MODAL SPLIT TO CAMPUS UNIVERSITAS MUHAMMADIYAH ACEH USING ANALYTICAL HIERARCHY PROCESS

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ABSTRACT

Muhammadiyah University of Aceh is one of private university in Banda Aceh. This study only focus on the Engineering Faculty of Muhammadiyah University of Aceh. The purpose of this study were to find out the rank, the rank of criteria, and the models of selection of selected means of transportation used to reach the campus. This study is useful in order to give input for the Muhammadiyah University about the criteria and selected means of transportation used by students in reaching the university. This study used AHP questionnaire and calculation used Microsoft exel. method. Data were processed and analyzed by using Analytical Hierarchy Process Method to determine modal split to campus factors. The result of the research showed that criteria influencing the selection of means of transportation were safety (24.78%), flexibility (22.37%), comfort (20.32%), time (16.49%), and cost (16.04%). The general alternative selection of means of modal spilt students were motor cycle (40.89%) in the first, car (32.98%) the second, and on foot (26.13%) the last.

Keywords : questionnaire, Analytical Hierarchy Process, criteria, alternative

II. INTRODUCTION

Muhammadiyah University (Unmuha) is a private university located in the city of Banda Aceh. One of his faculty is the Faculty of Engineering (FT), which consists of department of civil engineering and architectural. Civil engineering depertment is one of the most preferred by students with the level of new students are increasing. Based on observations in the field, there are several modes of choice to the FT Unmuha, which motorcycles, cars and on foot. Motorcycles are a favorite mode and dominated almost the entire parking lot and even up into the road in front of the university and disrupt traffic. Although the campus is served by public transport track (labi-labi) but not much demand.

The high private vehicle use by students have a direct impact on the high traffic flow in around the campus. Personal vehicles takes up a lot of space when compared to using public transport. For that wanted to wanted to know the criteria and alternative modes of mode split modal of students on a travel to the campus with Analytical Hierarchy Process (AHP). AHP is a decision maker to support system to include modes used for travel to the campus.

II. LITERATURE REVIEW

2.1 Modal Split and Its Relation to Another Model

Tamin (2008: 393), Miro (2002:64) and Morlok (1984 : 452), mode selection analysis can be done at varied stages in transportation planning and modeling. Mode selection model approach is varied, depends on transportation planning purpose. But the most frequent mode that being used is approach by considering mode selection process prior the route selection being done. In this case, every mode is considered competing in getting passenger so that the determination attribute from kinds of movement become the main factor in selecting mode.

2.2 Public Transport Problems

Munawar (2005: 41), a problem which frequently occurs in city area is the public transport does not function optimally. This problem caused by many things, such as uncomfortability, unsecure, irregular schedule, messy, stop at any place, not integrated with other transport, and the problems with time.

2.3 Modal Choice Model

Tamin (2008) explains that the mode choice model aims to determine the proportion of people who will use any mode. Factors that may affect the selection of these modes can be grouped into 3 (three), described below:

1. Characteristics of road users.
2. Characterize the movement.
3. Characteristic mode of transportation facilities.
4. Characteristics of the city or zone.

2.4 Analytic Hierarchy Process (AHP) Method

AHP method is a decision support model which was developed by Thomas L. Saaty, a mathematician who worked at University of Pittsburgh in the United States in early 1970s. AHP method is one of decision making method that use factors such as logic, intuition, experience, knowledge, emotion, and feeling to be optimalize in a systematic process, and able to compare sets of things which literally not visible and things that visible, the quantitative and qualitative data. The AHP method is a common measuring theory which is used to decrease the ration scale from some discrete and continue comparison (Saaty, 1980 in Setiawan, 2003).

2.5 AHP Stages

Silitonga (2012) elaborates the decision making stages in AHP method are as follow: 1.System identification, 2. Hierarchy structure arrangement; 3. Set comparison; 4. Individual opinion matrix. 5. Matrix collective opinion, 6. Horizontal processing, 7. Vertical processing used to arrange effect priority of each element at certain decision hierarchy to each main target; and 8. Opinion revision, it is done if the inconsistency ration value is relatively high (>0,1).

2.6 AHP Basic Principle and Axiom

In completing the problems with AHP method, there are basic principles that should be understood as follow:

1. Decomposition

Decomposition is breaking down or dividing whole problem to become a decision making hierarchy form, where each elements are interconnected. Hierarchy is called to be complete if all elements at one level has relation to all elements in the next level. Generally the real problem has incomplete structure as its characteristic.

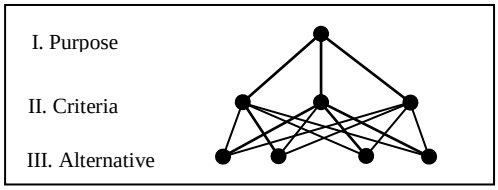

Fig.1. Complete Hierarchy Structure
Source: Iryanto (2008)

2. Pairwise Comparison

The scale which is used is 1 that shows the lowest level and scale 9 to shows the highest level as shown at Table 1 below:

Table 1 Pairwise Comparison Evaluation Scale

Need Intensity	Verbal Definition	Explanation
1	The same important	Both elements have the same influence
3	A little more important	The evaluation is more aside on one of elements compared to the couple
5	More important	The evaluation is really aside on one of the elements compared to its couple
7	Very important	One of the element really affect and domination look real
9	Absolutely more important	The proof that one of the elements is more important than its couple is very clear
2,4,6,8	The medium value from the above evaluation	The value which is given if there is any doubt of both evaluation

Source: Saaty (2008) and Saaty (1993) in Lubis (2010)

3. Priority Sinthesys, For each criteria and alternative, there is a need to do pairwise comparisons. Logic Consistency.

4. Logic consistency is an important characteristic in AHP method. All elements are grouped logically and reminded consistently align with a logic criteria. The calculation is conducted by following the following steps:
   a. The result of each line addition is divided by related priority and the result is combined.
   b. Then the result is divided by total number of elements (λmax).
   c. Inconsistency Index (*CI*) = (λmax-n) / (n-1)
   d. Consistency Ratio = *CI*/ *RI*, where *RI*is consistency random index.

If consistency ratio ≤ 0,1so the result of data calculation can be justified. List of RI can be seen in Table 2 as follow:

Table 2 Random Index (RI *)* value

N	1	2	3	4	5	6	7	8	9	10
RI	0	0	0,58	0,9	1,12	1,24	1,32	1,41	1,45	1,49

Source: Teknomo (1999)

Take samples of AHP for 30 respondent as the input data are sufficient, if the respondents are expert of problems faced. AHP has a special way to determine whether the data obtained is feasible or not, by calculating the ratio consistency. The data consistency value ratio of less than 10% were considered to be consistent (Teknomo, 1999).

3. METHODOLOGY

3.1 Stages of Research Survey and Data Source

Surveys conducted in this research consisted of two stages. The first phase is a pilot survey. The second phase is a major survey.

3.2 Data Collection Process

The number of samples in this study was taken as many as 40 samples. This is in conformity with section 2.6. The calculation of the number of samples of each batch of students can be seen in Table 3 as follows:

Tabel 3. Total Sample

No	Batch of Students	Total Students	Total Stratum Sample
1	2009	88	6
2	2010	106	7
3	2011	128	8
4	2012	146	10
5	2013	136	9
	Total	604	40

3.3 Hierarchy Structure

In the hierarchy structure are purpose, criteria and alternatives to be studied. Based on the literature review section 2.5 hierarchy in this research can be formulated as shown in Figure 3 below:

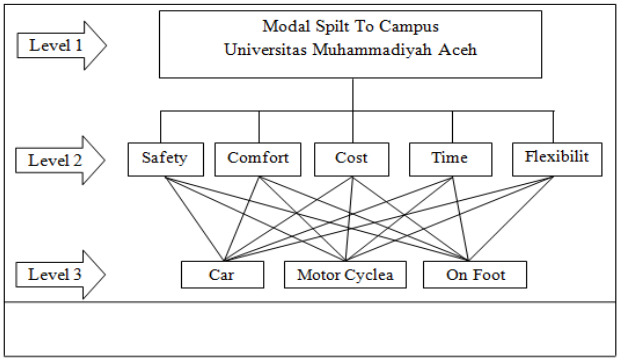

Fig. 2. Hierarchy Structure

3.4. Data Questionnaire

Pairwise comparisons based on questionnaire data to the criteria shown in Table 4 below:

Tabel 4 Pairwise Comparison of Criteria

No	Criteria	Pairwise Comparisonn	Result
1	Safety	Comfort Cost Time Flexibility	Safety & Comfort Safety & Cost Safety & Time Safety & Flexibility
2	Comfort	Cost Time Flexibility	Comfort dan Cost Comfort & Time Comfort dan Flexibility
3	Cost	Time Flexibility	Cost & Time Cost & Flexibility
4	Time	Flexibility	Time dan Flexibility

Next pairwise comparisons based on questionnaire data to the criteria shown in Table 5 below:

Tabel 5 Pairwise Comparison of Alternative

No	Alternative	Pairwise	Result
1	Car	Motor Cycle On Foot	Car dan Motor Cycle Car dan Jalan kaki
2	Motor Cycle	On Foot	Motor Cycle dan On Foot

3.5 Data Processing

Data processing is done with the help of Microsoft Excel programto the data from the questionnaire that had been circulated before hand. To resolve the problems faced with the using AHP method needs to be done the following steps:

1. Define the problem and determine the desired solution.
2. Createa hierarchical structure that begins with general purpose, followed by the criteria and alternatives.
3. Make apairwise comparison matrix that describes the relative contribution or impactof each element on each of the goals and criteria of a level above it.
4. Perform pairwise comparisons to obtain a judgmenten tirelyasnx[(n-1) /2] pieces, where n is the number of elements being compared.
5. Compute eigen value and tested for consistency, if notinconsistent data collection should berepeated.
6. Repeat steps 3,4and5 foral llevels of hierarchy.
7. Calculate the eigen vectors of each pairwise comparison matrix. Eigen vector value is the weigh tof each element.
8. Check the consistency of the hierarchy, if not inconsistent data assessment judgment must becorrected.

IV. RESULT AND DISCUSSION

4.1 Respondent Criteria Selection

If the priority vector (PV) for student criteria for selection are ranked, it will be easier to knows the criteria of choice of the students. Criteria for choice of students can be seen in Table 6 below:

Tabel 6 Matrix Normalization

Criteria	Safety	Comfort	Cost	Time	Flexsibility	Jumlah	PV	PV %
Safety	0,249	0,226	0,262	0,239	0,260	1,239	0,247	24,78
Comfort	0,224	0,203	0,181	0,210	0,196	1,015	0,203	20,32
Cost	0,151	0,177	0,158	0,162	0,153	0,801	0,160	16,04
Time	0,172	0,159	0,161	0,165	0,166	0,824	0,164	16,49
Flexibility	0,203	0,232	0,236	0,222	0,224	1,118	0,223	22,37
Total	1,000	1,000	1,000	1,000	1,000	5,000	1,000	100,00

From the results of the normalization matrix to secure the respondents found that safety criteria (24.78%) is the first choice in the selection of alternatives to the campus. Students also choose flexibility criteria (22.37%) as the second choice. From these choices can be concluded that the criteria considered to be the most influential for the student is traveling and flexible security on the way to campus. Criteria convenient, cost and time each worth 20.32%, 16.04% and 16.49% considered less influence

4.2 Respondent Global Selection

The global alternative selection is based on the combined criteria and alternatives as shown in Table 7 as follows:

Tabel 7 Global Criteria/Alternative

Criteria/ Alternative	Safety	Comfort	Cost	Time	Flexsibility	Global Priority (%)
Percentage	24,78	20,32	16,04	16,49	22,37	
Carl	41,36	49,37	20,62	31,56	18,71	32,98
Motor Cycle	31,28	38,22	50,76	56,52	35,37	40,89
On Foot	27,37	12,41	28,62	11,92	45,92	26,13

From the results of the matrix multiplication obtained that modal split alternatives of students to the campus is motorcycles (40.89%) followed by car (32.98%) and the choice the next student is on foot (26.13%). From these choices can be concluded that the combined global priority criteria and alternatives can be concluded first choice motorcycle, two cars and a third pilhan foot.

V. CONCLUSION

According to the results and discussion described above, it can be concluded that:

Base on respondent choices, the main criteria of modal split to campus of Unmuha-Aceh were safety (24,78%), flexsibility (22,37%), comfort (20,32%), time (16,49%) and cost (16,04%). Alternative modal choice of the first rank were motorcycles (40.89%), ranking second car (32.98%) and the third on foot 26,13%).

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