DECISION SUPPLIER PACKAGE SYSTEM USING FUZZY SUBJECTIVE AND OBJECTIVE INTEGRATED WEIGHTS METHOD (CASE STUDY: PT GARUDAFOOD PUTRA PUTRI JAYA)

[1]MUHAMMAD SAIFUL IRAWAN, [2]RIFKI FAHRIAL ZAENAL, [3]SYARIFUL ALIM

[123]Department of Informatic Engineering University Bhayangkara Surabaya

Jl. A. Yani,No 114 Surabaya

Email: stupidpio@gmail.com

ABSTRACT

The purchasing department is the part that plays an important and influential role in a company even can be said most of the business process comes from this section. Because of its nature as a procurement of goods and services then one of its duties and responsibilities is to choose suppliers of procurement of goods and services for production operational processes within the company. In this case PT Garudafood Putra - Putri Jaya often have difficulty in determining the best product packaging supplier because of the performance instability of each supplier. For that the company needs a system whose purpose is to help decide the best supplier determination. Decision support system is a computer-based information system that generates various decision alternatives to assist management in handling various structured or unstructured problems using data or models. There are many methods used in a decision support system such as Fuzzy Subjective And Objective Integrated Weights. Fuzzy can solve the problem of uncertainty in determining the weight of each supplier's criteria. The result of the implementation of this decision support system resulted in the supplier of Mandhara Adhitama Utama as the best supplier. Where the results of calculations with Fuzzy Subjective And Objective Integrated Weights this supplier obtained the highest value with the number 1.742.
Keywords: *fuzzy subjective, garudafood, decision support.*

INTRODUCTION

The purchasing department is the part that plays an important and influential role in a company even can be said most of the business process comes from this part, in addition to the function of procurement of goods and services within the company's purchasing department also plays a strategic role in determining the quality of products to be marketed to customers . Because of its nature as a procurement of goods and services then one of its duties and responsibilities is to choose suppliers of procurement of goods and services for production operational processes within the company. Improper supplier selection may disrupt the company's operational activities, while choosing the right suppliers will minimize the cost of purchasing, enhancing market competitiveness and end-user satisfaction.

PT Garudafood Putra Putri Jaya Gresik is a company engaged in the provision of finished goods in the form of snacks in packaging. In the production process PT Garudafood Putra Putri Jaya Gresik is definitely going to need raw materials and packing materials needed to be processed into finished products. But recently - PT Garudafood Putra Putri Jaya experienced problems related to the suppliers of raw materials and packing materials in this case is the product packaging that is the performance instability shown by the mismatch delivery schedule and quality. Performance appraisal of suppliers is important by PT Garudafood Putra Putri Jaya so that supplier performance can be controlled and improved. Therefore a system is needed to support the selection of the best suppliers who have certain criteria. These criteria later will be an assessment in the selection of the best suppliers so it is expected from the assessment results obtained suppliers who have a more reliable performance.

There are many methods used to build a decision support system such as Fuzzy Subjective and Objective Integrated Weights where fuzzy is still included in fuzzy MADM class. Fuzzy Subjective and Objective Integrated Weights is one of the MADM fuzzy which determines the attribute weights derived from a combination of subjective and objective approaches.

RESEARCH METHODS

Analysis after data collection in the manufacture of a decision support system in determining the election later every alternative in this case is the supplier must have certain criteria. Where these criteria later as a reference in the decision-making process or as a final assessment. Each criterion has a value of interest intensity. Furthermore the value of the intensity of interest will be used as a benchmark in assessing the importance of each criterion.

Criteria to be used in this research include: Quality, Delivery, Service, Price, and Environment. And for more details can be seen as contained in the following table:

No.	Criteria	Information
1.	*Quality*	- Conformity of supply to the quality standards set by the company. - Ability to provide consistent quality packaging supplies.
2.	*Delivery*	- On time delivery. - The accuracy of the number of shipments.
3.	*Service*	- Ability to respond to complaints. - Ability to provide information clearly. - Warranty and complaint services. - Complaints procedure.
4.	*Price*	- Conformity of packaging price with packaging price standard.
5.	*Environment*	- Condition of the vehicle when shipping. - Cleanliness of the vehicle when shipping. - Condition of loading and unloading of goods.

General Explanation of the System

The decision support system that will be made later will contain 5 criteria as reference penilainnya. Where the decision maker will then assign a value to each - each criterion on the alternatives to be selected. The values will be processed based on the method that will be used is Fuzzy Subjective and Objective Integrated Weights. After the input value processed then will be output that will determine the ranking of the alternatives that have been selected. The system will receive input (input data) from supplier criteria and values (alternatives). It will then be processed by applying the Fuzzy Subjective and Objective Integrated Weights method and generating output alternate ranking data from the best value of the best supplier candidate along with the result of the decision in the form of ranking list.

System Model

The model of decision support system will be to determine the best packaging supplier with mathematical or quantitative model using Fuzzy Subjective and Objective Integrated Weights method.
The steps of calculating the Fuzzy Subjective and Objective Integrated Weights method are as follows:

1) Determination of subjective weights

Suppose the decision maker provides a pairwise vector of V on attributes arranged according to certain rules.

$$V = (v_{11}, v_{12}, \dots, v_{1n}),$$

Where V_1j is the fuzzy number comparison scale, V_1j = (v_1j ^ l, v_1j ^ m, v_1j ^ r) ∈ [0.1], which represents the relative importance of the first attribute connected to the jth attribute. The fuzzy comparison scale can be determined from the decision maker.

Eg v_11 = (0.5,0.5,0.5). The first attribute is considered equally important with the jth attribute, if v_1j = 0.5, the first attribute is more important than the jth attribute, if v_1j> 0.5, and the first attribute is not as important as the jth attribute, if v_1j <0.5.

Using the normalization method of fuzzy numbers from Dubois and Prade (1982), we can calculate the subjective weights of the attributes:

$$W_j^s = \left(W_j^{sl}, W_j^{sm}, W_j^{sr}\right), j = 1,2, \dots, n,$$

$$W_j^{sm} = \frac{\frac{1}{v_{1j}^m} - 1}{\sum_{k=1}^{n}\left(\frac{1}{v_{1k}^m} - 1\right)}, k = 1,2, \dots, n,$$

$$W_j^{sl} = \frac{\frac{1}{v_{1j}^l} - 1}{\frac{1}{v_{ij}^l} - 1 + \sum_{k\neq 1}\left(\frac{1}{v_{1k}^r} - 1\right)}, k = 1,2, \dots, n,$$

$$W_j^{sr} = \frac{\frac{1}{v_{1j}^r} - 1}{\frac{1}{v_{ij}^r} - 1 + \sum_{k\neq 1}\left(\frac{1}{v_{1k}^l} - 1\right)}, k = 1,2, \dots, n,$$

2) Determination of objective weights

As we know, entropy theory is another important theory to learn about the problem of uncertainty. The weight of entropy is a parameter that describes the different alternative approaches to each other related to a particular attribute. The greater the entropy value, the less entropy weights the smaller the differences of the different alternatives within the specific attributes, the lack of available attribute information and the lack of importance of these attributes into a process of decision making. Therefore we provide a Fuzzy Entropy Weights.

For strict numbers, the calculation of entropy is very easy. Usually we use the following formula:

$$E(i) = -K \sum_{i=1}^{m} x_{ij} \operatorname{In} x_{ij},$$

Where K is a constant.

As for fuzzy numbers, we can not use the above formula. Generally, we will first convert the fuzzy number to a firm number and then we calculate the entropy of each. Although there are many methods for calculating fuzzy numbers, most of these methods do not take into account decision-making preferences for their level of uncertainty. Kong (2004) provides a formula for calculating these factors:

$$F\left(x_{ij}\right) = m\left(x_{ij}\right) - \beta\sigma\left(x_{ij}\right),$$

$$m\left(x_{ij}\right) = \frac{\int xu(x_{ij})dx}{\int u(x_{ij})},$$

$$\sigma(x_{ij}) = \left[\frac{\int x^2 u(x_{ij})dx}{\int u(x_{ij})} - m^2(x_{ij})\right]^{\frac{1}{2}},$$

Where F (x_ij) is the rank index of the i jth alternative attribute, β is the reluctance coefficient of the uncertainty of the decision maker, when β> 0 the decision maker's uncertainty is reluctant, when β <0 the uncertainty of the decision maker is agreed and when β = The uncertainty of the decision maker is neutral.

Next is normalization of F (x_ij) according to the following equation:

$$f_{ij} = \frac{F(x_{ij})}{\sum_{i=1}^{m} F(x_{ij})}$$

Then, the attribute of fuzzy entropy can be calculated by:

$$\tilde{E}_j = -K \sum_{i=1}^{m} f_{ij} \mathrm{In} f_{ij} = -\frac{1}{\mathrm{In}m} \sum_{i=1}^{m} f_{ij} \mathrm{In} f_{ij}.$$

Now, compute the fuzzy entropy weight with the following equation:

$$W_j^o = \frac{1-\tilde{E}_j}{\sum_{j=1}^{n}(1-\tilde{E}_j)}$$

3) Composite attribute calculation - attribute of fuzzy entropy weight

The combined derivative of fuzzy entropy weight is as follows:

$$W_j = (W_j^s)^{\alpha}(W_j^o)^{\gamma},$$

Where α and γ reflect the relative importance of the subjective and objective weights of each decision maker, α+γ = 1.

The combined weight of fuzzy tells us that, if the attribute values in various alternatives do not differ much from each other then the attributes will not be so important in the decision making process even though these attributes seem very important in the decision making process. Only these attributes that are both important to decision makers and values in different alternatives can significantly play an important role in the decision-making process. The combined weight of fuzzy is like an indicator that not only shows how many attributes are important in the decision maker but also shows how much of the difference of attribute values in different alternatives.

RESULTS AND DISCUSSION

Testing

After implementing the software, we will further test the application of this decision support system. And it is clear that the method we will use is a merger between the calculation of subjective and objective calculation in determining the value - the value of the weight criteria of each supplier.

For the first stage in testing this application we will be asked to fill a quisioner. This questionnaire will compare between one criterion and the other criteria reflecting the relative importance of each of the criteria.

Here is a picture of test results:

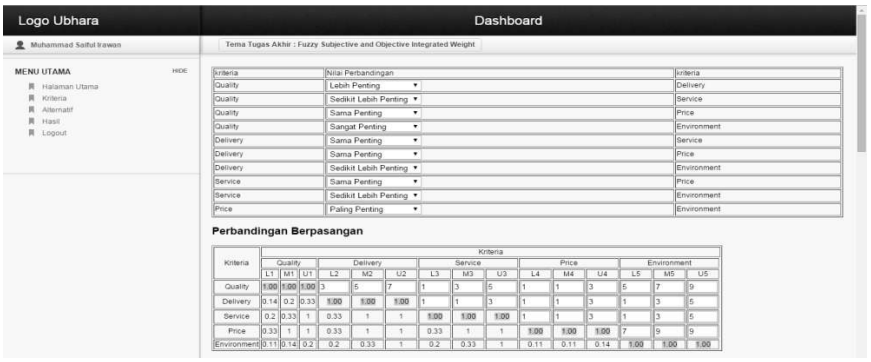

Figure 1 Testing Questionnaire 1

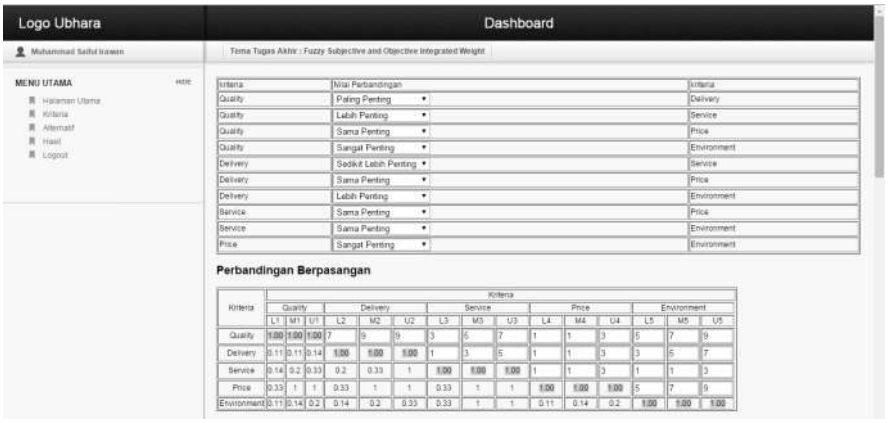

Figure 2 Testing Questionnaire 2

Seen from the test results above image, when we do input quisioner with different data then the result will be different also in the phase of pairwise comparison between the criteria. And different results we will also get on the process of ranking it.

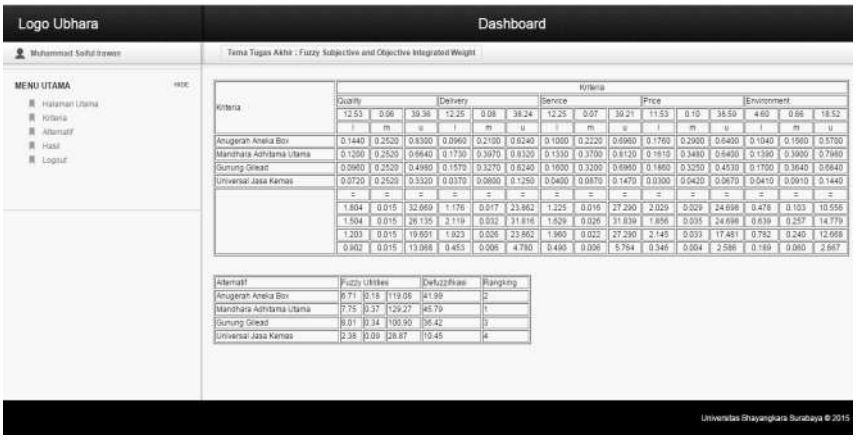

Figure 3 Results of Questionnaire Ranking 1

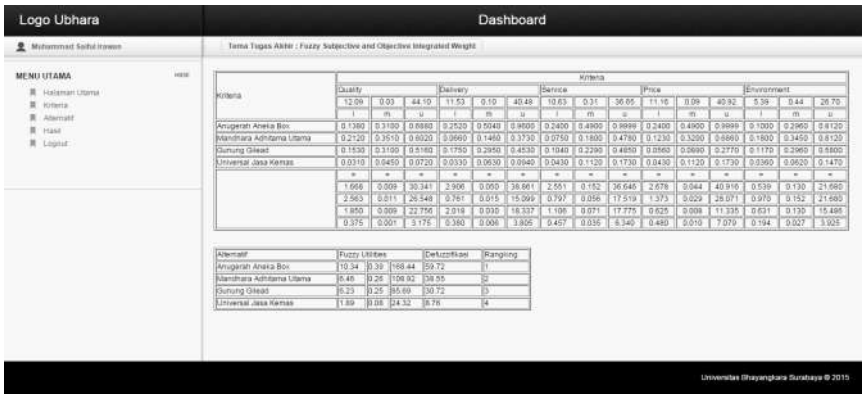

Figure 4 Results of Questionnaire Ranking 2

Discussion of Results

After doing the test in the first part earlier, it can be compiled test results earlier in the table below:

Table 2 Pairwise Comparison Criteria

Kriteria	Kriteria														
	Quality			***Delivery***			***Service***			***Price***			***Environment***		
	l	***M***	***u***	***l***	***m***	***u***	***l***	***M***	***u***	***l***	***m***	***u***	***l***	***m***	***u***
Quality	1	1	1	7	9	9	3	5	7	1	1	3	5	7	9
Delivery	0.11	0.11	0.14	1	1	1	1	3	5	1	1	3	3	5	7
Service	0.14	0.2	0.33	0.2	0.33	1	1	1	1	1	1	3	1	1	3
Price	0.33	1	1	0.33	1	1	0.33	1	1	1	1	1	5	7	9
Environment	0.11	0.41	0.2	0.14	0.2	0.33	0.33	1	1	0.11	0.14	0.2	1	1	1

And next is the weighting process of Fuzzy Subjective and Objective Integrated Weights. The results can be seen in the table below:

Table 3 Subjective Subdivision

Kriteria	Bobot *Subjective*		
	l	***m***	***u***
Quality	0,276	0,057	0,008
Delivery	0,553	0,160	0,027
Service	0,685	0,273	0,051
Price	0,493	0,152	0,036
Environment	0,750	0,358	0,101

Table 4 Objective Weighting

Kriteria	Bobot *Objective*
Quality	0,200
Delivery	0,187
Service	0,202
Price	0,211
Environment	0,200

Furthermore, the result of subjective weight and objective weight will be combined weight. And the results can be seen in the table below:

Table 5 Combination Criteria Weights

Kriteria	Bobot Kombinasi		
	l	m	u
Quality	0,243	0,094	0,028
Delivery	0,358	0,170	0,058
Service	0,421	0,242	0,088
Price	0,351	0,173	0,073
Environment	0,441	0,283	0,133

The next step is to determine the best supplier. And the results can be seen on the calculation of utility fuzzy utilities below:

Tabel 6 Fuzzy Utilities Supplier

Alternatif	*Fuzzy Utilities*		
Anugerah Aneka Box	0,666	1,081	1,552
Mandhara Adhitama Utama	1,321	1,702	2,204
Gunung Gilead	0,954	1,280	1,761
Universal Jasa Kemas	0,554	0,759	0,961

After getting the results of fuzzy utilities supplier, next is ranking to determine which supplier is the best among the four suppliers above. The results of ranking can be seen in the table below:

Table 7 Results of Supplier Ranking

Alternatif	Rangking	
Anugerah Aneka Box	0,244	2

Mandhara Adhitama Utama	0,351	1
Gunung Gilead	0,185	3
Universal Jasa Kemas	0,105	4

Viewed from the above table it is found that the best supplier is Mandhara Adhitama Utama.

CLOSED

Conclusion

From the implementation, results, and discussions that have been done, it can be concluded from the case study of this final project, namely:

1. The determination of the criteria weights with the subjective approach is a reflection of the decision-making's subjective considerations so as to make an alternative rating in the MADM fuzzy problem has an arbitrary factor. The objective approach chooses weighting through a mathematical calculation which ignores the subjective judgment consideration information. Since both subjective and objective approaches have their respective advantages and disadvantages, these integrated or combined methods seem to be more desirable in determining the criteria weights.
2. Weighing criteria is very important in determining the best supplier ratings. And the final result of determining the best supplier is determined by the weighting of this criterion.
3. The ranking result in get that supplier of Mandhara Adhitama Utama is selected supplier as the best supplier according to value obtained.

Suggestion

1. For future case studies may be in addition to the assessment criteria can also be added subcriteria assessment.
2. Determination of decision makers should be someone who is really expert and understand about the criteria - criteria that have been determined.
3. In the calculation of criteria weights both in terms of subjective and objective can be improved by using other algorithmic methods.

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