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Transportation Model Inter-Islands Cluster Trans Maluku In Supporting For Regional Development Of Maluku Province (A Study Integrated Model Between Road And Ferry Transport)

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Abstract: ***M****Geography with the dominant marine areas scattered small islands (Island Cluster), resulting in high transportation costs, the level of isolation, lack of accessibility, and infrastructure and transportation affect the region's economic growth. This study, a case study and policy, using a combination of quantitative and qualitative description to find out how the operational characteristics and integrated model between Road and Ferry Transport. In general, transport services are far from adequate, especially in the inter-islands cluster in the East and South Maluku. Required system integration between modes of air transport services and waters subsystem transport (pioneer sea transportation, shipping people, and transport ferry). Intermodal transport capacity sensitive to the speed and density of Average Daily Traffic (ADT).*

Keywords: *Simulation model, Integrated Transport, Road and Ferry Capacity*

I INTRODUCTION

Geography Maluku province lies between 2 ° 30 ° - 9 ° south latitude and 124 ° - 136 ° east longitude, with administrative boundaries as follows: Northern borders of North Maluku province, South side adjacent to East Timor and Australia, East with West Papua, and Next to the western borders of Southeast Sulawesi and Central Sulawesi [1].

The total area of the whole is 712.479.69 km^2, 92.40% is 7.60% and the territorial waters of an area of land. Maluku province is a region of islands has 1340 islands, so that the role of water transportation is very important as Infrastructure supporting community activities and development of the region.

Entanglement interactions islands in the Maluku province has run followed the pattern of activity in the field of economic and social development. Internal spatial structure of Maluku becomes a reference in managing the service hierarchy, function and range of services of the transport system on the island of Maluku. The accessibility levels in the utilization of economic resources, both physical and non-physical can be measured by the amount of traffic or the movement of traffic generation at transit points. The linkage between regions in the island cluster Maluku Province, internally materialized in the form of patterns of interaction between growth centers and settlement hierarchical/levels so as to form a pattern of regional transport network in the region as a whole tissue. This is expected to develop integrated transport and crossing the road in one unified system called the Trans Maluku.

II THEORITICAL FRAMEWORK

1. Capacity and Degree of Saturation

Morlok [2] suggests that traffic volume is the number of vehicles passing through a point on a path of motion per unit time, measured in units of vehicles per unit time. Traffic volume can be expressed in the following formula;

$$Q = n / t \quad (1)$$

In this case, Q is the volume of traffic (veh/h), n is the number of vehicles passing through that point in the time interval of observation; t is the time interval of observation. Capacity is the ability of roads to accommodate the traffic load can be expressed as follows:

$$C = C_o \times F_{Cw} \times FC_{sp} \times FC_{sf} (veh/h) \quad (2)$$

In this case, C is the capacity (vch/h), Co is the basic capacity (smp/hour), FCW is the adjustment factor due to the width of a traffic lane, FC_{sp} is the adjustment factor due to the separation direction, and FC_{sf} are adjustments due to side friction factor.

Degree of saturation (DS) is the ratio of the volume (veh/h) of the traffic capacity [3]. Plans between urban roads should be in order to ensure the degree of saturation does not exceed the acceptable value (DS <0.75). The degree of saturation is calculated by using traffic flow and capacity and is expressed in the following equation:

$$DS = Q/C \quad (3)$$

where:
Q is the volume or traffic flow (veh/hour)
C is the capacity (veh/hour)
DS is the degree of saturation

Line Capacity of Ferry

Determination of the capacity of a ferry ship on a route determined by the characteristics of the voyage distance, trip frequency, and port facilities and the potential amount of cargo Hinterland. Parameter is a constraint for planners to determine the capacity of the vessel. Similarly, the designer of the vessel in determining the size and speed of the vessel, which is expected to give the effect of a minimal cost to the users of transportation services.

Vessel capacity optimization model can be established based on the characteristics of the components of vessel operating expenses are the cost components at sea and in port. Vessel capacity analysis model is shown in Figure 1, the capacity of the vessel on crossing trajectories determined by three factors, namely: i). Demand characteristics, ii). Infrastructure connectivity over unloading at the port and, iii). Typologi ships including load capacity and speed.

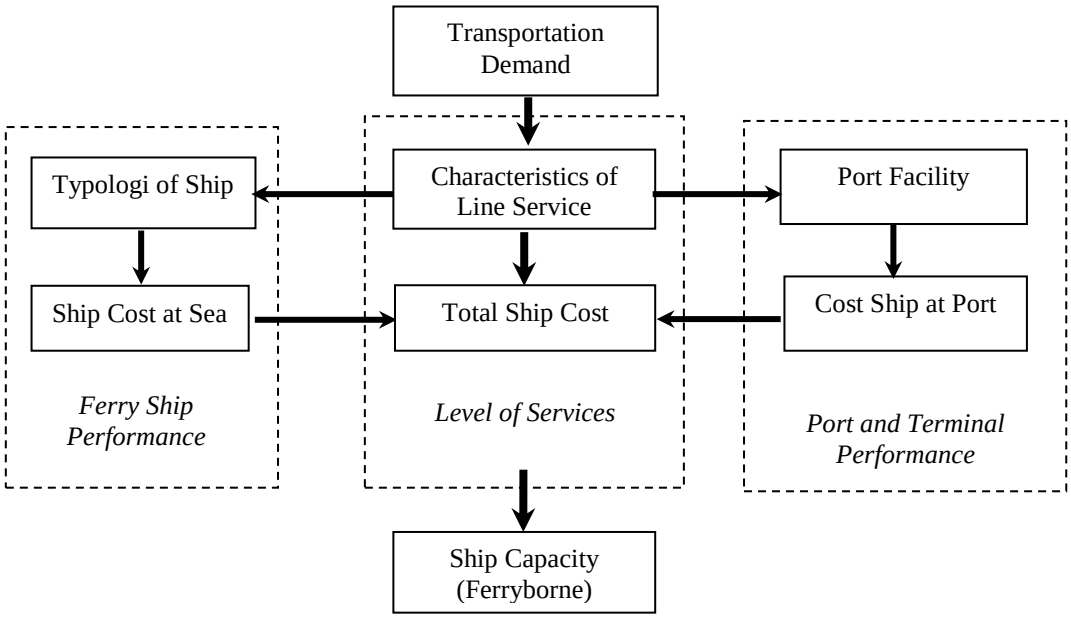


Figure 1. Analysis Model of Ship Capacity
(From, Jinca M.Y. [4])

Speed and Capacity Line

The primary measure that determines the amount of time operating a ship at sea is a parameter related to ship technology with ship speed (Vk), and the characteristics of the shipping routes, line ferriage [4]. So a ship at sea can be formulated as follows:

$$W1 = \frac{Jp}{Vk} \qquad (4)$$

where, Jp is Distance Line Ferry and Vk is the speed of the ship ferry. Some research suggests that Vk is an exponential function of the variable tonnage (DWT or GRT conversion). The results on 118 cargo ship with a variation between 400 DWT ships up to 11,500 DWT, indicating that the speed of the ship is:

$$Vk = k.(DWT)^{ev} \qquad (5)$$

where: *k* is a parameter that varies from ship design ship type, *ev* is the elasticity of speed boats, from the results obtained values of k = ev = 3.1322 and 0.1674. The principle of ship design that the size of ships (DWT), the ship's speed is influenced by the Froude number, the number and length of boat speed appeal. Shneerson (1982) also suggests that the elasticity of speed boats (ev) are among the values 0.33, 0.24 to 0.19 depending on the type of ship.

Starting from the Theory of Traffic Flow Analysis and synthesis tonnage capacity should be equal to the line ferriage the road capacity that is linked by ferry / line, thus remaining consistent with the flow of traffic and ground transportation into a single unit. This is according to its function as a bridge connecting the road network that is separated by water to transport passengers and vehicles and their cargo [5]. Thus, the formulation of a graphical simulation line capacity is a function of speed and Average Daily Traffic (ADT) path connected.[6,7,8].

(Capacity of Lines) = f (Speed, ADT, Distance of Ferry Road Connection)

FRFAMEWORK AND LOCUS OF RESEARCH

This study classified cases and policy research is studying the transportation system Inter-Islands Cluster Trans Maluku as a product of public service policies, to know how the causal relationship that affects the transport characteristics and performance of transport, using a combination of quantitative and qualitative description to find out how the operational characteristics and transport simulation model an integrated of the road network and ferry capacity of the track. The study was conducted in the province of Maluku in eastern Indonesia.

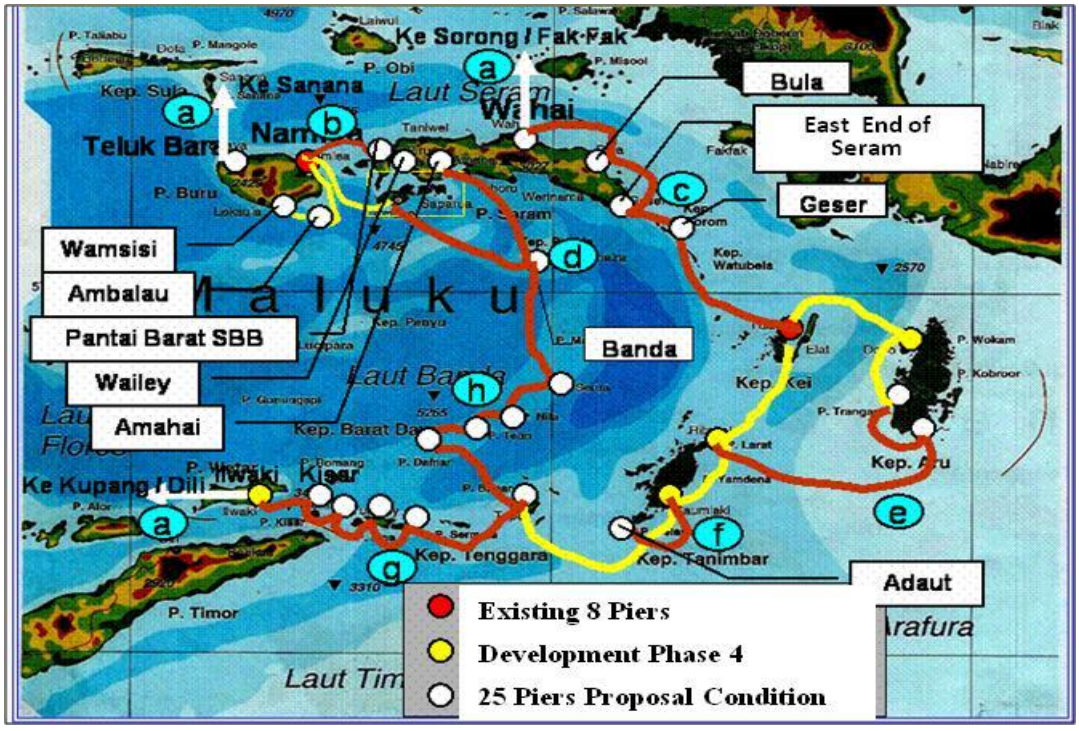


Figure 2. Locus of Research
(From Maluku Province [1]

In scope, the spatial structure of the province consists of twelve remote islands, each island group has development centers that serve the region or city orientation for other cities stratified hierarchy lower. Although not all, most centers service pattern is the district capital. Based on the analysis of patterns of population movement, and the goods transport service network internal Maluku region to do based on the orientation of the island group is divided into 12 clusters Island. The framework Research, see Figure 3.

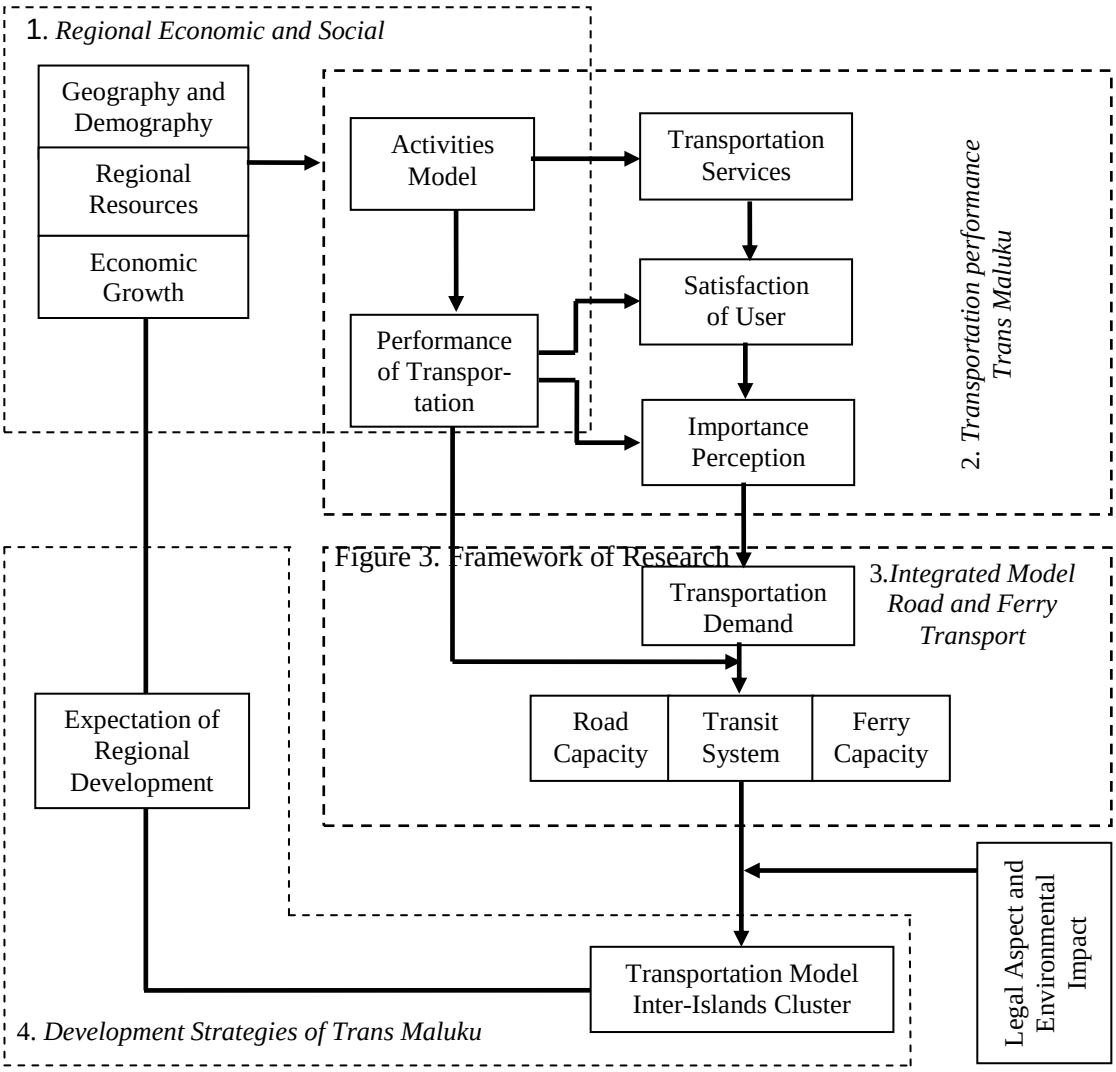


Figure 3. Framework of Research

III RESULT AND DISCUSSION

1. Road and Ferry Connection

The analysis of road capacity shows that the traffic flow on the Passo-Galala road network that serves as the national arterial roads capacity about 3.450 pcu and current road network of the Passo-Galala has traffic volume 2200 pcu still satisfy the traffic flow during peak hours. Congestion already occurs in the visible during peak hours with the degree of saturation of about 0.501. Level of service roads, including the category B is a stable flow, speed of operation began to be restricted by other vehicles and vehicles began to be felt by the surrounding obstacles.

Traffic volume collector road network in Seram island 60 to 150 pcu capacity of approximately 700 to 1000 pcu to accommodate the existing traffic flow. Degree of saturation is still of low value.

Table 1. Internodes of Interisland Cluster Trans Maluku

Island	Road/ Ferry	Internode	Road or Ferry Lines		Traffic Volume (pcu)
			Distance Km/(Mile)	Capacity or Veh (GRT)	
P. Buru	Road	Teluk Bara - Air Buaya - Samalagi - Namlea	125	682	63
	Ferry	Namrole - Leksula	(15)	(385)	-
	Road	Namrole - Mako - Marsolo - Namlea	127	970	71
	Ferry	Namle -Waisala	(49)	-	-
		Namle - Galala	(85)	(1500)	-
P. Seram	Road	Waisala - Piru - Sp. Eti - Kairatu	75	980	133
P. Ambon	Road	Ambon - Galala - Paso - Tulehu - Liang	38	3293	2171
	Ferry	Hunimua - Waipirit	(8)	(495)	-
P. Seram	Road	Kairatu - Waiselan - Latu - Liang - Waipia - Makariki - Masohi - Amahai - Tamilou - Haya - Tehoru - Laimu - Werinama	617	1022	109

Source: Analysis results 2012

The density of road network is in the North cluster, namely Buru Island, Seram, and Ambon Island. Road capacity ranges from 500 to 350 vehicles per hour. Traffic is still very low ranging from 60 to 2200 ADT. The level of service (VCR) range 0.09 to 0.65 with a speed ranging from 15 to 50 kilometers per hour.

Table 2. Daily Production of Ferry Transport

The Ferry Line	Trip	Passengers	Vehicles		Goods (tons)	Passenger Vehicle Unit (PVU)
			Motorcycles	Vehicle		
Galala- Poka	77	3077	1969	338	-	660-700
Hunimua- Waipirit	14	1181	351	168	115	260-300
Galala- Namlea	1	241	26	10	2	18-25
Tulehu – Kailolo - Umeh Putih – Wailey	4	52	20	3	6	15-20
Tulehu – Umeputih - Nahalia – Amahai	2	30	7	2	5	10-15
Galala-Ambalauw - Wamsisi - Namrole – Leksula	2	101	6	2	1	10-15

Source: From Sihaloho [9]

Characteristics ferry speeds nationwide classified four parts, namely, the speed is less than 9 knots speed was 10 to 13 knots speed, between 13 to 16 knots and the ship at high speed over 16 knots in the grade very high speed [9]. The majority of the ship's speed is between 10 to 12 knots, or about 18 to 22 kilometers per hour as many as 137 units (64%), speed of over 16 knots there are only about 2%. For shipping ferriage in remote islands of Maluku are 2 boats trans very low speed (6 to 7 knots), one low-speed boats and speed boats were 9 (10 to 12 knots). Distance varies ferriage lines; the lines of the most served ferry are between 0-30 nautical miles by 44% and the national trajectory as much as 39%.

Line ferry that has a short distance of less than 12 miles, generally have been commercialized and semi commercial is within up to 30 miles. Lines that have a distance of over 40 miles a subsidy or *Perintis* transportation, except line Galala-Namlea within 85 miles already commercial status. Lines are generally more commercial prospect in the northern cluster transport ferry appeal cluster operating in the East and South. It is associated with economic growth and population density. Ship capacity (GT) ferriages that operates nationally are very diverse. However, almost 50% of the vessel with a capacity of between 251-500 GT.

3. Transportation Performance Trans Maluku

Transportation performance is very less and felt by public very important for the transport services in the area of Cluster islands the Southern (GP IX to XII) the Aru Island, Yamdena Island, Babar Island and West Southeast Maluku. It was found that there are some aspects of the indicators related to social and environmental aspects considered less and pay attention to is the aspect of pollution in the waters of the port, comfort, smoothness/frequency service, integrity and accessibility of the center knot or connectivity. Transport freight subsidy burden remains high and aviation pioneer.

Table 3. Transport Performance

Performance Indicators	Transport Modes				Explanation
	Road	Ferry	Sea	Air	
Social	3,37	3,44	3,33	3,27	(Quite)
Economic	3,61	3,59	3,58	3,63	(relatively Good)
Environment and Comfort	3,31	3,41	3,28	3,52	(Quite)

Ssource: Result Analysis, 2012, Sihaloho [9]

In general, the performance of transport in Maluku province is quite good value and by testing the hypothesis that the four modes can be explained transportation (sea, air, and highway crossings) have the same impact on the effectiveness of the development of Maluku province. There are 3 categories of transportation performance by region, namely Island Cluster III, IV and IX are very low performing, Island Cluster I, II, V, VI, X and XII were performing, and performing relatively well is the region Island Cluster VII, VIII, and IX (see Figure 7). Performance indicators are very poor indicators of safety, pollution, capacity and regularity, as in Figure 7.

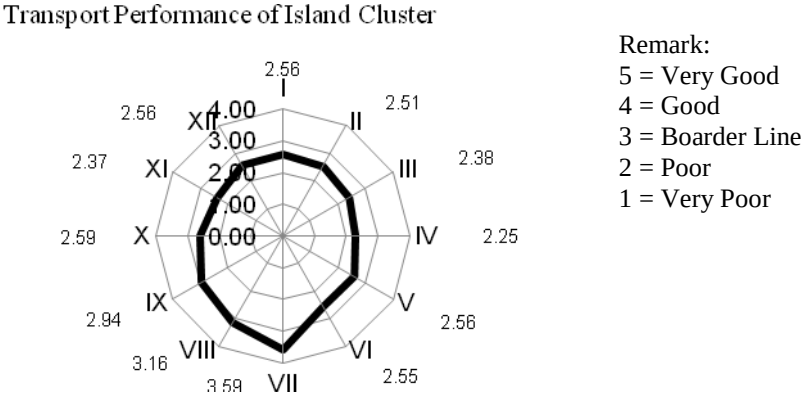


Figure 7. The average performance of transportation in Maluku Province

Some indicators that need attention is the regularity of transport services and water pollution in the harbor. Neither the aspects of safety and security as well as access to its hinterland aspect ferry ports. In general, the indicators relating to economic rather than social aspects of environmental performance.

4). Inter-Mode Synthesis Model Development

Capacity ferry line across the segment of Trans Maluku Maluku province is analyzed based on the density of traffic, i.e. ferry high density and low density traffic flow.

Simulations for each model line path is influenced by the distance (nautical miles) and a ship speed and daily traffic average which is connected to the road intermodal crossing lines. Thus, it can be formulated as the following equation,

$$\mathbf{Y = f\ (X_1, X_2, and\ X_3)} \quad (7)$$

Where, Y is the capacity of the line, X_1 is the average daily Traffic (ADT), X_2 and X_3 is the distance crossings are served Speed ferry crossings. Further development of the basic model as follows;

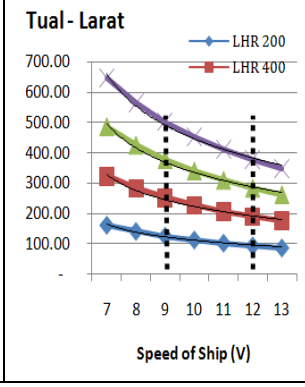
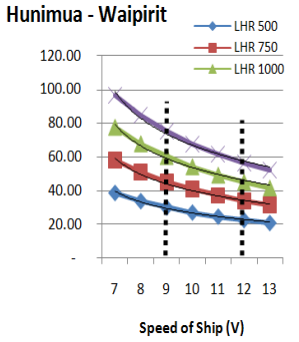
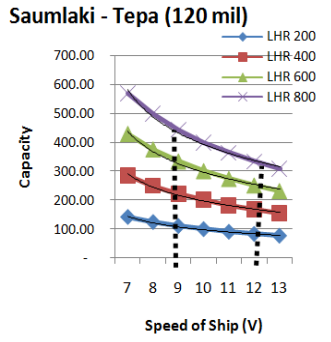
$$\mathbf{(LFC)\ = 0{,}0417\ (ADT).\ S.\ V^{-1}} \quad (8)$$

Where: LFC is a Line Ferriage Capacity, coefficient (0.0417) is the conversion value of time Average Daily Traffic and ship speed (knot), *S* is ferry distance and V is speed of ferry ship.

The capacity of ships line speed Trans Maluku divided into 2 models track the trajectory of high density and low density line, or path and pioneer commercial / subsidies. Simulations for each model line is affected by distance trajectory and speed boats. Poka- Galala and Hunimua - Waipirit are the busiest ferriage lines Maluku province than other lines.

For the variables used Average Daily Traffic with the rise hose between 200 to 800 ADT. The results showed that the higher the capacity of the vessel, the lower the speed of vessels operating on each line crossings. More can be seen in Table 4.

Table 4. Line Capacity and Simulation Model

Average Daily Traffic	Line Capacity (Y)		
	30 Miles	60 Miles	90 Miles
200	184,3-45 ln(x)	368,7-90 ln(x)	553,1-135 ln(x)
400	147,4-36 ln(x)	294,9 -72 ln(x)	442,4-108 ln(x)
600	110,6-27 ln(x)	221,2-54 ln(x)	331,8 -81 ln(x)
800	73,74 -18 ln(x)	147,4-36 ln(x)	221,2 -54 ln(x)
Simulation Graph Model			

Source: Result of Simulation Model

IV CONCLUSION

1. The geographic of Maluku province is islands, dominance distribution areas of the oceans and islands - small islands comprising 12 Cluster island and the lack of infrastructure to transport lead to high transportation costs and slow economic growth in the community. Required the development of infrastructure and integrated transport infrastructure between modes of ocean/crossings and land. The integration of transportation is still very low, both intra-and inter-modal.
2. Transportation service performance is still far from adequate, especially the comfort aspect, pollution, safety, accessibility and frequency of regularity. Development of transport should be prioritized in areas remote islands in the south, to accelerate economic growth between northern and southern clusters.
3. Synthesis model of intermodal transportation network capacity and road crossings affected by the capacity factors of road service (Volume capacity Ratio), ship speed and voyage distance. The further modeling needs to be simulated by considering the performance of connectivity in Ferry Station.

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