The Trips Assignment Influence of Freight Vehicle Network System on the Need for Fuel Consumption in Internal - Regional

The Trips Assignment Influence of Freight Vehicle Network System on the Need for Fuel Consumption in Internal - Regional

Juang Akbardin[1*], Danang Parikesit[2], Bambang Riyanto[3], Agus Taufik[3], Mulyono[2], Sri Wiwoho Mudjanarko[4]

[1]Department of Civil Engineering, Universitas Pendidikan Indonesia, Bandung, Indonesia
[2]Department of Civil Engineering, Universitas Gadjah Mada,Yogyakarta, Indonesia
[3]Department of Civil Engineering, Universitas Diponegoro, Semarang, Indonesia
[4]Department of Civil Engineering, Universitas Narotama, Surabaya,Indonesia

*akbardien@upi.edu

Abstract. The road network system in the distribution of the freight transport movement has a strategic role to create economic value of goods that is more efficient than the transportation cost component of goods commodity. The increase of expensive oil fuels requires estimated needs for the distribution of the goods traffic movement on a road network. The consumption of fuel oil is estimated based on the value of the energy content needed in the type of vehicle used. Analysis of the fuel oil needs from the movement distribution of road freight transportation is based on variables that determine the need for fuel oil consumption in the type of freight transport. Moreover, the distribution distance, vehicle type and fuel consumption coefficient are variables that determine the need for oil fuel in the loading of the road network system on a macro basis. The results of the road network system loading model based on the all or nothing model method on the regional regional - internal road network of Central Java province were produced = 352.48 + 0.965 with model validation with traffic counting data obtained was R2 = 0.55. The consumption of oil fuel in the road network system from road network loading obtained the highest fuel consumption from the consumption of pick up vehicle material as the largest vehicle consumption. So that from the analysis results of the need for fuel consumption in road freight transport, a new strategy can be made to reduce the use of small transport on the movement of road freight in the road network system.

Keywords: Trip Assignment, Freight Vehicle, Fuel Consumption, Internal-Regional

1. Introduction

Increasing high road freight transportation requires large fuel oil consumption. With fluctuations in oil prices that are uncertain require estimates of fuel oil needs to be known in accordance with the traffic demand of goods from the road freight strategic role in the distribution system. Road freight transportation which is formed from the production movement system of the commodities generation between zones in the internal region of a region is difficult to be limited because it is directly a derivative of the region economic system. The need estimation for fuel oil based on the loading of the road network system in the internal - regional Central Java Province is needed to base the strategy on the use of transportation modes on the right road goods in the goods transportation system in the internal - regional in accordance with the distance of movement

distribution. The strategy of using road freight transport in accordance with the distribution of commodity goods will greatly determine the economic price of the goods distributed if it is in accordance with the carrying capacity and distribution volume [1].

The use of road freight transportation with effective fuel consumption in accordance with the transportation of goods will reduce the need for fuel consumption in general in building the road network system. So that the development of infrastructure supporting the distribution system of road freight can be appropriately constructed in accordance with the transport of goods, it serves to suppress the overall internal – regional of oil fuel consumption needs. [2], [3], [4]

2. Transportation Modelling

Transportation modeling is the process of distributing a destination matrix on a road network in order to produce traffic flow in the year of the planning.The Destination Origin Matrix (MAT) is the data as the main component used in planning and modeling of transportation system. [2]

2.1. Trip Assignment

Trip assignment is a process where the travel requests (obtained from the distribution stage) are charged to the network road. The purpose of trip assignment is to get the current on the road and / or the total trip in the reviewed network.

2.2. Highway Capacity

$$C = C_0 \text{ x } FC_W \text{ x .} FC_{SP} \text{ x .} FC_{SF} \text{ x .} FC_{CS} \quad \text{... (1)}$$

C = Capacity (pcu/jam)
C_0 = Basic capacity (pcu / hour)
FC_{SP} = Distribution adjustment factor
FC_W = Road width adjustment factor
FC_{SF} = Side disturbance adjustment factor
FCcs = City size adjustment factor

2.3 Modelling of Transportation based on Traffic Flow

$\hat{V}$ total flows on certain roads is the sum of the movement between the zones within the study area that use these roads, shown in equation (5).

$$\hat{V}_l = \sum_{i=1}^{N} \sum_{d=1}^{N} T_{id} \cdot p_{id}^{l} \quad \text{…(2)}$$

Commodity moved between the zones within the study area is represented by a model of transportation demand with Gravity Model Opportunity (GO) in which T_{id} total movement with the i starting point zone and the destination zone for all commodity movements purposes are indicated by equation (3) [1]

$$T_{id} = \sum_{k=1}^{K} T_{id}^{k} \quad \text{…(3)}$$

where the commodity that moves from i zone to d zone is shown on equation (4)

$$T_{id}^{k} = b_k . O_i^k . D_d^k . A_i^k . B_d^k . f_{id}^k \quad \text{…(4)}$$

By subtituting equation (2) to equation (4), the basic equation for the transportation demand estimation model with traffic flow data is shown on equation (5) [1]

$$V_l = \sum_{k=1}^{K} \sum_{i=1}^{N} \sum_{d=1}^{N} \left(b_k . O_i^k . D_d^k . A_i^k . B_d^k . f_{id}^k p_{id}^l . \right) \quad \text{…(5)}$$

2.4. Traffic Impact Analysis on the need for fuel consumption

Fuel consumption which is the dominant variable of transportation services is based on the formulation of Vehicle Operating Costs (BOK) in the transportation service transportation service system. Fuel consumption in the needs of the fuel oil amount in the freight transportation system, using a method based on energy content data. Energy data content is obtained from the literature [5], [4] at it is shown in equation (6)

Fuel = the amount of fuel x energy content ...(6)

Energy is the ability to do work. Energy Contents (energy content) as a term used for the amount of energy stored in a particular system or space per unit/ volume.

Table 1 shows a relative measure of the amount of substances that can be equivalent in producing the required results.[2].

Table 1. Energy Content

Energy Content			
Electricity	Hydro	3,6	MJ/kWh
	Nuclear (typical value)	11,6	MJ/kWh
Steam		2,33	MJ/kg
Natural Gas		37,23	MJ/m3
Ethane (liquid)		18,36	MJ/l
Propane (liquid)		25,53	MJ/l
Petroleum Products	Aviation Gasoline	33,62	MJ/l
	Motor Gasoline	34,66	MJ/l
	Kerosene	37,68	MJ/l
	Diesel	38,68	MJ/l
	Light fuel oil	38,68	MJ/l
	Heavy fuel oil	41,73	MJ/l

3. Research Methods

The research approach studies the effect of loading goods transport road network systems on the need for fuel consumption in the internal - regional road network system as it is shown on the below flow chart.

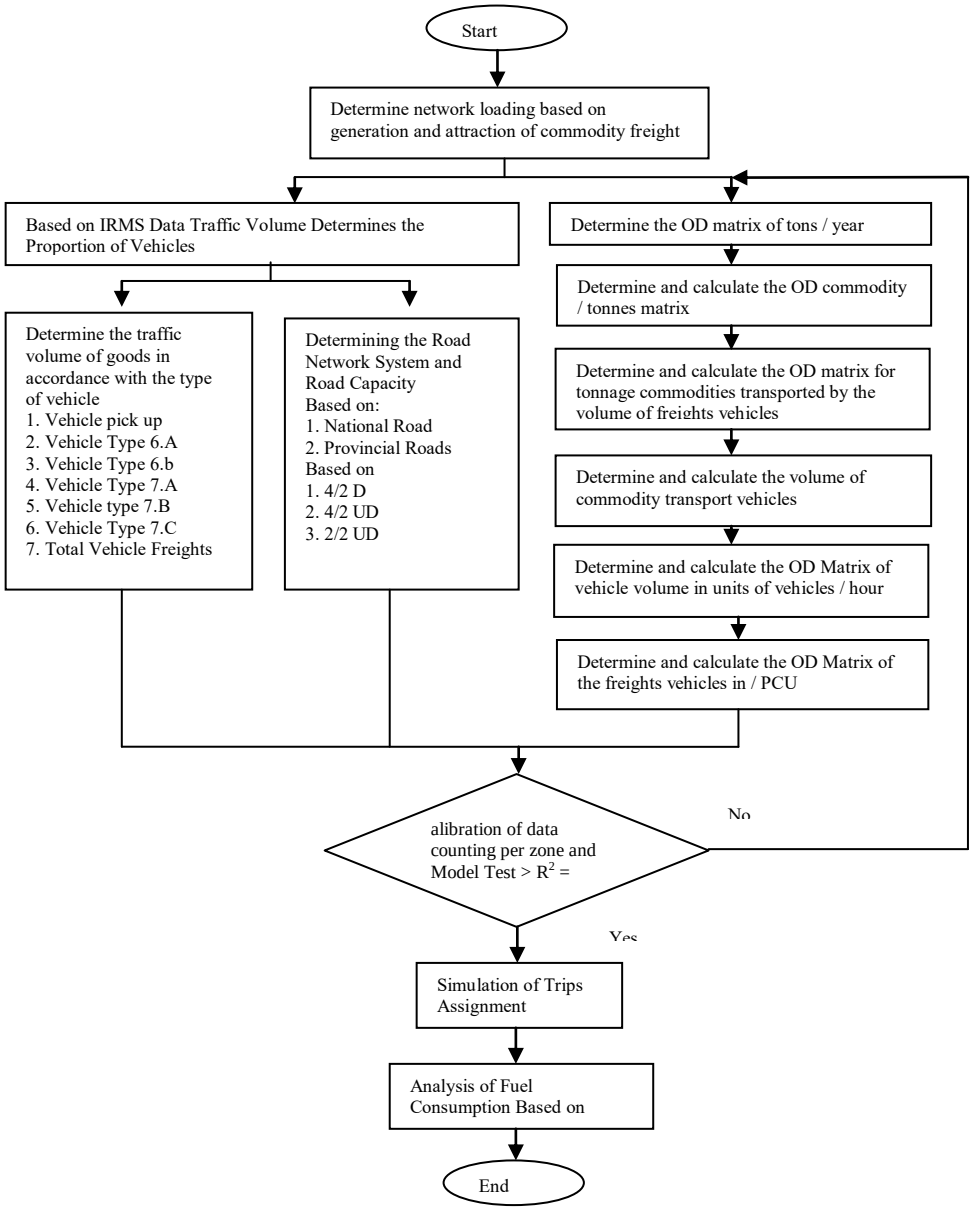

Figure 1. Research Flow Chart

4. Results and Discussion

4.1 Modeling of Trips Assignment Road Network in Central Java

Based on the road network data in Central Java, the road capacity in Central Java is based on the road width or space owned by the road in accordance with the type of road.

Table 2. Road Capacity in Central Java

Road Width (m)	C_o	FC_w	FC_{sp}	FC_{sf}	Capacity	Model Input
17	1900	1.03	1	0.95	7436.6	3718.3
12	1900	0.91	1	0.95	6570.2	3285.1
9	1700	1.15	1	0.95	1857.25	928.625
7	3100	1	1	0.91	2821	1410.5
6.5	3100	1	1	0.91	2821	1410.5
6	3100	0.91	1	0.91	2567.11	1283.555

Based on the network system loading modeling in accordance with the service perspective, the operator shows that the main lines between zones to determine the route selection of the traffic movement is shown in the network that has sufficient density on the served sections. Model validation is carried out based on IRMS 2016 data validated from each zone. The validation results of network load modeling based on commodity production are shown in the figure (7). The traffic volume of goods transport truck vehicles based on operator service perceptions shows that the transport of goods transport vehicles serves transportation with one shipment operation with empty freight on the way of home delivery. Model validation equation, the movement of Vid commodities, is indicated by equation ( ) Y = 352.48 + 0.965 X ( ) with R2 = 0.55. Characteristics of movement of traffic volume (Vid).

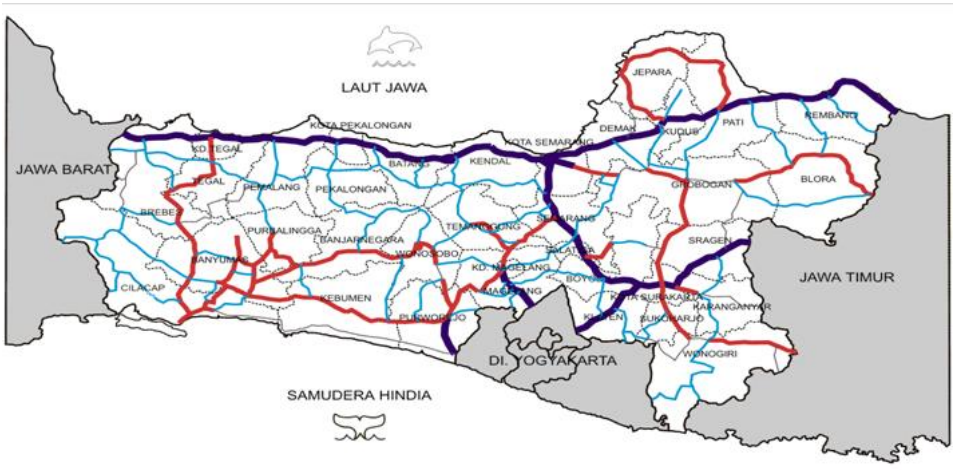

Figure 2. Map of the Central Java Road Network

4.2 Influence of Freights Vehicle Traffic Volume on Fuel Consumption Needs

The movement of road goods transportation has a very large energy demand, especially for the consumption of oil fuel (BBM). Then, the need for oil fuel consumption from the transportation sector is estimated based on the Energy Content needed in accordance with the type of fuel. Fuel consumption needs from the movement of the goods traffic volume from the road freight transportation system in Central Java based on the standard of PICC analysis shown in Figure. 3 [3].

From the analyze of the need for freights fuel consumption in the road network system in Central Java, it shows that the biggest need for transportation of the largest commodity freights fuel needs in accordance with Pick Up vehicles has the need for 233,582,708.7 liters. This shows that the fuel consumption of small-type transport vehicles has more consumption than the large-capacity freight vehicles. Therefore, the movement of goods transportation is not efficient to use small transport. From the analysis of the petroleum fuels needs for freight transport, it is preferred to use freight transport in the distribution of regional - internal goods to reduce the need for consumption of fuel. [6], [7], [8].

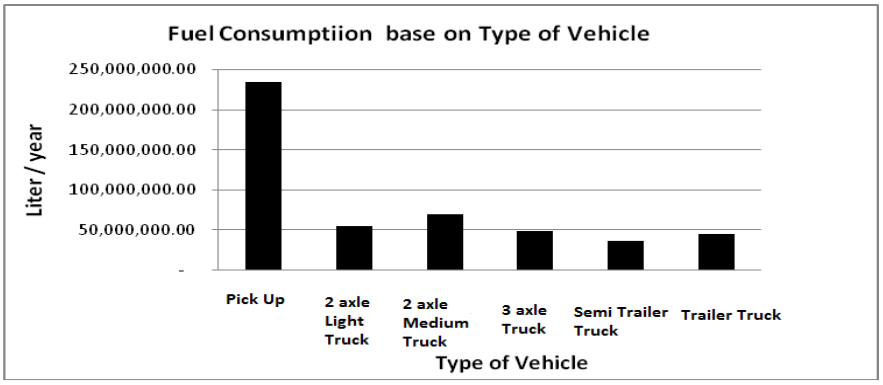

Figure 3. Consumption of oil fuel (BBM)

Table 3. Fuel Consumption Needs (Vid) of Freights Vehicles in the Road Network System in Central Java

No	Type of Vehicle	Numbers of Vehicle	Type of Fuel	Specific Of Fuel Consumption (lt/100km)	Specific Of Fuel Consumption (lt/km)	Movement Distance in a Network System Xid (km)	Fuel consumption on the network system (liter)
1	Pick Up	10945	Gasoline	10.64	0.1064	200578	233582708.7
2	2 axle light truck	1500	Diesel	18.5	0.185	200578	55660395
3	2 axle medium Truck	1843	Diesel	18.8	0.188	200578	69497067.75
4	3 axle truck	1276	Diesel	19	0.19	200578	48628130.32
5	Semitrailer truck	958	Diesel	19.1	0.191	200578	36701361.28
6	trailer truck	1193	Diesel	19.2	0.192	200578	45943594.37

5. Conclusion

Based on the results of modeling and analyzing the fuel consumption requirements data on the system of loading the regional - internal road network, it shows that the need for fuel consumption in very large road freight is dominated by small types of transportation. This is very inefficient in the pattern of internal - regional freight distribution. So that in the results of this study it is possible to change the distribution pattern of internal - regional freight transport with vehicles with greater transport capacity and to improve the trade system of freight transportation for the greater use

References

[1] J. Akbardin, "Variable Relationships Estimation Of Cargo Transportation Network System To The Number Of Internal Regional Cargo Mode (Case Study Of Road Network System in Central Java Province)," 2013.
[2] Z. T. Ofyar, "Perencanaan dan Permodelan Transportasi," *Ed. kedua, ITB Bandung*, 2000.
[3] S. Tanatvanit, B. Limmeechokchai, and S. Chungpaibulpatana, "Sustainable energy development strategies: implications of energy demand management and renewable energy in Thailand," *Renew. Sustain. energy Rev.*, vol. 7, no. 5, pp. 367–395, 2003.
[4] J. Akbardin, D. Parikesit, B. Riyanto, and A. T. Mulyono, "The Influence of Freight Generation Production Characteristics of the Internal–Regional Zone Commodities on Sustainable Freight Transportation Highway Network System," in *MATEC Web of Conferences*, 2018, vol. 159, p. 1014.
[5] I. Y. Davydenko, L. A. Tavasszy, and P. S. G. M. Smeets, "Commodity freight and trip generation by logistics distribution centers based on sectorial employment data," 2012.

[6] Y. Jin, I. Williams, and M. Shahkarami, "Integrated regional economic and freight logistics modelling: results from a model for the Trans-Pennine Corridor, UK," *Proc. ETC 2005, STRASBOURG, Fr. 18-20 Sept. 2005-TRANSPORT POLICY Oper. Logist. Model. I*, 2005.
[7] S. W. Mudjanarko, H. Sulistio, L. Djakfar, and A. Wicaksono, "Behaviour Model of Motor Cycle User in Selecting Parking Location (Case study in Surabaya City of Indonesia)," *J. Basic Appl. Sci. Res.*, vol. 3, pp. 842–846, 2013.
[8] W. Slamet, K. Made, P. Tubagus, S. Agus, and M. S. Wiwoho, "Internet of Things (IoT) as Green City Economic Development Smart Transportation System," in *MATEC Web of Conferences*, 2017, vol. 138, p. 7015.