TANTO LESTARI	127	5	123	123	500
199	KM. TANTO LUMOSO	138	6	8	12	700
200	KM. TANTO TERANG	145	5	9	12	800
201	KM. TANTO REJEKI	84	6	3	4	500
202	KM. TANTO EXPRESS	135	5	9	11	600
203	KM. TANTO STAR	148	7.9	9	13	1000
204	KM. TANTO SEHATI	122	5.67	5	7	500
205	KM. TANTO SEKAWAN	101	5.5	4	6	500
206	KM. TANTO SURYA	128	4	8	9	600
207	KM. TELUK BINTUNI	114	6	4	7	500
208	KM. TELUK BERAU	114	6	4	123	500
209	KM. TELAGA MAS	120	730	7	8	558
210	KM. TELUK FLAMINGO	114	6	4	68	388
211	KM. TANTO FAJAR 1	98	4	4	5	300
212	KM. TANTO FAJAR 2	98	6	4	5	500
213	KM. TANTO FAJAR 3	98	6	4	5	500
214	KM. TANTO HARI	126	8.7	6	8	500
215	KM. TANTO HANDAL	98	5	4	5	600
216	KM. TANTO HARMONI	98	5.4	4	5	312
217	KM. TITANIUM	118	615	6	8	628
218	KM. TASIK MAS	120	5	7	8	558
219	KM. TANTO PERMAI	145	6	9	11	500
220	KM. TANTO RAYA	121	7.5	7	9	558
221	KM. TANTO SAKTI I	126	6.5	6	7	600
222	KM. TANTO SAKTI II	126	6.5	6	7	600
223	KM. TANTO SATRIA	127	6.8	6	8	500
224	KM. TWADIKA	107	8.8	4	7	500
225	KM. UMBUL MAS	120	8.32	9	13	600
226	KM. VERTIKAL	118	6.15	6	8	300
227	KM. WARIH MAS	120	7	7	8	558