Feasibility Study on Type-B Terminal Location of Gorontalo City Using Analytical Hierarchy Process

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Abstract. A well-functioning urban and regional transportation system is one of determining factors in creating an efficient urban area. Terminal is one of important components in a regional and urban transportation system where people and goods are in and out in a system. Given the importance of a terminal, it should be located in a strategic place. This study is to evaluate the best location for a type-B terminal in Gorontalo City. Method of analysis used was Analytical Hierarchy Process (AHP) in which eight criteria of feasibility, based on related regulations, literature on the field, and FGD are tested in terms of their consistency and analyzed their scores. Based on the gradation of the selection process of type-B terminal location in Gorontalo City, the second alternative (located in Limba U1 Kota Selatan subdistrict) appeared to be dominant with score of 7.05.

Keyword: terminal AHP

1. Introduction

The rapid development of region and urban area is characterized by significant increase in various activities in the area resulting in high mobility of people. These people movements require a well-managed transportation system, which is one of key factors in developing regional and urban area effectively and efficiently. In terms of people mobility and their goods within an area a terminal plays an important role. Terminal according to Undang-Undang no 22 Tahun 2009 functions as a place in which both people and goods are in and out, the place where passengers are loaded and unloaded, the place where passengers change the mode of transportation and as the place to manage the arrival and the departure.

Being the capital city of Gorontalo province and a densely-populated town in the province, Gorontalo City is relatively hectic. The people and goods mobility in the area is relatively high. This condition will consequently need a terminal. At present there are two terminals in Gorontalo City; one Type-B terminal in Ferry Port of Gorontalo in Leato and one Type-C terminal in Central Market of Gorontalo. Unfortunately, both terminals are in bad condition. For example the terminal in Leato is not operated well. Similarly, the one in Central Market is dirty and not well managed. Local government is

planning to develop one of these terminals to be a Type-B terminal whose standard will be at the same level with that of airport.

Given the vital role the terminal plays, a careful, research-based selection process should be staged to choose one of the terminals to be developed into a representative Type-B terminal. The selection process should involve the feasibility analysis on factors such as environment and other factors concerning the urban life. Equally important, effectiveness and efficiency factors of terminal function should also be analyzed.

Feasibility criteria of location of Type-B Terminal can be found in regulation such as PM No.40/2015, PM No.132/2015, and other regulations. This includes: 1) legal permits; 2) regional development; 3) technical feasibility; 4) operational feasibility; 5) the appropriateness of management of akdp service; 6) environmental feasibility; 7) sociocultural feasibility; 8)financial feasibility

The selection process of feasible location used Analytical Hierarchy Process (ARP), in which to solve the problem the complex multi-criteria is changed into a hierarchy. There are three principles that should be applied in solving the problem using ARP method: 1) decomposition, decomposition is breaking down the problem into smaller related components); 2) comparative judgement is applied by assigning scores of relative importance to two elements in a certain level in relation to those in higher level to rank the elements based on their priority. Those scores will be easier to be presented in the form of matrix pairwaise comparison. In creating pairwaise, Saaty (1980) assigned quantitative scale of 1 through to 9 to assess the importance level of one element toward the others; 3) logical consistency

Logical consistency is an important characteristic of ARP. Consistency has two meanings. Firstly, consistency means that similar objects can be grouped based on its homogeneity and relevance. Secondly, consistency refers to degree of relationship among objects based on certain criteria.

2. Methodology

This study uses direct survey approach which is continued with data collection. Data consists of primary and secondary data. Primary data were collected by observation technique which yielded the visual data on planned site. Secondary data collection in this study was done using limited interview with related government offices. The data were compiled and presented as which were analyzed using Analytical Hierarchy Process (ARP) in which the principles of decomposition, comparative judgement, and logical consistency (Saaty, 1995)

3. Findings and Discussion

Based on field survey, the profile of each site which was based on existing location in general, topography, and the level proneness of the location was explained.

Table 1. The Profile of Plan of alternative 1 location of Gorontalo City Terminal

Location I		Existing site condition		Topography condition	
Village:	**LEATO SELATAN**	1	The land is mostly state-owned	1	The planned land expansion is in high land with hills
		2	The existing site is for Type-B terminal of land transportation	2	The slope of site is 15 – 25%
		3	There exists Ferry seaport	3	The latitude is 5 – 7 m above sea level .
Subdistrict :	**KOTA TIMUR**	4	Densely-populated with proximity of 6 – 8 to planned site.	**Other physical conditions**	
City:	**GORONTALO**	5	There already exists accessible road to the planned site	1	Prone to landslide and flood due to the location lying on the area with the > 25% with no drainage

Distance to City center	5 KM	6	There exists land for possible expansion of development	2	Area size = 6000 M^2
		7	Basic land support is relatively good		
		8	The location does not have drainage for the whole area		

Table 2. The profile of Plan of alternative 2 location of Gorontalo City Terminal

Location II		Existing land condition		Topography Condition	
Village:	**LIMBA U1**	1	The land is mostly state-owned	1	The planned land expansion is in low land with flatland
		2	The existing site is for Type-C terminal of land transportation	2	The slope of site is 0 – 0.5%
		3	There is a market, shopping complex, place of worship, and densely populated settlement	3	The latitude is 5 – 7 m above sea level
Subdistrict :	**KOTA SELATAN**	4	There is a shopping complex on the planned site	**Other physical conditions**	
City:	**GORONTALO**	5	There exists accessible road to the planned site	1	Prone to flooding due to the fact that the area is flatland without drainage
Distance to the city center	**1 KM**	6	The possible land for expansion is limited	2	Area size = 3000 M^2
		7	Basic land support is relatively good.		
		8	The location does not have drainage system for the whole area		

Data collected were decomposed, compared and were tested their consistency based on 8 criteria taken from analysis on related regulation, literature on the field, and focused group discussion with stakeholders. This was followed by assigning score to each criterion.

3.1 Criterion Score of Feasibility Parameter
The criterion score of feasibility parameter which was analyzed based on method of Analysis of Multi-criteria is as follows:

Table 3. Analysis of Comparison among Feasibility Parameter

No	Indicators of feasibilty	Legal Permit	Area expansion	Development Technicality	Operational Feasibility	Feasibility of Inter provincial Transportation Management.	Environmental Feasibility	Sociocultural Feasibility	Financial Feasibility
1	Legal Permit		1.0	1.0	1.0	3.0	5.0	7.0	7.0
2	Area expansion	1.00		1.0	1.0	3.0	5.0	5.0	7.0
3	Technicality of Development	1.00	1.00		1.0	3.0	5.0	5.0	7.0
4	Operational feasibility	1.00	1.00	1.00		3.0	5.0	7.0	3.0
5	Feasibility of Inter provincial Transportation Management	0.33	0.33	0.33	0.33		3.0	5.0	3.0
6	Environmental Feasibility	0.20	0.20	0.20	0.20	0.33		3.0	3.0
7	Sociocultural feasibility	0.14	0.20	0.20	0.14	0.20	0.3		1.0
8	Financial Feasibility	0.14	0.14	0.14	0.33	0.33	0.33	1.00	
	Total	4.82	4.88	4.88	5.01	13.87	24.67	34.00	32.00

Source: The result of analysis

Following the analysis of comparison among feasibility parameter was the score of feasibility parameter of AHP which was followed by arranging Matrix of Normalization of the Score of Feasibility Parameter. Based on the score using variable of feasibility indicators, the consistency test was done to find out the level of consistency of feasibility variable. The allowed level of consistency tolerance is 10%, or the score of consistency ratio of 0,1 (Saaty,1995). Based on the calculation it was found that the score of CR was 0.06 meaning that the calculation can be continued to next level. It can also be concluded that feasibility variables were consistent and can be used in analysis.

3.2 The Score of Average Criteria
Following the calculation of criteria on 8 feasibility parameter was the calculation of score of average criteria of all variables.

Table 4. The score of Average Criteria of 8 Feasibility parameter

No	Indicators of Feasibility	Total Score	Percentage
1	Legal Permit	1,66	**20,8%**
2	Area Expansion	1,60	**20,0%**
3	Technicality of development	1,60	**20,0%**
4	Operational feasibility	1,54	**19,2%**
5	Feasibility of Inter-Provincial Transportation Management	0,71	**8,8%**
6	Environmental feasibility	0,41	**5,1%**
7	Sociocultural feasibility	0,23	**2,9%**
8	Fianacial feasibility	0,25	**3,2%**
Total		8,00	100

Based on the calculation of the score of average criteria of all feasibility parameters, the scores of criteria of each Type-B terminal location in each alternative location were found. Based on table 4 above criteria of Legal Permit appears to be the highest. However, its score is not dominant based on Regulator Preference. The scores of criteria of operational feasibility and the feasibility of inter-provincial transportation management appear to be influential to regulator preference, operators, or the users in determining the criteria of location of public transportation.

3.3 The Score of Location of Each Site Based on the Score of Criteria
The scoring interval used was 1-3 by taking into account aspects of objectivity and subjectivity which is supported by data from observation, interview with stakeholder, and document on The Medium-Term Development Plan (RPJM) and Spatial Layout Plan of Gorontalo City (RTRW) coupled with recommendation from Office of Transportation Affairs of Gorontalo City. The final score are used to determine the potential location for Type-B terminal for public transportation.

Tabel 5. The result of scoring (Interval 1-3) of Alternative location of Type-B terminal based on criteria score in Gorontalo City

No	Indicators of Feasibility and Variable	Condition	Score	Weight	Alternative 1	Alternative 2
					Score (SxW)	
1	**Feasibility of Legal Permit**			21%		
	a Land Status (Land ownership)	State owned	3		0.62	0.62
		Owned by citizen	1			
2	**Feasibility of area expansion**			20%		
	a Compatibility with National, Provincial, or district spatial layout (RTRW)	Compatible	3		0.60	0.60
		Will be compatible	2			

		Not compatible	1			
	b Compatibility with National, Provintial and District Transportaion System (Sistranas, Tatrawil, Tatralok)	Compatible	3		0.60	0.60
		Will be compatible	2			
		Not compatible	1			
3	**Feasibilty of development technicality**		3	20%		
	a Location and Accesibility	There is accessible road	3		0.60	0.60
		There will be accessible road	2			
		No accessible road	1			
	b Energy, water and telecommunication resources	Sufficient	3		0.60	0.60
		Sufficient enough	2			
		Not sufficient	1			
	c Physical condition of location (DDT and Drainage)	Good and proper	3			
		Enough and proper	2			0.40
		Bad	1		0.20	
	d The need for space (Area size)	Meeting the size standard	3			
		Relatively meeting	2		0.40	
		Not meeting	1			0.20
	e Level or Proneness to Disaster	Not prone	3			0.60
		Prone enough	2			
		Prone	1		0.20	
4	**Operational feasibility**			19%		
	a The Border of area of operation	Clear	3		0.58	0.58
		Not clear	1			
	b Number of routes network	Compatible with demand	3			0.58
		Compatible enough	2			
		Not compatible	1		0.19	
	c Quality of route network	Compatible with performance standard	3			0.58
		Compatible enough with performance standard	2			
		Not compatible	1		0.19	
5	**The feasibilitys of Inter-Provincial transportation Management (AKDP)**			9%		
	a Estimation of Demand on land transportation service	Increasing	3			
		Stagnan	2			0.18
		Decresing	1		0.09	
	b The plan of Route	Compatible with the area size	3			0.27
		Compatible enough	2		0.18	
		Not compatible	1			
	c Types of Inter-provincial transportation management (AKDP) and Load Factor	Compatible with performance standard	3			0.27
		Compatible enough	2			
		Not compatible	1		0.09	
6	**Environmental feasibility**			5%		
	a Natural environment	Low changing degree	3			
		Medium changing degree	2		0.10	
		High changing degree	1			0.05
	b Land provision	Low function change	3		0.15	0.15
		Medium function change	2			
		High function change	1			
7	**Sociocultural feasibility**		3	3%		
	a People relocation	Unlikely	3		0.09	
		Likely	1			0.03
	b Suitability with local culture	Not influencing	3		0.09	
		Influencing	1			0.03
8	**Financial feasibility**			3%		
	a Land and building acquisition	Can be acquired	3		0.09	
		Can not be acquired	1			
	b Construction fund	Available	3		0.09	0.09
		Not yet available	2			
		Not available	1			
Total				100%	5.76	7.02

3.4 Matrix of the score result of the selection of alternative location of Type-B terminal
After calculating the scores of all feasibility parameters, the total score for all feasibility variables of each alternative are as follows:

Table 6. The result of Score of the Location selection of Type-B terminal in Gorontalo City

NO	Indicator of Feasibility and Variables	Alternative 1	Alternative 2	Note
1	Feasibility of legal permit	0.62	0.62	A1 & A2 proper
2	Feasibility of area expansion	1.20	1.20	A1 & A2 Proper
3	Feasibility of development technicality	2.00	2.40	A2 > Proper
4	Operational feasibility	0.96	1.73	A2 > Proper
5	Feasibility of Inter-Provincial transportation Management (AKDP)	0.35	0.71	A2 > Proper
6	Environmental Feasibility	0.26	0.21	A1 > Proper
7	Sociocultural Feasibility	0.17	0.06	A1 > Proper
8	Financial feasibility	0.19	0.09	A1 & A2 Proper
	Total	5.76	7.02	A2 > Proper
	Average	0.72	0.88	A2 > Proper
	Selected location	**ALTERNATIVE 2**		

Source: Analysis result

Based on the selection result of location of terminal as shown above (Table 8), location in alternative 2 area is more dominant than that of alternative 1 area (the scores are respectively 7,02 and 5,76), meaning that the development of public transportation terminal of type-B should be in Limba U1 village, Kota Selatan sub-district.

4. Conclusion
Location in alternative 2 area (Limba U1 village, Kota Selatan sub-district) is more appropriate as the location for the development of Type-B because based on analysis result of AHP the area got score of 7,02 higher than alternatif 1 location(Leato Selatan village) with score of 5,76.

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