International Refereed Journal of Engineering and Science (IRJES)
ISSN (Online) 2319-183X, (Print) 2319-1821
Volume 3, Issue 8 (August 2014), PP.28-37

Typical river transport for Banjarmasin based on the criteria of the National Transportation System

Iphan F. Radam[1], Agus T. Mulyono[2], Bagus H. Setiadji[3]
[1]*Study Program of Civil Engineering, Lambung Mangkurat University, Banjarmasin, Indonesia*
[2]*Department of Civil Engineering, Gadjah Mada University, Yogyakarta, Indonesia*
[3]*Department of Civil Engineering, Diponegoro University, Semarang, Indonesia*

Abstract:- In attempts to re-enable the river transport that is considered less desirable by users, a typical approach/an approach related to the types of river transport that people expect. In this research, four types of river transport are offered to the community which is expected to physically meet the criteria of the (Indonesian) National Transportation System. Analysis of the selected priority level using an approach of the AHP method to relative and absolute measurement was carried out. The results of the analysis find that people generally tend to expect the typical river transport with the following criteria: *catamaran* type, the entry/exit can be from the front and the rear, the sides of the ship are flexible and can be open or closed, passengers can stand up inside the vehicle, the ship can load bikes, and the lower position of the passengers is above the surface of the water. In terms of the fulfillment of the (Indonesian) National Transportation System criteria, safety is the most dominant criterion to be considered (18.87%), followed by the criterion of security (16.45%), the utilization criterion (12.49%), and the comfort criterion (11.53%). While the criteria for a low level of pollution and capacities are the lowest criteria that influence the selected choice.

Keywords:- AHP method, the National Transportation System, typical river transport

I. INTRODUCTION

Banjarmasin is known as a city of a thousand rivers, therefore lives on the edge of rivers are commonly found. A documentary taken by Ochse (1925) illustrates Banjarmasin since it was in the Dutch colonial era where it has been known as the 'Venice of the East Indies'[1]. However, in its development, it is very unfortunate that the community's interest in the use of river transport now has decreased compared with the use of road transport. The decrease in users' interest in the use of river transport is due to the comfort aspects, such as the safety guarantee, the sense of security from external nuisances such as the weather and waves, poor services provided to passengers, and the shape/ design of the river transport and facilities that do not facilitate the accessibility of the movement [2][3]. Conditions of the existing river transport do not seem to improve both in terms of (physical) appearance, technology, and services. The physical conditions of the vehicles lag so far behind the development of the land modes of transport. In fact, seen from the physical conditions of the river transport, such as less good seating facilities, acessess to the entry/exit that is not specifically provided, load capacity, and stability when the vehicle is moving, those all are still possible to be repaired. The repair according to Law No.17 Year 2008 on shipping is one of seaworthiness requirements [4]. The assertion that the river transport that is used must meet the seaworthiness requirements is stated in Regulation No. 20 Year 2010 on water transport [5]. Furthermore, river transport should meet the criteria of the National Transportation System (*Sistranas*), namely ensuring safety, having high accessibility, being integrated, having sufficient capacity, being on a regular basis, being smooth and fast, being accessible, being timely, being convenient, offering affordable rates, being orderly, being safe, having low levels of pollution, having low public burden, and having high utility in one unified national transport network [6].

Based on the identification of the problems above, how exactly is the typical river transport that people want so that it can function as optimally as the road transport? And what are the aspects of the National Transport System that have an important or dominant role in influencing the selected choice?

II. LITERATURE REVIEW

2.1 Conditions of the river transport

It is undeniable that social exclusion on (river) transport is not necessarily resulted from the assumption that one region is said to lag behind or to be isolated when it has not been connected by the road transport [7] and the lack of needs for the amount of such transport, it is indeed mainly resulted from problems related to a poor level of services [8]. The perception of the movement actors of these services becomes very important to understand and to be presented in a marketing concept and strategy [9]. Therefore, changes in the newly built

transport system should be acceptable and should not raise a new problem among the community. River transport has already beeen known by the people of Banjar since 600 AD [10]. This is an advantage because socioculturally, people are familiar with the transport.

2.2 The AHP approach

The AHP method is one form of a comprehensive model of decision-making, and takes into account matters that are quantitative and qualitative in nature well as matters in the selection of alternatives [11]. The AHP model uses perceptions of people considered an 'expert' as its main input. In connection with the selection of the river modes of transport with the explanation of the typical plan that can be more than one, then the model of decision-making is necessary to be taken. This is necessary because to see the level of the river transport selection in in competition with other transport requires the typical river transport that is most desirable. The AHP measurement method uses two measurement methods, namely the Relative Measurement Method (RMM) and the Absolute Measurement Method (AMM). Furthermore, a mathematical formula on the AHP model is implemented using a matrix in order obtain weighting of all the elements.

Polls in the AHP process can be conducted using several methods, namely: (1) the aggregation of individual judgments (AIJ) for every single set of paired comparisons into a combined hierarchy; (2) synthesizing each individual hierarchy and combining the resulting priority (the aggregation of individual priorities (AIP)); and (3) combining individual priorities of each mode in the hierarchy. The two most common methods for group decision are AIJ and AIP [12]. In AIJ, the assessment matrix is built based on the group's decision using measures of central tendency of the data from every single perspective of the individuals within the group, then the value of the overall priorities or of each criteria is calculated using the AHP procedure. In AIP, priorities of each criteria of each individual are first calculated and then the group priority is obtained using the geometric or arithmetic mean. In addition to using the (geometric/arithmetic) mean as a measure of central tendency of the data [13], some researchers also used the median and the mode to obtain a group decision.

The assessment scale of the AHP comparison was made based on the categorization or classification of the level of importance and there is a relationship among the data. Therefore, the AHP preference data can be categorized into the ordinal type of data. When viewed from the distribution of the data, the tendency of the preference is not normally distributed. Based on this condition, it is suggested that the AHP reference data are included into nonparametric statistics. Nonparametric statistical data with the ordinal data type are better to use the median or the module as a measure of central tendency than the geometric or arithmetic mean [14][15]. A wide distribution of responses, the median will be better than the module because the median still considers all the responses. To strengthen the median, a value that can represent the preferences of all the respondents is selected. Thus, nonparametric tests such as the sign test or the Wilcoxon signed-rank test [16] can be used. The mathematical formula of the AHP model is then performed using a matrix and after that weighting is given to all the elements.

2.3 Conceptual framework

The concept of determining the river transport offered refers to the achieved objectives of the National Transportation System that relate directly to the means of transportation that are later used as measurement criteria, namely:

(1) The criterion of **safety** against nuisances/accidents due to the internal factors of the transport.
(2) The criterion of **accessibility** in terms of the range of services of the means of transport in the form of the area of the transport network.
(3) The criterion of available **capacity** of the means of transport to meet the demand of the service users.
(4) The criteria of **smoothness and speed** of the means of transport
(5) The criterion of **ease** of the means of transport to be used both in terms of the services to/ from the vehicle to the destination as well as the ease to switch to another mean of transport.
(6) The criterion of **convenience** of the means of transport in the forms of tranquility and enjoyment for passengers when they are in the vehicle.
(7) The criterion of **security** of the means of transport against nuisances resulted from external factors of the transport.
(8) The criterion of the **pollution level** that the means of transport emit, including exhaust pollution, water pollution, noise pollution, and vibration pollution.
(9) The criterion of **public burden** of the means of transport in providing benefits to the government, operators, communities, and the environment that is as small as possible.
(10) The criterion of **utilization** of the means of transport in the form of the interest rate of the service users in choosing a means of transportation.

There are four types of river transport plans offered. Determination of the type of river transport was done based on improvements in the existing river transport and the modes of river transport that have already been operating in other areas. Type 1 refers to the development of the existing river transport with one single hull, type 2 refers to the development of the existing river transport with double hulls (*catamaran*), and types 3 and 4 refer to a type of river transport that has been operated in the areas of Jakarta and Palembang as presented in Figure 1.

Figure 1. The offered plans for the river transport

The types of river transport offered for all the types were technically assumed (the ship design) to have already met the seaworthiness standards of a ship. Measurement was made based on the elements or components that were made based on the levels of satisfaction of the hierarchical structure.

Level 1 refers to the level of satisfaction of the selected river transport, Level 2 is the classification for the National Transportation System criteria based on the effectiveness and efficiency, Level 3 is the description of the 10 selected criteria of the National Transport System, and the offered alternatives for the river transport are given in Level 4 The overall levels are presented in a hierarchical structure of satisfaction of selected river transport as shown in Figure 2.

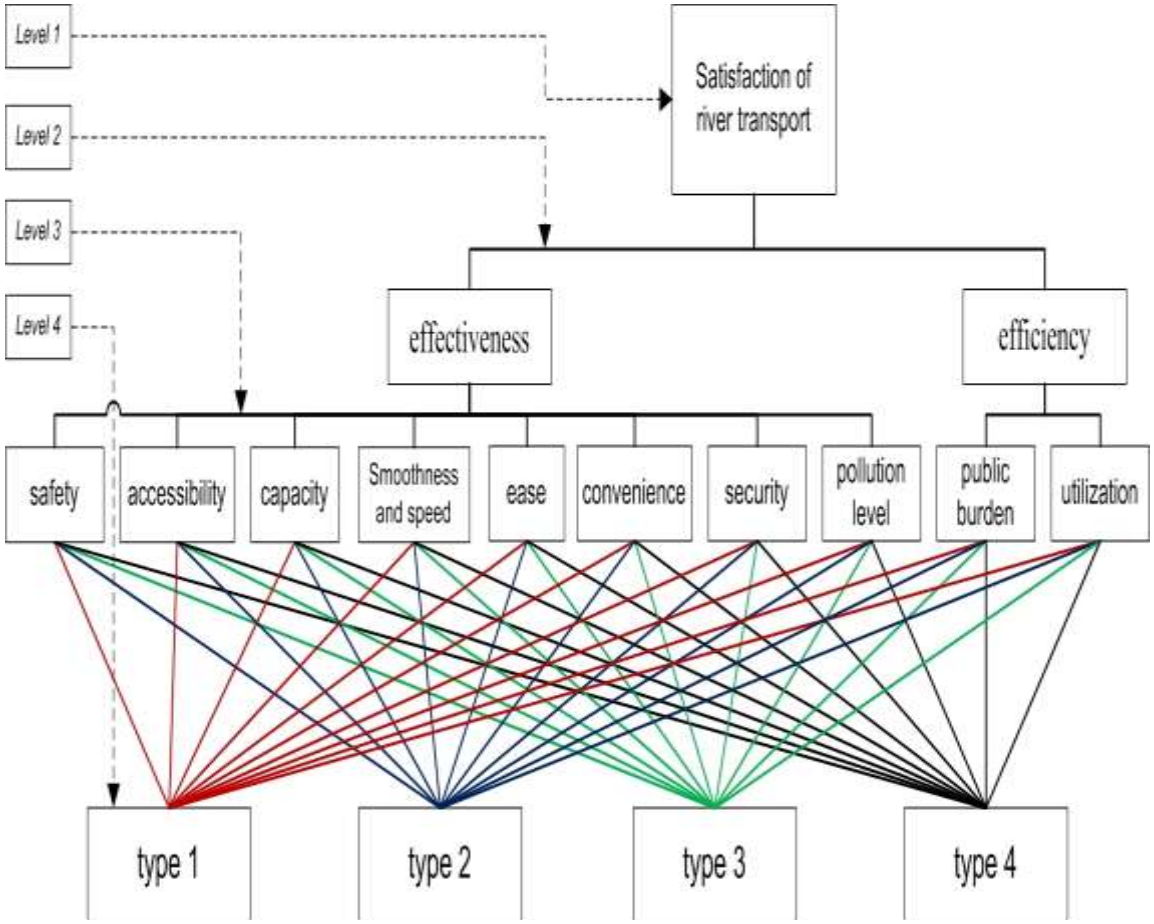

Figure 2. The concept of the hierarchical structure for the satisfaction from the river transport

III. RESEARCH METHODS

3.1 The design of AHP questionnaires

The questionnaires were designed according to an approach to the measurement method used in the specified hierarchical structure. The level of importance was measured based on the ordinal sequence in terms of options tha consist of numbers from 1 to 9, which describe a certain category of quality comparisons [11][17], namely: (i) Number of 1 implies that both elements are equally important; (ii) Number 3 implies that the element being compared is a little more important than another element; (iii) Number 5 implies that the element being compared is essential or far more important than another element; (iv) Number 7 implies that the element being compared is definitely more important than another element; (v) Number 9 implies that the element being examined is absolutely more important than another element; (vi) Numbers 2,4,6, and 8 are options in between the two adjacent numbers of such considerations.

For the design at the alternative level, each element comparison was performed in an absolute manner to the existing conditions (the existing river transport). As in the relative measurement, the level of importance was measured based on the ordinal sequence with the range of options from 1 to 9. The number of combinations of elements in the absolute comparison is the same as the number of the elements themselves.

3.2 AHP sample collection method

Sample collection for the AHP analysis was carried out on a limited basis (*purposive sampling*), i.e. the sample collection was used for a specific purpose which made the population limited or the respondents had been determined. The selected respondents consist of the ones considered an expert on issues related to river transport, especially the typical physical design of the means of the river transport.

Stakeholders chosen as a respondent were selected from several cities in Indonesia which still operate river transport as the transport of passengers, specifically the entire cities in South Kalimantan, Central Kalimantan, East Kalimantan, North Kalimantan, West Kalimantan, Jakarta, and South Sumatra. Furthermore, the selected respondents were put into categories according to their respective elementary units, that consist of the element of government bureaucracy as policy makers, the element of academics, and the element of practitioners.

3.3 AHP data processing

The steps of element weighting and hierarchical determination are shown in Figure 3. Based on both assessment indicators of consistency and similarity of the reference pattern, the hierarchy of satisfaction with the offered alternative options (types of the river transport) can be determined.

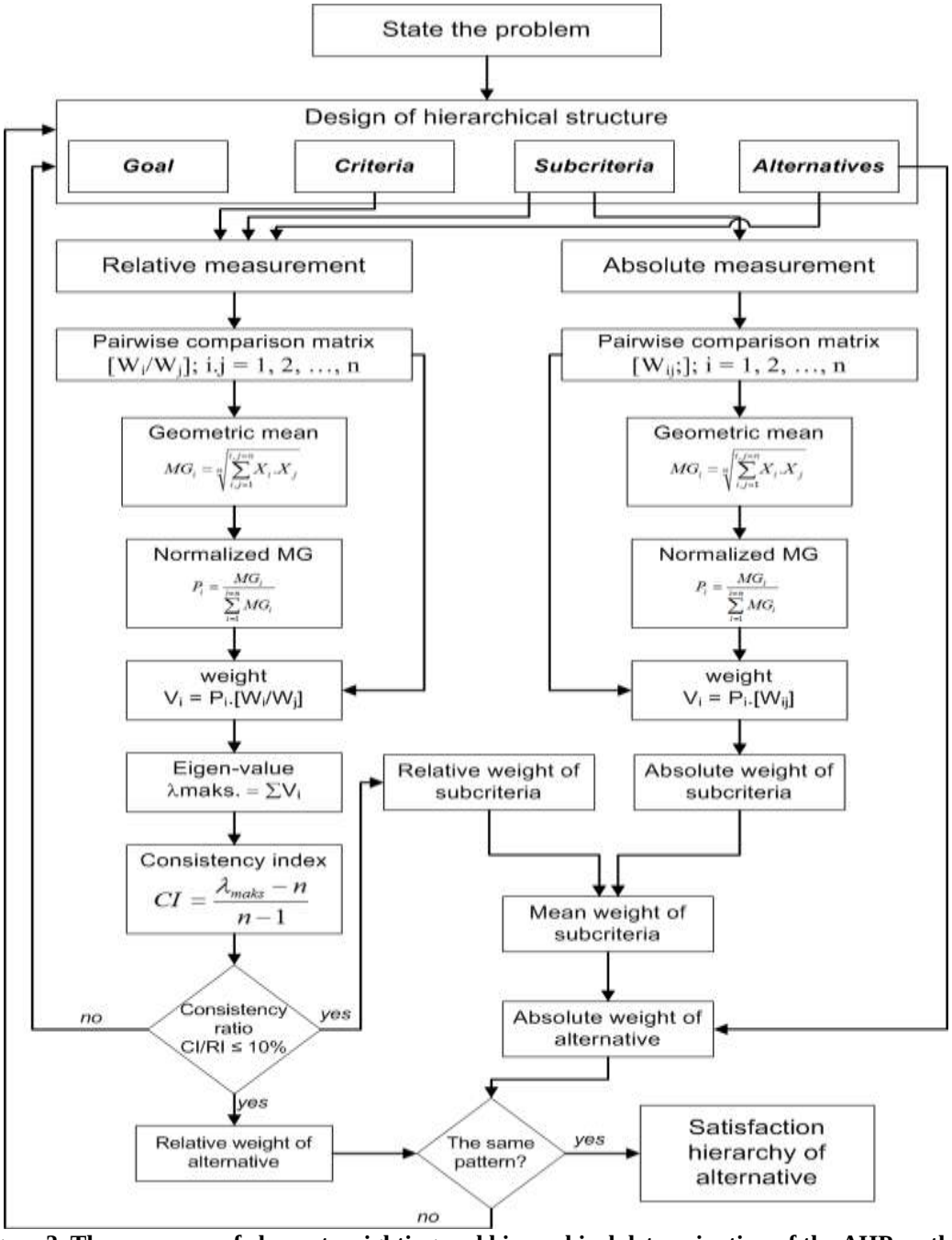

Figure 3. The processes of element weighting and hierarchical determination of the AHP method

IV. DATA ANALYSIS AND RESULT

4.1 Descriptions of the AHP data

The data collected consist of as many as 58 samples. Based on their occupation, the respondents from all the collected sample are categorized into three elementary units, namely the respondents coming from the element of governmental bureaucracy from the central level (Jakarta) to the level of cities/ regencies in South Kalimantan with a total of 39 respondents (67.2%), the the element of academics from 7 universities (scattered around Kalimantan, Jakarta, and South Sumatra) as many as 10 respondents (17.3%), and the element of practitioners that include consultancy agencies, organizations, and operators as many as 9 respondents (15.5%).

Based on the educational background, the majority of the respondents are a holder of a post-graduate degree (S2) with a total of 25 respondents, based on their age, the respondents are normally distributed with the age group of 40-50 years as an age group with the largest members with a total of 21 respondents. Graphically, the distribution of respondents based on their educational background and age is presented in Figure 4.

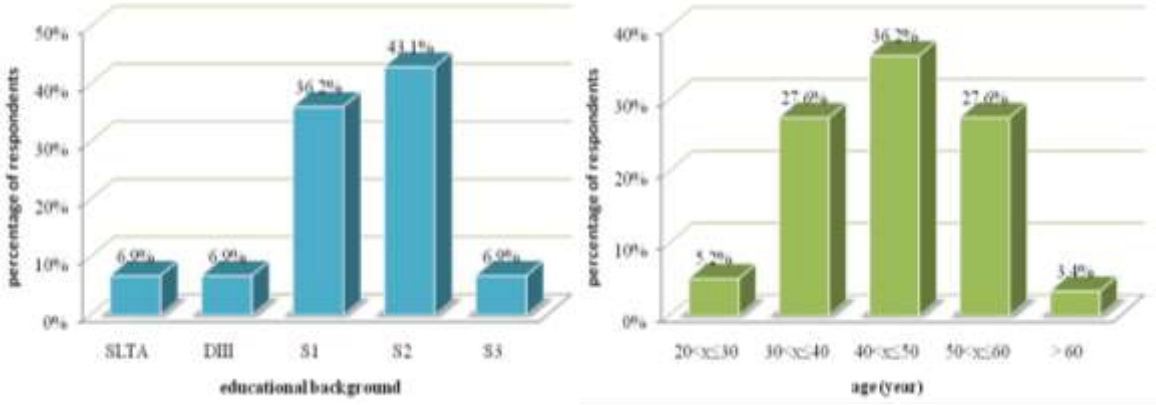

Figure 4. Distribution of the Respondents Based on Their Educational Background and Age

4.2 Preference data processing

The data on the preference of each respondent consist of 92 data covering 36 data of paired comparisons, 16 data of absolute comparisons, and at the level of alternatives for the four types, there are each 10 data on the fulfillment level of the elements in the subcriteria of the related types. The data of paired comparisons are data of preferences used in the relative measurement, the preference data in question are the combined preference data obtained from all the 58 respondents. While for the data of absolute comparisons and the data of the fulfillment level, the preference data refer to the data of individual preferences.

Determination of combined preferences was done by employing an approach of central tendency in the form of the median which significance was then tested using the Wilcoxon signed-rank test. The fulfillment of the significance is at a P-value > 0.05 and for the paired comparisons that do not meet the value, a shift in the θ value by +/- 1 of the initial value of θ or the resulting observed median. Usually, the shifting direction tends to follow the direction of the curve's skewness, of 36 paired comparisons, there are 18 values of θ that were adjusted. Furthermore, the P-value can be seen in Table 1.

Table 1. The combined preference value of the paired comparisons

No. question	Element		Observed median		hypothetical median	
	compared	comparison	value	P-*value*	value	P-*value*
1	effectiveness	efficiency	3	0,123	3	0,123
2	safety	accessibility	7	0,002	6	0,496
3	safety	capacity	7	0,001	6	0,591
4	safety	smoothness and speed	3	0,000	4	0,091
5	safety	ease	3	0,060	3	0,060
6	safety	convenience	3	0,858	3	0,858
7	safety	security	1	0,006	2	0,203
8	safety	pollution level	7	0,000	6	0,266
9	efficiency	capacity	2	0,660	2	0,660
10	efficiency	smoothness and speed	1/4	0,003	1/3	0,067
11	efficiency	ease	1/5	0,000	1/4	0,801
12	efficiency	convenience	1/5	0,001	1/4	0,666
13	efficiency	security	1/7	0,000	1/6	0,791
14	efficiency	pollution level	4	0,099	4	0,099
15	capacity	smoothness and speed	1/5	0,000	1/4	0,740
16	capacity	ease	1/5	0,003	1/4	0,474
17	capacity	convenience	1/6	0,000	1/5	0,466
18	capacity	security	1/7	0,000	1/6	0,579
19	capacity	pollution level	2	0,080	2	0,080
20	smoothness and	ease	1/2	0,951	1/2	0,951

	speed					
21	**smoothness and speed**	**convenience**	**1/3**	**0,139**	**1/3**	**0,139**
22	**smoothness and speed**	**security**	**1/4**	**0,234**	**1/4**	**0,234**
23	**smoothness and speed**	**pollution level**	**3**	**0,994**	**3**	**0,994**
24	**ease**	**convenience**	**1/3**	**0,729**	**1/3**	**0,729**
25	**ease**	**security**	**1/4**	**0,471**	**1/4**	**0,471**
26	**ease**	**pollution level**	**4**	**0,386**	**4**	**0,386**
27	**convenience**	**security**	**1/2**	**0,303**	**1/2**	**0,303**
28	**convenience**	**pollution level**	**4**	**0,002**	**3**	**0,162**
29	**security**	**pollution level**	**7**	**0,000**	**6**	**0,604**
30	**public burden**	**utilization**	**1/2**	**0,822**	**1/2**	**0,822**
31	**type 1**	**type 2**	**1/3**	**0,008**	**1/2**	**0,536**
32	**type 1**	**type 3**	**3**	**0,276**	**3**	**0,276**
33	**type 1**	**type 4**	**1/3**	**0,000**	**1/2**	**0,399**
34	**type 2**	**type 3**	**3**	**0,028**	**4**	**0,833**
35	**type 2**	**type 4**	**2**	**0,679**	**2**	**0,679**
36	**type 3**	**type 4**	**1/3**	**0,986**	**1/3**	**0,986**

4.3 Element weighting

The process of element weighting with the AHP method employed an approach of matrices with the values of (individual/ combined) preferences as the values in the cells. Next, priority at the sub-criteria level can be drawn from the value of the average weight of the elements generated from relative and absolute measurement as shown in Table 2.

Table 2. The average element weight at the subcriteria level

No.	Element	Weight (%)			Priority
		Relative	Absolute	Average	
1	**safety**	**22,57**	**15,17**	**18,87**	**1**
2	**accessibility**	**3,45**	**8,74**	**6,09**	**8**
3	**capacity**	**2,50**	**7,76**	**5,13**	**9**
4	**smoothness and speed**	**5,97**	**9,38**	**7,68**	**7**
5	**ease**	**7,91**	**9,88**	**8,90**	**5**
6	**convenience**	**11,85**	**11,20**	**11,53**	**4**
7	**security**	**18,70**	**14,20**	**16,45**	**2**
8	**pollution level**	**2,05**	**6,47**	**4,26**	**10**
9	**public burden**	**8,33**	**8,89**	**8,61**	**6**
10	**utilization**	**16,67**	**8,31**	**12,49**	**3**
				100,00	

From Table 2, it can be seen that the ten criteria of the National Transportation System have different weight values and will certainly have a different influence on the selection of the types of river transport. Based on the weight, the priority of the National Transportation System criteria can be arranged from the largest one namely; 1) the safety criterion, 2) the security criterion, 3) the utilization criterion, 4) the comfort criterion, 5) the criterion of ease achieved, 6) the public benefit criterion, 7) the criteria of smoothness and speed, 8) the accessibility criterion, 9) the capacity criterion, and 10) the criterion of a low level of pollution.

4.4 Determination of priority at the alternative level

The determination of the priority at the alternative level is a process of element weighting at the alternative level which was done in two ways, namely; 1) in a direct manner with paired comparisons, and 2) by giving a value to each alternative being compared based on the fulfillment level of elements in the subcriteria. The hierarchy of priorities by both methods is acceptable if it has the same pattern of priorities. The resulting

priorities at the alternative level using the first method reveal that Type 2 has the highest hierarchy (42.97%), followed by Type 4 (28.27%), Type 1 (19.99), and Type 3 (8.77%) successively. The determination of priorities using the second method is based on the average fulfillment value of the respondents to the elements of the sub-criteria for each offered alternative (type). Furthermore, by normalizing the resulting number generated from the multiplication of the weight of the elements and the value of fulfillment of each type, the absolute weight was then obtained as described in Table 3.

Table 3. The absolute weight of elements at the alternative level based on the fulfillment value

No.	Element	Weight (%)	Average Fulfillment			
			Type 1	Type 2	Type 3	Type 4
1	safety	18,87	6,72	7,19	6,62	6,59
2	accessibility	6,09	6,31	6,55	5,86	6,43
3	capacity	5,13	6,29	6,79	5,05	6,67
4	smoothness and speed	7,68	6,45	6,07	7,31	5,97
5	ease	8,90	6,12	6,71	5,41	6,53
6	convenience	11,53	6,14	7,00	5,62	6,41
7	security	16,45	6,16	6,91	6,43	6,41
8	pollution level	4,26	5,53	5,38	5,67	5,21
9	public burden	8,61	6,21	6,28	5,60	5,98
10	utilization	12,49	6,41	6,52	5,76	6,21
Score			630,68	669,44	605,75	632,26
Normalized (%)			24,85	26,38	23,87	24,91
Priority			3	1	4	2

Using the absolute weight presented in Table 3, the hierarchy of priorities for the alternative options can be determined, i.e in the first priority is Type 2 (26.38%), followed by Type 4 (24.91%), Type 1 (24.85%), and finally Type 3 (23.87%). The hierarchy of the relative weight and that of the absolute weight at the alternative level do not differ as illustrated in Figure 5.

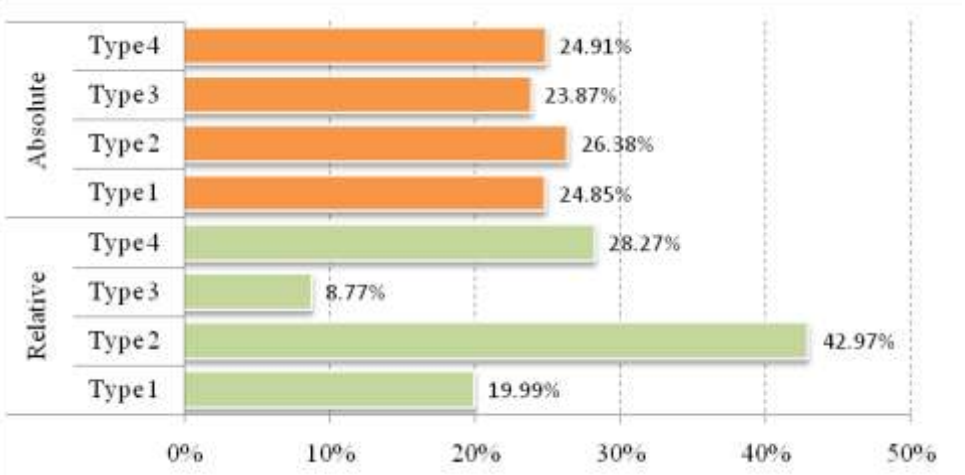

Figure 5. The hierarchical patterns at the alternative level for the relative weight and the absolute weight

Based on the same hierarchical patterns for the relative and absolute weighting, it can be concluded that among the 4 types of river transport offered, Type 2 is the type with the greatest weight or the highest priority. Thus, the river transport Type 2 is the river transport selected based on the hierarchy of the alternative satisfaction.

V. CONCLUSION

In accordance with the analysis of perceptions done to the 58 data of stakeholders concerning the rating of the selected river transport options based on the fulfillment of the (Indonesian) National Transportation System criteria, the follwoing can be concluded:

(1) The typical river transport that people want based on the rules of efficiency and effectiveness according to the criteria of the National Transportation System is the river transport which generally has double hulls (*catamaran*), the entry/ the exit can be accessed from the front and the rear, standard speed desired is 25 km/ hr, the sides of the ship can be designed to be open or closed, passengers can stand during the operations of the river transport, it is possible for the ship to carry bicycles, the bottom position of the passengers is above the water surface, and the position of the captain is in the middle of the back with a rising position. The form of the river transport is illustrated in Figure 6.

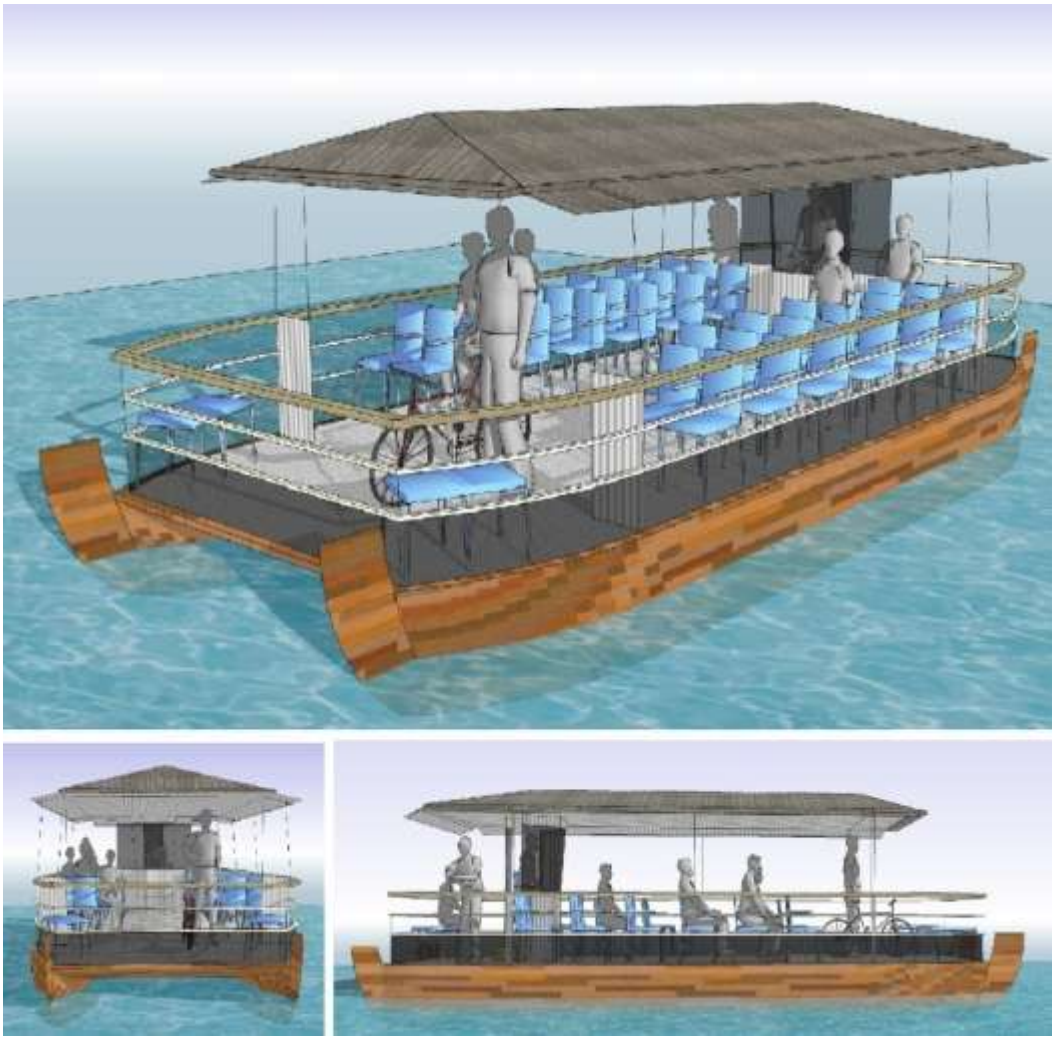

Figure 6. An illustration of the selected forms of river transport

(2) The aspects of the National Transport System with dominant influences based on their hierarchy are 1) the safety criterion (18.87%), 2) the security criterion (16.45%), 3) the utilization criterion (12.49%), 4) the comfort criterion (11.53%), 5) the criterion of ease achieved (8.90%), 6) the public benefit criterion (8.61%), 7) the criteria of smoothness and speed (7.68%), 8) the accessibility criterion (6.09%), 9) the capacity criterion (5.13%), and 10) the criterion of a low level of pollution (4.26%). Based on the hierarchy, it is shown that the river transport offered should be able to ensure its ability to avoid passengers from both internal and external nuisances, the means of transport have a good appeal that does not seem "cheap", and finally the aspect of comfort in the services provided is necessary. While the aspects of capacity and the reduced level of pollution have a small percentage in influencing the selected option.

ACKNOWLEDGEMENTS

Special thanks go to Directorate of LLASDP in Jakarta, the Provincial Development Planning Agency (BAPPEDA) in South Kalimantan, and all the individuals that were integral to the creation of this paper.

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