Application of The Fuzzy Analytical Hierarchy Process Method on Soil Drilling Projects

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Abstract

The aim of this study is to use the FAHP method (Fuzzy Analytical Hierarchy Process) at PT. Autiara Indah Anugrah to analyze and find the right stone and soil suppliers for the company. The research method used in this study is a quantitative method with the type of descriptive research. The analysis tool used is FAHP, where the priority of the dimensions is researched. The priority dimensions are the dimensions of price, accuracy, customer care, delivery accuracy and quality dimensions. When implementing the FAHP method, the author collects data from interviews with the company as well as internal data provided by the company involved in the work on the excavator project. Research results from the calculations performed, with a value of 0.334, MIA is the best provider compared to other providers.

Keywords
Fuzzy, AHP, Selecting Suppliers, Ground Dredging, Construction.

1. Introduction

The urgency of the sustainability of infrastructure development is increasingly felt amid the sharp increase in economic competition between regions, because building infrastructure is actually building the future of a civilization, because it can act as a stimulus for the movement of various economic activities. (Ministry of State Secretariat of the Republic of Indonesia, 2019). Through the acceleration of infrastructure development more evenly throughout the country, of course the hope that is created is strong connectivity between regions, reducing logistics costs, reducing inequality, improving people's quality of life, and eliminating economic disparities between regions in Indonesia, which will ultimately lead to increased competitiveness and economic growth stimulus in order to reach developed countries. (Ministry of State Secretariat of the Republic of Indonesia, 2019). A percentage of 10% in economic growth in Indonesia. The role of the construction sector can be seen from the absorption of labor, investment, the number of infrastructure and building projects, reciprocal relations with supporting sectors, and even being a facilitator in the movement and growth of goods and services. (Central Bureau of Statistics, 2018). Equitable development for all sectors is also supported by the construction sector, including food security in each region, fulfillment of national electricity and energy needs, improvement of education and health facilities, adequate road access for the transportation of goods and services, and increasing tourism attractiveness. (Central Bureau of Statistics, 2018). In the 2014-2015 period, there were 129,819-134029, then there was an increase again in the 2016-2017 period from 142,852-155,833. There was an increase in the 2017-2018 period from 155.833-160,576. Continuous improvement proves that construction companies in Indonesia are companies that are in great demand in Indonesia. (Central Bureau of Statistics, 2018)

In conducting the research, the writer collects data by carrying out three activities, including conducting interviews with workers who are directly related to the dredging project being researched; then given a questionnaire in order to get results in the form of numbers so that they can be processed in calculations using the Fuzzy Analytical Hierarchy Process method; and the last is the author conducted a literature study using previous journals in solving the same problem as the research being conducted.

By doing this research, it is expected to provide optimal results in weighting to find out what criteria are needed by the company and the value of the weights on each criterion to be made into the level of importance and to find out which suppliers meet the company's criteria in the weighted value. do to decide which is the best supplier that can be made as a priority supplier for the company in placing an order.

2. Literature Review

According to Griffin (2013) defines management as an activity (including planning and decision making, organizing, leading, and controlling) directed at organizational resources (human, financial, physical, and information), with the aim of achieving organizational goals in an efficient and effective manner. effective. According to Heizer and Render (2014) Operational Management is a set of activities to create value for products or services produced through the transformation process from inputs to outputs. According to Vroom and Jago as quoted by Hoy and Miskel (2014) effective decisions depend on three things, namely decision quality, subordinate acceptance, and timeliness. Decisions are said to be quality if they are able to solve problems faced by a person or organization.

According to Paramitac (2012) a supplier is a company and an individual that provides the resources needed by companies and competitors to produce certain goods and services. and selecting suppliers in the right way can reduce purchasing costs. The companies in question are suppliers, factory distributors, shops or retailers, as well as supporting companies such as logistics companies. Fuzzy logic is an appropriate way to map an input space into an output space. For very complex systems, the use of fuzzy logic is one solution. Traditional systems are designed to control a single output from multiple unrelated inputs. Because of this independence, adding new inputs complicates the control process and requires recalculation of all functions. (Pranata, Prayudha & Sandika, 2017) The Analytical Hierarchy Process (AHP) was first developed by Dr. Thomas L. Saaty of the Wharton School of Business in the 1970s. By using AHP, complex problems can be simplified, and the decision-making process accelerated. The working principle of AHP is to simplify a complex, unstructured problem into simpler parts, and to organize it in a hierarchy. (Radionovs, Uzhga-Rebrov, 2017)

Hierarchy is a description of complex problems in one structure. there are many levels where the top level is the goal and is followed by the criteria level, sub criteria and so on down to the lowest level is the alternative level. The hierarchy graphically depicts the interdependence of the relevant elements, showing the relationship between

homogeneous elements and the relationship with the system so that it becomes a unified whole. (Sihombing, Santoso, Rahayu, 2015)

According to Sangwook Lee (2016) the FAHP method was first introduced in 1983 by Van Laarhoven and Pedrycz. Fuzzy AHP is an analytical method developed from traditional AHP. Although AHP is commonly used in dealing with qualitative and quantitative criteria in MCDM, fuzzy AHP is considered to be better at describing vague decisions than traditional AHP.

3. Methods

The method used in this study is a descriptive method, namely finding facts with proper interpretation. The approach to selecting suppliers has been an important issue in construction management research for a long time due to the fact that there are many problems construction often requires considering multiple factors at the same time and relies on subjective judgments made by experts in their area of interest. (Lee, 2016). We use primary data collected using a questionnaire given to 8 respondents to stakeholders in the selection of suppliers at PT. Mutiara Indah Anugrah and secondary data obtained from several literatures and various journals in previous research. The method we use in this research is the Fuzzy Analytical Hierarchy Process (FAHP). The FAHP method was first introduced in 1983 by Van Laarhoven and Pedrycz. Fuzzy AHP is an analytical method developed from traditional AHP. Although AHP is commonly used in dealing with qualitative and quantitative criteria in decision making, fuzzy AHP is considered better at describing vague decisions than traditional AHP. (Lee, 2016). The use of a combination of fuzzy and AHP methods can produce more accurate weighting and supplier determination values with a low tolerance error level. (Pickles, Beskese, & Temur, 2018). According to Sugiono (2017) Says that population is a generalization consisting of subjects and objects that have certain quantities and characteristics that are determined by researchers to be studied and then conclusions are drawn. For this reason, the researchers determined that the population that the researchers would examine were 8 employees in the company related to the soil dredging project in making supplier selection decisions. According to Sugiyono (2017) the definition of the sample is part of the number and characteristics possessed by the population. Sample measurement is a step to determine the size of the sample taken in carrying out a study. In addition, it is also noted that the selected sample must show all the characteristics of the population so that it is reflected in the selected sample, in other words the sample must be able to describe the actual or representative (representative) state of the population.

4. Results and Discussion

The results of the research conducted by the author after collecting data from 8 respondents who filled out the questionnaire and then processed using the Analytical Hierarchy Process method in table 1 show that the price dimension is ranked first with a weight (0.357). The timeliness dimension is ranked second with a weight (0.232), the quantity accuracy dimension is in the third rank with a weight (0.191), the quality dimension is ranked fourth with a weight (0.147) and the customer care dimension is a dimension with the last rank with a weight (0.073).

Table 1. Weighting of the Main Criteria Analytical Hierarchy Process

Criteria	H	K	KW	KP	CC	EIGEN VALUE					Amount	Averge
H	1	2	3	2	3	0.375	0.272	0.562	0.343	0.230	1.785	0.357
K	0.5	1	0.5	0.5	3	0.187	0.136	0.093	0.085	0.230	0.734	0.147
KW	0.33	2	1	2	3	0.124	0.272	0.187	0.343	0.230	1.158	0.231
KJ	0.5	2	0.5	1	3	0.187	0.272	0.093	0.171	0.230	0.956	0.191
CC	0.33	0.33	0.33	0.33	1	0.124	0.045	0.061	0.056	0.076	0.364	0.073
Totl	**2.66**	**7.33**	**5.33**	**5.83**	**13**							**1**

Source: Processed by the author

Information:

H: Price

K: Quality

KW: Punctuality

KJ: Quantity Accuracy

CC: Customer Care

The average column is representative of the weight of each main criterion and this calculation is also carried out on the list of suppliers examined by the author.

The results of the weighting carried out by the author from the results of filling out questionnaires on the supplier section which are then processed using the Analytical Hierarchy Process method. The results of the average weighting of each supplier on each criterion are multiplied by the average value of each main criterion in table 1 then added up to get the results in table 2 that Pak Saiman is ranked first with a score of (0.404), PT. Mia was ranked second with a score (0.348), PT. Rajawali was ranked third with a score of (0.213), PT. Batu Prakasa was ranked fourth with a score of (0.110) and PT Nusantara Batulicin was ranked last with a weight of (0.104).

Table 2. Analytical Hierarchy Process Rank Score

RANK	SCORE	RANKING
MR. SAIMAN	0.404	1
PT MIA	0.348	2
PT RAJAWALI	0.213	3
PT BATU PRAKASA	0.110	4
PT NUSANTARA BATULICIN	0.104	5

Source: Processed by the author

Then the results of the research conducted by the author after being processed using the Analytical Hierarchy Process method in table 1 then the number is changed to the Fuzzification number as in table 3 which shows that the price dimension is ranked first with a weight (0.344). The dimension of timeliness is ranked second with a weight of (0.225), the dimension of accuracy in quantity is ranked third with a weight of (0.2), the quality dimension is ranked fourth with a weight of (0.157) and the dimension of customer care is the dimension with the last rank with a weight of (0.074)

Table 3. Score Weighting Criteria Fuzzy Analytical Hierarchy Process

Criteria	H			K			KW			KP			CC			NI
	l	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	*l*	*m*	*u*	
H	1	1	1	1	2	3	2	3	4	1	2	3	2	3	4	0.344
K	0.3	0.5	1	1	1	1	0.3	0.5	1	0.3	0.5	1	2	3	4	0.157
KW	0.2	0.3	0.5	1	2	3	1	1	1	1	2	3	2	3	4	0.225
KJ	0.3	0.5	1	1	2	3	0.3	0.5	1	1	1	1	2	3	4	0.2
CC	0.2	0.3	0.5	0.2	0.3	0.5	0.2	0.33	0.5	0.2	0.3	0.5	1	1	1	0.074

Source: Processed by the author.

Information:
H: Price
K: Quality
KW: Punctuality
KJ: Quantity Accuracy
CC: Customer Care
NI: Normality

To calculate Table 3, is to calculate the matrix for each supplier and consider the priority criteria. In calculating this matrix, a comparison is used between each supplier dimension and also each supplier. The comparison provisions can be seen in table 4. The same method is also applied to each dimension.

Table 4. Paired Principal Dimension Matrix

Criteria	Price	Quality	Punctuality	Quantity Accuracy	Customer Care
Price	1	2	3	2	3
Quality	0,5	1	0,5	0,5	3
Punctuality	0,33	2	1	2	3
Quantity Accuracy	0,5	2	0,5	1	3
Customer Care	0,33	0,33	0,33	0,33	1
Total	2,66	7,33	5,33	5,83	13

Source: Processed by the author

The NI column in table 3 is Normality which is the weight of each criterion in order to determine the order of priority for each dimension of the supplier criteria. This calculation is also applied to the list of suppliers examined by the author.

The results of the calculations carried out by the authors of data processing from the Analytical Hierarchy Process to Fuzy Analytical Hierarchy Process produce ranking weights on each criterion which are finally compared into table 4 to find out which supplier is the best after the results of the weighting show that PT. Mia was ranked first with a score (0.334), Pak Saiman was ranked second with a score (0.221), PT Rajawali was ranked third with a score (0.212), PT. Batu Prakasa was ranked fourth with a score of (0.118) and PT. Nusantara Batulicin was ranked last with a score (0.113).

Table 5. Score Rating Fuzzy Analytical Hierarchy Process

CRITERIA	WEIGHT	BP	PS	MIA	NB	RJ
H	0.344	0.081	0.175	0.394	0.128	0.221
K	0.157	0.149	0.239	0.303	0.105	0.203
KW	0.225	0.164	0.263	0.307	0.108	0.159
KJ	0.2	0.108	0.254	0.276	0.108	0.254
CC	0.074	0.113	0.192	0.359	0.093	0.242
Totl	1	0.118	0.221	0.334	0.113	0.212

Source: Processed by the author

Information:

H: Price
K: Quality:
KW: Punctuality
KJ: Quantity Accuracy
CC: Customer Care

BP: PT. Mighty Stone
PS: Mr. Saiman
MIA: PT. Mia
NB: PT. Nusantara Batulicin
RJ: PT. Eagle

5. Conclusion

PT. Mia is the supplier with the highest rank in value weighting which is calculated using the Fuzzy Analytical Hierarchy Process (table 5) method from the results of the questionnaire data. In selecting suppliers, companies must always consider the priority weights of supplier dimensions and supplier priorities based on each dimension, and also maintain good relations with the four existing suppliers, so that if at one time the company which currently ranks first as the best supplier does not able to meet the company's demand, the company can switch to other suppliers by considering the priority weights of the supplier dimensions and supplier priorities based on each dimension.

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