

Conceptual Modeling of Port Development in Eastern Indonesia

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Abstract:- The objective of this conceptual model is to create the port development and planning model which comprise of.- (i) traffic generation; (ii) traffic distribution; (iii) port assignment; (iv) shipping network model; (v) port hierarchy, and (vi) port capacity requirement. The other objectives are to formulate the development and design concept of ports in the eastern Indonesia in order to be able to encourage Indonesian economic growth, especially in the eastern Indonesia. It is highly hoped that this concept will be able to give benefits especially for the port planners and decision-makers in the field of port development and policies.

Keywords:- Cargo Traffic Sea Transportation, Shipping Network, Port Performance.

I. INTRODUCTION

Eastern Indonesia has more islands than the western part, so sea transportation is very much dominant in encouraging economic growth which is at present slower than the western Indonesia.

Most provinces in the eastern Indonesia are far from each other, while means of transport is dominated by sea transport, so the role of ports in eastern Indonesia is vital. But since the hinterland is not developed yet, the volume of industrial cargo is still much lower than ports in western Indonesia, while special cargo likes oil, gas, coal, plywood, etc. are dominant. Therefore eastern Indonesia is often known as a "long distance but less cargo" area. The growth of industrialization in eastern part is a little bit slower [1,2].

The lack of cargo traffic at ports results in port development, which in general faces financial obstacles. Many ports do not own appropriate equipment to handle heavy machines used in construction projects, and are not ready to overcome packing pattern changes from general cargo to containerized cargo. The impact is the decrease of export ship call frequency strategic ports such as Makassar, Bitung, Jayapura, Sorong, and Ambon [3,4].

II. SEA TRANSPORTATION PROBLEM

As an archipelago country with limited land access, sea transportation plays a very important role to the development of various regions [5,6,7]. Sea transportation network is expected to be able to connect surplus area and minus area, both overseas and inside the country. Port as sea transportation infrastructure is required to provide ship and cargo service as demanded by the customers. It means that the port service technology fits the technology of berthing ships, and cargo handling is appropriate to the packing of cargo which is being handled see the figure 1. The frequency of ship call at one port is expected appropriate to cargo delivery frequency [6].

On the other hand, the condition of ports in the Eastern Indonesia is as follows:

In general (except Makassar Port), the technology of ports in Eastern Indonesia is still conventional, while ships and cargo packing trend to use modern technology [8]. These ports generally do not have proper equipment to handle containers.

Less export cargo ship calls except for special cargo such as coal, wood product and sea product, so cargo is mostly exported through Surabaya and Tg. Priok Jakarta. Most ships from western to eastern Indonesia usually voyage back with less load factor. Financially inappropriate, yet economically feasible, port development [4]. Until now, the management does not own a flexible-planning tool that could be updated to reflect the continuing changes in maritime trade.

In accordance with Network and flow of sea transport for cargo in the eastern Indonesia, cargo is at present consolidated in Surabaya. - See the figure 2 of estimated cargo traffic flow [2,3]. This results in Surabaya becoming the gateway of the eastern Indonesia. From the geographic position, this condition is inefficient and costly. Bitung and Biak or Sorong that is prospective to be trading gateway to the Asia Pacific countries, in the mean time, have not been fully developed. On the other hand, the sea transport connecting remote areas is still in poor condition. Less load factor of ships from eastern Indonesia becomes the reason for developing several ports as transshipment ports either for domestic or foreign cargo.

Therefore, following questions will be the formulation of problems in this concept what is the development concept of ports in eastern Indonesia and how is the port development planning model appropriate to the eastern Indonesia as a flexible planning tool which could be used to forecast the traffic every years and to

review master plan of port.

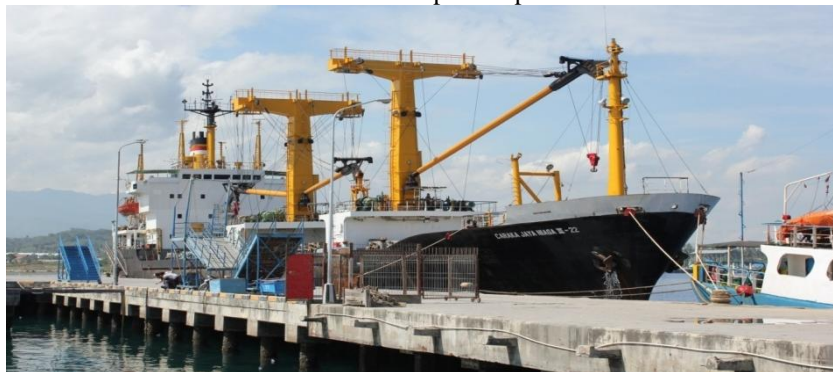


Figure 1. Port Activity in Palu Eastern Indonesia

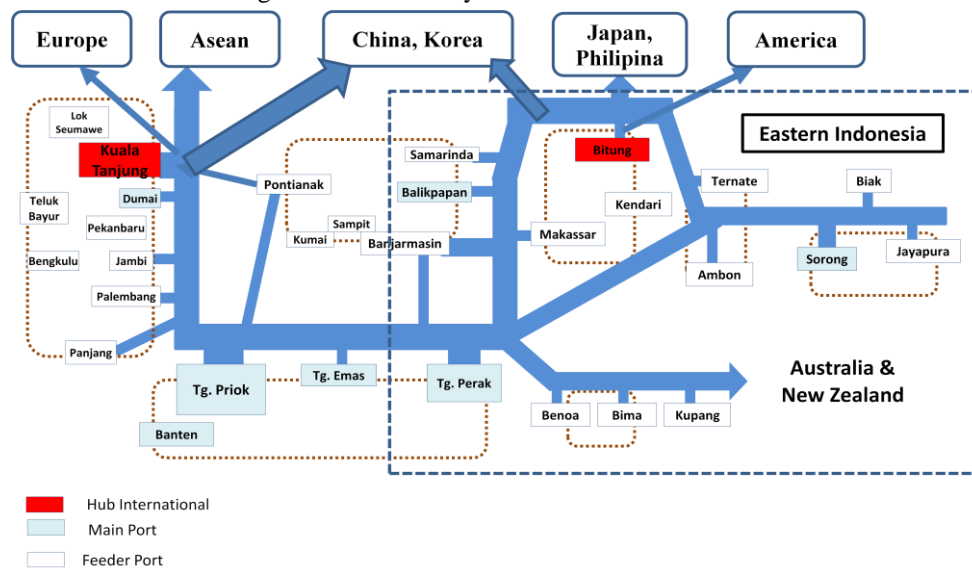


Figure 2. Indonesian Transportation Network Model [6,10]

III. BASIC CONCEPT OF MODEL

This model will make a development concept of port in the eastern Indonesia. For this purpose, a set of port development planning models for the eastern Indonesia will be provided. It comprises of: (i) traffic model; (ii) port assignment model; (iii) shipping network model; (iv) port hierarchy; and (v) port capacity. The second state is to formulate the development concept of port in the eastern Indonesia.

3.1. Traffic Model

The objective of traffic model is to forecast maritime traffic flows by mode of maritime transportation from and to the eastern Indonesia [7,11,6]. The modeling approach used is similar to the general transportation planning approach that incorporates the traffic generation, traffic distribution and modal split stages. In the first stage, i.e. traffic generation, historic traffic pattern can be analyzed by looking at either regression function estimations with socio-economic variable as predictor variables or growth rate of trade and passenger. The output of the traffic generation phase is a set of projections of cargo (the imports, exports, unloading, and loading) by the main commodities and passenger for each ports. In the second stage, traffic distribution, the projected traffic of each port is transformed into projected traffic flow from and to the eastern Indonesia with a number of mathematical methods. Finally, the projected traffic flows of commodities and passenger are translated into traffic flows by mode of transport i.e. the cargo type's container, dry bulk and general cargo. The preference of maritime transportation mode is based on the technology of ship appropriate to the packaging technology and the cargo quantity.

3.2. Port Assignment

Port assignment model directs traffic flows to individual ports in each port by cargo types. The container cargo estimation was made according to tones/TEU ratio for imported, exported, loaded, and unloaded cargo in each port. The empty containers are estimated by the share data of empty containers for each port. The main output of the model is the port-to-port traffic flows that are used in the shipping network, port hierarchy

mode, and port capacity model [10,6]. To analyze the minimum cost of maritime transport describing the sailing time or the distance between the origin and destination of port, the linear programming for the transshipment case is used.

3.3. Shipping Network Model

The shipping network model contains the models for the liner conventional, container, and others. The main functions of these models are to assess the shipping capacity required to carry the forecast traffic flows and implied vessel calls at ports. The shipping model assigns cargo to routes according to user preferences [8,2]. This preference includes frequency of service as a proxy for the price, transit time, and transshipment cost and transshipment delays.

3.4. Port Hierarchy and Capacity Model

The objective of this model is to analyze the hierarchy of port into gateway port, collector port, feeder port, or trunk port, consistent with the trade, passenger and shipping forecast. So, the preference factors are related to geographic position, land use activity, product and hinterland width. This model is based on the analytical hierarchy process or through the analysis of the main component with the statistic model. The port capacity model contains the mathematical queuing model and the simulation model. This model assess the capacity requirements of ports in the eastern Indonesia, consistent with the trade, passenger and shipping forecast, and provides an analysis of berth expansion cost against ship waiting time costs [6,9,10].

IV. DEVELOPMENT AND DESIGN CONCEPT

The development and design concept of ports consist of cargo and traffic, port performance and shipping network. Design concept can be constructed and programmed of several mathematical models of traffic generation and distribution, modal split, port assignment, liner shipping network, analytical hierarchy process and simulation model as shown as figure 3 basic models for port development.

The port hierarchy includes the type of terminal, quay, storage, and equipment for handling could be assigned by the port hierarchy model. Furthermore, the phases of port development planning based on the output of the port capacity model.

The previous activity of this concept is collecting the existing and future prospect. The first stage is developing traffic generation models that will be produce commodities and passenger estimates. The second stage is developing traffic distribution models to obtain origin destination of commodities and passengers estimated. Then the third stage is using the modal split to separate cargo types.

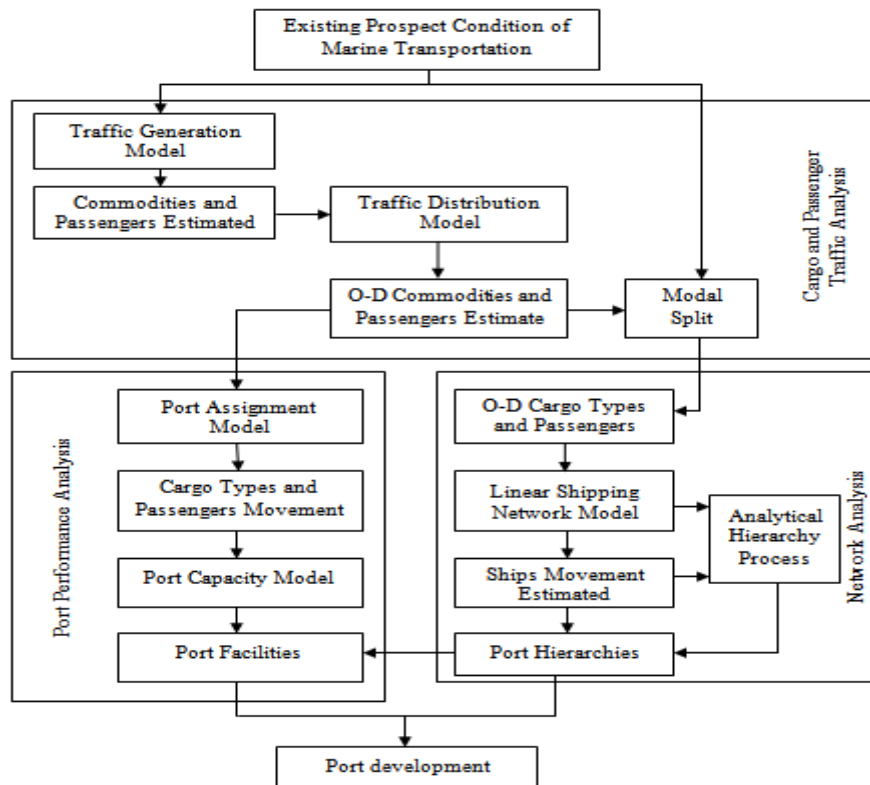


Figure 3. Conceptual Modeling of Port Development

The four stages are to analysis port assignment in order to separate cargo types and passengers movement estimated. Then the fifth stage is to analysis liner shipping network that will be assessing the ship movement estimated. The seventh stage is built port capacity include simulation model and several approach to obtain the port facilities and equipment's requirement. Finally, using analytical hierarchy process to determine port hierarchies. The output of overall model is port development and design concept in Eastern Indonesia. Furthermore port development model can divide to traffic movement estimate, modal split, liner-shipping network and simulation of port capacity and analytical hierarchy process.

The variables depend on each conceptual model. The variable of:

- a) Traffic generation model are: (i) GRDP; (ii) total population; (iii) agriculture product; (iv) mining and quarrying product; (v) fishery product; (vi) forestry product; manufacturing product; etc.
- b) Traffic distribution model are (i) growth factors of traffic production and attraction; (ii) cargo movement (export, import, loading, unloading) and passenger travelling behavior.
- c) Port assignment model are (i) cargo types; (ii) tones/TEU; (iii) name of origin and Destination port; (iv) Volume of cargo; and (v) port shares.
- d) Shipping network model are: (i) sailing time; ((ii) distance from origin to destination port; (iii) Frequency; (iv) maritime transport cost; (v) load factor of ship; and (vi) size of ship.
- e) Port hierarchy are: (i) export cargo flow; (ii) import cargo flow; (iii) loading cargo flow; (iv) unloading cargo flow; (v) container cargo flow; (vi) passenger flow; (vii) port capacity; and (ix) port facility; (x) geographic position; etc.

Port capacity requirement are: (i) length of berth; (ii) occupancy of berth; (iii) waiting time; (iv) total ship call per year; (v) technologies of ship (vi) total cargo flows per year; (vii) length of ship; (viii) berthing time; (ix) ship crane or mobile crane productivity; and (x) port operation time.

V. CONCLUSION

This concept model research is very important to create the concept development of ports in eastern Indonesia with the new sea transportation network to appropriate sea transportation as well as effective and efficient, so the port can perform its function as hinterland development supporter and is very important for developing region to anticipate free trade. In addition to the port's development concept, this concept also produces the flexible planning tool consists a set of port development planning models to be used in forecasting the traffic every year and reviewing the master plan of port. This tool could be updated to reflect the continuing changes in maritime trade.

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