Chapter 4

Policy Development Leading to Logistics Systems in a More Integrated Eastern Indonesia

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Chapter 4

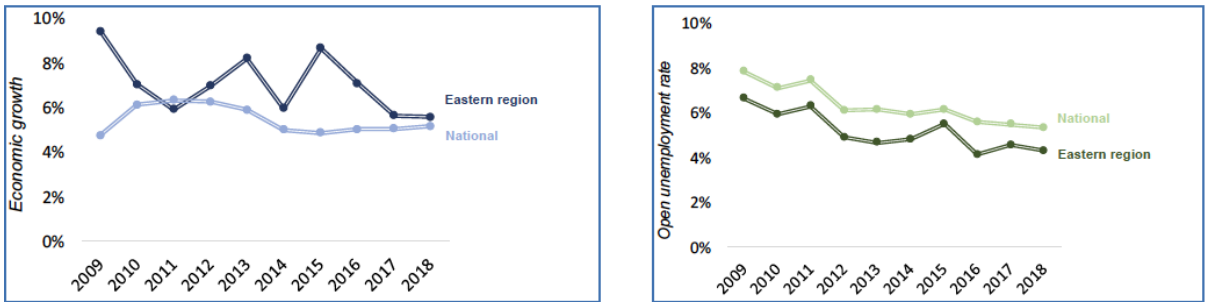
Policy Development Leading to Logistics Systems in a More Integrated Eastern Indonesia

4.1 Development Policy Direction for Eastern Indonesia

Although most of Indonesia's economic activities tend to remain concentrated in the Western Indonesia Region, the prospects for the economic advancement of provinces in eastern Indonesia cannot be neglected. One of these prospects is the macroeconomic resilience of eastern Indonesia, which was quite impressive following the global economic recession in 2008. Since 2009, economic growth in eastern Indonesia has always been higher than the national economic growth rate. Regional gross domestic product (GDP) in eastern Indonesian provinces has risen approximately 7% per year in the last decade, while the national average for economic growth is at 5.4% per year. West Papua emerged as the province with the fastest rate of regional GDP growth (9.1% per year), followed by Central Sulawesi (8.5% per year) and West Sulawesi (7.7% per year) as shown in Figure 4.1a.

The regional GDP growth of provinces in eastern Indonesia may be capable of expanding employment opportunities for local residents, as seen by the reduced open unemployment rate in the region in Figure 4.1b. The percentage of the workforce in eastern Indonesia that is unemployed has gradually decreased from 7.9% in 2009 to 5.3% in 2018. During the same period, the open unemployment rate in eastern Indonesia was consistently below the national rate.

Figure 4.1. Economic Performance, Eastern Indonesia Region



a. Economic Growth b. Open Unemployment

Source: Adapted from BPS data.

Agricultural production remains one of the key sectors in the provinces of eastern Indonesia as described in Table 4.1. Saltwater fish, cocoa, logs, and nickel are leading commodities from eastern Indonesia.

Eastern Indonesia is the main contributor of marine fisheries production in Indonesia. Provinces located in eastern Indonesia generally exceed western Indonesia in terms of saltwater fish production. Maluku was the province with the largest catches of skipjack tuna and tuna in Indonesia in 2017 (the

volume of skipjack tuna production was 76,790 tonnes and 66,065 tonnes for tuna production).[7] On the other hand, the majority of the production of aquacultured freshwater fish, --a type of gourami, catfish, walking catfish, and carp-- comes from western Indonesia.

Cocoa emerged as a plantation commodity that is widely produced in eastern Indonesia, especially in provinces located on the island of Sulawesi. Unlike western Indonesia, there is not much production of national strategic commodities, such as palm oil and rubber, in eastern Indonesia. Meanwhile, eastern Indonesia is also leading in terms of log production from the forestry sector and nickel from the mining sector.

Table 4.1. Dominant Agricultural Products from Provinces in Eastern Indonesia

Province	Commodity
West Nusa Tenggara	Soybean, shallot, chilli, mango, tobacco, seaweed
East Nusa Tenggara	Pork meat, seaweed
North Sulawesi	Potato, cabbage, coconut, clove, pork meat, skipjack, tilapia, carp
Central Sulawesi	Coconut, cocoa, skipjack, nickel
South Sulawesi	Rice, corn, shallot, tomato, cocoa, chicken, duck, prawn, seaweed, nickel
Southeast Sulawesi	Clove, cocoa, cashew, seaweed, nickel, asphalt
West Sulawesi	Cocoa
Gorontalo	Skipjack, tuna
Maluku	Skipjack, tuna, seaweed
North Maluku	Coconut, tuna
Papua	Timber, pork meat, skipjack, mackarel tuna, copper, gold
West Papua	Timber

Source: Adapted from BPS data.

[7] The three provinces in Indonesia that had the largest skipjack tuna catches in 2017 were Maluku, Gorontalo (51,391 tonnes), and Central Sulawesi (50,481 tonnes). Meanwhile, the three provinces in Indonesia that had the largest tuna catches in 2017 were Maluku, Papua (51,709 tonnes), and Jakarta (27,983 tonnes) (BPS Data: https://www.bps.go.id/indicator/56/1515/1/produksi-perikanan-tangkap-di-laut-menurut-komoditas-utama.html [Accessed 4 January 2022])

4.2 Purpose of Developing an Integrated Logistics System in Eastern Indonesia

The development of ports in Eastern Indonesia can be analysed through the shipping capacity at these ports. The port capacity in this study will focus on selected ports in eastern Indonesia. The selection of ports will be based on infrastructure data at major ports in eastern Indonesia.

The major ports in eastern Indonesia are: (i) Tenau/Kupang, (ii) Bitung, (iii) Pantoloan, (iv) Makassar, (v) Ternate, (vi) Ambon, (vii) Sorong, and (viii) Jayapura. Table 4.2 provides information on vessel capacity in TEU from two points of view: current traffic and the latest draft. The shipping capacity cannot be ascertained immediately from the depth of the draft due to several reasons: (i) inadequate quality of dock infrastructure; (ii) low efficiency in equipment handling, and (iii) lack of shipping demand from the market.

Table 4.2. Shipping Capacity at Ports in Eastern Indonesia

Port	Current maximum draft (m)	Maximum vessel size that can be accommodated in the current traffic (TEU)	Maximum vessel size that can be accommodated in the current draft (TEU)
Tenau	13	606	4,900
Bitung	14	3,534	5,250
Pantoloan	9.5	608	1,700
Makassar	12	2,700	4,000
Ternate	10	644	2,200
Ambon	10	1,560	2,200
Sorong	12	3,000	4,000
Jayapura	12	2,524	4,000

M = metre, TEU = twenty-foot equivalent unit.
Sources: IHS Markit (2019), Pelindo 3 (2019), and Pelindo 4 (2019).

Based on draft data, the Ports of Bitung, Tenau, Makassar, Sorong, and Jayapura have a draft of more than 10 metres, enabling them to serve vessels equivalent to or more than 4,000 TEU in size. This section will be the basis for developing ports in eastern Indonesia to be competitive as international hubs for East Asia and the Pacific.

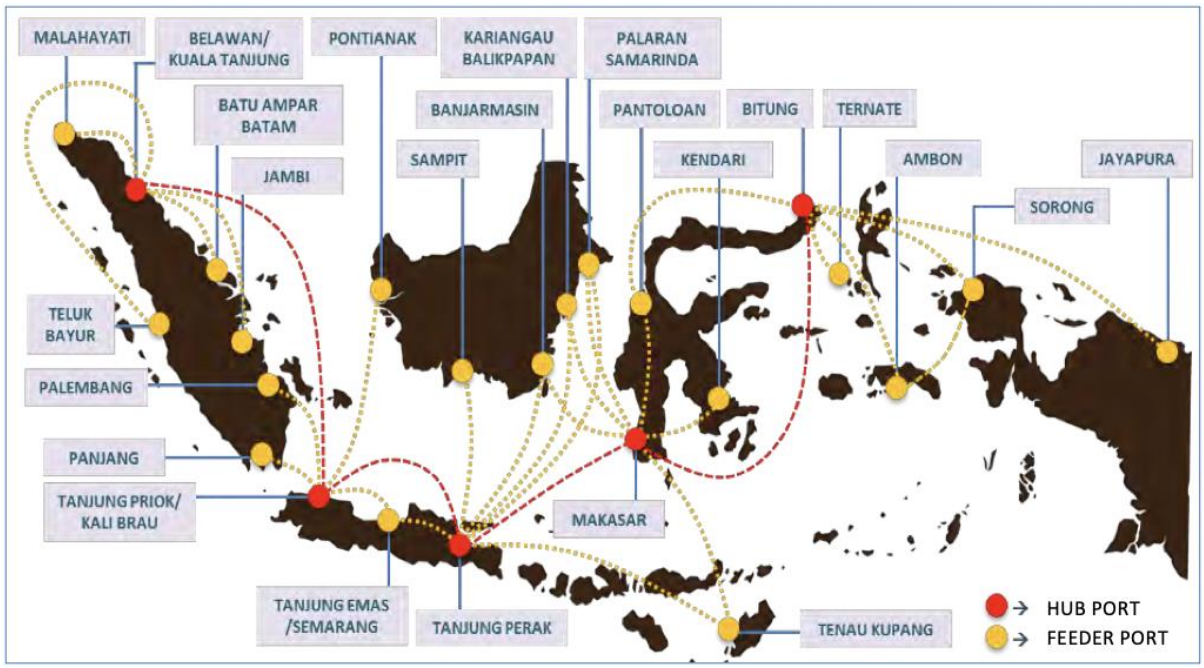
Main Maritime Highway Corridors and Potential Network Expansion

The Maritime Highway definition can be categorised into two different types: main corridors and feeder corridors. This section will focus on the main corridors. The main corridors connect the main ports: Belawan, Batam, Tanjung Priok, Tanjung Perak, Makassar, Balikpapan, Ambon, Bitung, and Sorong. Balikpapan and Ambon have been added to the current networks since the first version was released in 2015 by the National Planning Agency (BAPPENAS) (Figures 4.2 and 4.3).

Figure 4.2. Current Main Corridors of the Maritime Highway

Source: Adapted based on data from Ministry of Transportation, 2017.

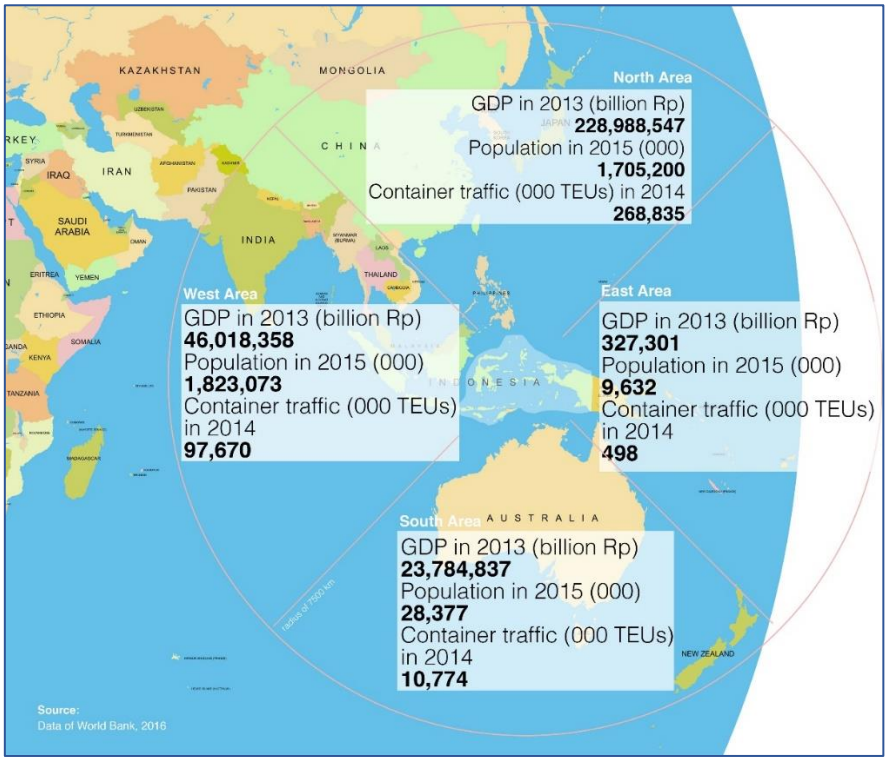
Figure 4.3. First Version of the Main Maritime Highway Corridors



Source: BAPPENAS (2015).

Potential network expansion can be assessed by analysing the closest international routes. In this study, the scope of international routes will be limited to international routes around eastern Indonesia. The largest market for eastern Indonesia is in the northern region (Figure 4.4), mostly dominated by areas with high consumption populations, such as Japan, China, Taiwan, and Hong Kong. This consumption is also represented by the volume of containers, which is three times that of western Indonesia.

Figure 4.4. Market Potential for Eastern Indonesia



GDP = gross domestic product, Rp = rupiah, TEU = twenty-foot equivalent unit.
Source: Analysed from 2015 World Bank data.

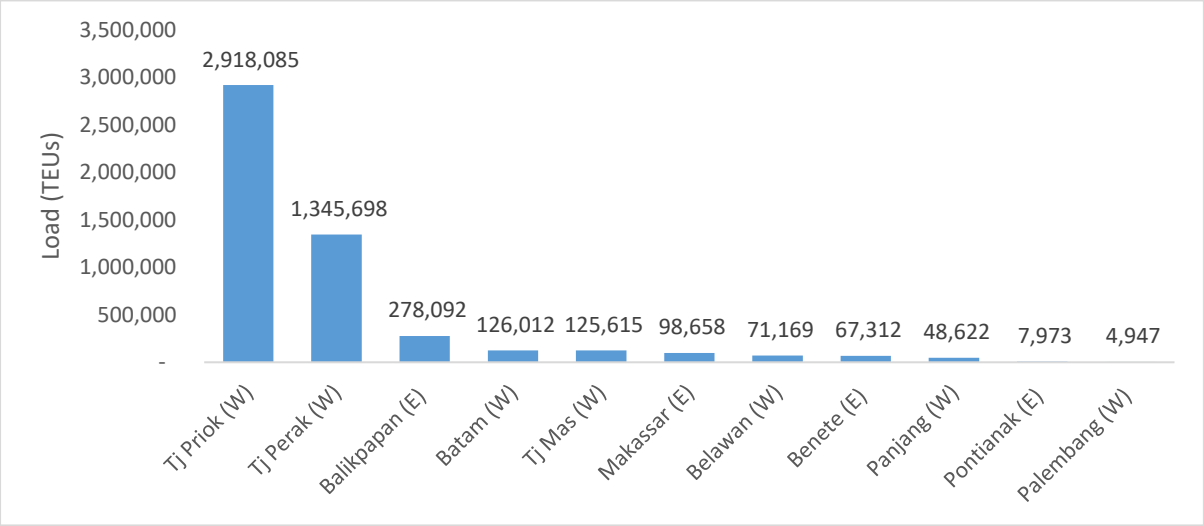
Table 4.3. Major Indonesian Ports serving International Shipping

No.	Origin	Destination
1	Busan (Korea)	Tanjung Priok
2	Shanghai (China)	Tanjung Priok
3	Shekou (China)	Tanjung Priok
4	Kaohsiung (Taiwan, China)	Tanjung Perak
5	Kaohsiung (Taiwan, China)	Tanjung Priok
6	Davao (Philippines)	Tanjung Perak
7	Davao (Philippines)	Balikpapan
8	Davao (Philippines)	Tanjung Priok
9	Cebu (Philippines)	Makassar
10	Taipei (Taiwan, China)	Tanjung Perak
11	Cebu (Philippines)	Makassar
12	Taipei (Taiwan, China)	Tanjung Perak
13	Manila (Philippines)	Tanjung Perak

Source: Alphaliner (2016) database (Accessed 5 August 2019).

In 2016, of the 11 ports in Indonesia serving international shipping from various locations, Tanjung Priok is the busiest port with a total annual container volume of 2.9 million TEU (Table 4.3). The least busy port is Palembang with a volume below 5,000 TEU per year. The total flow of international trade in these 11 ports is shown in Figure 4.5. Amongst the ports of eastern Indonesia, only Makassar has international shipping with minimal volumes. This illustrates the huge gap between eastern and western Indonesia.

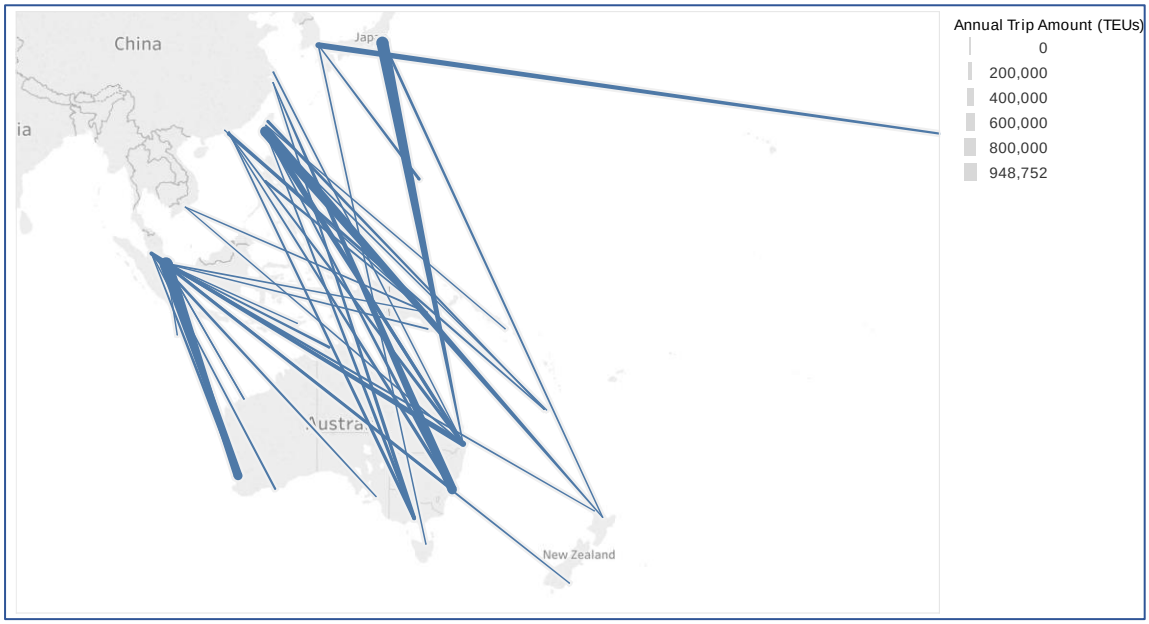
Figure 4.5. Volume of Containers in Indonesian Ports with International Shipping Demand



Note: W indicates Western Indonesia, E indicates Eastern Indonesia.
Source: Alphaliner (2016) database. Accessed 5 August 2019.

Potential network expansion can be started by analysing potential shipping routes passing through ports in eastern Indonesia from the largest market in the northern region. Most routes originate from East Asia into Australia and Oceania, as illustrated in Figure 4.6. Other busy routes are from Southeast Asia to the western part of Australia, but most do not pass through eastern Indonesia, instead passing through the Sunda Strait.

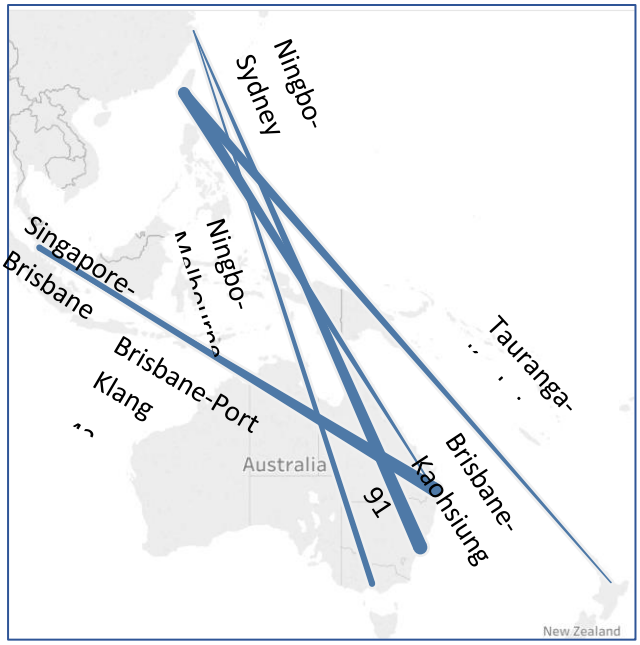
Figure 4.6. Potential Shipping Routes for Eastern Indonesia from and to the Northern Region



TEU = twenty-foot equivalent unit.
Source: Analysed with data from Alphaliner (2016).

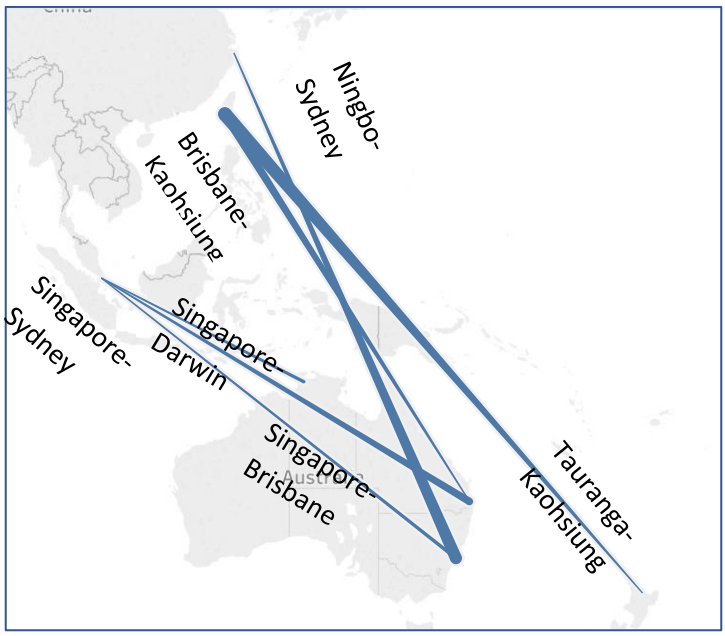
To identify the ports in eastern Indonesia that are most likely to receive shipping demand with adequate cargo, it is assumed that international ships can meet shipping demand if the total distance deviation from the initial route is no more than 10%. Based on this assumption, there are 27 potential routes that can provide shipping demand at ports in eastern Indonesia.

Figure 4.7. Six Main Routes with Highest Annual Frequency



Source: Analysed with data from Alphaliner (2016).

Figure 4.8. Six Main International Routes with the Highest Annual Volume



Source: Analysed with Alphaliner data (2016).

After identifying potential international routes that may be of interest for eastern Indonesia, the next step is to determine which ports have the highest potential for attracting international demand. Traffic and volume analysis is conducted for each Indonesian port, as shown in Figure 4.7 (traffic) and Figure 4.8 (volume). The analysis is conducted by calculating the value and frequency of international routes that might provide demand for eastern Indonesian ports with a total distance deviation of less than 10%.

The results of the analysis are: (i) the volume of international shipping passing through and/or in proximity to eastern Indonesia, and (ii) the frequency of services. Figures 4.9 and 4.10 show the volume for routes passing near ports in eastern Indonesia. The highest volumes pass close to the ports of Bitung (4.3 million TEU), Ambon (4.2 million TEU), Sorong (4.1 million TEU), Merauke (4.1 million TEU), and Kendari (4 million TEU).

Figure 4.9. Volume of International Routes Passing Close to Ports in Eastern Indonesia

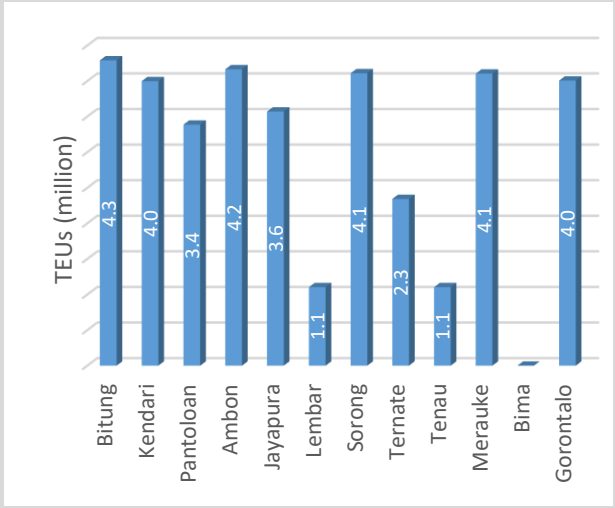
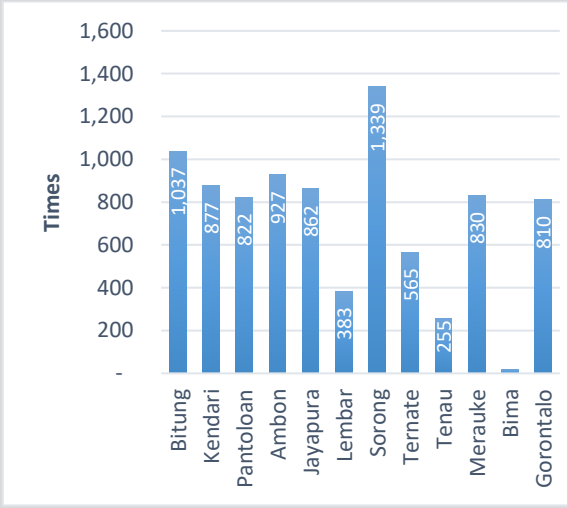


Figure 4.10. Frequency of International Routes Passing Close to Ports in Eastern Indonesia



TEU = twenty-foot equivalent unit.
Source: Analysed with Alphaliner data (2016).

The highest frequencies are from international routes in close proximity to Sorong (1,339), Bitung (1,037), Ambon (927), Kendari (877), and Merauke (830). In both analyses, the port of Bima is described as not being attractive to international shipping routes because the total distance deviation from the original route is greater than 10%.

The ports that appear in terms of both frequency and volume are Bitung, Ambon, Sorong, Kendari, and Merauke. These five ports are the best choice in terms of strategic location as trans-shipment hubs in eastern Indonesia. This may be a vital consideration for the government if it wants to capture the shipping potential of eastern Indonesia.

4.3 Prerequisites and Challenges

Efforts to accelerate development and make it equitable in eastern Indonesia face several issues and challenges, which are affected by both domestic factors and global dynamics. These issues and challenges include: (i) intra-regional, interregional, and regional, and global connectivity problems; (ii) human resource capacity; (iii) institutional and governance issues in local government; and (iv) globalisation and urbanisation.

One of the seven development agendas in the 2020–2024 National Mid-Term Development Plan (RPJMN) is to strengthen infrastructure to support economic development and basic services. The main objective of strengthening infrastructure is to support economic expansion and to encourage equitable national development. The infrastructure development being raised in the development agenda was triggered by the continuing limited availability of and the persistently low quality of infrastructure, which are amongst the main obstacles leading to the stagnation of Indonesia's economic growth. Therefore, the 2020–2024 RPJMN will continue infrastructure development, which

was intensively implemented through the previous RPJMN, particularly with infrastructure related to connectivity and energy to foster economic activity and inclusive growth. Roads, ports, and the availability of electricity may be categorised as primary infrastructure to bring Indonesia towards achieving such objectives.

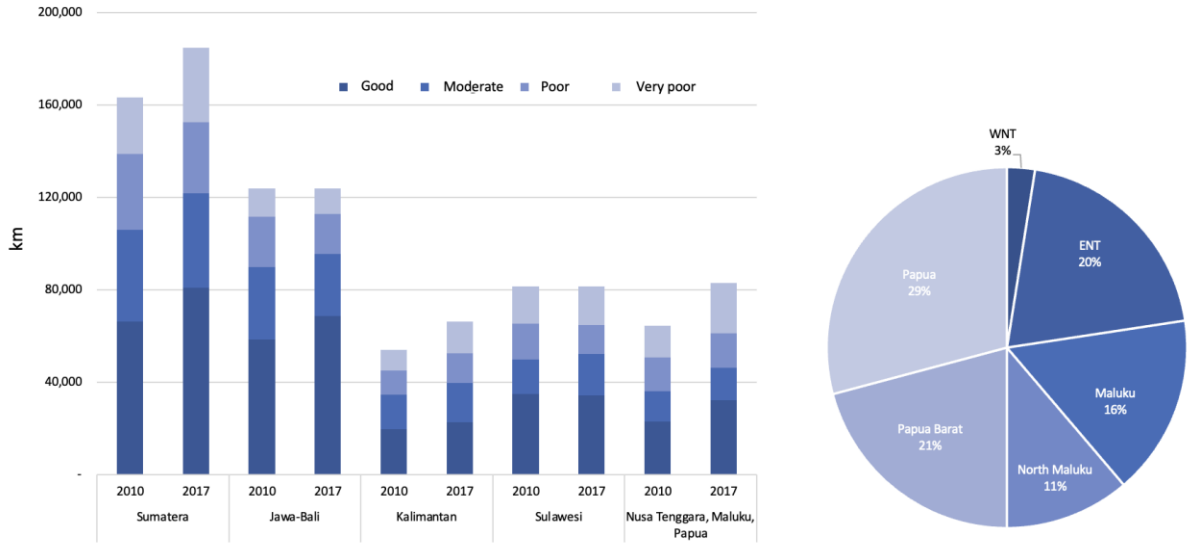
Infrastructure

Roads

Limited infrastructure, including road infrastructure, has been the primary obstacle to taking advantage of opportunities to increase investment and has been the cause of high logistics costs. Therefore, one of the missions of the Public Works and Housing Ministry in 2015–2019 has been to accelerate the development of road infrastructure to support connectivity to improve productivity, efficiency, and national logistics system services to strengthen national competitiveness on a global scale, which focuses on integrated land and maritime connectivity.

Based on data from the Ministry of Public Works, the total road length in 2017 was 539,400 kilometres, an increase of 10.7% compared to the road length in 2010. According to the administrative level authority, district and/or city roads remain the largest proportion at 437,700 kilometres or 81.8% of the total road length in Indonesia, while state roads and provincial roads stand at 47,000 kilometres (8.7%) and 54,600 kilometres (10.1%), respectively.

Figure 4.11. Total Road Length by Region and Condition (km) and Percentage of Road Length Increases in Nusa Tenggara, Maluku, and Papua, 2010 and 2017



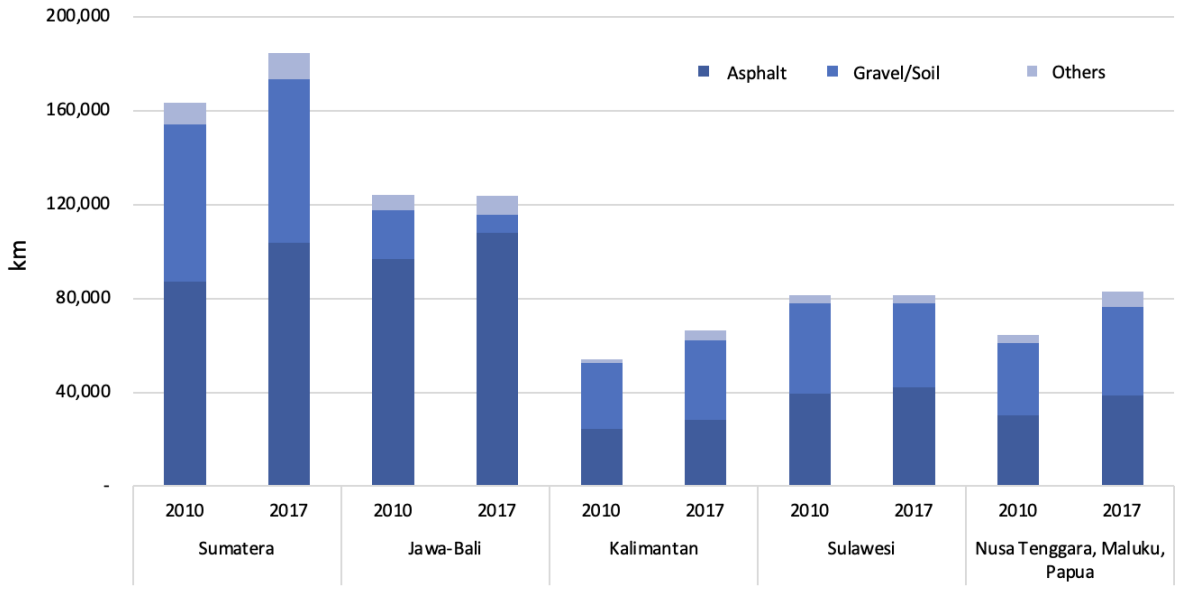
km = kilometre, WNT = West Nusa Tenggara, ENT = East Nusa Tenggara.
Source: BPS from the Ministry of Public Works (2010 and 2017, adapted).

When assessed by region, Nusa Tenggara, Maluku, and Papua experienced the most significant increase in road length during 2010–2017 with 28.8%. The length of roads in Papua and West Papua

has increased significantly with the construction of the Trans Papua Highway that stretches from the city Sorong in West Papua Province to Merauke in Papua Province. Meanwhile, the construction of the Red Belt Road (Jalan Sabuk Merah) near the border of East Nusa Tenggara Province with Timor–Leste significantly adds to road length in the region. The Sumatra region also experienced a substantial increase of 22.9% in road length with the construction of the Trans Sumatra Highway (Figure 4.11). Road infrastructure development is expected to increase accessibility to support regional development along with the better distribution of goods and services.

According to road condition, the Java–Bali region has the most roads that are in good condition with a percentage reaching 55.5% of the total road length in the region in 2017. The roads in other areas that are in good condition are in the range of 40% of the total length of existing roads. Only 22.7% of roads in the Java–Bali region are classified as damaged or heavily damaged roads. Meanwhile, the total number of damaged or heavily damaged roads reached more than 30%, and even 44% for the Nusa Tenggara, Maluku, and Papua regions.

Figure 4.12. Road Length by Region and Surface Type, 2010 and 2017



Source: BPS from the Ministry of Public Works (2010 and 2017, adapted).

According to surface type, more than 40% of the roads in each region are paved. As an economic and government hub, the Java–Bali region has asphalt roads, with the largest percentage reaching 87.2% of the total road length in the region. On the other hand, there remains a large percentage of roads with gravel and/or soil surfaces in other regions (Figure 5.12).

Ports

As an archipelagic country, ports are important infrastructure for fostering connectivity between the economic corridors of islands and between regions to encourage the creation of inclusive economic growth. This may occur as high inter-regional connectivity affects the increase in the value-added of natural resources and regional competitiveness. The importance of the role of sea transportation is reflected in the 2015–2019 and 2020–2024 RPJMN in which sea transportation is positioned as a special priority to further enhance its function and role in making Indonesia a global maritime axis.

Law No. 17/2008 on Shipping classifies seaports into three hierarchies: main ports, hub ports, and feeder ports. The difference in the three types lies in the sea transportation activities that are conducted, the volume of trans-shipment at sea, and the range of passenger and/or goods services (Table 4.4).

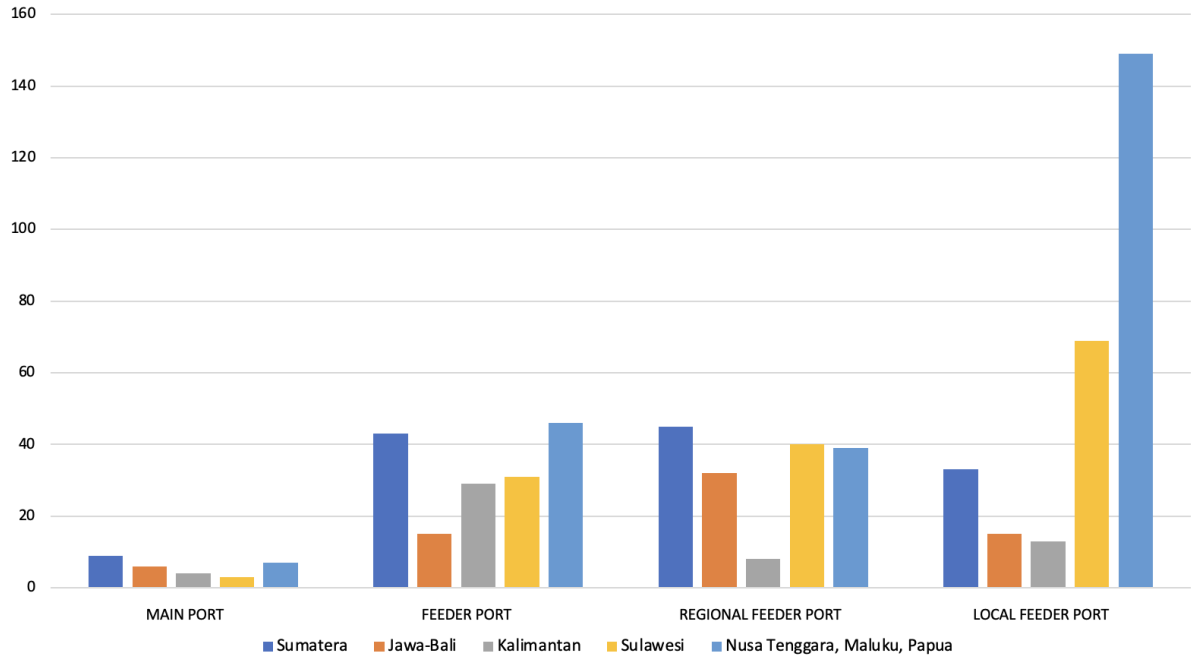
Table 4.4. Sea Port Hierarchy

Category	Sea Port Hierarchy		
	Main Port	Hub Port	Feeder Port
Shipping activities	Domestic and International	Domestic	Domestic
Volume of trans-shipment at sea	Large Volume	Medium Volume	Limited Volume
The range of passenger/goods and crossing services	Interprovincial	Interprovincial	Intra-provincial

Source: Law No. 17/2008 on Shipping.

According to the Transport Ministry's Port Information System (Simpel) data, the total number of ports in Indonesia in 2017 was recorded at 636. Of these, 29 are main ports that are spread throughout almost every province in Indonesia. While there are 164 operating feeder ports, the majority are in Sumatra and the regions of Nusa Tenggara, Maluku, and Papua. Feeder ports are categorised further as regional feeder ports (located around economic growth centres in the province and acting as feeders for hub ports and main ports) and local feeder ports (around the district and/or city economic growth centres and acting as passenger service points in remote, isolated, border, and restricted areas that are only supported by sea transport). Meanwhile, there were 279 hub ports recorded, of which 50% were in Nusa Tenggara, Maluku, and Papua (Figure 4.13). The large number of local feeder ports in eastern Indonesia shows how important the role and function of sea transport is in the region. However, the availability of port infrastructure becomes less meaningful without the availability of regular sea transport. As a consequence, the Indonesian government initiated the Maritime Highway programme to improve inter-island connectivity in Indonesia.

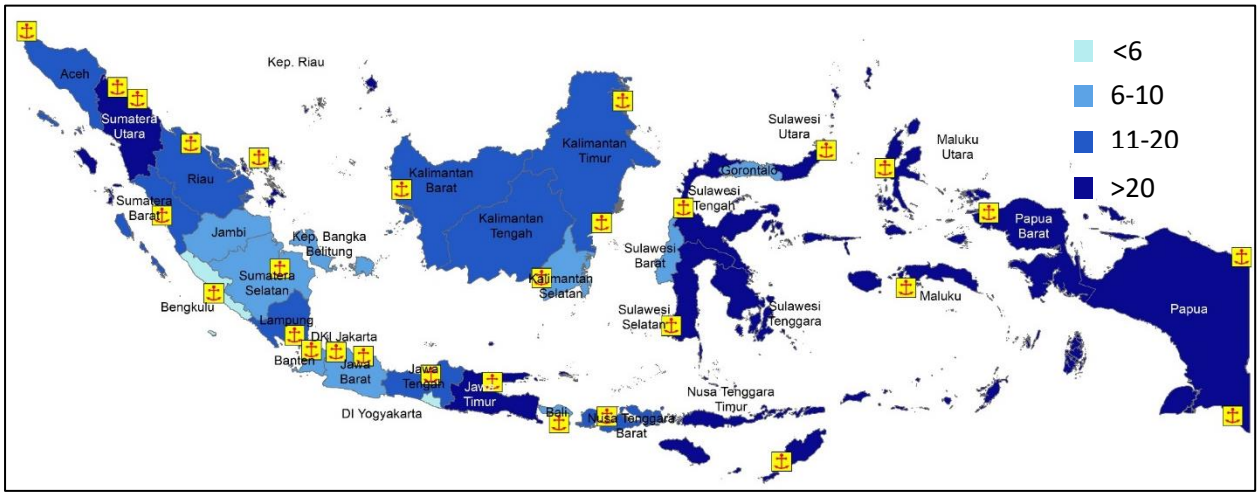
Figure 4.13. Total Seaports by Hierarchy and Region, 2017



Source: Adapted from the Port Information System, Indonesian Department of Transportation (2017).

The importance of maritime transport's main role in eastern Indonesia is clarified in Figure 4.14. Almost every province in eastern Indonesia has more than 20 ports, most of which are local feeder ports.

Figure 4.14 Map of the Number of Indonesian Ports and their Locations, 2017



Note: the legend shows the number of ports in each province.
Source: Adapted from the Port Information System, Indonesian Department of Transportation (2017).

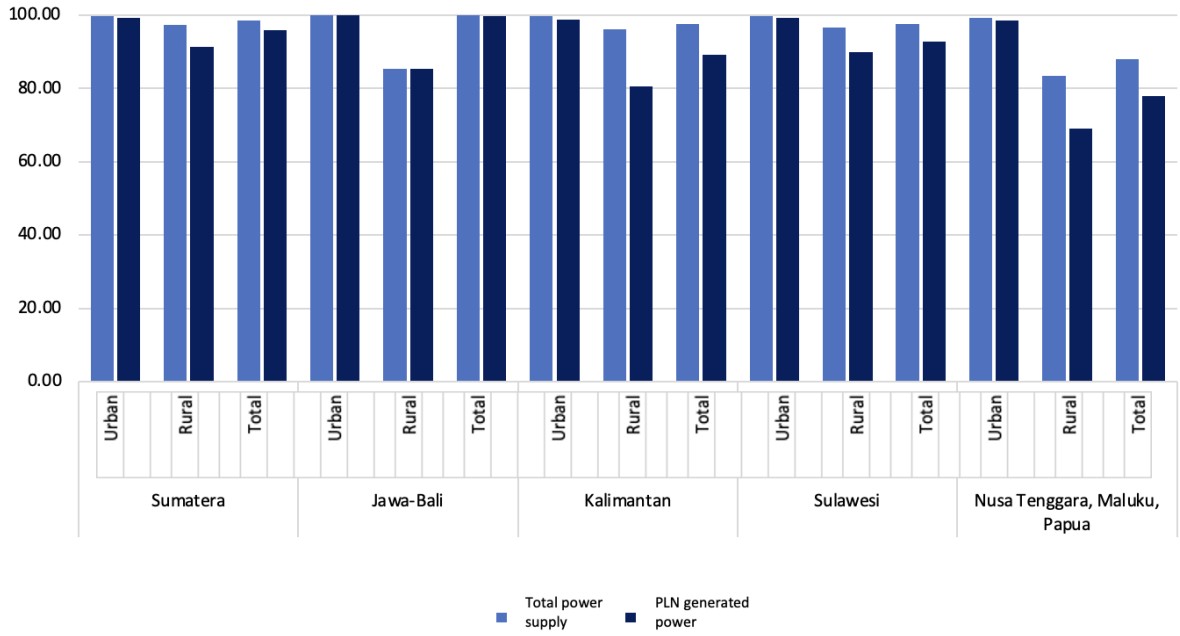
Availability of Electricity

It is undeniable that almost all human activities are currently supported by energy. Of the many types of energy, electrical energy is the most important in sustaining human needs. The inclusion of accelerating minimum service standards compliance for basic public services in disadvantaged areas, including the provision of electricity, shows the importance of the role of electricity in human life, not only in urban areas, but also in rural areas.

According to National Socio-Economic Survey (Susenas) data, the source of lighting for 98.5% of households in Indonesia in 2018 came from electricity. This figure is up from 94.2% in 2010. The state-owned power company, Perusahaan Listrik Negara (PLN), provides electricity to 96.5% of households. Therefore, only 2% of the electricity used by households comes from non-PLN sources, mainly from private generators.

Based on the type of region, the percentage of households in urban areas that had access to electricity in 2018 amounted to 99.8% or 3% higher than rural areas. Almost all electricity used by households in urban areas came from PLN. Meanwhile, 4% of households in rural areas still use non-PLN electricity as their main source of electricity. However, more households in rural areas have begun to enjoy electricity supplied by PLN.

Figure 4.15. Percentage of Households by Area, Type of Region, and Main Sources of Lighting, 2018



Source: Adpated from BPS National Socio-Economic Survey (2009–2018).

Figure 4.15 shows that electricity has become accessible by almost all households in urban areas and PLN supplies more than 98% of it. Rural areas in the regions of Nusa Tenggara, Maluku, and Papua were the areas with the lowest electrification ratio at only 83.3% and PLN only supplied electricity to 69.2% of households in the region. Accessibility difficulties are suspected to be the main cause of households in the region with electricity facilities not being covered. Therefore, one of the development goals in the 2020–2024 RPJMN is to continue infrastructure development, especially connectivity and energy, which aims to increase economic productivity and inclusive growth by prioritising the increase of new and renewable energy to meet those energy needs.

Connectivity

Connectivity remains a major problem in the government's efforts to accelerate the development of eastern Indonesia. Connectivity problems still arise in various contexts, such as inter-regional connectivity within eastern Indonesia, connectivity between areas in the Eastern Indonesia Region

and those in the Western Indonesia Region, and Eastern Indonesia Region connectivity in the Asia Pacific and global contexts.

Connectivity within the Eastern Indonesia Region

Connectivity for regions of eastern Indonesia in general remain behind that of inter-regional connectivity in western Indonesia, even though the proper flow of goods and services is one of the factors driving high economic growth. The Maritime Highway is also actually indirectly attempting to overcome the problem of intra-regional connectivity within the Eastern Indonesia Region. Of the 18 Maritime Highway routes that have been operating up until 2018, only 2 routes have not served ports in eastern Indonesia. The challenge over the next few years is how to optimise the existence of the Maritime Highway programme to accelerate development both in the areas it serves directly as well as the surrounding areas.

Furthermore, the development of eastern Indonesia also needs to consider the aspect of connectivity between coastal areas – especially those directly served by the Maritime Highway – and hinterland areas. Good connectivity between the two regions will ensure that development is equitably distributed.

Connectivity with Java–Sumatra

Indonesia's economic activity is currently concentrated in Java and Sumatra, which is a condition that is expected to persist in the long term. For this reason, the acceleration of development in eastern Indonesia must be directed to improve connectivity with the Java–Sumatra economy.

In relation to the Maritime Highway, connectivity between the Eastern Indonesia Region and the Western Indonesia Region currently relies on two main ports, Tanjung Perak Port (Western) and Makassar Port (Eastern). The challenge in the long term is to ensure that the facilities and infrastructure at the two ports are able to meet the needs of sea transport services for effective development acceleration of the Eastern Indonesia Region.

Connectivity with other regions in Indonesia

In addition to increasing the economic connectivity of the Eastern Indonesia Region with Java–Sumatra, the development of eastern Indonesia also needs to consider the level of connectivity with other Indonesian regions, particularly with Kalimantan. In relation to national development planning, the focus is on the island of Kalimantan as the national energy source capable of supporting industrial development. In addition, the development of eastern Indonesia must also anticipate the impact of the relocation of the new capital to the island of Kalimantan.

Connectivity with countries in the Asia Pacific region

In the long term, the strategy of developing eastern Indonesia needs to be directed towards optimising the existence of the global shipping lanes in the Eastern Indonesia Region that pass through two Indonesian archipelagic sea lanes (ALKI). ALKI II is a global shipping lane that passes through the Sulawesi Sea, Makassar Strait, Flores Sea, and Lombok Strait; ALKI III crosses the Pacific Ocean, Maluku Sea, Seram Sea, Banda Sea, Ombai Strait, Sawu Sea, and the Indian Ocean.

Human Resource Capacity

Efforts towards accelerating development and making it equitable in eastern Indonesia will be more effective if supported by the availability of quality human resources that are competitive. Human

resource capacity can be strengthened by expanding the scope of infrastructure services for education and health, especially in disadvantaged, remote, and outermost (3T) regions.

Local Government Institutions and Governance

Institutional capacity and governance for local governments needs to be strengthened given the important role of these institutions in developing and maintaining a stable industrial climate at the local level. Capacity building for local governments is useful in supporting regional independence and competitiveness in an effort to accelerate regional economic development. In addition, a region with a capable government will guarantee the availability of reliable, quality public services that support the strengthening of the region's human resources.

Urbanisation

Currently, 54% of Indonesia's population live in urban areas (World Bank, 2015). This figure is expected to continue to rise until it reaches approximately 67% in 2050. Urbanisation brings benefits such as the ease of obtaining input for industries and facilitating the faster exchange of information and knowledge. However, urbanisation must also be managed properly to minimise adverse effects such as traffic jams and pollution, along with the declining quality of life and the environment.

The development of eastern Indonesia must consider the management of urbanisation in the coming years, especially for regions with metropolitan areas as major growth centres such as Makassar and Manado. City governments must focus on providing basic infrastructure such as adequate housing, drinking water, sanitation and waste facilities, as well as mass transportation facilities and infrastructure. Infrastructure readiness in anticipating the pressure of urban populations may increase the chances of regions to benefit from agglomeration with minimal negative impacts.

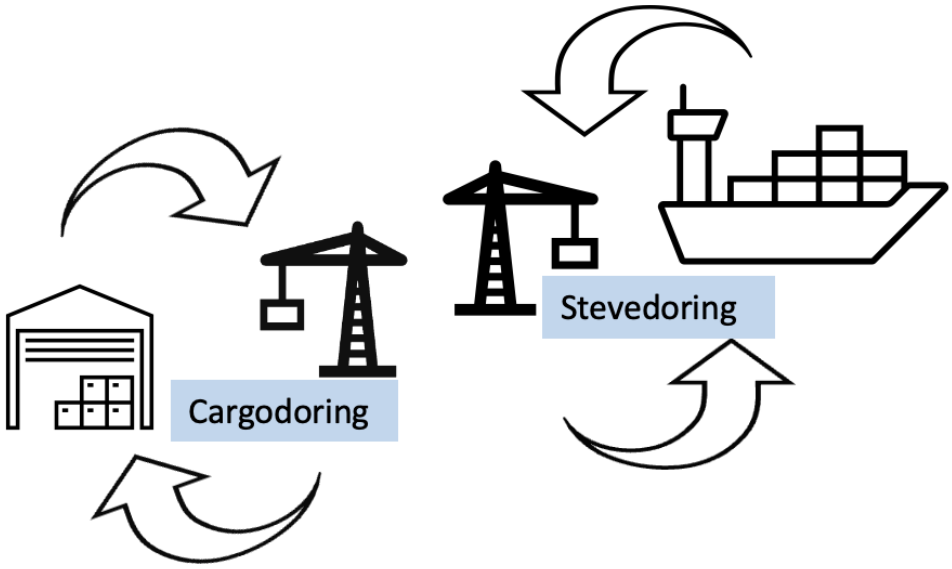
4.4 Future Steps

Port Operations Design

The previous section described the potential in eastern Indonesia from the parameters of dock infrastructure (related to shipping capacity) and strategic locations. However, in order to compete with other ports in the region, how port operators regulate operations at ports must be considered.

Port operations comprise stevedoring and cargodoring activities (Figure 4.16). Stevedoring is the process of loading and unloading cargo to and from terminals to vessels. Cargodoring is loading and unloading from terminals to secondary port areas (warehouses or stockpiles). It is necessary to consider the two activities to ensure efficient cargo flow at ports. Efficient cargo flow at the port depends on well-prepared infrastructure (dock length, dock capacity, adequate stockpile areas) and equipment operating systems (conventional, semi-automated, and fully automated).

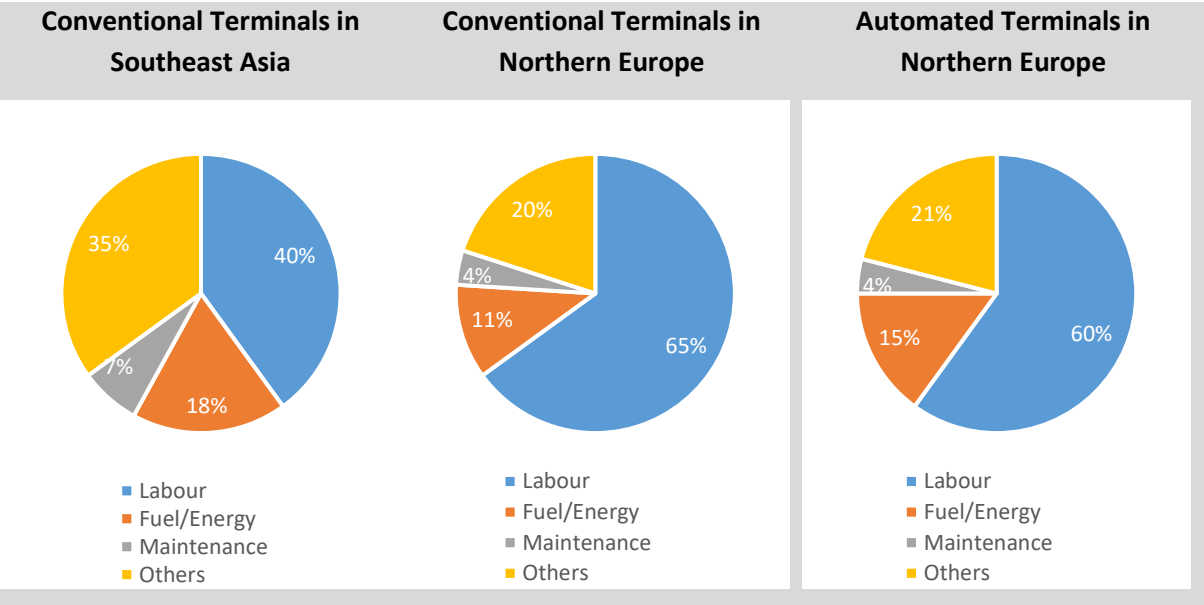
Figure 4.16. Main Activities in Port Operations



Source: Authors.

In the current port industry, operation port designs can be divided into three types: (i) conventional ports, (ii) semi-automated ports, and (iii) fully automated ports. The difference between these designs is the use of equipment and human resources, which leads to a decrease in the value of operational expenditure (OPEX) and capital expenditure (CAPEX).

Figure 4.17. Comparison of Actual OPEX Composition in Southeast Asia and Europe



OPEX = operational expenditure
Source: Royal HaskoningDHV (2018).

In Southeast Asian countries, the cost of labour is the dominant component (40%). The second largest is allocated to 'others,' which represents expenditure for depreciation as well as selling, general, and administration. Fuel/energy is at 18% of OPEX. The smallest proportion is for maintenance (Figure 4.17).

The main advantage of automation is usually a reduction in labour costs. Therefore, most of this type of development is carried out in Western Europe, the United States, and Australia, where labour prices are exceedingly high and even a slight reduction in the number of workers can contribute to investment payback. However, it is also important to mention that the actual OPEX difference shows that the reduction in labour costs is not as significant as originally envisioned at the start of the project because more competent staff usually demand higher wages, even when the number of workers is reduced.

In Southeast Asia, the labour cost at container terminals is smaller, thereby leading to relatively insignificant profits from automated terminals. For some countries where the level of education is not too high, automation will increase operational costs due to the need to bring in experienced expatriates to operate the terminal. In choosing the level of automation, a meticulous cost-benefit analysis needs to be conducted to ensure that a comprehensive decision is made. Table 5.5 shows the difference between operating designs at ports.

Table 4.5. Differences in Port Operation Designs

Category	Item	Fully Automated	Semi-Automated	Conventional
Design type	Gate operation	Automated	Automated	Manual or automated
	Container Stacking cranes	Automated Stacking cranes	Hybrid stacking Cranes	
	Transfer the stockpile to the vessel	Automatic guided vehicles	Not automated (trucks and trailers)	Not automated (trucks and trailers)
	STS operation	Semi-automated	Semi-automated	Manual
	Empty lot	-	Conventional	Conventional
Reduction of labour compared to conventional operations	Gate	~80%	~80%	-
	Stockpile area	~80%	~30%	-
	Dock	~20%	~20%	-
	Mechanic	~20% Increase	Similar to conventional	-
Productivity		30–35 gross moves per hour (GMPH)	30–35 GMPH	25–30 GMPH

STS = ship-to-shore.
Source: Adapted from Notteboom, Pallis, and Rodrigue (2022).

Application of Efficient Port Operations in Indonesia

In the case of eastern Indonesia, finding a semi-automated or fully automated container terminal is difficult. Even in the ports of western Indonesia, only the Teluk Lamong Terminal (Gresik, Pelindo III) has semi-automated equipment. Therefore, the most necessary step for the government to take is improving port operations with respect to the level of standards for container terminal services. The standards consist of infrastructure (dock draft, bearing capacity of the dock,[8] and dock length) and handling equipment (ship-to-shore cranes [STS]/mobile harbour cranes [MHC], Rubber Tyred Gantry Crane [RTG crane], forklifts, trucks, and trailers).

Regarding the draft dock and standards, referring to BAPPENAS, the minimum draft required for an effective trans-shipment hub is 13 metres (m). This draft can accommodate 3,000–4,000 TEU vessels suited to the main corridors of the Maritime Highway. On average, ports in eastern Indonesia have adequate drafts from 10 m to 12 m. However, handling equipment and the bearing capacity of docks must be improved.

Estimation of the total handling equipment based on the number of STS cranes for every 150 m of dock length (a benchmark in the port industry). The analysis of the handling equipment and draft required is shown in Table 4.6. The results of the analysis show that only Pantoloan has a non-standard dock draft. From the perspective of handling equipment, most of the ports in eastern Indonesia combine STS and MHC cranes for cost efficiency and flexibility for the size of ships that may dock. They are more flexible than STS cranes. Tenau, Bitung, Pantoloan, Makassar, and Jayapura have the ideal amount of handling equipment.

Table 4.6. Analysis of the Handling Equipment Required at Selected Eastern Indonesia Ports

Ports	Current maximum draft (m)	Draft required for main corridors of the Maritime Highway	Dock Length (m)	Current handling equipment	Handling equipment according to industry standards
Tenau	13	10–12 m	223	2 STS	2 STS
Bitung	14	10–12 m	830	3 STS, 2 MHC	5 STS
Pantoloan	9.5	10–12 m	250	1 STS, 1 MHC	2 STS
Makassar	12	10–12 m	1,461	9 STS, 2 MHC	10 STS
Ternate	10	10–12 m	413	1 STS, 1 MHC	3 STS
Ambon	10	10–12 m	576	2 STS	4 STS
Sorong	12	10–12 m	340	2 MHC	2 STS
Jayapura	12	10–12 m	310	2 STS	2 STS

m = metre, MHC = mobile harbour cranes, STS = ship-to-shore cranes.
Sources: Pelindo 3 (2019), Pelindo 4 (2019), Google Earth (2019).

[8] Dock strength to bear the load on it. Further analysis on bearing capacity will not be addressed in this study.