Analysis Concept Design of Corn Raw Materials Suppliers in the Animal Feed Industry using Analytical Hierarchy Process (AHP) Method

Monica¹ and A C Sembiring²

¹,²Department of Industrial Engineering, Faculty of Technology and Computer Sciences, Universitas Prima Indonesia, Medan, Indonesia

E-mail: monicaw138@gmail.com, anitakembaren@unprimdn.ac.id

Abstract. Procurement of raw materials is a major activity in the manufacturing industry. Therefore, the role of supplier is very important in the supply flow of an industry. Supply Chain Management in the industry must be managed efficiently. The animal feed industry located in Medan City has constraints in determining suppliers in the supply of timely and quality raw materials, it greatly affects industrial activities so the industry can’t provide the consumers’ needs properly. Therefore, this research was conducted to determine the suppliers that fit the company’s needs. The analysis used Analytical Hierarchy Process (AHP) method by taking data randomly from 20 suppliers in Animal Feed Industry. The AHP method analyzes based on the main criteria then obtained the first priority criterion is Delivery (0.4385), the second priority is Quality (0.2775), the third priority is Cost (0.0890), the fourth priority is Service (0.0854), the fifth priority is Flexibility (0.0582) and the last is Performance (0.0513). As for the selection of suppliers that have been adjusted to the priority level of the existing criteria is supplier B (0.5026), followed by supplier A (0.3129) and the last is supplier C (0.1845). So, it can be concluded that Supplier B is the best supplier.

1. Introduction

Procurement of raw materials is a major activity in the manufacturing industry. [1]. A manufacturing industry will not be separated from the activities of supplying and distributing raw materials. This becomes important because the availability of raw materials and products determines an industry in conducting its production and operational activities [2]. Therefore, Supply Chain Management in the industry must be managed efficiently. Supply Chain Management is an activity of managing in the industry like managing the flow chain of materials - so as to create an appropriate supply flow to expedite the supply process of raw materials and the production process until the product is distributed to consumers [3]. In the supply chain the role of supplier selection is very important because it becomes the center of the next process [4].

Animal Feed Industry located in Medan City is a manufacturing industry that produces chicken feed. To produces chicken feed, the main raw material needed is corn [5]. From the interview results it is known that ordering raw materials to suppliers is done based on demand from consumers, with an average order of corn in 1 month that the Animal Feed Industry can order raw materials to corn suppliers ± 8,000 tons. In procuring raw materials, they have more than 20 suppliers, of which the
suppliers are farmers. The selection of suppliers made by the Animal Feed Industry is usually randomly based on suppliers who set the lowest prices and based on the availability of raw materials. In carrying out raw material procurement activities, the animal feed industry located in Medan City has constraints in determining suppliers, in the supply of timely [6] and quality raw materials, the good quality of corn is the low water-grade corn, but those imported have high-water content (low quality) [7] so that the low quality one can’t be used for chicken feed production because it will produce poor output as well, in addition, the corn raw material distributed to the Animal Feed Industry is not in accordance with the delivery lead time due to macro conditions originating from the supplier so that it will also have an impact on production activities and industrial operations [8]. With these problems, it will be able to disrupt the production activities of the animal feed industry, such as the interrupted production flow which will cause the output of feed produced will not be distributed to consumers properly. That is because there is no supplier determination so it has a negative impact on the process that occurs. Based on the background description of the problem above, the purpose of this research is to determine the right supplier according to the company's needs based on the most important priority criteria by using the Analytical Hierarchy Process Method (AHP) [9]. The novelty of this research is the selection of suppliers with the Analytic Hierarchy Process (AHP) method has never been done to select suppliers of corn raw materials for chicken feed production.

2. Methodology
Research conducted using qualitative and quantitative research because research requires observations and calculations [10]. Data collection techniques carried out by interview, observation, with the research instrument used is a questionnaire. The data used in this study are primary data; in the form of data directly obtained from the animal feed industry such as data on the number of raw material orders, the number of suppliers, the amount of product distribution, and the results of questionnaires and secondary data; in the form of data obtained from books and literature [11].

The method used in this study is the Analytical Hierarchy Process Method [12]. Analytical Hierarchy Process (AHP) is a method for solving an unstructured complex situation into several components in a hierarchical arrangement, by giving a subjective value of the relative importance of each variable, and determining which variable has the highest priority to influence the outcome of the situation. [13].

In determining the most important criteria in supplier selection using Analytical Hierarchy Process [14], first determine the selection criteria [15]. In selecting suppliers, criteria are needed to become the standard for suppliers to supply their raw materials. The criteria in this study was determined through a questionnaire. The next step is calculate the weight of each criterion / element by using pairwise comparisons with the following steps are: making a comparison matrix, do the normalized matrix test, calculate the multifactor evaluation process, and perform weight sum vector calculations and the last step to determine the most important criteria is determine the order of the criteria for calculating pairwise comparison based on the largest value. The following figure 1 shows the AHP Method steps:

![Figure 1. AHP method steps](image)

3. Results and Discussion
The process of ordering raw materials involves the purchasing department, which means the purchasing part is directly related to the supplier to negotiate prices, quality, availability, delivery times and others. After that, suppliers will come to the Animal Feed Industry to distribute corn. Corn raw materials are not directly accepted by the logistics department because they must first go through certain stages such as the weighing process, which aims to ensure whether they are in accordance with
the orders ordered, and the quality checking process by Quality Control (QC). Corn raw material will be checked by the QC department by measuring the moisture content of the imported corn. Corn that has a high moisture content will be rejected by the QC department so that it will not pass to the raw material warehouse and will be returned to the relevant supplier.

At this stage it will take quite a long time because it must be really thorough in selecting it. In the process of value chain analysis above, it can be seen that corn raw materials that do not have good quality will not be accepted and they will find another supplier. Analysis of the activity shows that the activity is very inefficient because it takes time and cost, although the raw material selection stage is indeed needed, so that the activity does not provide Value Added to the supply chain of the animal feed industry. Therefore, a supplier selection strategy is needed in accordance with the most important criteria.

3.1 Determination of Criteria
From the 30 respondents' answer data in the open questionnaire, several criteria were collected:

Table 1. Collected supplier’s criteria

| No | Criteria | Description |
|----|----------|-------------|
| 1  | Quality  | Quality of raw materials according to company standards |
| 2  | Quality  | Quality of raw materials worthy of use |
| 3  | Fresh Raw Materials |
| 4  | Supplier Reputaion |
| 5  | Performance | Business Ethics and Supplier honesty |
| 6  | Trustworthy |
| 7  | Raw materials delivered on time |
| 8  | Shipping Status info from the Supplier |
| 9  | Delivery | Accuracy of booking quantities |
| 10 | Outside City / City Supplier |
| 11 | Standard Price |
| 12 | Cost | Payment Method |
| 13 | Price negotiation |
| 14 | Supplier’s Communicate Way |
| 15 | Service | Refunds if they are damages |
| 16 | Ability to fulfil the demand (Consistent) |
| 17 | Response in any complaints |
| 18 | Flexibility | Easy Ordering Procedure |
| 19 | Supplier Availability meets additional orders |

3.2 Data Processing
The following paired matrix is assessed by the Animal Feed Industry employees.

Table 2. Comparison matrix

| Criteria | Assessment | Criteria |
|----------|------------|----------|
| Quality  | 9 7 5 3 1 3 5 7 9 | Performance |
| 9 7 5 3 1 3 5 7 9 | Delivery |
| 9 7 5 3 1 3 5 7 9 | Cost |
| 9 7 5 3 1 3 5 7 9 | Service |
| 9 7 5 3 1 3 5 7 9 | Flexibility |
| 9 7 5 3 1 3 5 7 9 | Delivery |
| 9 7 5 3 1 3 5 7 9 | Cost |
| 9 7 5 3 1 3 5 7 9 | Service |
Based on data processing with Normalized Matrix Test, obtained criteria with weight and priority as follows:

| Criteria   | Weight | Priority |
|------------|--------|----------|
| Quality    | 0.2775 | 2        |
| Performance| 0.0513 | 6        |
| Delivery   | 0.4385 | 1        |
| Cost       | 0.0890 | 3        |
| Service    | 0.0854 | 4        |
| Flexibility| 0.0582 | 5        |

Figure 2. Priority level of criteria

Next is calculate the multifactor evaluation process. In selecting suppliers, researchers took 3 suppliers who according to the company were superior compared to other suppliers. In this case, supplier judgments are given by employees, they are: Quality - Supplier B is 2 times superior to Supplier A, Supplier A is 3 times superior to Supplier C, Supplier B is 5 times superior to Supplier C, Performance - Supplier C is 3 times more superior to Supplier A, Supplier B 4 times superior to Supplier A, Supplier B 2 times superior to Supplier C, Delivery - Supplier A 2 times superior to Supplier C, Supplier B 4 times superior to Supplier C, Supplier B 2 times superior to Supplier A, Cost - Supplier A 3 times cheaper than Supplier C, Supplier C 2 times cheaper than Supplier B, Supplier A 4 times cheaper than Supplier B, Service - Supplier B 2 times superior to Supplier C and Supplier A, Supplier C = Supplier A, Flexibility - Supplier C is 4 times superior to Supplier B, Supplier A is 3 times
superior to Supplier B, Supplier C is 2 times superior to Supplier A. From the data processing of the multifactor evaluation process, obtained the results as follows:

Table 4. Multifactor evaluation process results

| Results | Quality | Performance | Delivery | Cost | Service | Flexibility |
|---------|---------|-------------|----------|------|---------|-------------|
| Supplier A | 0.3090 | 0.1220 | 0.2857 | 0.6250 | 0.2500 | 0.3196 |
| Supplier B | 0.5816 | 0.5584 | 0.5714 | 0.1365 | 0.5000 | 0.1220 |
| Supplier C | 0.1095 | 0.3196 | 0.1429 | 0.2385 | 0.2500 | 0.5584 |

Next step is performed weight sum vector calculations by multiply the multifactor evaluation and the normalized Criteria Matrix Test, obtained the results and decision as follows:

Table 5. Priority level of suppliers

| Corn Supplier | Weight | Priority |
|---------------|--------|----------|
| Supplier A    | 0.3129 | 2        |
| Supplier B    | 0.5026 | 1        |
| Supplier C    | 0.1845 | 3        |

The following figure. 4 shows the AHP Hierarchy from the selection of Corn Suppliers in the Animal Feed Industry located in Medan City:
4. Conclusion
From the results of data processing using the Analytical Hierarchy Process Method, obtained the first priority criterion is Delivery (0.4385), the second priority criterion is Quality (0.2775), the third priority criterion is Cost (0.0890), the fourth priority criterion is Service (0.0854), the fifth priority criterion is Flexibility (0.0582) and the last is Performance (0.0513). As for the selection of suppliers that have been adjusted to the priority level of the existing criteria is supplier B (0.5026), followed by supplier A (0.3129) and the last is supplier C (0.1845). So, it can be concluded that Supplier B is the best supplier.

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