

# Analytical Hierarchy Process (AHP): Implementation in the Selection of Suppliers of Coagulant Chemicals

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**Abstract**— This research was conducted at a water treatment company with coagulant chemicals as the main raw material. So far, the company has only used one supplier to procure coagulants, but the company has received offers from several suppliers. This is of course a problem of how to choose the best supplier in accordance with the criteria set by the company. The AHP method is used to solve the problem of coagulant supplier selection. Supplier selection is one of the most important things in purchasing activities for companies, where purchasing activities are activities that have important value for companies because purchasing components, raw materials, and supplies represents a fairly large portion of the finished product. There are many offers by suppliers, selected 3 suppliers (A, B, C) that are worthy of consideration with the 6 criterias. The results of this study are supplier A in the first rank (weight 0.67), Supplier B in rank 2 (weight 0.19) and supplier C in rank 3 (weight 0.15).

**Keywords**— Coagulant, decision maker, supplier, Analytical Hierarchy Process.

## I. INTRODUCTION

Supplier selection is one of the most important activities of a company, because the purchase of raw materials and components represents 40% - 80% of the total product cost and has an impact on company performance [1][2]. Many studies on supplier selection have been carried out before [3]. In general, the problem that arises is the difficulty of determining the best supplier from the many options available by considering the desired criteria for prospective suppliers [4].

Supplier selection is one of the most important things in purchasing activities for companies, where purchasing activities are activities that have important value for companies because purchasing components, raw materials, and supplies represents a fairly large portion of the finished product [5]. Supplier selection is a multi-criteria problem which includes both quantitative and qualitative factors. Some of the criteria that influence the selection of these suppliers are both quantitative and qualitative [6]. Therefore, we need a method that can include both in the measurement. One method that can be used for supplier selection is the AHP (Analytical Hierarchy Process) method. This method includes both qualitative and quantitative measures [7].

This research was conducted at a water treatment company for the supply of coagulant chemicals as one of the materials used in water treatment. Coagulation is one of the most effective and easy in using methods for extracting suspended substances from aqueous systems [8]. The coagulant used is PAC (Poly Aluminum Chloride) in liquid form. The coagulant

substances added to the water provokes a decrease in the surface charge, after which the particles can become close [9].

The problem that arises is that the supplier selection method has not been implemented so that the current supplier selection is only based on emotional closeness between management and one supplier and of course this needs to be evaluated. In fact, there are several suppliers who offer the supply of this coagulant chemical. This research will discuss how to select suppliers by implementing the AHP method as an analytical tool.

## II. LITERATURE REVIEW

Supply Chain Management or supply chain management is the activity of managing activities in order to obtain raw materials, transform these raw materials into goods in process and finished goods, and send these products to consumers through a distribution system [10]. These activities include the traditional purchasing function plus other activities essential to the supplier-distributor relationship. SCM can include determining: (1) carrier, (2) credit and cash transfers, (3) suppliers, (4) distributors and banks, (5) accounts payable and receivables, (6) warehousing, (7) order fulfillment, and (8) share information regarding forecast demand, production, and inventory control activities. [11].

The Analytical Hierarchy Process (AHP) was developed by Thomas L. Saaty in the 1970s. This method is a multi-criteria decision-making model that can help the human frame of mind in which logic, experience, knowledge, emotions, and feelings are optimized into a systematic process. The AHP method has been widely applied by various industry variations and has proven its quality in explaining the priority scale of choice based on expert judgment and proposed criteria [12]. With these advantages, the AHP method can make it easier to determine alternative workshops by considering several specified criteria AHP is widely used for decision making in solving problems in terms of planning, determining alternatives, setting priorities, selecting policies, allocating resources, determining needs, forecasting results, planning results, planning systems, measuring performance, optimization, and solving conflicts [13].

Decision making in the AHP methodology is based on 4 basic principles, namely:

1. Decomposition, namely breaking the whole problem into its elements so that several levels or hierarchies are obtained. There are two types of hierarchies, complete and incomplete. It is called a complete hierarchy if all elements

are at the next level, otherwise the hierarchy formed is called an incomplete hierarchy.

2. Comparative Judgment, making judgments about the relative importance of two elements at a certain level in relation to the criteria above. This assessment is the essence of AHP, because it will influence the priority of existing elements as a basis for decision making. The results of this assessment are presented in the form of a matrix called the pairwise comparison matrix.
3. Synthesis of Priority, from the pairwise comparison matrix, then look for eigenvectors to get local priority to get global priority, namely sub-criteria weights and alternatives to the overall hierarchical goal.
4. Logical Consistency, namely the grouping of similar objects can be grouped according to uniformity and relevance.

### III. RESEARCH METHODOLOGY

The research method is a systematic step that plays an important role as a guide in solving and providing solutions to problems that arise in the preparation of the research that will assist in solving the problem so that it is more focused and in accordance with the purpose of writing the research. The method in this research is as follows:

1. Determination of respondents, namely parties who have the authority to make decisions in terms of supplier selection, namely Plant Managers, Finance Managers, Asmen Lab and Head of Warehouse and Purchasing and Warehousing employees who receive goods directly from suppliers so they know directly from the supplier's performance
2. Data collection consisting of
  - a. Determine AHP criteria. AHP criteria as follows:
    - Quality/K1 : Providing consistent quality (Q1), goods received according to specifications and not expired (Q2), goods sent have good and safe packaging (Q3).
    - Accuracy of Delivery (K2) : Ability to deliver goods according to a set schedule (D1), Ability to handle the transportation system (D2).
    - Price (K3) : Price appropriateness with the quality of the goods produced (H1), Ability to provide the lowest price from other suppliers' offers (H2).
    - Guarantee of Certification (K4) : Having ISO 9000, ISO 14001 (J1) and OHSAS 18001 (J2) management systems, carrying out work with due regard to K3.
    - After-sales service (K5) : Convenience to be contacted, Ability to resolve customer complaints quickly and well. Has a usage guarantee within a certain period of time.
    - Accuracy of Quantity K6) : Accuracy of quantity, namely the accuracy and suitability of the quantity in delivery, measured by the Pairwise Comparison Rating Scale.
  - b. Develop a hierarchical structure of the problem like Figure 1 below :

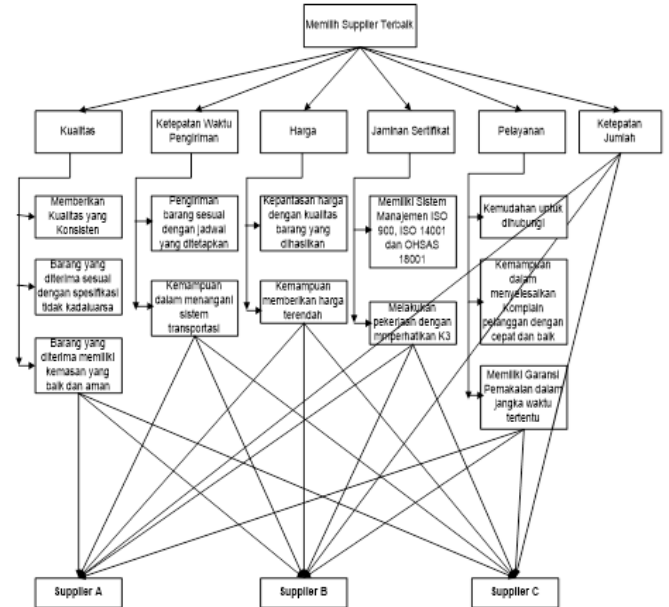


Fig. 1. Supplier Selection Hierarchy Structure

- c. Create a pairwise comparison matrix.
- d. Calculating the weight/priority of each variable at each level.
- e. Calculating the consistency ratio.
- f. Calculating the weight/priority of each variable at each level.
- g. Determine supplier ranking

### IV. RESULT AND DISCUSSION

At this stage, the research performs weighting for each level in the hierarchical structure of the problem. This process can be seen in the following figure:

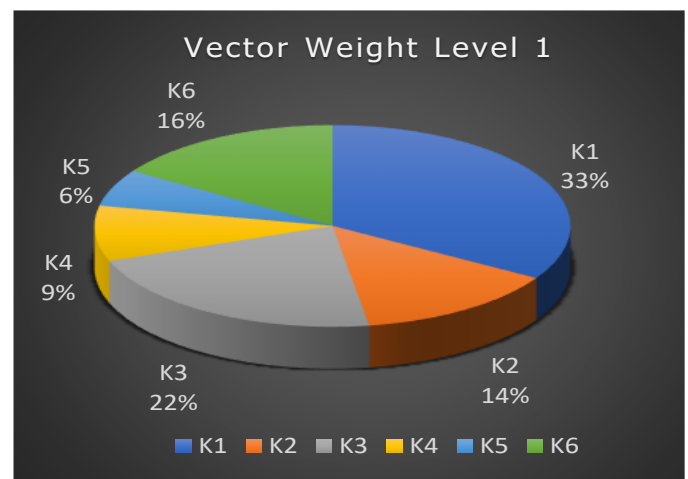


Fig. 2. Vector Weight of level 1

After calculating the ratio consistency value, a CR of 0.06 is obtained. The CR value is below 0.1 so the level of inconsistency is acceptable

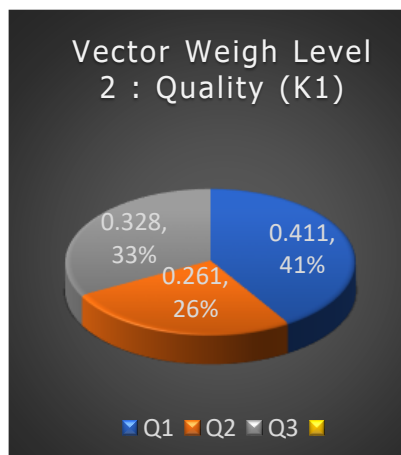


Fig. 3. Vector Weight of Level 2 : Quality

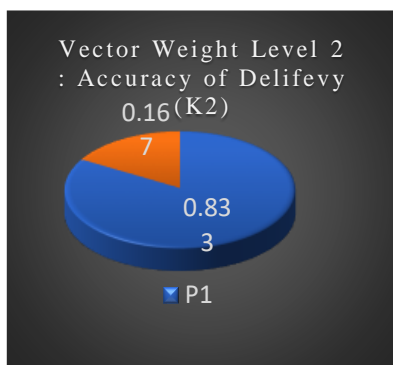


Fig. 4. Vector Weight of Level 2 : Accuracy of Delivery

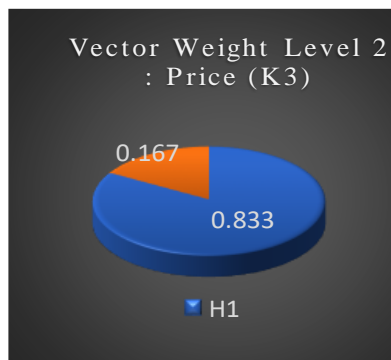


Fig. 5. Vector Weight of Level 2 : Price

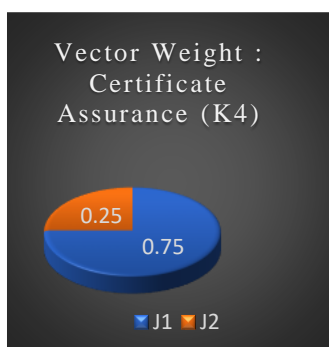


Fig. 6. Vector Weight of Level 2 : Certificate Assurance

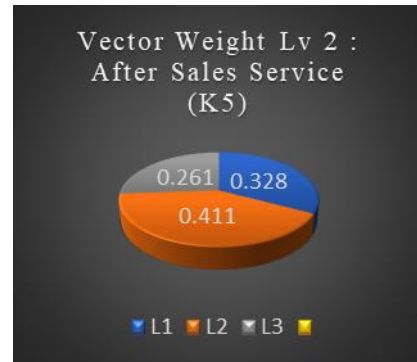


Fig. 7. Vector Weight of Level 2 : After Sales Service

After calculating the value of the consistency of the ratio, it is obtained that the CR is less than 10%, which means that there is no inconsistency. Next is to calculate the overall weight vector, the results appear in this Figure 8 below:



Fig. 8. Overall Vector Weight

From the results of this ranking, the company will be more objective in determining which supplier will supply the need for coagulant chemicals in the drinking water treatment process.

## V. CONCLUSION

1. Supplier selection of coagulant chemical raw materials is a multi-criteria decision problem. The selected candidate must meet the established criteria and have the highest average score of the criteria. The AHP method can produce one or more of the best decisions.
2. The criterion that has the most influence on the selection of coagulant chemical raw material suppliers at PT TKCM is the quality criterion with a weight of 0.34. The second priority that has an effect is the price criterion with a weight of 0.22. while the fourth priority is the timeliness of delivery with a weight of 0.14 while the fifth criterion is a guarantee of certification with a weight of 0.09 and after-sales service criteria with a weight of 0.06.
3. Based on the criteria in supplier selection, overall supplier A is considered the best supplier with a weight of 0.67 The next priority is supplier B with a weight value of 0.19 and the last priority is supplier C with a weight value of 0.15 This shows that Overall, the best coagulant chemical raw

material supplier for a company to serve as a partner/long-term partner is supplier A because overall this supplier has the highest value compared to the other two suppliers.

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