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DEFINING THE MOST IMPORTANT CRITERIA FOR SUPPLIERS EVALUATION IN CONSTRUCTION COMPANIES

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Abstract

Abstract: The aim of this paper is to define the most important criteria for the suppliers evaluation and selection in the field of construction. From a set of 20 criteria that were established i.e. four sets of criteria: finances, logistics, quality and communication and business which containing five sub-criteria is necessary to allocate most important for making decision about suppliers. The research was conducted in three companies of the construction industry of which two are located on the territory of Bosnia and Herzegovina and one in Montenegro. In the given companies has formed a professional team of five managers in procurement logistics subsystem that made a comparison to the criteria specified groups. For suppliers evaluation and selection in lately most often used methods is methods of multi-criteria analysis combined with fuzzy logic, which is the case in this research, where is using fuzzy AHP method based on triangular fuzzy numbers.

Key words*: Logistics, supply chain, fuzzy AHP, suppliers*

1 INTRODUCTION

In today's supply chains where such the procurement subsystem and the selection of adequate suppliers as the most important process in the subsystem procurement is an issue of strategic importance for the functioning of production, and other companies, the objective is to modeling the supply chain and a way that will ensure profitable exits for all parts of the supply chain and its participants. The importance of an adequate supplier selection has been recognized at the beginning of the last decade of the last century when [2] emphasizes that the failure of suppliers to fulfill the promises and expectations regarding delivery is one of the three main sources of uncertainty plaguing the supply chain. Kagnicioglu in [3] considers that the supplier selection is critical procurement activity in the supply chain management because of the crucial role of the characteristics of the suppliers on price, quality, delivery and service in achieving the objectives of the supply chain

2 FUZZY AHP METHOD

Analytic hierarchy process is created Thomas Saaty [7] and according to him AHP is a measurement theory which is dealing with pairs comparing and which relies on expert opinion in order to perform the priority scale.
AHP in a certain way resolves the problem of subjective influence of the decision-maker because it measures the degree of consistency (CR), and informs the decision makers of the result. Depending on the size of the matrix the value of this ratio is recommended, so in [6] we find that the maximum permissible level of consistency for the 3x3 matrix is 0.05, for the 4x4 matrix it is 0.08, and for larger matrices it is 0.1.

Kwong's method [4] has been used to check the consistency of pairwise judgement of comparison matrix. A TFN, denoted as $M=(l,m,u)$, can be defuzzified to a crisp number as follows:

$$M_{-crisp} = \frac{(4m + l + u)}{6} \tag{1}$$

TFN, which were used in this work are marked as (lij,mij,uij). The parameters (lij,mij,uij) are the smallest possible value, the most promising value and highest possible value that describes a fuzzy event, respectively. In this study, the extent analysis method by [1] is adopted.
Chang's expanded analysis includes following steps:

Step 1: the value of fuzzy synthetic extent Si with respect to the ith criteria is defined as:

$$S_i = \sum_{j=1}^{n} M_{gi}^{j} \times \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} \tag{2}$$

In order to obtain expression

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} \tag{3}$$

it is necessary to perform additional fuzzy operations with "m" values of the extended analysis, which is represented by the following expressions:

$$\sum_{j=1}^{m} M_{gi}^{j} = \left(\sum_{j=1}^{m} l_j, \sum_{j=1}^{m} m_j, \sum_{j=1}^{m} u_j\right) \tag{4}$$

$$\sum_{i=1}^{n}\sum_{j=1}^{n} M_{gi}^{j} = \left(\sum_{i=1}^{n} l_i, \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right) \tag{5}$$

Then it is necessary to calculate the inverse vector:

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{gi}^{j}\right]^{-1} = \left[\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right] \quad (6)$$

Step 2: The degree of possibility of Sb ≥ Sa is defined as:

$$V(S_b \geq S_a) = \begin{cases} 1, & if\ m_b \geq m_a \\ 0, & if\ l_a \geq u_b \\ \frac{l_a - u_b}{(m_b - u_b) - (m_a - l_a)}, & otherwise \end{cases} \quad (7)$$

where „d“ ordinate of a largest cross-section in point D between μSa andi μSb.
To compare S_1 and S_2, both values $V(S_1 \geq S_2)$ and $V(S_2 \geq S_1)$ are needed.

Step 3: Level of possibility for convex fuzzy number to be greater than „k“ convex number Si (i =1,2,...,k) can be defined as follows:

$$V(S_i \geq S_1, S_2, \ldots, S_k) = \min V(S_i \geq S_k), = w'(S_i) \quad (8)$$

$$d'(A_i) = \min V(S_i \geq S_k), k \neq i, k = 1,2,\ldots,n \quad (9)$$

The weight vector is given by the following expression:

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

Step 4: Through normalization, the weight vector is reduced to the phrase

$$W = (d(A_1),\ d(A_2), \ldots, d(A_n))^T, \quad (11)$$

3 NUMERICAL EXAMPLE

For the purposes of this study is used criteria that were established for the doctoral thesis (doctoral thesis deals with the development of a universal model for the supplier evaluation in the manufacturing industry and currently is in development phase) in which the same defined on the basis of relevant literature review and research conducted in the economic sector.
Figure 1 presents the criteria finance, logistics, quality and communications and business, and each of these criteria contains five subcriteria which are also shown in the figure below each criterion. Review the given criteria for suppliers evaluation through literature is presented in the paper [8].

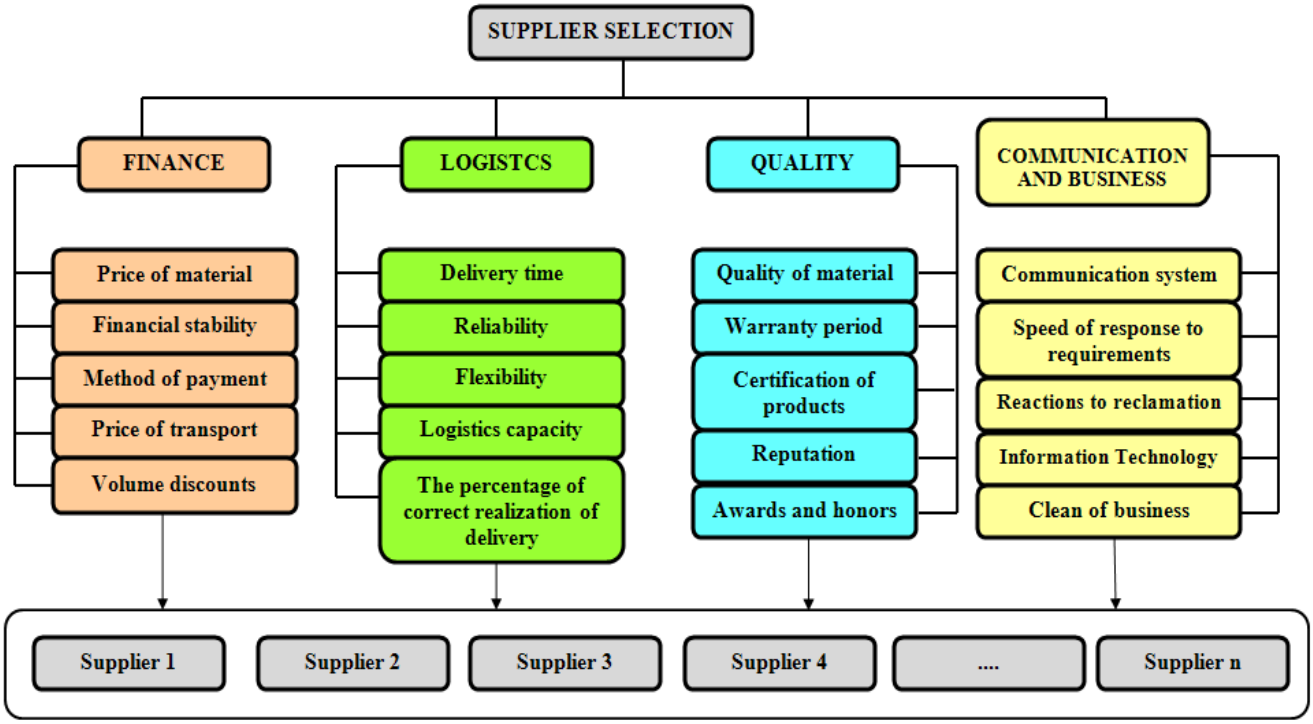

Fig. 1 *Criteria for supplier selection*

The aim of this paper is to determine the most important criteria for suppliers evaluation in the construction field. As already mentioned research was carried out in three companies in which was formed a expert team. The task of the experts is evaluation criteria using the scale shown in Table 1 [9].

So, this is a group decision, where five decision makers affect on the value of the selected criteria. Since for obtaining the relative weight of criteria is using described fuzzy AHP method, more than nine comparison is impossible and untrue. For that reason was formed the main criteria and subcriteria and the expert team assessing the first criteria, subcriteria and within each the main criteria.

In the following tables are presented values of expert comparison of 20 criteria grouped into levels.

Table 1. Triangular fuzzy scale table

Linguistic Scale	TF Scale	TF Reciprocal Scale
Just equal	(1,1,1)	(1,1,1)
Equaly important	(1/2,1,3/2)	(2/3,1,2)
Weakly more important	(1,3/2,2)	(1/2,2/3,1)
Strongly more important	(3/2,2,5/2)	(2/5,1/2,2/3)
Very strongly more important	(2,5/2,3)	(1/3,2/5,1/2)
Absolutely more important	(5/2,3,7/2)	(2/7,1/3,2/5)

Table 2 Comparison criteria by five experts

		C_1	C_2	C_3	C_4
C_1	E_1	(1,1,1)	(1, 3/2, 2)	(1/2, 1, 3/2)	(1, 3/2, 2)
	E_2	(1,1,1)	(1/2, 1, 3/2)	(1/2, 1, 3/2)	(1, 3/2, 2)
	E_3	(1,1,1)	(1, 3/2, 2)	(1/2, 1, 3/2)	(1/2, 1, 3/2)
	E_4	(1,1,1)	(1/2, 1, 3/2)	(1/2, 1, 3/2)	(3/2, 2, 5/2)
	E_5	(1,1,1)	(1/2, 1, 3/2)	(1, 1, 1)	(1, 3/2, 2)
C_2	E_1	(1/2, 2/3, 1)	(1,1,1)	(2/3, 1, 2)	(1/2, 1, 3/2)
	E_2	(2/3, 1, 2)	(1,1,1)	(1, 1, 1)	(1/2, 1, 3/2)
	E_3	(1/2, 2/3, 1)	(1,1,1)	(2/3, 1, 2)	(2/3, 1, 2)
	E_4	(2/3, 1, 2)	(1,1,1)	(1, 1, 1)	(1, 3/2, 2)
	E_5	(2/3, 1, 2)	(1,1,1)	(1, 1, 1)	(1/2, 1, 3/2)
C_3	E_1	(2/3, 1, 2)	(1/2, 1, 3/2)	(1,1,1)	(1/2, 1, 3/2)
	E_2	(2/3, 1, 2)	(1, 1, 1)	(1,1,1)	(1/2, 1, 3/2)
	E_3	(2/3, 1, 2)	(1/2, 1, 3/2)	(1,1,1)	(1/2, 1, 3/2)
	E_4	(2/3, 1, 2)	(1, 1, 1)	(1,1,1)	(1, 3/2, 2)
	E_5	(1, 1, 1)	(1, 1, 1)	(1,1,1)	(1, 3/2, 2)
C_4	E_1	(1/2, 2/3, 1)	(2/3, 1, 2)	(2/3, 1, 2)	(1,1,1)
	E_2	(1/2, 2/3, 1)	(2/3, 1, 2)	(2/3, 1, 2)	(1,1,1)
	E_3	(2/3, 1, 2)	(1/2, 1, 3/2)	(2/3, 1, 2)	(1,1,1)
	E_4	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1,1,1)
	E_5	(1/2, 2/3, 1)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)

Fuzzy important weight of the criteria is calculated by taking geometric mean of the responses of the experts [5] this is shown in Table 3.

Table 3. Fuzzy important weight of the criteria calculated by taking geometric mean

	C_1			C_2			C_3			C_4		
C_1	1,000	1,000	1,000	0,660	1,176	1,683	0,574	1,000	1,383	0,944	1,465	1,974
C_2	0,594	0,850	1,516	1,000	1,000	1,000	0,850	1,000	1,320	0,699	1,176	1,783
C_3	0,723	1,000	1,741	0,758	1,000	1,176	1,000	1,000	1,000	0,660	1,176	1,683
C_4	0,506	0,683	1,059	0,594	1,000	1,783	0,594	0,850	1,516	1,000	1,000	1,000

After application of the described steps of FAHP method is obtained the following value of criteria:

W=(0.275; 0.247; 0.253; 0.225)

Obtained weights of criteria indicate that the first criterion (finance) is most important, while second most important criteria is quality. Logistics has slightly lower value of quality, while the fourth criterion of communication and business has a minimum value.

After the calculated weight of criteria, it is necessary to check the consistency. It is necessary to perform defuzzification of values shown in Table 3 by using the equation 1. Defuzzification is shown in table 4.

Table 4 Defuzzification

	C_1	C_2	C_3	C_4
C_1	1,000	1,175	0,993	1,463
C_2	0,919	1,000	1,028	1,198
C_3	1,077	0,989	1,000	1,175
C_4	0,716	1,063	0,919	1,000

After defuzzification shown in the previous table, by applying the AHP method steps, we obtain the following values: λ_{max} = 4,146; CI = 0,049; CR = 0,054, which means that the degree of consistency is 0,054, which is much less than the maximum permitted limit of 0.1

Table 5 Comparison subcriteria of criteria finance by five experts

		C_1	C_2	C_3	C_4	C_5
C_1	E_1	(1,1,1)	(1, 3/2, 2)	(1/2, 1, 3/2)	(3/2, 2, 5/2)	(1, 1, 1)
	E_2	(1,1,1)	(1/2, 1, 3/2)	(1, 3/2, 2)	(3/2, 2, 5/2)	(1/2, 1, 3/2)
	E_3	(1,1,1)	(3/2, 2, 5/2)	(2/3, 1, 2)	(3/2, 2, 5/2)	(2/3, 1, 2)
	E_4	(1,1,1)	(3/2, 2, 5/2)	(1/2, 2/3, 1)	(1, 3/2, 2)	(2/3, 1, 2)
	E_5	(1,1,1)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(2/3, 1, 2)
C_2	E_1	(1/2, 2/3, 1)	(1,1,1)	(2/3, 1, 2)	(1/2, 1, 3/2)	(1/2, 2/3, 1)
	E_2	(2/3, 1, 2)	(1,1,1)	(1/2, 1, 3/2)	(1, 3/2, 2)	(1, 1, 1)
	E_3	(2/5, 1/2, 2/3)	(1,1,1)	(1/3, 2/5, 1/2)	(1, 1, 1)	(1/3, 2/5, 1/2)
	E_4	(2/5, 1/2, 2/3)	(1,1,1)	(2/7, 1/3, 2/5)	(2/3, 1, 2)	(1/3, 2/5, 1/2)
	E_5	(1, 3/2, 2)	(1,1,1)	(1, 1, 1)	(3/2, 2, 5/2)	(1/2, 1, 3/2)
C_3	E_1	(2/3, 1, 2)	(1/2, 1, 3/2)	(1,1,1)	(1, 3/2, 2)	(2/3, 1, 2)
	E_2	(1/2, 2/3, 1)	(2/3, 1, 2)	(1,1,1)	(1/2, 1, 3/2)	(2/3, 1, 2)
	E_3	(1/2, 1, 3/2)	(2, 5/2, 3)	(1,1,1)	(2, 5/2, 3)	(1, 1, 1)
	E_4	(1, 3/2, 2)	(5/2, 3, 7/2)	(1,1,1)	(2, 5/2, 3)	(1/2, 1, 3/2)

	E_5	(1, 3/2, 2)	(1, 1, 1)	(1,1,1)	(3/2, 2, 5/2)	(1/2, 1, 3/2)
C_4	E_1	(2/5, 1/2, 2/3)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)	(2/5, 1/2, 2/3)
	E_2	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(2/3, 1, 2)	(1,1,1)	(1/2, 2/3, 1)
	E_3	(2/5, 1/2, 2/3)	(1, 1, 1)	(1/3, 2/5, 1/2)	(1,1,1)	(1/3, 2/5, 1/2)
	E_4	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1/3, 2/5, 1/2)	(1,1,1)	(2/5, 1/2, 2/3)
	E_5	(2/3, 1, 2)	(2/5, 1/2, 2/3)	(2/5, 1/2, 2/3)	(1,1,1)	(1/2, 2/3, 1)
C_5	E_1	(1, 1, 1)	(1, 3/2, 2)	(1/2, 1, 3/2)	(3/2, 2, 5/2)	(1,1,1)
	E_2	(2/3, 1, 2)	(1, 1, 1)	(1/2, 1, 3/2)	(1, 3/2, 2)	(1,1,1)
	E_3	(1/2, 1, 3/2)	(2, 5/2, 3)	(1, 1, 1)	(2, 5/2, 3)	(1,1,1)
	E_4	(1/2, 1, 3/2)	(2, 5/2, 3)	(2/3, 1, 2)	(3/2, 2, 5/2)	(1,1,1)
	E_5	(1/2, 1, 3/2)	(2/3, 1, 2)	(2/3, 1, 2)	(1, 3/2, 2)	(1,1,1)

Applying the same steps as was the case with the main criteria are obtained by weighting the value of subcriteria criteria finance: W=(0.230; 0.159; 0.250; 0.114; 0.247)

After defuzzification we obtain the following values: λ_{max} = 5,107; CI = 0,027; CR = 0,024

Table 6 Comparison subcriteria of criteria logistics by five experts

		C_1	C_2	C_3	C_4	C_5
C_1	E_1	(1,1,1)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1, 3/2, 2)	(2/3, 1, 2)
	E_2	(1,1,1)	(2/3, 1, 2)	(1/2, 1, 3/2)	(1, 3/2, 2)	(1, 1, 1)
	E_3	(1,1,1)	(1/2, 1, 3/2)	(2/3, 1, 2)	(1, 3/2, 2)	(1/2, 1, 3/2)
	E_4	(1,1,1)	(1/2, 1, 3/2)	(2/3, 1, 2)	(1, 3/2, 2)	(1, 3/2, 2)
	E_5	(1,1,1)	(2/3, 1, 2)	(1, 1, 1)	(2/3, 1, 2)	(1, 3/2, 2)
C_2	E_1	(1, 3/2, 2)	(1,1,1)	(3/2, 2, 5/2)	(2, 5/2, 3)	(1/2, 1, 3/2)
	E_2	(1/2, 1, 3/2)	(1,1,1)	(1, 3/2, 2)	(3/2, 2, 5/2)	(1/2, 1, 3/2)
	E_3	(2/3, 1, 2)	(1,1,1)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1, 1, 1)
	E_4	(2/3, 1, 2)	(1,1,1)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1/2, 1, 3/2)
	E_5	(1/2, 1, 3/2)	(1,1,1)	(1/2, 1, 3/2)	(1, 1, 1)	(3/2, 2, 5/2)
C_3	E_1	(2/3, 1, 2)	(2/5, 1/2, 2/3)	(1,1,1)	(1/2, 1, 3/2)	(1/2, 2/3, 1)
	E_2	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)	(1/2, 1, 3/2)	(2/3, 1, 2)
	E_3	(1/2, 1, 3/2)	(1, 3/2, 2)	(1,1,1)	(1, 3/2, 2)	(1, 3/2, 2)
	E_4	(1/2, 1, 3/2)	(1, 3/2, 2)	(1,1,1)	(3/2, 2, 5/2)	(3/2, 2, 5/2)
	E_5	(1, 1, 1)	(2/3, 1, 2)	(1,1,1)	(2/3, 1, 2)	(1, 3/2, 2)
C_4	E_1	(1/2, 2/3, 1)	(1/3, 2/5, 1/2)	(2/3, 1, 2)	(1,1,1)	(1/2, 2/3, 1)
	E_2	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(2/3, 1, 2)	(1,1,1)	(1/2, 2/3, 1)
	E_3	(1/2, 2/3, 1)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)	(2/3, 1, 2)
	E_4	(1/2, 2/3, 1)	(2/3, 1, 2)	(2/5, 1/2, 2/3)	(1,1,1)	(1, 1, 1)
	E_5	(1/2, 1, 3/2)	(1, 1, 1)	(1/2, 1, 3/2)	(1,1,1)	(3/2, 2, 5/2)
C5	E_1	(1/2, 1, 3/2)	(2/3, 1, 2)	(1, 3/2, 2)	(1, 3/2, 2)	(1,1,1)
	E_2	(1, 1, 1)	(2/3, 1, 2)	(1/2, 1, 3/2)	(1, 3/2, 2)	(1,1,1)
	E_3	(2/3, 1, 2)	(1, 1, 1)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1,1,1)
	E_4	(1/2, 2/3, 1)	(2/3, 1, 2)	(2/5, 1/2, 2/3)	(1, 1, 1)	(1,1,1)
	E_5	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(1,1,1)

W=(0.213; 0.219; 0.212; 0.170; 0.186)

After defuzzification we obtain the following values: λ_{max} = 5,110; CI = 0,028; CR = 0,025

Table 7 Comparison subcriteria of criteriaquality by five experts

		C_1	C_2	C_3	C_4	C_5
C_1	E_1	(1,1,1)	(1, 3/2, 2)	(1, 3/2, 2)	(1, 3/2, 2)	(5/2, 3, 7/2)
	E_2	(1,1,1)	(3/2, 2, 5/2)	(1, 3/2, 2)	(1/2, 1, 3/2)	(5/2, 3, 7/2)
	E_3	(1,1,1)	(1, 3/2, 2)	(3/2, 2, 5/2)	(1, 3/2, 2)	(2, 5/2, 3)
	E_4	(1,1,1)	(1/2, 1, 3/2)	(3/2, 2, 5/2)	(1, 3/2, 2)	(2, 5/2, 3)
	E_5	(1,1,1)	(1/2, 1, 3/2)	(1, 1, 1)	(1, 3/2, 2)	(3/2, 2, 5/2)
C_2	E_1	(1/2, 2/3, 1)	(1,1,1)	(1/2, 1, 3/2)	(1/2, 1, 3/2)	(3/2, 2, 5/2)
	E_2	(2/5, 1/2, 2/3)	(1,1,1)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1, 3/2, 2)
	E_3	(1/2, 2/3, 1)	(1,1,1)	(1/2, 1, 3/2)	(1, 1, 1)	(1, 3/2, 2)
	E_4	(2/3, 1, 2)	(1,1,1)	(1, 3/2, 2)	(1/2, 1, 3/2)	(3/2, 2, 5/2)
	E_5	(2/3, 1, 2)	(1,1,1)	(2/3, 1, 2)	(1/2, 1, 3/2)	(1, 3/2, 2)
C_3	E_1	(1/2, 2/3, 1)	(2/3, 1, 2)	(1,1,1)	(1, 1, 1)	(1, 3/2, 2)
	E_2	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1,1,1)	(2/3, 1, 2)	(3/2, 2, 5/2)
	E_3	(2/5, 1/2, 2/3)	(2/3, 1, 2)	(1,1,1)	(2/3, 1, 2)	(1/2, 1, 3/2)
	E_4	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(1,1,1)	(2/3, 1, 2)	(1/2, 1, 3/2)

	E_5	(1, 1, 1)	(1/2, 1, 3/2)	(1,1,1)	(1, 3/2, 2)	(3/2, 2, 5/2)
C_4	E_1	(1/2, 2/3, 1)	(2/3, 1, 2)	(1, 1, 1)	(1,1,1)	(1, 3/2, 2)
	E_2	(2/3, 1, 2)	(1, 3/2, 2)	(1/2, 1, 3/2)	(1,1,1)	(2, 5/2, 3)
	E_3	(1/2, 2/3, 1)	(1, 1, 1)	(1/2, 1, 3/2)	(1,1,1)	(1, 3/2, 2)
	E_4	(1/2, 2/3, 1)	(2/3, 1, 2)	(1/2, 1, 3/2)	(1,1,1)	(1, 3/2, 2)
	E_5	(1/2, 2/3, 1)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)	(1, 3/2, 2)
C_5	E_1	(2/7, 1/3, 2/5)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1,1,1)
	E_2	(2/7, 1/3, 2/5)	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(1/3, 2/5, 1/2)	(1,1,1)
	E_3	(1/3, 2/5, 1/2)	(1/2, 2/3, 1)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)
	E_4	(1/3, 2/5, 1/2)	(2/5, 1/2, 2/3)	(2/3, 1, 2)	(1/2, 2/3, 1)	(1,1,1)
	E_5	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(1,1,1)

W=(0.310; 0.214; 0.198; 0.211; 0.067)

After defuzzification we obtain the following values: λ_{max} = 5,107; CI = 0,027; CR = 0,024

Table 8 Comparison subcriteria of criteriacommunication and business by five experts

		C_1	C_2	C_3	C_4	C_5
C_1	E_1	(1,1,1)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1/3, 2/5, 1/2)
	E_2	(1,1,1)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(1/2, 1, 3/2)	(1/2, 2/3, 1)
	E_3	(1,1,1)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)
	E_4	(1,1,1)	(1/3, 2/5, 1/2)	(2/5, 1/2, 2/3)	(2/3, 1, 2)	(1/3, 2/5, 1/2)
	E_5	(1,1,1)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1, 1, 1)	(2/5, 1/2, 2/3)
C_2	E_1	(1, 3/2, 2)	(1,1,1)	(1/2, 1, 3/2)	(3/2, 2, 5/2)	(2/3, 1, 2)
	E_2	(3/2, 2, 5/2)	(1,1,1)	(1/2, 1, 3/2)	(2, 5/2, 3)	(1/2, 1, 3/2)
	E_3	(3/2, 2, 5/2)	(1,1,1)	(1/2, 1, 3/2)	(1, 1, 1)	(1/2, 1, 3/2)
	E_4	(2, 5/2, 3)	(1,1,1)	(1/2, 1, 3/2)	(1, 3/2, 2)	(1, 1, 1)
	E_5	(1, 3/2, 2)	(1,1,1)	(1/2, 1, 3/2)	(1, 3/2, 2)	(2/3, 1, 2)
C_3	E_1	(1, 3/2, 2)	(2/3, 1, 2)	(1,1,1)	(3/2, 2, 5/2)	(2/3, 1, 2)
	E_2	(1, 3/2, 2)	(2/3, 1, 2)	(1,1,1)	(3/2, 2, 5/2)	(1, 1, 1)
	E_3	(1, 3/2, 2)	(2/3, 1, 2)	(1,1,1)	(1/2, 1, 3/2)	(1, 1, 1)
	E_4	(3/2, 2, 5/2)	(2/3, 1, 2)	(1,1,1)	(1, 3/2, 2)	(2/3, 1, 2)
	E_5	(1, 3/2, 2)	(2/3, 1, 2)	(1,1,1)	(1, 3/2, 2)	(2/3, 1, 2)
C_4	E_1	(2/3, 1, 2)	(2/5, 1/2, 2/3)	(2/5, 1/2, 2/3)	(1,1,1)	(2/7, 1/3, 2/5)
	E_2	(2/3, 1, 2)	(1/3, 2/5, 1/2)	(2/5, 1/2, 2/3)	(1,1,1)	(2/5, 1/2, 2/3)
	E_3	(3/2, 2, 5/2)	(1, 1, 1)	(2/3, 1, 2)	(1,1,1)	(2/3, 1, 2)
	E_4	(1/2, 1, 3/2)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1,1,1)	(2/5, 1/2, 2/3)
	E_5	(1, 1, 1)	(1/2, 2/3, 1)	(1/2, 2/3, 1)	(1,1,1)	(2/5, 1/2, 2/3)
C_5	E_1	(2, 5/2, 3)	(1/2, 1, 3/2)	(1/2, 1, 3/2)	(5/2, 3, 7/2)	(1,1,1)
	E_2	(1, 3/2, 2)	(2/3, 1, 2)	(1, 1, 1)	(3/2, 2, 5/2)	(1,1,1)
	E_3	(1, 3/2, 2)	(2/3, 1, 2)	(1, 1, 1)	(1/2, 1, 3/2)	(1,1,1)
	E_4	(2, 5/2, 3)	(1, 1, 1)	(1/2, 1, 3/2)	(3/2, 2, 5/2)	(1,1,1)
	E_5	(3/2, 2, 5/2)	(1/2, 1, 3/2)	(1/2, 1, 3/2)	(3/2, 2, 5/2)	(1,1,1)

W=(0.107; 0.252; 0.242; 0.136; 0.264).

After defuzzification we obtain the following values: λ_{max} = 5,097; CI = 0,024; CR = 0,022. In table 8 is shown final results and weights of criteria and subcriteria.

Table 8 Final results and weights of criteria and subcriteria

	Criteria	**wj**		**Subcriteria**	**Local weights**	**Global weights**	**Local rank**	**Global rank**
1.	Finance	0,275	1.1	Price of material	0,230	0,063	3	4
			1.2	Financial stability	0,159	0,044	4	15
			1.3	Method of payment	0,250	0,069	1	2
			1.4	Price of transport	0,114	0,031	5	18
			1.5	Volume discounts	0,247	0,068	2	3
2.	Logistics	0,247	2.1	Delivery time	0,213	0,053	2	10
			2.2	Reliability	0,219	0,054	1	7
			2.3	Flexibility	0,212	0,052	3	12
			2.4	Logistics capacity	0,170	0,042	5	16
			2.5	The percentage of correct	0,186	0,046	4	14

				realization of delivery				
3.	Quality	0,253	3.1	Quality of material	0,310	0,078	1	1
			3.2	Warranty period	0,214	0,054	2	8
			3.3	Certification of products	0,198	0,050	4	13
			3.4	Reputation	0,211	0,053	3	11
			3.5	Awards and honors	0,067	0,017	5	20
4.	Communication and business	0,225	4.1	Communication system	0,107	0,024	5	19
			4.2	Speed of response to requirements	0,252	0,057	2	6
			4.3	Reactions to reclamation	0,242	0,054	3	9
			4.4	Information Technology	0,136	0,031	4	17
			4.5	Clean of business	0,264	0,059	1	5

4 CONCLUSION

According to the methodology applied in this paper the most important criterion for the supplier evaluation in field of construction are quality of material, method of payment, volume discounts, price of material, clean of business, speed of response to requirements, reliability, reactions to reclamation, while the other criteria are less important in that field. Compared to some research that have been done in the area of supplier evaluation, this paper shows that until now fewer criteria used can have a major impact on the supplier selection. Future research related to this work based on most important criteria represent the application of some of the methods for decision making in combination with fuzzy logic for supplier evaluation and their ranking.

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