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RESEARCH ARTICLE

A STUDY ON BEHAVIOURS OF INTER-CITY FREIGHT TRANSPORT WITHIN PROVINCE (A CASE STUDY: THE FREIGHT TRANSPORT IN SOUTH SULAWESI PROVINCE-INDONESIA)

***¹Hakzah, ²Lawalenna Samang, ³Rudy Djamaluddin and ⁴dan Muhammad Isran Ramli**

¹Doctorate Student, Civil Engineering, Hasanuddin University Makassar, Jl. Perintis Kemerdekaan, Km 10

²Professor, Civil Engineering, Dept. Engineering Faculty, Hasanuddin University Makassar,
Jl. Perintis Kemerdekaan, Km 10 Makassar

³Associate Professor, Civil Engineering, Dept. Engineering Faculty, Hasanuddin University Makassar,
Jl. Perintis Kemerdekaan, Km 10 Makassar

⁴Associate Professor, Civil Engineering, Dept. Engineering Faculty, Hasanuddin University Makassar,
Jl. Perintis Kemerdekaan, Km 10 Makassar

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ABSTRACT

Infrastructure development of freight transport system is vital in Master Plan for Acceleration and Expansion on Indonesia's Economic Development (Masterplan Percepatan dan Perluasan Pembangunan Ekonomi Indonesia/MP3EI). Based on this context, this study aims to analyse one of freight transport main characteristics namely transport cost between cities in South Sulawesi Province. Survey using questionnaire interviews with the freight transport operators was carried out in order to gather information on characteristics of the freight transport including operator characteristic, vehicles characteristic, trip characteristic, and commodity characteristic. Interviews with the freight transport operators travelling across Parepare - Makassar, one of freight transport main routes in South Sulawesi Province, was carried out for one week. The survey data was analysed using descriptive statistic approach to understand the existing freight transport characteristic phenomenon. Furthermore, the transport cost analysis was conducted by developing relationship model between cost and distance travelled by freight transport using regression model approach. The result of the analysis shows that the transport cost of the freight transport is significantly determined by the operator salary cost, fuel cost, and vehicle maintenance cost. The freight transport operational cost model gives decent significance level in aspect of the transport modes used as well as the commodities transported. These results provide basis and expectation toward more advanced analysis on developing more comprehensive model of freight transport modes choice for freight transport trip in South Sulawesi Province in further studies.

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INTRODUCTION

In order to implement the Master Plan for Acceleration and Expansion on Indonesia's Economic Development (MP3EI, 2011), construction and development of freight transport system hold vital position. Several studies of freight transport in Indonesia have been and still being conducted to understand the behavior and characteristic of infrastructure construction

and development of the freight transport system including characteristic or behavior of the stakeholders in the freight transport system, freight transport model of needs, infrastructure budgeting concept of freight transport, etc. Most studies were conducted for freight transport behavior in Jawa, Sumatera, and Kalimantan. Among others were Ridwan (2012) for Jawa, Syahminan, *et al.* (2011a, 2011b, 2012) for Sumatera, and Mahmudah, *et al.* (2012) for Kalimantan. Specifically, the research on freight transport behavior and characteristic in South Sulawesi Province is still rarely conducted and not yet profoundly explored. Previous research

***Corresponding author: Hakzah**

Doctorate Student, Civil Engineering, Hasanuddin University
Makassar, Jl. Perintis Kemerdekaan, Km 10

attempted to observe the characteristic of freight transport in South Sulawesi Province only focused on development of container port in South Sulawesi Province (Idrus *et al.*, 2012; Dewa *et al.*, 2012). In order to explore the behavior and characteristic of the freight transport in South Sulawesi Province, the writer have attempted to depict the characteristic of freight transport operating in region Mamminasata Metropolitan Area, South Sulawesi Province (Hakzah *et al.*, 2013a and 2013c) and also the characteristic of freight transport trip across Makassar - Parepare in northern of South Sulawesi Province (Hakzah, *et al.*, 2013). Moreover, the load value and cost characteristic of the freight transport based on the transport modes and commodities transported have also been successfully described (Hakzah *et al.*, 2014). As a follow-up of these research results, and contributes to development of freight transport in South Sulawesi Province, this study aims to describe operational cost characteristic of freight transport, and models the relationship between freight transport operational cost against the distance traveled for the category transport modes and comodities transported in freight tranport trip across Makassar - Parepare as one of main axis in freight transport network in South Sulawesi Province.

MATERIALS AND METHODS

This study used data collected from the interviews survey on characteristic of freight transport operating in Makassar-Parepare, as main axis in freight transport network in South Sulawesi. This survey results data was partially elaborated and analysed gradually as in Hakzah *et al.* (2013b; 2014). This freight transport survey covered interviews survey on many aspects of the existing freight transport system, carried out for 24 hours for 5 days started from 06.00am to 06.00am the next day. The survey used form that have been designed and tested before.

The interview method on the vehicle operator was conducted by stopping the vehicle to roadside then interviewed the driver or the operator based on the question items in the questionnaire. As for the question items in the questionnaire, they covered the trip origin-destination, departure time, estimated cost and travel time, types and quantities of the commodities transported, and the freight transport vehicles types along with the the loads values, etc. The data collected then described and analysed statistically against the phenomenon of the freight transport operational cost in aspect of the transport modes as well as the commodities transported. Furthermore, the study also developed model of freight transport operational cost against the distance traveled using the simple linear regression model approach.

RESULTS AND DISCUSSION

Characteristic of Freight Transport Operational Cost

Based on the results of the freight transport survey carried out in Makassar - Parepare corridor and performed data compilation, then obtained representation of the freight transport operational cost characteristic is shown in Figure 1 from the viewpoint of transport modes used, and Figure 2 shows from the viewpoint of the commodities transported. Figure 1 and Figure 2 show that there are 3 (three) types of freight transport operational cost (namely: fuel operational cost, operator salary operational cost, and vehicle maintenance operation cost) which dominate the amount of transport operational cost of freight transport in South Sulawesi. As for additional cost, although not in big proportion, is in the form of payments in weighbridge. Based on types of transport modes used, Figure 1 shows that the operator salary cost has bigger portion than the fuel cost and maintenance cost.

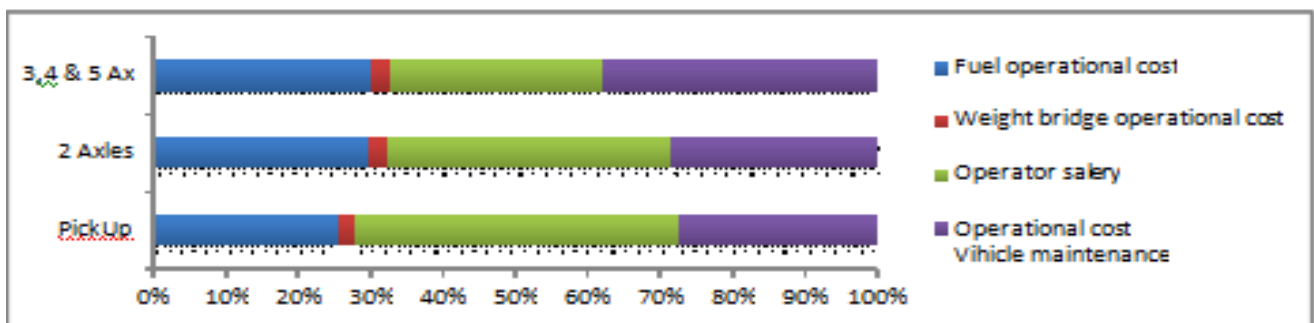


Figure 1. Model and degree of freedom with bar ends in rigid tip

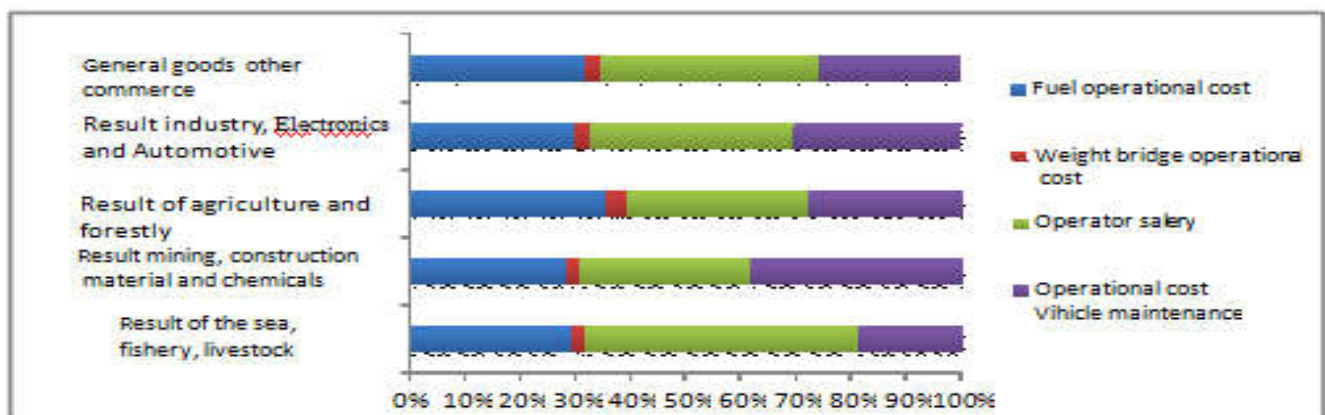


Figure 2. Model and degree of freedom with bar ends in rigid tip

Similar thing happens for the type of 2-axles truck where the fuel cost and maintenance cost is relatively equal. However, for the 3-4-5-axles truck, the vehicle maintenance cost is more dominant than the fuel cost and operator salary cost where both are relatively have equal portions. In Figure 2, it is shown that between those three dominant cost are alternately having high proportion from commodities transported viewpoint. For the marine products, fishery and livestock, industrial products, electronics and automotives, and others commerce goods, the operator salary cost is more dominant than other cost. However, for the commodities of agriculture and forestry, the fuel cost is more dominant. In case of mining, construction materials, and chemicals, the maintenance cost is more dominant than the other cost.

Operational cost model against distance travelled based on modes of freight transport

The model results of relationship between freight transport operational cost against the distance travelled using simple linear regression model based on the types of modes used is shown in Figure 3, and the parameter values of the regression model are presented in Table 1. Table 1 and Figure 3 show that the modeling results of relationship between freight transport operational cost and distance traveled for the types of transport modes using simple linear regression as presented in Table 1 have decent significance level where all models have value of determination coefficient (R^2) near to 1 ranging from 0,8 - 0,9.

Table 1. Parameter values of the regression model based on types of modes

Model Category	Parameter Value		Determination Coefficient (R^2)
	β_0	β_1	
Mode Pickup	461.729	2.680,5	0,9026
Mode 2 Axles Truck	605.264	3.233,5	0,9223
Mode 3-4-5 Axles Truck	450.451	4.708,0	0,8811

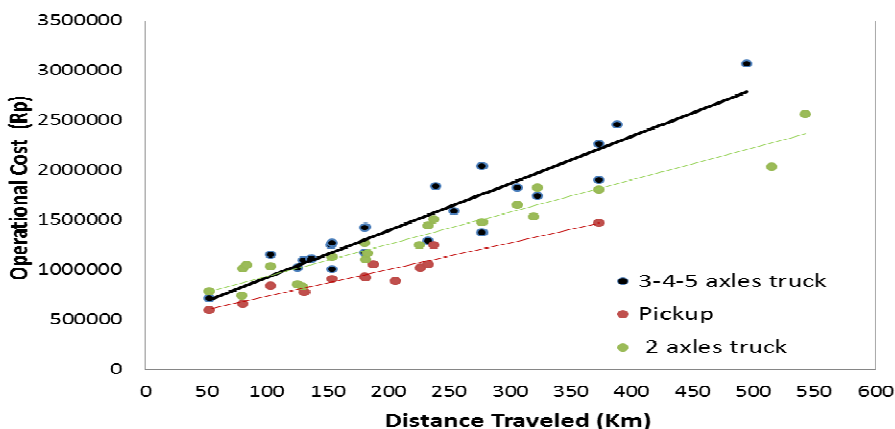


Figure 3. Regression model

Table 2. Parameter values of regression model based on type of commodities

Model Category by Commodities	Parameter Value		Determination Coefficient (R^2)
	β_0	β_1	
Marine, fishery & livestock	298.310	3.219,9	0,9409
Mining, Construction & Chemical	397.443	4.996,8	0,9333
Agriculture and forestry	243.164	3.421,5	0,9095
Electronic, automotive & industrial	657.557	2.949,7	0,9349
Other commerce goods	239.014	4.329,5	0,9419

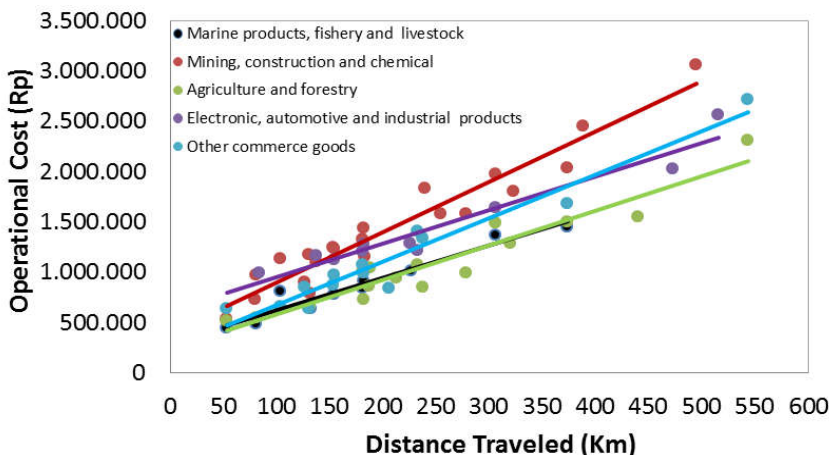


Figure 4. Regression model

Furthermore, Table 1 and Figure 3 show that the model line of operational cost for 3-4-5 axles truck mode has higher slope than the model of two other modes. This is indicated by the higher parameter value of β_1 for 3-4-5 axles truck mode than 2 axles truck mode and pickup mode. As for the two modes mentioned latest, the model line for 2 axles truck mode has higher slope than the model line of pickup mode. These indicate that the operational cost of freight transport using 3-4-5 axles truck mode is higher than the two other modes. Similarly, the operational cost for 2 axles truck has higher operational cost than pickup mode. In other words, the more the machine and the container capacity of the mode used, the more the operational cost in operating the mode.

Operational Cost Model Against Distance Travelled Based on the Freight Transport Commodities

The model results of freight transport operational cost against distance travelled based on the commodities transported is shown in Figure 4 where the parameter values of the regression model is presented in Table 2. Table 2 and Figure 4 show that the modeling results of freight transport operational cost against the distance traveled for the transported commodities have the determination coefficient values (R^2) near to 1 indicating that the models have decent significance level by using simple linear regression model as presented in Table 2. Furthermore, Table 2 and Figure 4 show that model of freight transport operational cost for mining, construction, and chemical has higher slope of line than the 4 other commodities. This is shown by higher value of β_1 parameter of the model for mining, construction, and chemicals than value of β_1 parameter of the other commodities. Consecutively followed by model line of commerce goods, agriculture and forestry, marine products, fishery and livestock, and electronics, automotive, and industrial products. The diversity of the line slope of the operational cost model indicates that the mining, construction materials and chemicals has the highest operational cost of all transported commodities, then followed by other commodities according to their height of the line slope of the model.

The the modeling of freight transport operational cost against distance traveled by its transport modes as well as by commodities transported as presented in Table 1, Table 2, Figure 3, and Figure 4 gives phenomenon that the operational cost of the freight transport are vastly varies depend in the transport modes used and commodities transported. This indicates a behavior exists that choice of transport modes is sensitive to the commodities transported which becomes consideration for the freight owner or even the sender in operating freight transport in South Sulawesi Province. Indication that this behavior in choosing the freight transport mode is existed needs to be elaborated further including to explore other factors influencing mode choice of the freight transport stakeholders in South Sulawesi.

Conclusion

This study has explored one of main characteristics of freight transport namely freight transport operational cost which travels between cities in South Sulawesi Province. By carrying

out survey through interviews using questionnaires with the freight transport operators travelling across Parepare-Makassar, one of freight transport main routes in South Sulawesi Province for one week, the characteristics of freight transport including operator characteristic, vehicle characteristic, trip characteristic, and commodity characteristic has been well described. Furthermore, operational cost of freight transport against distance travelled by freight transport model has been conducted using regression model approach resulting indication of decent regression model significantly. Operator salary cost, fuel cost, and vehicle maintenance cost are 3 (three) components of freight transport operational cost which comprehensively dominant of total operational cost of freight transport in South Sulawesi Province. The amount of freight transport operational cost is quite sensitive to transport modes used and commodities transported. The results model indicates that the more the capacity of transport mode, the more the operational cost of the freight transport, in which the 3-4-5 axles truck transport mode has the highest operational cost. By commodities, the highest freight transport operational cost is the mining, construction materials, and chemicals. The model results of freight transport operational cost obtained in this study becomes one of basis in developing a model of freight transport mode choice in South Sulawesi Province in further studies.

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