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O-D STRUCTURE OF DOMESTIC MARITIME TRAFFIC IN INDONESIA

Ian C. ESPADA, Dr. Eng.
ALMEC Corporation
Rm 301 One Corporate Plaza
845 Arnaiz St., Makati City
Philippines
Fax: 63-2 818-8145
E-mail: ian@almec.org

Ken KUMAZAWA
ALMEC Corporation
1-19-14 Aobadai, Meguru-ku, Tokyo, Japan
Fax: +81-3 5489-3210

Adolf TAMBUNAN, MSc
Deputy Director
Directorate General of Sea Communication,
Ministry of Communication
Republic of Indonesia
Fax: +62-21 350-1406

Abstract: There is very limited information on the nature of domestic maritime traffic demand in Indonesia. Without clear understanding of the nature of maritime traffic it is very difficult to deliberate on programs and policies regarding the country's domestic maritime sector. The objective of this paper is to characterize the OD structure of domestic maritime traffic demand.

Keywords: Indonesia, Maritime, Origin-Destination

1. BACKGROUND

Indonesia being an archipelago is highly dependent upon maritime transport for the movement of goods and people across the country. Figure 1 and 2 shows the trend in sea traffic with respect to GDP for cargo and passenger respectively.

Though there are records on Indonesian domestic sea traffic and port activity, very little is known about the origin-destination (OD) structure of domestic sea traffic. Understanding the traffic patterns of demand is critical particularly considering that Indonesia is a vast expanse measuring about 5,500 kms from east to west, 1,500 kms from north to south and consisting of more than 18,000 islands (see Annex for Indonesian Map).

In this paper, the OD structure of cargo and passenger traffic is developed. The primary purpose of the exercise is to develop a traffic database for the development of a domestic maritime masterplan for Indonesia, under the "Study on the Development of Domestic Sea Transportation and Maritime Industry in the Republic of Indonesia (STRAMINDO)"[1].

[1] STRAMINDO is a technical study of the joint cooperation of the Japan International Cooperation Agency and Director General of Sea Communication Ministry of Communications and the Director General of Metal, Machinery, Electronics and Multifarious Industries Ministry of Industry and Trade.

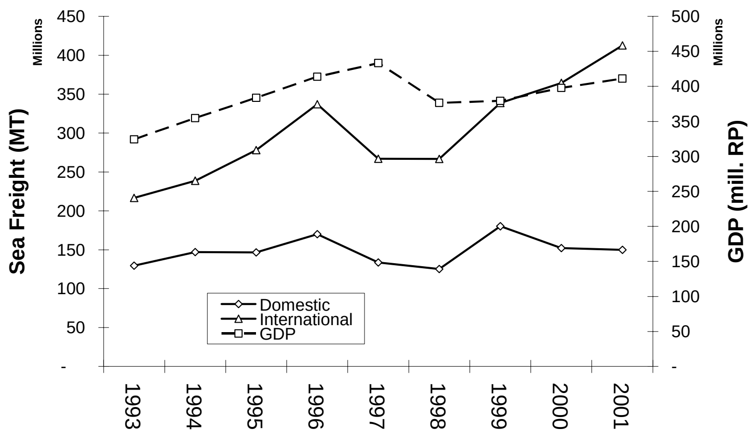

Figure 1. Sea Cargo Traffic from 1993 to 2001

Note: GDP in constant 1993 Rupiah
Source: Sea traffic from DGSC 2001; GDP from BPS 2001

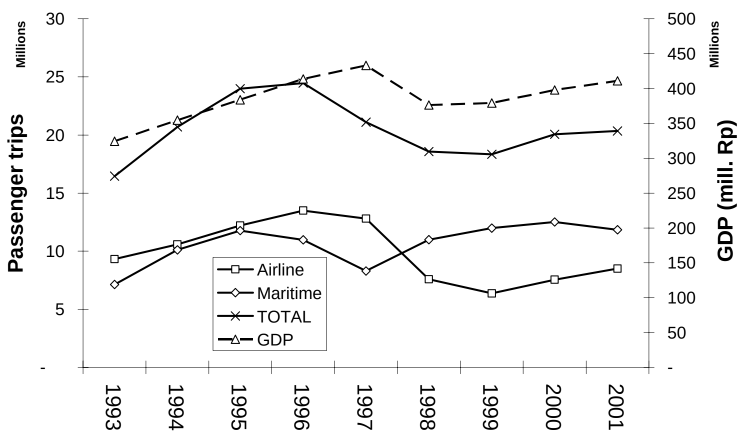

Figure 2. Inter-island Passenger Traffic from 1993 to 2001

Note: GDP in constant 1993 Rupiah
Source: Sea traffic from DGSC 2001; Air Traffic and GDP from BPS 2001

2. OD DATABASE DEVELOPMENT

In the case of domestic cargo OD, data issues are as follows:

- Complete OD data is available in the form of Ship Call Reports. In these reports, OD data is available. However, this report is submitted to local port offices and only summarized reports are submitted to the head office in Jakarta. The data is ideal for developing the OD database, but significant resources are required to collect and encode data coming from the numerous ports in Indonesia.
- The Directorate General of Sea Communications has completed encoding the Voyage

Report. The Voyage Report details the ship activities including OD data (20,815 records). The Voyage Report is submitted to the head office in Jakarta, but unfortunately data accuracy is suspect and reporting compliance is very weak (i.e. many shipping companies do not submit).The Voyage Report database accounts for about 28 million MT of sea freight or 20% of total.

To be able to arrive at a reasonably reliable OD database within the time and budget available, the Ship Call Reports and Voyage Reports are combined. Surveyors were dispatched to the 23 classified Strategic Ports to collect Ship Call Reports. This basically covered about 60% of all domestic throughputs. For the rest of the ports, the Voyage Report is utilized. Thus, the data usage to complete the OD database is illustrated in Figure 3. Port loading/unloading data from PELINDO and DGSC are used to expand the OD data. Depending on data availability, either packing type or commodity type classifications are used to correct reporting biases – as there appears to be a tendency for some commodities to have a higher reporting compliance than others.

Destination / Origin	23 Strategic Ports	Other Ports
23 Strategic Ports	Ship Call Reports	Ship Call Reports
Other Ports	Ship Call Reports	Voyage Report

Figure 3. Combination of OD Survey and Voyage Report

In the case of domestic passenger OD, complete OD data is available from P.T. Pelni, the state owned company that is the primary operator of passenger vessels in Indonesia. This covers about 60% of all inter-island passenger traffic. There is unfortunately limited information on private passenger shipping operators. There is however, passenger embarking and disembarking data and routes operated by private operators are one-origin-one destination routes. Thus, the embarking and disembarking data can be use to estimate the missing OD traffic.

3. DOMESTIC SEA FREIGHT

Domestic Sea Traffic by Commodity

Domestic sea freight is largely dominated by petroleum accounting for a little over half of the total tonnage. General cargo is the second largest commodity type followed by coal at 14% and 10% of the total respectively. Wood products - primarily composed of sawn wood, logs, and plywood - accounts for nearly 7% of domestic tonnage. Other major commodities include cement, fertilizer and mining/quarrying products.

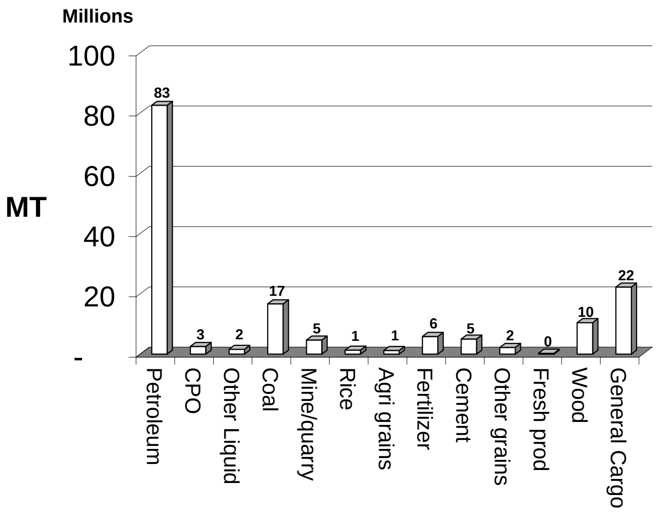

Figure 4. Commodity Breakdown of Domestic Sea Freight

Note: 1/ CPO is Crude Palm Oil
2/ Other liquid is primarily composed of chemicals
3/ Mine/quarry refers to mining and quarry products other than coal, e.g. sand and gravel
4/ Agri grains refer to agricultural grains; e.g. legumes
5/ Other grains, refers to granular cargo other than agricultural or mining/quarrying products; e.g. sugar
6/ Fresh prod refers to fresh products such as fruits, vegetables, fresh or frozen meat
7/ General cargo refers to other unclassified cargo
Source: STRAMINDO Survey, Year 2002 figures

<u>OD Structure of Main Commodities</u>

The following presents the Origin-Destination structure of main commodities – including petroleum, general cargo, coal, wood, fertilizer and cement.

Petroleum Traffic: Much of the petroleum is being produced at Kalimantan and Sumatra. The province of Riau generates about 40 million MT of domestic petroleum sea traffic – the highest of all provinces accounting for about 45% of all generated domestic petroleum traffic. However, a quarter of this volume is transported within its borders only and another quarter to neighboring Sumatra Utara. The rest largely goes to Jawa Island, especially Jakarta at nearly 5 million MT. About 3 million MT of the Riau traffic (primarily crude oil for refining) goes to Kalimantan Timur. Kalimantan Barat also receives about 1.5 million MT of petroleum from Riau. Kalimantan Timur is second to Raiu and generates about 31% of the domestic petroleum traffic. About half of the traffic however, is being loaded and unloaded within Kalimantan Timur only. The primary recipient of Kalimantan Timur traffic is Jawa Timur at nearly 5 million MT. The rest of the traffic goes to Jawa Tenggah, Bali, Kalimantan Selatan, and Sulawesi Selatan. The third highest generator of petroleum traffic is Sumatra Selatan, which goes to ports in Sulawesi and Jawa – in particular Lampung, Jakarta and Jawa Timur.

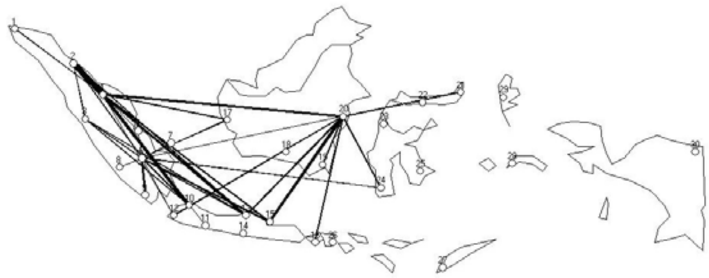

Figure 5. OD Structure of Domestic Petroleum Sea Traffic

General Cargo Traffic: General cargo traffic is centered at Jakarta and Jawa Timur (Surabaya) the first and second largest industrialized areas in Indonesia. Traffic entering and leaving Jakarta is dispersed to major cities in the central and western parts of the country. Jawa Timur on the other hand is by and large exchanging general cargo with major cities in the eastern parts of the country, especially Sulawesi Selatan. Unlike petroleum traffic (and other commodities as well), general cargo traffic tends to be more dispersed.

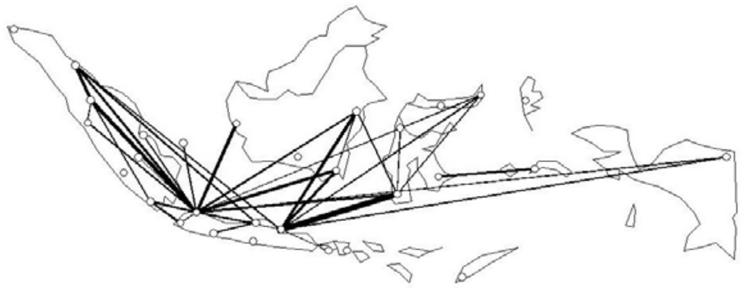

Figure 6. OD Structure of Domestic General Cargo Sea Traffic

Coal Traffic: Banten attracts 10.3 million MT seaborne coal or 62% of the entire seaborne coal traffic and about 6.9 million MT of which comes from Lampung just across the Sunda Channel. 2.7 million MT of Banten coal comes from Kalimantan Selatan. Jawa Tenggah also attracts much seaborne coal of around 1.4 million MT – much of it comes from Sulawesi Barat. There is also substantial intra-province traffic of coal in Kalimantan Selatan of around 3.1 million MT.

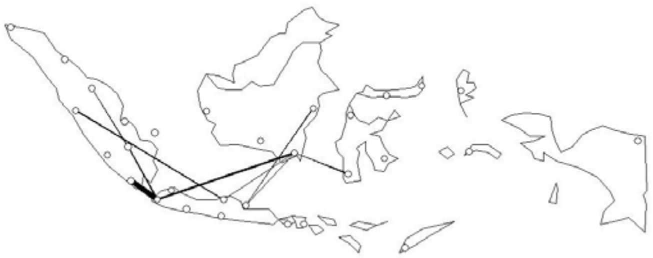

Figure 7. OD Structure of Domestic Coal Sea Traffic

Wood Traffic: Much of the seaborne wood traffic originates from Kalimantan Timur and Riau at 5.5 million (52%) MT and 1.2 million MT (11%) respectively. About a third of the wood traffic from Kalimantan Timur goes to Jawa Timur and about 20% of the Kalimantan Timur wood traffic is intra-provincial traffic and Jawa Tenggah accounts for about 9%. Jakarta attracts 15% of the wood sea traffic but derives it from varied sources from Kalimantan as well as Sumatra. Riau wood sea traffic is largely transported intra-provincially.

Figure 8. OD Structure of Domestic Wood Sea Traffic

Fertilizer Traffic: The origin of fertilizer traffic is by in large concentrated at Sulawesi Selatan and Kalimantan Timur at 47% and 30% of the total fertilizer sea traffic respectively. 2.7 million of the 2.8 million MT of seaborne fertilizer coming from Sulawesi Selatan goes to Jawa Tenggah. About half of the 1.8 million MT Kalimantan Timur traffic goes to Sulawesi Selatan. The rest of the Kalimantan Timur traffic largely goes to Jawa Timur, Nusa Tenggara Barat and Sulawesi Tenggara.

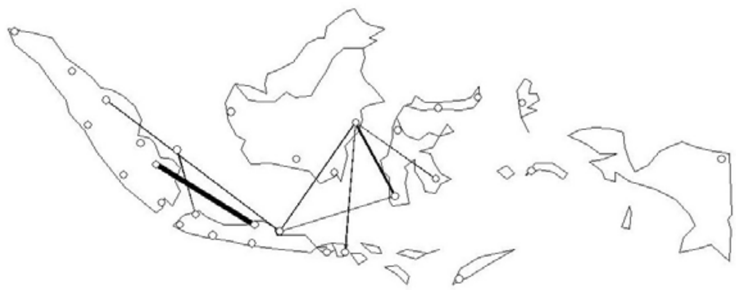

Figure 9. OD Structure of Domestic Fertilizer Sea Traffic

Cement Traffic: Around 71% of the 5 million MT cement traffic originates from Sumatra Barat, Kalimantan Selatan and Sulawesi Selatan – 1.5 million MT, 1.3 million MT and 0.8 million MT respectively. Sumatra Barat traffic largely goes to Sumatra Utara and Jakarta. Kalimantan Selatan cement traffic serves demand in the central region of the country – most especially, Bali, Nusa Tenggara Barat and some parts of Sulawesi. Sulawesi Selatan traffic, on the other hand, serves the demand of the eastern region of the country. About a third of the traffic goes to Kalimantan Timur and Papua with Kalimantan Timur getting a slightly higher share.

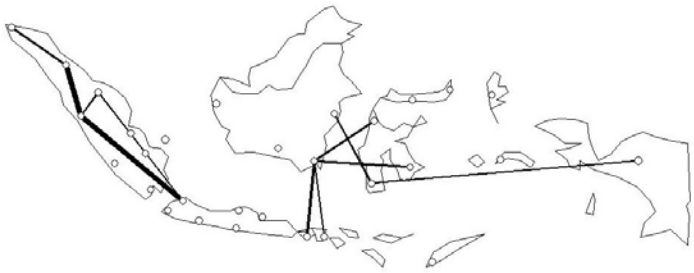

Figure 10. OD Structure of Domestic Cement Sea Traffic

<u>OD Structure by Packaging Type</u>

Petroleum, CPO, and other liquid cargo (e.g. liquid chemicals) are largely carried in liquid bulk form. Coal and other mining/quarrying commodities are predominantly carried dry bulk form. Rice, cement and forestry products are predominantly carried in break bulk form – such as by bags for rice and cement and palletized or by stringing for forestry products. About half of the fertilizer is carried in dry bulk form and the other half by bags. Nearly all of the dry bulk fertilizer comes from Sumatra Selatan and goes to Jawa Tenggah. About 55% of general cargo is in break bulk form and about 40% is containerized.

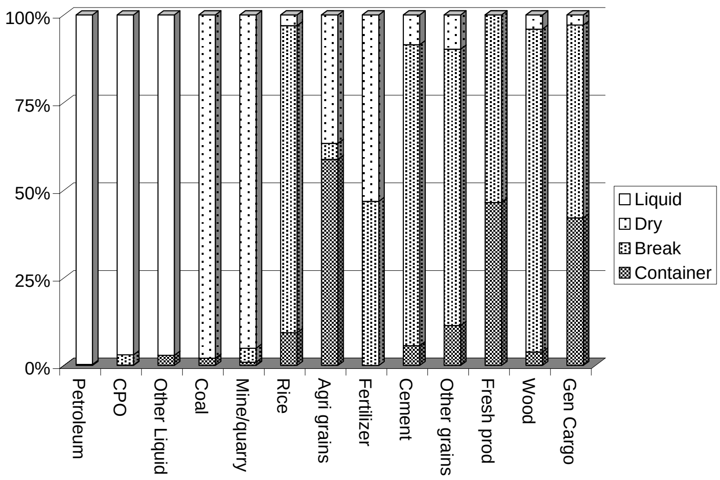

Figure 11. Current Trend in Packaging of Seaborne Commodities

Liquid Bulk Traffic: Liquid bulk traffic is primarily composed of petroleum – accounting for around 82 million MT of the 86 million MT of liquid bulk traffic. Crude Palm Oil and various chemicals make up the rest.

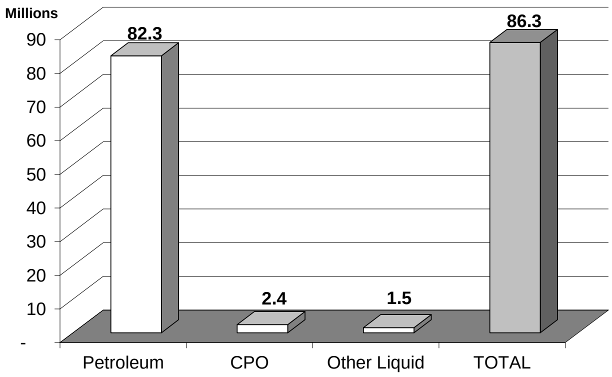

Figure 12. Composition of Liquid Bulk Traffic (MT)

As liquid bulk is primarily composed of petroleum it fundamentally follows the same OD structure of petroleum traffic. The general structure of liquid bulk traffic is from Sumatra and Kalimantan to Jawa. There is also very significant coastal traffic within Sumatra as well as Kalimantan. For example about half of the traffic originating from Kalimantan Timur is intra-zonal traffic. In Sumatra, Riau generate much of the liquid bulk traffic at nearly 40 million MT, but about half of the tonnage is either unloaded within Riau or to neighboring Sumatra Utara.

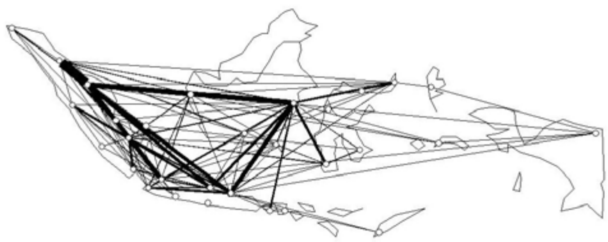

Figure 13. OD Structure of Liquid Bulk Sea Traffic

Dry Bulk Traffic: Dry bulk traffic is primarily composed of mining and quarrying based commodities. About 62% of the total tonnage is coal and about 17% is other mining and quarrying products. Fertilizer as well comprises a relatively significant share of 12% of total tonnage. The rest of the dry bulk traffic is composed of various commodities – including cement, general cargo, wood, etc.

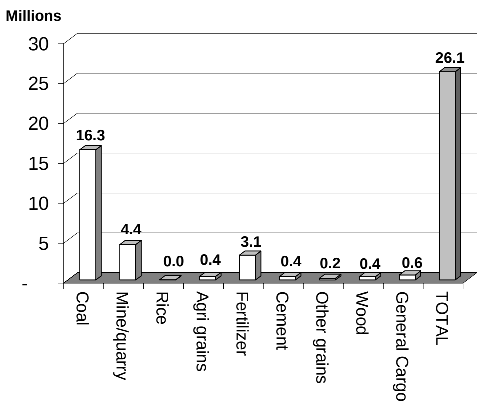

Figure 14. Composition of Dry Bulk Cargo (MT)

The general structure of dry bulk traffic is from Sumatra and Kalimantan to Jawa. 27% of the dry bulk traffic is traffic from Lampung to Banten, across the Sunda Channel, a narrow body of water separating Jawa and Sumatra. About 17% of the total traffic is intra-provincial traffic in Riau and Kalimantan Selatan.

Figure 15. OD Structure of Dry Bulk Sea Traffic

Break Bulk Cargo: Nearly 90% of break bulk cargo tonnage is comprised of general cargo (38%), wood (30%), cement (13%) and fertilizer (8%). Various commodities make up the rest of the tonnage.

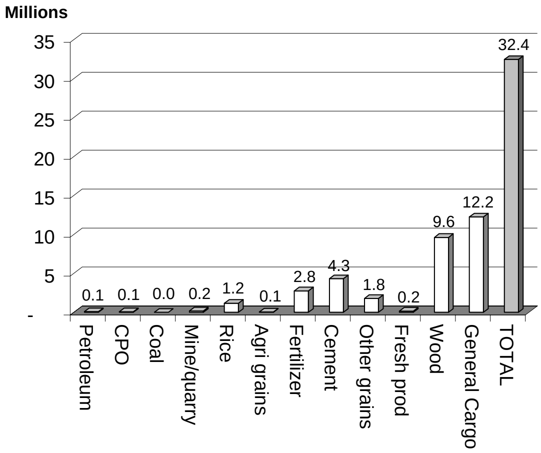

Figure 16. Composition of Break Bulk Cargo (MT)

About a 28% or 9.2 million MT of the break bulk traffic is generated from Kalimantan Timur and much of this traffic goes to neighboring islands of Sulawesi and Jawa and a significant portion is coastal traffic. In Sumatra, Riau generates much of the break bulk traffic at nearly 5 million MT, but about 2.8 million MT is intra-provincial traffic. Sumatra Utara and Riau attract most of the traffic, much of it is coastal traffic and Jawa generated traffic. In Jawa Island, break bulk activity is concentrated at Jakarta, Jawa Tenggah and Jawa Timur. Break bulk activity in Jawa Island, comes from many parts of the country and with little coastal traffic.

Figure 17. OD Structure of Break Bulk Sea Traffic

Containerized Traffic: Almost all of seaborne commodities have been in some way, transported using containers. However, general cargo takes up much of the tonnage at 79% of total tonnage. The rest of the tonnages are distributed to all other commodity types, with agricultural grains – having a relatively higher share at around 6% of the total tonnage.

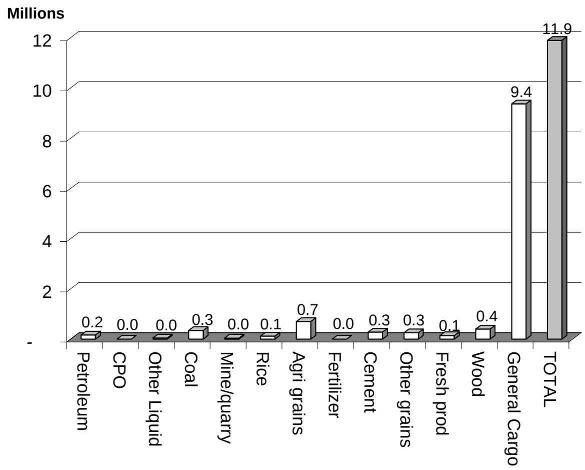

Figure 18. Composition of Containerized Cargo (MT)

Much of container activities are centered in Jawa Island particularly Jakarta and Jawa Timur – with Jakarta being the center of activities in the western side of the country and Jawa Timur being the center at the eastern part of the country. There is very little east-west container traffic.

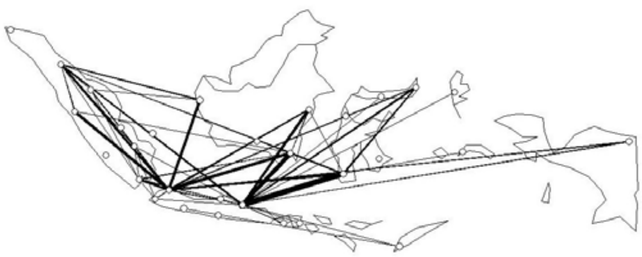

Figure 19. OD Structure of Containerized Sea Traffic

Domestic Sea Passenger

In all, there are about 12 million inter-island passengers per year. About 27% of the trips are generated from Riau, however, most (73%) of these are intra-provincial trips. About 22% of trips originate from Jakarta and Jawa Timur. Sulawesi Selatan and Kepuluan Bangka Belitung generate nearly 1 million trips, accounting 8% and 7% of total trips respectively. The primary trip destination is Riau (28%) but again most of these trips are intra-regional trips. Jakarta, Sulawesi Selatan, and Jawa Timur each receive more than 1 million trips per year and are the primary destination of inter-regional travel. Kalimantan Timur and Kepuluan Bangka Belitung also receives a lesser but relatively substantial traffic at nearly 800,000 per year each.

Inter-island maritime traffic concentrates on the Riau-Jakarta route in the western side of the country. In the eastern-side of the country, traffic is highest between the eastern provinces of Kalimantan, Sulawesi Selatan and Jawa Timur.

Figure 20. Inter-island Maritime Sea Passenger OD

About 40% of all maritime trips are coastal trips – originating from one region and ending within the same region. However, the trend is not uniform as Jawa, Kalimantan and Sulawesi generated trips are predominantly inter-regional while Sumatra and Papua are predominantly coastal in nature.

4. DOMESTIC SHIPPING ROUTING PATTERNS

This section discusses the domestic shipping patterns in relation to the developed OD database. The objective of the discussion is to present ideas and views on how domestic shipping may be enhanced through shipping network design.

Break bulk and bulk shipping is typically operated as trampers, thus shipping generally follows demand; on the other hand, container and passenger shipping is typically handled by liner shipping, thus shipping network structures affects efficiency and productivity. Thereby, the discussion in this section is restricted to container and passenger shipping only.

Container Liner Network

The following figure (Figure 20) illustrates the container liner network in Indonesia. Basically, the container liner patterns can be categorized into two, Jakarta based and Surabaya based.

General cargo traffic, as described earlier is primarily centered in the two main cities of Jakarta and Surabaya, with very little east-west traffic. That means there seems to be little potential for a domestic hub-spoke system to increase productivity. Thereby network-wise, the current liner network is well suited for the OD structure of demand.

It is more promising to consider technological improvements in the existing routes. Areas of consideration as follows:

- Increasing of vessel size, in particular at high volume corridors with deep ports and good container facilities; and,
- Deployment of larger capacity vessels but with shallower drafts at corridors with shallow ports (e.g. river ports).

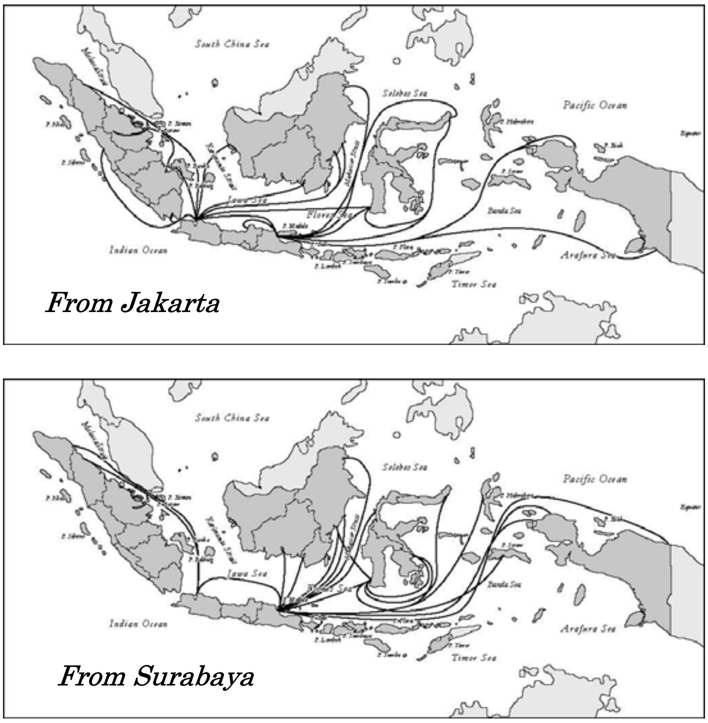

Figure 21. Container Shipping Network

<u>Inter-island Passenger Liner Network</u>

The passenger shipping network is illustrated in the following figure (Figure 21). The passenger shipping network features a network with very extensive coverage, and with multiple port call routes and very long route cycles. However, actual passenger demand is actually concentrated only on several corridors, as described earlier. That means, vessel space utilization is very inefficient as vessel operation frequency (or vessel size) have to be increased to serve high volume legs, but the same number of vessels (or size of vessel) is used to serve low volume corridors. Moreover, many vessels are made to serve corridors where there is very little demand. For example, many vessels call at Jakarta and Surabaya, but there is almost no sea passenger demand in between the two cities (almost all demand is served by either rail or air)

There is therefore a potential to improve the passenger shipping network by shortening routes and concentrating services to where it is much needed in accordance to the passenger OD structure presented earlier. For example, a hierarchical passenger network (Figure 23) can be introduced wherein; there are trunk routes to serve high volume corridors and serve as the backbone of the entire passenger network, and a feeder network to serve low volume corridors and to ensure connectivity. Shuttle services could also be introduced on the cross-Java Sea routes. The hierarchical network allows operators more flexibility of vessel assignment and to introduce vessels better suited to serve the given demand of the route. This is critical, not only in improving vessel utilization, but also in the introduction of more enhanced shipping forms such as Ro-Ro Passenger (Ropax) operation. At present, private operators are operating shuttle Ropax for cross Jawa sea routes. P.T. Pelni could be able to improve its operation by introducing its own Ropax operation, but given the multiple port call structure of its routes, it is difficult to envision a successful Ropax operation.

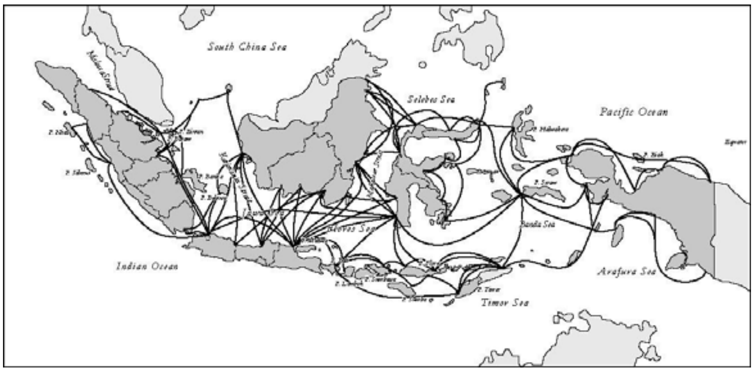

Figure 22. Passenger Ship Route Map

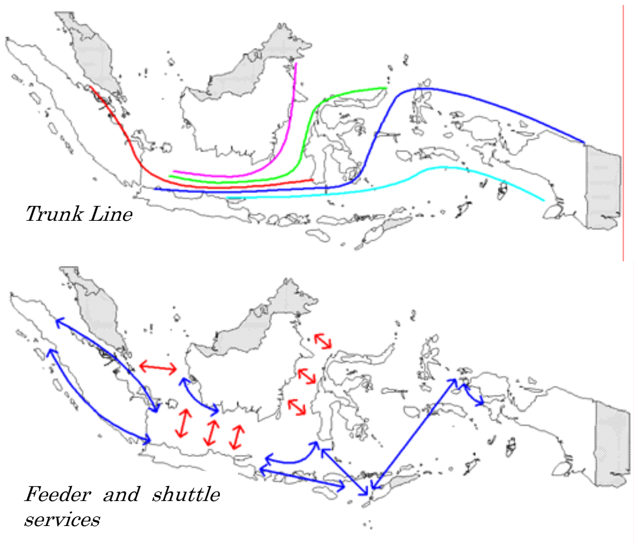

Figure 23. Hierarchical Passenger Shipping Network

Remarks

In the development of the OD database, there has been much difficulty as a result of many issues in the maritime traffic information system in Indonesia. Yet, knowledge of maritime traffic is a vital input in developing realistic plans and strategies to the improvement of the domestic shipping – not only from the government side but also private stakeholders. Maritime traffic database is not only important in transport planning, but also in the day-to-day operation. Knowledge of maritime traffic movement is very useful in monitoring of vessel movement as well as in the enforcement of maritime regulations, for example, the monitoring of pioneer shipping (i.e. subsidized operations for development routes). Knowledge of maritime traffic is also useful in the management of logistics chain including vessel space usage.

Information is available, but the problem is information is highly decentralized and rarely gets consolidated. There are also problems in the standardization of data, that it is very difficult to ensure consistency of data and to cross-reference data from many sources for value added information. Accuracy of data also needs to be improved.

Thereby, it is recommendable to consider improving the maritime traffic database in Indonesia through the use of Information and Communications Technology. To be able to do so, information holders and users need to be organized and a standardized nationwide maritime traffic information system be developed.

Annex: Map of Indonesia