Raw Material Supplier Selection With Analytics Hierarchy Process (AHP) Method

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Abstract. The purpose of this research is to select suppliers of raw materials that will be used for production activities within the company. In this paper the method used was Analytic Hierarchy Process (AHP). This method is a method for solving a complex and unstructured situation into several components in a hierarchical arrangement, by giving a subjective value about the relative importance of each variable, and determining which variable has the highest priority to influence the outcome of the situation. The results are obtained from decomposition result or problem structure division in each hierarchy, then determining relative importance scale from each element based on pairwise comparison of each element in hierarchy, further calculating priority synthesis by doing multiplication process between local priority with criteria on hierarchy. Certainly, decision support result which obtain is very helpful for company to choose supplier, so that production process is running smoothly and customer demand can completed on time.

1. Introduction

Raw material is the main ingredient which company must have in order to production to keep on going. Certainly, the main ingredient must have a good quality, so that production result is decent [1], [2]. Therefore, choosing supplier who supply raw material must do accurately. To choose supplier who supply raw material, there are several things must be considered. There are brand of raw material which ordered, price of raw material in order to fit production cost, quality of raw material in order to production result is have a company quality and delivery rapidity in order to not hold production process [3], [4]. This research used Analytic Hierarchy Process method to decide which supplier must company choose according to rank of method calculation result.

There are several earlier research which related to this research. First, research which discuss about decision making for choose medical tourism place in India [5]. Second, research which discuss about choosing supplier with integration of Analytic Hierarchy Process(AHP) and Grey Relational Analysis (GRA) [6]. Third, research which discuss about Analisys of AHP-SWOT for strategic plan and decision making [7]. Forth, research which discuss about using AHP for determine outstanding employee [8]. Fifth, research which discuss about non fatty waste classification using AHP [9]. The difference between this research to the first research is different case study. The first research case study chooses medical tourism place while this research is choosing supplier. The difference between this research to the second research is method used. Second research used 2 methods which are AHP and GRA, this research is only using 1 method. The difference between this research to the third research is the use of analysis differently. Third
research uses SWOT analysis for strategic planning and decision making, while this research is not using SWOT. The difference between this research to the forth research is different case study. Forth research case study is determining outstanding employee, while this research case study is supplier. The difference between this research to the fifth research is also different case study. Fifth research case study is non fat waste classification, while this case study is choosing supplier.

Therefore, the main goal of this research is obtain supplier recommendation which is the most suitable to choose to order raw material. Method used was Analytic Hierarchy Process (AHP). The result is several supplier ranking based on parameter criteria value which determine while analysis process using AHP. This matter also adjusted with comparison between earlier researches, then was decided to do raw material supplier choosing using AHP method, because this method can obtain the best raw material supplier.

2. Method

The method used in this research was Analytics Hierarchy Process(AHP). The Analytics Hierarchy Process (AHP) steps are follows [10]:

1. Defining the problem and defining solution.
2. Do pairwise comparison for criteria which applied. Table 1 below is intensity of interest for rating process.

| Level of Interest | Definition | Explanation |
|-------------------|------------|-------------|
| 1                 | Equally important | Both element have same effect |
| 3                 | A little more important | Experience and rating have a little more taking side to one element than other |
| 5                 | More important | Experience and rating have a more taking side to one element than other |
| 7                 | Very important | One element really preferred and practically the domination is very real than other element |
| 9                 | Absolute more important | One element proved to be absolutely preferred compared to its partner at the highest level of confidence |
| 2,4,6,8           | Middle value | Given if have doubt value between neighboring rating |

inverse $a_{ij} = 1/a_{ji}$

1. Arange criteria on matrix form, then collect evaluation result and input them into the matrix.
2. Calculate maximum eigen value based on eigen vector for estimate criteria weights.
3. Determine Consistency Index (CI) and Consistency Ratio (CR) with formula as follows:

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

$$CR = \frac{CI}{RI}$$

Table 2 below is contain Random Index (RI) value which used to calculate Consistency Ratio (CR) value. RI values are used based on the amount of data used in the study.
3. Results and Discussion

Criteria which used for choosing supplier is on Table 3.

Choosing supplier process using AHP method is as follows:

a. Arrange criteria on matrix form, then insert evaluation result into matrix based on importance intensity, then each criteria is doing summation. The result is on Table 4.

b. Calculate the maximum eigen value

Table 5 as follows contains eigen value. To get the eigen value, the first step is to square each value in the matrix. Then each criteria is do summation. Finally, calculate the average, from each number of criteria.

Based on data on table 5, then \( \lambda_{\text{max}} = 4.0615 \)
c. Determine Consistency Index (CI)

Consistency Index value is:

\[
CI = \frac{\lambda_{max} - n}{n - 1} = \frac{4,0615 - 4}{4 - 1} = 0,0205
\]

\[
CR = \frac{CI}{RI} = \frac{0,0205}{0,9} = 0,0228
\]

Based on calculation before, result is \( CR \leq 0,1 \) then evaluation is consistent.

d. Determine Position Vector and Priority Vector

Table 6 as follows is contain position vector and priority vector from criteria

| Criteria     | Position Vector | Priority Vector |
|--------------|-----------------|-----------------|
| Brand        | 0,022           | 0,005           |
| Price        | 0,114           | 0,027           |
| Quality      | 0,424           | 0,100           |
| Delivery Speed | 3,690       | 0,868           |

e. Determine Ranking

After all process is running, next is doing calculation priority factor process on each criteria from each supplier. Lastly is doing weight evaluation calculation each supplier, so that ranking is achieve and fit data on Table 7.

| Supplier | Evaluation Weight | Ranking |
|----------|-------------------|---------|
| S5       | 0,315             | 1       |
| S3       | 0,219             | 2       |
| S1       | 0,173             | 3       |
| S4       | 0,169             | 4       |
| S2       | 0,123             | 5       |

After all steps are running, the ranking result form 5 supplier and first rank is supplier 5 (S5). If it is compared to previous research, the result is different because research focus is different. As first research which has different study case, second research is using 2 method, third research is using SWOT analysis, fourth and fifth research have different study case [5-9]. However, the existence of previous research is very helpful to complete this research.

4. Conclusion

Conclusion from this research that was using Analytic Hierarchy Process(AHP) method. Company can choose supplier who match for purchase raw material for production. Based on the ranking results, the most suitable supplier is S5, with an Evaluation Weight value of 0.315. The next ranking sequence is S3, S1, S4, S2 with each value is 0.219; 0.173; 0.169; 0.123. By obtaining the weight of the evaluation, it makes it easier for companies to choose suppliers when they are going to order raw materials, so that the production process is not hampered.
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