JIT Journal of Innovation and Technology
e-ISSN: 2721-8562; p-ISSN: 2721-8570
Vol. 4, No. 1, April 2023. Page: 6 – 13

# The Selection of Suppliers of Ready Mix Concrete Raw Materials Using the Fuzzy Analytical Hierarchy Process Method for The Dam Construction Project

**Hajar Kamilah**[1], **Kristianto Usman**[2,*], **Dian Perwitasari**[1]

[1] *Civil Engineering Study Program, Institut Teknologi Sumatera, South Lampung, Indonesia.*
[2] *Department of Civil Engineering, Faculty of Engineering, Universitas Lampung, Jl. Prof. Soemantri Brojonegoro No.1 Bandar Lampung, 35145, Indonesia*

*Corresponding author: kristianto.usman@eng.unila.ac.id

*Article history*
Received: 28.12.2022
Revised: 13.02.2023
Accepted: 12.04.2023

DOI:10.31629/jit.v3i2.5605

**Abstract**
The construction of facilities such as buildings, roads, and dams has an important part role in supporting daily life activities. One of all the facilities currently being built is the Sadawarna Dam Construction Project Package 1. Where does the project function to supply the needs of water resources and irrigation in West Java. However, in the construction process the project has encountered obstacles such as delays in the delivery of raw materials by the suppliers which caused the casting time to be delayed. The solution to these problems can be found by the improvement the supplier selection method. One of the methods that can be used is the Fuzzy Analytical Hierarchy Process (Fuzzy-AHP). Where in the process will expand measuring tools in the selection decisions that involve expert respondent. As The variables in determining suppliers use 4 criteria such as price, delivery, quality, and location as well as 7 sub-criteria such as payment methods, bid prices, delivery times, delivery of flexibility, delivery of capacity, consistency of quality, and specification conformance. From these variables, a comparison value with the AHP scale will be obtained which will be converted into a Triangular Fuzzy Number (TFN) scale. The results of this research obtained the best criteria is quality and sub-criteria is the bid price, as well as the best alternative from the selection of suppliers of concrete raw materials suppliers of fine aggregate materials is CV BTP Cimalaka at 51.3% and suppliers of coarse aggregate materials are PT Fajar Mandiri at 63.7%.

**Keywords:** fuzzy analytical hierarchy process, decision making, aggregate, triangular fuzzy number

## 1. Introduction

Construction is an activity carried out to make facilities, one of the processes is casting, where on casting is done to establish strength the building structure. So, in the selection of raw materials from material to be used must guard so as to get good quality material for the manufacture of concrete [1]. One of the things used for the supply of raw materials is maintained in accordance with production needs is foster good cooperative relationships with suppliers. As well, the results obtained from supplier selection will be more optimal [2]. There are some criteria commonly used in supplier selection for companies, including the criteria for price, delivery, capacity, availability and

**DOI:10.31629/jit.v4i1.5605**

also the bid price. To find out the best supplier, the selection of suppliers can be performed periodically.

In the Sadawarna dam construction project Package 1, a required supplier of raw materials where one of the raw materials needed in this project is a supplier of concrete raw materials (fine aggregate and coarse aggregate) [3]. Where there's two suppliers of concrete raw materials in this project, which is used as alternatives, namely CV Vasco and CV BTP for suppliers of fine aggregate materials and PT DMB and PT Fajar Mandiri for suppliers of coarse aggregate materials.

In the Sadawarna dam construction project Package 1 had a delay in raw materials (fine aggregate). So, this research was conducted in order to determine the priority from each supplier in each period whit using the method of the Fuzzy Analytical Hierarchy Process (Fuzzy-AHP) [4].

Where this method can make decisions objectively from using a hierarchical structure from the goals, criteria/sub-criteria and alternatives. This method is carried out after converting the pairwise comparison value from the AHP scale into the Triangular Fuzzy Number scale (TFN) so that it can calculate the fuzzy value in the data [5-7].

## 2. Materials and Method

The data collection carried out in this reaserch was distributing questionnaires to expert respondents who interacted directly with raw material suppliers in the Package 1 Sadawarna Dam Development Project.

### *2.1 Fuzzy AHP*

The Fuzzy-AHP method proposed by Chang (1996) with developing the AHP method by changing the AHP scale on the pairwise comparison matrix into a Triangular Fuzzy Number scale (TFN) so that we get 3 member functions, namely l (lowest value), m (middle value) and u (highest value). Fuzzy-AHP can be solved with the following steps:

**Table 1.** AHP Scale

| Scale | Description |
|---|---|
| 1 | Both elements have the same importance |
| 3 | One element is slightly more important than the other |
| 5 | One element is more important than other elements |
| 7 | One element is clearly more important than the other elements |
| 9 | One element is absolutely essential from the other elements |
| 2,4,6 7,8 | Values that have close considerations between two values |
| Oppo - site | If i has one number compared to j, then j has the opposite value compared to i |

The process is as follow:

1. Create a hierarchical structure level of the problem to be resolved (goals, criteria or subcriteria, alternatives)
2. Determine the value of the pairwise comparison matrix.
3. Calculating the value of the consistency ratio (CR) with the provision of CR ≤ 0,1, with the following equation:

$$Vp = \frac{m_1}{\sum m} \quad (1)$$

*Eigen vector = pairwise comparison matric Vp* (2)

$$VB = matrix\ m \times Vp\ matrix \quad (3)$$

$$\lambda_{maks} = \frac{\sum VB}{n} \quad (4)$$

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \quad (5)$$

$$CR = \frac{CI}{RI} \ (6)$$

Whare:

Vp = normalized weight matrix; m = total value of each criterion VB = normalized matrix weight; $\lambda_{max}$ = the largest eigenvalues in the comparison matrix; n = number of items compared in the matrix (matrix dimensions); RI = random index, as on table 2.

**Table 2.** Ratio Index

| *n* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| RI | 0 | 0 | 0,52 | 0,89 | 1,11 | 1,25 | 1,35 | 1,40 | 1,45 | 1,49 | 1,51 |

Change of the value in pairwise comparison matrix from the AHP scale to the TFN scale, according to the following table 3.

**Table 3.** Triangular Fuzzy Number

| ***AHP Scale*** | ***Triangular Fuzzy Number*** | | |
|---|---|---|---|
| | **l** | **m** | **u** |
| 1 | 1 | 1 | 3 |
| 2 | 1 | 2 | 4 |
| 3 | 1 | 3 | 5 |
| 4 | 2 | 4 | 6 |
| 5 | 3 | 5 | 7 |
| 6 | 4 | 6 | 8 |
| 7 | 5 | 7 | 9 |
| 8 | 6 | 8 | 9 |
| 9 | 7 | 9 | 9 |

Calculate the value of fuzzy synthesis with the following equation:

$$Si = \sum_{j=1}^{m} M_i^j \times \left[\frac{1}{\sum_{i=1}^{n}\sum_{j=1}^{m} M_i^j}\right] \quad (7)$$

Where:
$\sum_{j=1}^{m} M_i^j$ = the number of values (l,m,u) on each criteria;
$\sum_{i=1}^{n}\sum_{j=1}^{m} M_i^j$ = total of $\sum_{j=1}^{m} M_i^j$; M = The value (l,m,u) in the pairwise comparison matrix;
i dan j = 1,2,3,..., etc. ; i≠j;
l,m,u = TFN value.

Calculate the value of the degree of probability with the following equation.

$$V(M_j \geq M_i) = \begin{cases} 1 & if\ m_j \geq m_i \\ 0 & if\ l_i \geq u_j \\ \frac{l_i - u_j}{(m_j - u_j) - (m_i - l_i)} & other \end{cases} \quad (8)$$

Where:
M = The value (l,m,t) in the pairwise comparison matrix;
i dan j = 1,2,3,..., etc. ; i≠j;
l,m,u = TFN value.

Determine the vector weight and normalize the value of the vector

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n)) \quad (9)$$

$$W = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad (10)$$

Where : $d'(A_{ij}) = min\ V(M_j \geq M_i)$

*2.2. Respondent Weight*

Is an assessment given to get the weight of each respondent to get the value given by expert respondents, using the following equation:

$$S = w_1 S_1 + w_2 S_2 + \dots + w_n S_n \quad (11)$$

$$\sum S = \sum \textit{the score of each respondent on the criteria} \quad (12)$$

$$W = \frac{S_n}{\sum S}$$

Where:
Sn = The score of the respondent's performance level for each criteria;
Wn = The weight of each criteria used.

*2.3 Geometric Mean*

Is an equation used in combining several assessments. In this research, the geometric mean was used to combine the assessments of the three expert respondents. The equations used are as follows:

$$G = \sqrt{x1^{w1} \times x2^{w2} \times \dots \times xn^{wn}} \quad (14)$$

Where: G = geometric mean; Xn = The value in the matrix in a certain row/column; Wn = The weight used for each data.

## 3. Results

From the data collection carried out, it was found that suppliers of fine aggregate materials, namely CV Vasco and CV BTP and suppliers of coarse aggregate, namely PT DMB and PT Fajar Mandiri. Respondent Weight.

With the criteria for expert respondents are as follows.

**Table 4.** Triangular Fuzzy Number

| $w_n S_n$ | | | | | | | |
|---|---|---|---|---|---|---|---|
| Position (25%) | | Education (20%) | | Years of service (35%) | | Expert certificate (20%) | |
| level | Score | level | Score | level | Score | level | Score |
| Supervisor | 5 | SLTA/ Equal | 4 | 1-5 | 7 | Do not have SKA | 4 |
| Logistics | 10 | D3 | 8 | 6-10 | 14 | SKT | 8 |
| Technique (QA/QC) | 15 | S1 | 12 | 11-15 | 21 | SKA (Young expert) | 12 |
| Plant Head | 20 | S2 | 16 | 16-20 | 28 | SKA (Associate expert) | 16 |
| PM | 25 | S3 | 20 | 21-25 | 35 | SKA (Main Expert) | 20 |

With the calculation of the respondent's weight is presented on table 5.

**Table 5.** Respondent Data

| NO | Respondent | Position | Education | Years of service | Expert certificate |
|---|---|---|---|---|---|
| 1 | Respondent 1 | QC Material Batching Plant | D3 | 8 years | Do not have SKA |
| 2 | Respondent 2 | Teknik (QA/QC) | S1 | 5 years | SKA (Young expert) |
| 3 | Respondent 3 | Teknik (QA/QC) | S1 | 5 years | SKA (Young expert) |

Calculation of respondent weight is as follow:

Score Respondent 1 = Position + Education + Year of service + Expert certificate

= 15 + 8 + 14 + 4

= 41

Score Respondent = Score Respondent 1+ Score Respondent 2+ Score Respondent 3

= 41 + 46 + 46

= 133

$$\text{Respondent weight 1} = \frac{\text{Score Respondent 1}}{\sum \text{Score Respondent}}$$

$$= \frac{41}{133}$$

= 0,31

= 31%

**Table 6.** Respondent Weight

| No | Respondent | Score Responden ($w_n S_n$) | | | | Sum | Respondent Weight |
|---|---|---|---|---|---|---|---|
| | | Position | Education | Year of service | Expert certificate | | |
| 1 | Respondent 1 | 15 | 8 | 14 | 4 | 41 | 0,31 |
| 2 | Respondent 2 | 15 | 12 | 7 | 12 | 46 | 0,345 |
| 3 | Respondent 3 | 15 | 12 | 7 | 12 | 46 | 0,345 |
| Total (∑) | | | | | | 133 | 1 |

### *3.2 CR Value Calculation*

With data from the pairwise comparison matrix for the fine aggregate criteria, it is as follows:

**Table 7.** Respondent Data 1

| Criteria | K1 | K2 | K3 | K4 |
|---|---|---|---|---|
| K1 | 1,00 | 3,00 | 1,00 | 7,00 |
| K2 | 0,33 | 1,00 | 0,14 | 3,00 |
| K3 | 1,00 | 7,00 | 1,00 | 7,00 |
| K4 | 0,14 | 0,33 | 0,14 | 1,00 |

**Table 8.** Respondent Data 2

| Criteria | K1 | K2 | K3 | K4 |
|---|---|---|---|---|
| K1 | 1,00 | 5,00 | 1,00 | 5,00 |
| K2 | 0,20 | 1,00 | 0,33 | 3,00 |
| K3 | 1,00 | 3,00 | 1,00 | 8,00 |
| K4 | 0,20 | 0,33 | 0,13 | 1,00 |

**Table 9.** Respondent Data 3

| Criteria | K1 | K2 | K3 | K4 |
|---|---|---|---|---|
| K1 | 1 | 4 | 0,25 | 4 |
| K2 | 0,25 | 1 | 0,25 | 2 |
| K3 | 4,00 | 4,00 | 1 | 7 |
| K4 | 0,25 | 0,50 | 0,14 | 1 |

Calculating the CR value for respondent 1 :

1. Normalize the pairwise comparison matrix

$$= \begin{bmatrix} 1 & 3 & 1 & 7 \\ 0{,}33 & 1 & 0{,}14 & 3 \\ 1 & 7 & 1 & 7 \\ 0{,}14 & 0{,}33 & 0{,}14 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 3 & 1 & 7 \\ 0{,}33 & 1 & 0{,}14 & 3 \\ 1 & 7 & 1 & 7 \\ 0{,}14 & 0{,}33 & 0{,}14 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 4 & 15{,}33 & 3{,}42 & 30 \\ 1{,}23 & 4 & 1{,}04 & 9{,}33 \\ 5{,}33 & 19{,}33 & 4 & 42 \\ 0{,}53 & 2{,}09 & 0{,}47 & 4 \end{bmatrix}$$

**Table 10.** Normalized Matrix

| Criteria | K1 | K2 | K3 | K4 | Sum (m) |
|---|---|---|---|---|---|
| K1 | 4 | 15,33 | 3,43 | 30 | 52,76 |
| K2 | 1,24 | 4 | 1,05 | 9,33 | 15,62 |
| K3 | 5,33 | 19,33 | 4 | 42 | 70,67 |
| K4 | 0,54 | 2,10 | 0,48 | 4 | 7,11 |
| TOTAL (∑m) | | | | | 146,16 |

2. Calculating VP value

$$Vp_1 = \frac{m_1}{\sum m} = \frac{52{,}76}{146{,}16} = 0{,}36$$

$$Vp_2 = \frac{m_2}{\sum m} = \frac{15{,}62}{146{,}16} = 0{,}11$$

$$Vp_3 = \frac{m_3}{\sum m} = \frac{70{,}67}{146{,}16} = 0{,}48$$

$$Vp_4 = \frac{m_4}{\sum m} = \frac{7{,}11}{146{,}16} = 0{,}05$$

3. Calculating the value of eigenvector.
   Eigenvector = pairwise comparison matrix × Vp matrix as follow :

$$\text{Eigenvector} = \begin{bmatrix} 1 & 3 & 1 & 7 \\ 0{,}33 & 1 & 0{,}14 & 3 \\ 1 & 7 & 1 & 7 \\ 0{,}14 & 0{,}33 & 0{,}14 & 1 \end{bmatrix} \times \begin{bmatrix} 0{,}36 \\ 0{,}11 \\ 0{,}48 \\ 0{,}05 \end{bmatrix}$$

$$= \begin{bmatrix} 1{,}55 \\ 0{,}44 \\ 1{,}93 \\ 0{,}20 \end{bmatrix}$$

**DOI:10.31629/jit.v4i1.5605**

4. Calculating VB value

VB = m matrix × Vp matrix

$$= \begin{bmatrix} 52,76 \\ 15,62 \\ 70,67 \\ 7,11 \end{bmatrix} \times \begin{bmatrix} 0,36 \\ 0,11 \\ 0,48 \\ 0,05 \end{bmatrix}$$

$$= \begin{bmatrix} 4,17 \\ 4,14 \\ 4 \\ 4,21 \end{bmatrix}$$

5. Calculating $\lambda_{maks}$ value

$$\lambda_{maks} = \frac{\sum VB}{n} = \frac{4,17+4,14+4+4,21}{4} = 4,13$$

6. Calculating CI value

$$CI = \frac{\lambda_{maks}-1}{n-1} = \frac{4,13-1}{4-1} = 0,043$$

7. Calculating CR value

$$CR = \frac{CI}{RI} = \frac{0,043}{0,9} = 0,048$$

Where the RI value is obtained in Table 2. Index Ratio is in accordance with the amount of existing data. Then the CR value for the respondent is obtained as follows:

**Table 11.** Respondent Consistency Ratio Value (CR)

| No | Respondent | CR Value (CR ≤ 0,1) | | | |
|---|---|---|---|---|---|
| | | Fine Aggregate | | Coarse Aggregate | |
| | | Criteria | Sub-criteria | Criteria | Sub-criteria |
| 1 | Respondent 1 | 0,048 | 0,03 | 0,048 | 0,03 |
| 2 | Respondent 2 | 0,041 | 0,09 | 0,041 | 0,09 |
| 3 | Respondent 3 | 0,076 | 0,07 | 0,062 | 0,07 |

After the consistency ratio value of the respondents has met the requirements of CR 0.1, then the next step is combining the pairwise comparison matrix to calculate the priority value of the criteria using the Fuzzy-AHP method.

### *3.3 Pairwise Comparison Matrix Combined of Respondent*

Combining pairwise comparison matrix with the mean geometric equation using the weights obtained in Table 12.

$$G_{12} = \sqrt{x1^{w1} \times x2^{w2} \times \ldots \times xn^{wn}}$$

$$= \sqrt{3^{0,31} \times 5^{0,345} \times 4^{0,345}}$$

$$= 1,58$$

**Table 12.** Combined Pairwise Comparison Matrix

| Criteria | K1 | K2 | K3 | K4 |
|---|---|---|---|---|
| K1 | 1,00 | 1,58 | 0,85 | 1,73 |
| K2 | 0,63 | 1,00 | 0,61 | 1,38 |
| K3 | 1,17 | 1,63 | 1,00 | 1,94 |
| K4 | 0,58 | 0,73 | 0,51 | 1,00 |

### *3.4 Fuzzy-AHP Calculation*

After obtaining a combined pairwise comparison matrix, then calculate using the Fuzzy-AHP method, which is as follows:

a) *Converting the combined pairwise comparison matrix to the TFN scale*

**Table 13.** Pairwise Comparison Matrix Criteria Respondent 1 in the TFN Scale

| Criteria | K1 | | | K2 | | | K3 | | | K4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | l | m | u | l | m | u | l | m | u | l | m | u |
| K1 | 1,00 | 1,00 | 1,44 | 1,23 | 1,58 | 1,82 | 0,81 | 0,85 | 1,17 | 1,45 | 1,73 | 1,93 |
| K2 | 0,55 | 0,63 | 0,81 | 1,00 | 1,00 | 1,44 | 0,54 | 0,61 | 0,78 | 1,00 | 1,38 | 1,67 |
| K3 | 1,08 | 1,17 | 1,56 | 1,28 | 1,63 | 1,86 | 1,00 | 1,00 | 1,44 | 1,75 | 1,94 | 2,08 |
| K4 | 0,52 | 0,58 | 0,69 | 0,60 | 0,73 | 1,00 | 0,48 | 0,51 | 0,57 | 1,00 | 1,00 | 1,44 |

$\sum l$ = (1+1,23+0,81+1,45) = 4,49
$\sum m$ = (1+1,58+0,85+1,73) = 5,16
$\sum u$ = (1,44+1,82+1,17+1,93) = 6,36

**Table 14.** Total Value of Each Criteria

| Criteria | Total | | |
|---|---|---|---|
| | l | m | u |
| K1 | 4,49 | 5,16 | 6,36 |
| K2 | 3,09 | 3,62 | 4,70 |
| K3 | 5,11 | 5,74 | 6,94 |
| K4 | 2,60 | 2,82 | 3,70 |
| Total | 15,29 | 17,35 | 21,71 |

b) *Fuzzy Syndetic*

$$\text{Si K1} = \sum_{j=1}^{m} M_i^j \times \left[\frac{1}{\sum_{i=1}^{n}\sum_{j=1}^{m} M_i^j}\right]$$

$$= \sum l, m, u \times \frac{1}{u}, \frac{1}{m}, \frac{1}{l}$$

$$= (\sum l \times \frac{1}{u}), (\sum m \times \frac{1}{m}), (\sum u \times \frac{1}{l})$$

$$= (4,49 \times \frac{1}{21,71}), (5,16 \times \frac{1}{17,35}), (6,36 \times \frac{1}{15,29})$$

= (0,21), (0,30), (0,42)

**DOI:10.31629/jit.v4i1.5605**

**Table 15.** Fuzzy Syndetic Value

| Criteria | l | m | u |
|---|---|---|---|
| K1 | 0,21 | 0,30 | 0,42 |
| K2 | 0,14 | 0,21 | 0,31 |
| K3 | 0,24 | 0,33 | 0,45 |
| K4 | 0,12 | 0,16 | 0,24 |

*c) Degree of probability*

$V(K_j \geq K_i) = V(K_2 \geq K_1)$

➢ $m_2 \geq m_1 = 1$

$0{,}21 \geq 0{,}30$

➢ $l_1 \geq u_2 = 0$

$0{,}21 \geq 0{,}31$ (Salah)

Therefore, it make equation as follow.

➢ $\frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} = \frac{0{,}21 - 0{,}31}{(0{,}21 - 0{,}31) - (0{,}30 - 0{,}21)} = 0{,}53$

Where :

$$V(K_2 \geq K_1) = \frac{l_i - u_j}{(m_j - u_j) - (m_i - l_i)}$$

**Table 16.** Value of Degree of Probability

| Criteria | K1 | K2 | K3 | K4 |
|---|---|---|---|---|
| K1 | | 0,53 | 1 | 0,21 |
| K2 | 1 | | 1 | 0,68 |
| K3 | 0,84 | 0,37 | | 0,03 |
| K4 | 1 | 1 | 1 | |
| $d'(A_{ij})$ | 0,84 | 0,37 | 1 | 0,03 |

The vector weights and normalize is as follow.

$W = (d'(A_1), d'(A_2), \ldots, d'(A_n))$

$W = 0{,}84 ; 0{,}37 ; 1 ; 0{,}03$

$W' = (d'(A_1), d'(A_2), \ldots, d'(A_n))^T$

$W' = (0{,}84 ; 0{,}37 ; 1 ; 0{,}03)^T$

$W' = 0{,}37 ; 0{,}17 ; 0{,}44 ; 0{,}02$

**Table 17.** Vector Weights and Normalized Weights

| Criteria | K1 | K2 | K3 | K4 |
|---|---|---|---|---|
| W | 0,84 | 0,37 | 1 | 0,03 |
| W' | 0,3738 | 0,1650 | 0,4435 | 0,0176 |

So, from the calculation results obtained weights for criteria, sub-criteria and alternatives for suppliers of fine aggregates and suppliers of coarse aggregates can be seen in the graphic image, which is as follows:

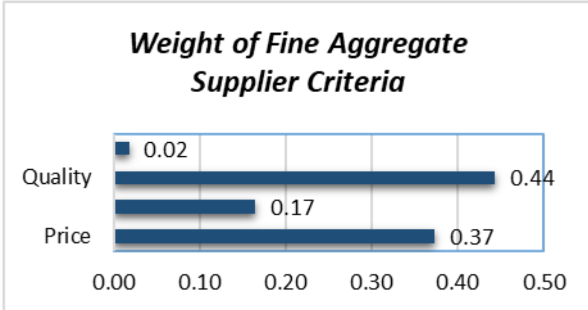


**Figure 1.** Weight of Fine Aggregate Supplier Criteria

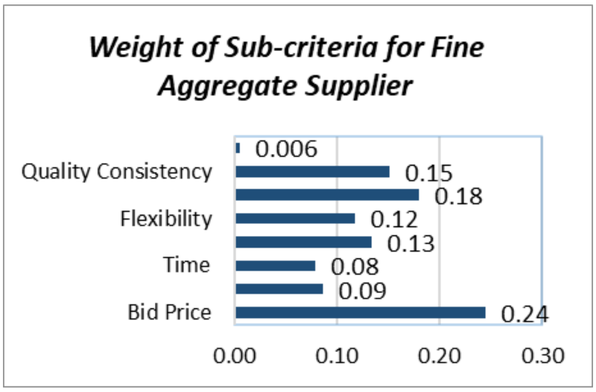


**Figure 2.** Weight of Sub-criteria for Fine Aggregate Supplier

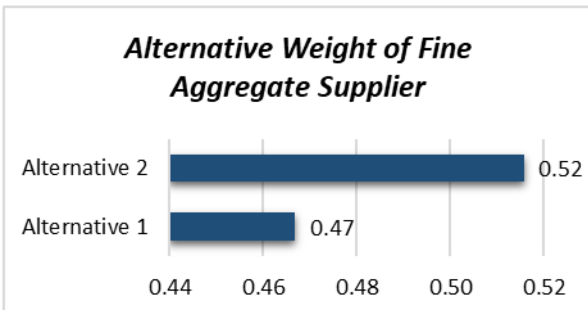


**Figure 3.** Alternative Weight of Fine Aggregate Supplier

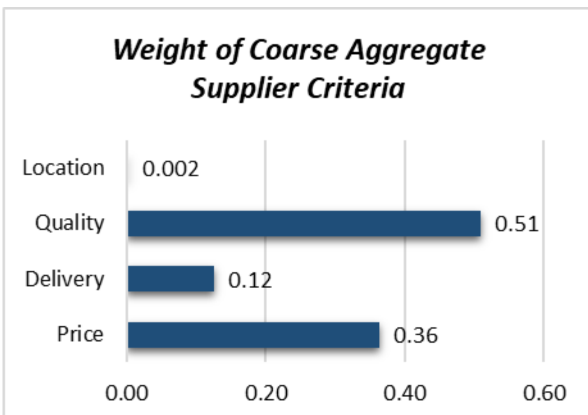


**Figure 4.** Weight of Coarse Aggregate Supplier Criteria

**DOI:10.31629/jit.v4i1.5605**

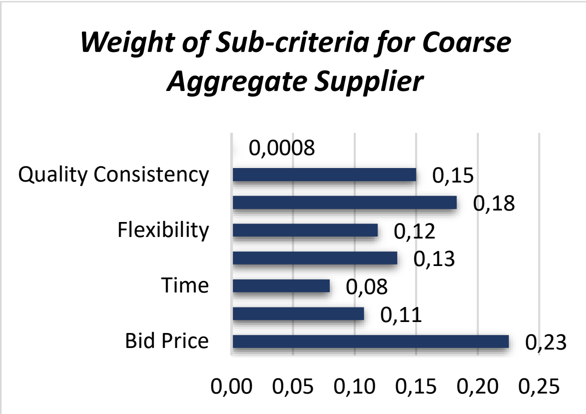


**Figure 5.** Weight of Sub-criteria for Coarse Aggregate Supplier

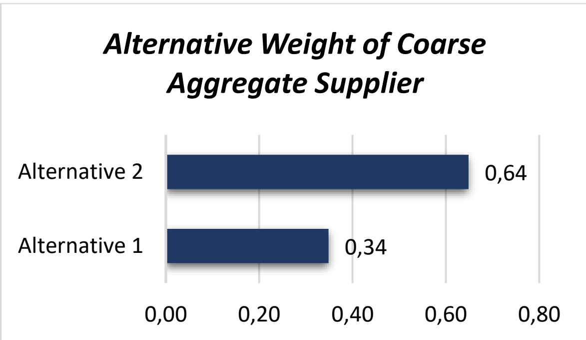


**Figure 6.** Alternative Weight of Coarse Aggregate Supplier

## 4. Data Analysis

Based on the results of the questionnaires and interview, then obtained 4 criteria and 7 sub-criteria in the suppliers selection of coarse aggregates and suppliers of fine aggregates. On the results otained from the weighting of fine aggregate supplier criteria, the highest criterion is the quality criterion (44,35%) with the highest sub-criteria are the bid price (24%) with an alternative that is CV. BTP (51,58%). While the results obtained from the weighting of the coarse aggregate supplier criteria the highest criterion is the quality criterion (50,91%) with the highest sub-criteria are the bid price (22%) with an alternative that is PT. Fajar Mandiri (64,87%) whit a discussing the priority level from criteria and sub-criteria.

The criteria obtained are the criteria for price, quality, delivery and location. Where for suppliers of fine aggregate material the most influential criteria are quality criteria (44.35%) followed by price criteria (37.38%), delivery (16.5%) and location (1.76%). Meanwhile, for suppliers of coarse aggregate materials, the most influential criteria are quality criteria (50.91%) followed by price criteria (36.35%), delivery (12.49%) and location (0.2%). The quality criteria are used as a reflection of the supplier of raw materials provided in accordance with the consistency of the quality provided and the conformity of specifications.

The quality can be used as a reflection of suppliers who can show the quality and consistency of the materials provided by supplier so that the concrete produced is in accordance with the quality desired by the project. While the price criteria, where the price criteria can be used as one of advantages if the bid price obtained by the company is worth less than the predetermined budget price so that it becomes more efficient and can adjust the price needs of other raw materials with weekly invoice payments.

Delivery criteria can show the project always pays attention to delivery time, delivery capacity and also the flexibility of delivery, so that the availability of goods provided by the supplier can be guaranteed. The location criteria according to which each supplier has agreed that the goods to be shipped will conform to the timetable established by the company.

## 5. Conclusions

The price criteria can be an advantage if the bid price is lower than the original design cost with the quality provided in accordance with the company's request. The delivery criteria can show that the supplier pays attention to the raw materials sent in accordance with the agreement where the delivery time, delivery capacity, and delivery flexibility of raw materials come on schedule so as not to cause work on the project to be disrupted. While the location criteria if the supplier is in agreement, then the supplier will meet the raw material requirements according to the agreement between the two parties. Based on the criteria and sub-criteria used in the selection, the best alternative supplier in the project and selected objectively for the supplier of fine aggregate material are CV BTP at 51.58% different from the main supplier in the project is CV Vasco, while for alternative material suppliers The coarse aggregate obtained is PT Fajar Mandiri at 64.87% and is in accordance with the main supplier on the project.

**DOI:10.31629/jit.v4i1.5605**

## References

[[1] Fajri Muhammad, Putri R. R. M, dan Muflikhah L,. "Implementasi Metode Fuzzy Analytical Hierarchy Process". Program Studi Teknik Informatika, Fakultas Ilmu Komputer, Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer, Vol. 2, No. 5, hlm. 2109-2117, Mei 2018.

[2] Pratama, R. F., "Integrasi Metode Analytical Hierarchy Process (AHP) Dan Technique For Orders Reference By Similarity To Ideal Solution (TOPSIS) Dalam Pemilihan Supplier yang Optimal (Studi Kasus Di PT. Cegeone)", Universitas Islam Sultan Agung, Semarang, 2018.

[3] Puspitasari, Dwi., "Penerapan Metode Fuzzy Analytical Hierarchy Process Dalam Penentuan Kriteria Penilaian Performa Vendor (Studi Kasus PT.X)", Fakultas Teknik, Program Studi Teknik Industri, Universitas Indonesia, Depok, 2010.

[4] Rani Irma Handayani, Yuni Darmianti., "Pemilihan Supplier Bahan Baku Bangunan Dengan Metode Analytical Hierarchy Process (Ahp) Pada Pt. Cipta Nuansa Prima Tangerang", Jurnal Techno Nusa Mandiri Vol.XIV, No.1, 2017.

[5] Riyan Taufik, Yeni Sumantri, dan Ceria Farela Mada Tantrika., "Penerapan Pemilihan Supplier Bahan Baku Ready Mix Berdasarkan Integrasi Metode AHP Dan TOPSIS (Studi Kasus Pada Pt Merak Jaya Beton, Malang)", Jurusan Teknik Industri, Universitas Brawijaya Malang, 2014.

[6] Safitra, B. D., "Penentuan Prioritas Pemilihan Supplier Bahan Baku Beton Menggunakan Metode Analytical Hierarchy Process", Universitas Brawijaya, Malang, 2017.

[7] Santoso, Agung., "Aplikasi Fuzzy Analytical Hierarchy Process Untuk Menentukan Prioritas Pelanggan Berkunjung Ke Galeri (Studi Kasus Di Secondhand Semarang)", Universitas Diponegoro, Semarang, 2016.

[8] Sapta Adi Permana, Budi Widjajanto, M.Kom., "Sistem Pendukung Keputusan Berbasis Fuzzy Analytical Hierarchy Process untuk Kelayakan Kredit Rumah", Fakultas Ilmu Komputer, Universitas Dian Nuswantoro, Semarang, 2013.

[9] Setiyaningsih, W., & Prasetyo, A. Y., "Penerapan Fuzzy AHP untuk Peningkatan Ketepatan dan Evektifitas Penilaian Kinerja Karyawan". Jurnal Teknologi, Informasi, dan Industri , Vol. I, No. 1, 21-33, 2018.

[10] Suryamaharani, D., "Sistem Pendukung Pengambilan Keputusan Pembelian Rumah Menggunakan Fuzzy Analytical Hierarchy Process (FAHP)", Program Studi Teknik Informatika, Universitas Sanata Dharma, Yogyakarta, 2017.

[11] Teuku Afriliansyah., "Analisis Kinerja Fuzzy Ahp Dalam Perangkingan", Magister Teknik Informatika, Fakultas Ilmu Komputer Dan Teknologi Informasi, Universitas Sumatera Utara, Medan, 2018.

[12] Wicaksono, A., "Pemilihan *supplier* baja H-Beam dengan Integrasi Metode AHP dan Topsis", *Skripsi*, Universitas Brawijaya, Malang, 2015.