

**USULAN PEMILIHAN PEMASOK BAHAN BAKU KELAPA SAWIT UNTUK
PRODUKSI MINYAK CRUDE PALM OIL DENGAN MENGGUNAKAN
METODE ANALYTIC NETWORK PROCESS (ANP)
DI PT. UKINDO BLANKAHAN OIL MILL**

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PROGRAM STUDI TEKNIK INDUSTRI

FAKULTAS TEKNIK

UNIVERSITAS MEDAN AREA

2021

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Document Accepted 30/5/22

Access From (repository.uma.ac.id)30/5/22

ABSTRACT

Rizki Nanda Gusti. 178150009. “The Proposed Selection of Palm Oil Raw Material Suppliers for Crude Palm Oil Production by Using Analytic Network Process (ANP) Method at PT. Ukindo Blankahan Oil Mill”. Supervised by Ir. Hj. Ninny Siregar M.Si. and Yuana Delvika, S.T., M.T.

PT. Ukindo Blankahan Oil Mill is a company engaged in the processing of Crude Palm Oil (CPO) and oil palm kernels. The problem that often occurred in the company was the lack of service from suppliers such as late delivery of raw materials and fruit quality which was still often not following company procedures, which resulted in not achieving CPO oil production targets. For this reason, it was necessary to propose the best supplier selection to re-evaluate the performance results and to maintain and improve the quality of palm oil raw materials in the company. The purposes of this study were to identify the main criteria to be used in selecting suppliers, to get the best supplier rankings to be maintained by the company using the Analytic Network Process (ANP) method. The criteria that would be used in the selection of suppliers at PT. Ukindo Blankahan Oil Mill had 5 criteria and 15 sub-criteria, namely quality criteria with sub-criteria of the desired standard composition, providing consistent quality, and level of defects. Price criteria with sub-criteria for payment methods, low prices, price stability, and convenience in determining price agreements. Delivery criteria with sub-criteria of delivery speed, the number of deliveries determination. Service criteria with sub-criteria provided guarantees for goods, assisting, and responsiveness. Environmental criteria with sub-criteria of delivery distance, road/terrain conditions, weather climate. The criteria had a weight value of 0.449, λ_{\max} value = 5.40, CI value = 0.102, and CR value = 0.091 while the sub-criteria had a weight value of 1.136, λ_{\max} value = 16,990, CI value = 0.1421, and CR value = 0.089398. The selected supplier based on the assessment of decision making using the Analytical Network Process (ANP) method was CV. LANGKAT MAKMUR Supplier with a value of 0.056844.

Keywords: Raw Materials, Suppliers, ANP

CHAPTER I

INTRODUCTION

1.1 Background of Study

The supplier selection process is a critical part of purchasing activities. Selection of the right supplier in the purchase of raw materials will greatly support the achievement of the company's output. Basically every company has the main criteria that will be used in the selection of suppliers, ranging from price to service and so on. These criteria are determined by each company.

Ukindo Blankahan Oil Mill is a company engaged in the processing of crude palm oil (CPO) with a FFB processing capacity of 43 tons/hour. The oil production process is strongly influenced by the availability of Fresh Fruit Bunches (FFB). FFB raw materials used by Ukindo Blankahan Oil Mill company comes from its own plantations, smallholder plantations and suppliers.

The obstacle that occurs in the company is that the supplier's performance is not optimal, resulting in not achieving the maximum production target. This refers to the discrepancy between the performance provided by the supplier and the criteria provided by the company.

The main criteria in selecting suppliers in the company are good fruit quality with perfect ripeness, stable prices, fast delivery, good service, and a good environment. The sub-criteria provided by the company are the determination of the number of deliveries, adequate transportation, responsiveness, etc. These criteria and sub-criteria must be owned by suppliers who have collaborated with the company. However, in reality the suppliers still do not comply with the criteria

provided by the company. There are 4 (four) permanent suppliers in the company, namely: CV. DRP, CV. NAGA MOON, CV. LANGKAT MAKMUR, and Farmer Yusuf.

The performance of CV. DRP still has many shortcomings, ranging from unstable prices and maturity levels that do not match the given criteria. CV. DRAGON MOON often does not send fruit which does not match the agreement. CV. LANGKAT MAKMUR has a service that lacks responsiveness. Farmer Yusuf himself has a high rate of fruit defects and long deliveries.

To overcome the problems that exist in the company, it is necessary to evaluate and re-identify the supplier's performance by conducting research on the selection of raw material suppliers according to the company's criteria so as to produce the best suppliers. The best suppliers are selected based on the level of conformity between the supplier's performance with the criteria and sub-criteria in the determining factors, namely Price, Quality, Delivery, Service and Environment. This test was conducted using the Analytic Network Process (ANP) method.

This method was chosen because the ANP method is a form of decision support model which involves checking the consistency of the assessment, making an assessment matrix until finally a weighted value is obtained that can help make the best supplier decision. By applying the ANP method, Ukindo Blankahan Oil Mill company can find out the most potential suppliers in supplying raw materials.

1.2 Formulation of Study

The formulation of the study that is discussed in this study is to select the right supplier of raw materials by determining the supplier criteria and sub-criteria, based on the relationship among these criterias so that they can overcome problems related to selecting the best supplier.

1.3 Limitation of Study

The limitations of the study used in this study are:

1. Determination of criteria and sub-criteria obtained from literature studies and based on discussions with the company in accordance with company policies.
2. The research and data collection is carried out until the proposal submitted.
3. The research will be conducted on suppliers that have been collaborated with the company.
4. The research used Super Decision Applications

1.4 Purpose of Study

The purposes of this study are:

1. To identify the main criteria that is used in selecting suppliers.
2. To get the best supplier ranking to be maintained by the company.

1.5 The Significance of Study

The results of this study are expected to benefit and provide the following uses:

1. It can assist in providing benefits to the development of knowledge in the field of purchasing the best raw materials, especially in applying a method of selecting the best supplier.
2. In order to add insight for the researcher when making decisions in this study.
3. The results of this study are expected to be used as material for information and input for those who are researching the same problem.

1.6 Writing Systematic

In writing this Final Project, the systematics of writing are arranged as follows:

CHAPTER I INTRODUCTION

The introductory chapter contains the background of why this research was conducted, besides that it also contains the problems to be raised, limitations, purposes, and significances of study, and writing systematic.

CHAPTER II THEORETICAL REVIEW

It contains a summary of the results of research that has been done previously that has to do with the research which was conducted. In addition, it also contains the basic concepts and principles needed to solve research problems, the theoretical review that supports the study to be carried out in research.

CHAPTER III RESEARCH METHODS

This chapter contains materials, tools, research procedures and what data is used in reviewing and analyzing according to the flow chart that has been made.

CHAPTER IV COLLECTION AND ANALYSIS OF DATA

It contains a description of what data is generated during the research which is then processed using a predetermined method.

CHAPTER V CONCLUSIONS AND SUGGESTIONS

It contains the conclusions obtained from the discussion of the research results. In addition, there are also suggestions or inputs that this research needs to be given, both to this researcher and to future researchers who make it possible for this research to be continued.

REFERENCES

The references contain the sources used in this research, they can be journals, books, quotes from the internet or from other sources.

CHAPTER II

THEORETICAL REVIEW

2.1 Production System

Production System is a series of operations that process or process inputs in the form of raw materials, intermediate products, parts, components and/or subassemblies to produce value-added outputs or final products. (finished good) by using resources from elements of technology (machinery, equipment, production facilities and energy) and elements of organization (labor, management, information and capital). Production system includes activities of design (design), procurement (procure), manufacture (produce), storage (store), delivery (deliver) and service.

Industry is a line of business or activity that uses work skills and perseverance with/without the help of work tools to produce value-added output. Industry is a business link in producing products that function to help humans as individuals or communities. The output of the industry or product can be in the form of goods or services.

The Production System covers all industries from upstream to downstream industries. The production system is applied in the goods industry and the service industry. In the goods industry, for example, the manufacturing industry, the agricultural industry, the mining industry, the chemical industry and others. In the service industry, for example, the health industry, the financial industry, the transportation industry, the information industry and others.

Michael Porter describes the production system as a value chain as a series of activities to generate added value margins where primary activities are supported by support activities.

Production systems are implemented to ensure that the products produced can meet market needs at the right time, in the right place and in the right quantity. Based on the point of view of the push/pull system (push/pull view) where when the order arrives (customer order decoupling points) become the reference point for the implementation of the production process, it will affect the lead time required to meet the market needs.

2.2 Supplier

Suppliers are companies or individuals who provide the resources needed by the company and its competitors to produce certain goods and services. Inappropriate supplier selection can cause losses to the company if the lead time from suppliers is long, it will result in the production process being disrupted so that it will result in delays in meeting customer requests, in addition if the raw materials sent by the supplier have a quality that is not in accordance with production needs. which results in delays in fulfilling requests from customers. Therefore, choosing the right supplier will result in significant savings, and minimize the risks that occur. This is why many experts believe supplier selection is the most important activity of a purchasing department.

2.3 Supplier Selection Criteria

Some expert opinions reveal the main factors considered by a company when choosing a supplier are:

1. Price: this factor is usually the main factor, whether there is a discount offer, although it is sometimes not the most important thing.
2. Quality: a company may spend more to get good quality goods.
3. Service: specialized services can sometimes be important in supplier selection. Replacement of damaged goods, instructions for use, repair of equipment and similar services, can be key in choosing one supplier over another.
4. Location: the location of the supplier can have an influence on delivery times, transportation costs, and response times when there are sudden orders or emergency services. Purchasing in local/local areas can foster goodwill (good influence) in a relationship and can help the local economy.
5. Supplier inventory policy: if the supplier can maintain its inventory policy and maintain its spare parts, this can help in the case of a sudden need for raw materials.
6. Flexibility: the good intentions and ability of suppliers to respond to changing demands and meet changing design orders can be an important factor in supplier selection. (Maulana Arif Umaindra, Darminto Pujotomo, Purnawan Adi W: 2015)

Table 2.1 Supplier Selection Criteria

Criteria	Description
Regulatory compliance	The suppliers' ability to supply the company's needs in accordance with the company's request
Quality	The suppliers' ability should be able to provide quality raw

	materials
Cost	Costs that must be incurred by the company to obtain raw materials
Service	The suppliers' service level, consisting of delivery time, value added services and ease of communication

2.4 Raw Material

Raw materials are one of the most important factors in the production process of a factory. Without raw materials the production process in a company will not be able to run. Lack of raw materials will result in the cessation of the company's activities.

A raw material is something that is used to make finished goods. In a company, raw materials and auxiliary materials have a very important meaning, because they are the capital for the production process to produce results. (Agus Ristono, 2013). Raw materials or direct materials are also the basic materials used in the company's processes which constitute the largest part in the formation of finished goods. Raw materials also include all materials used in manufacturing companies, except for materials that will physically be combined with products produced in the manufacturing company.

The raw materials that can be used in the production process can be grouped into the following.

1. Direct materials

All raw materials that are part of the various finished goods produced.

2. Indirect materials

Raw materials that play a role in the production process remain but are not directly visible in the finished goods to be produced. (Assauri, 2016).

2.5 Analytic Network Process (ANP)

The Analytic Network Process (ANP) method is a technique to help solve problems. In its development, ANP is not only used to determine the priority of choices with many criteria, but its application has been expanded as an alternative model to solve various problems. This is possible because ANP relies enough on intuition as its main input, but intuition must come from decision-making that is sufficiently informed and understands the decision problem at hand. Basically ANP is a general theory of measurement. ANP is used to find the ratio scale of both discrete and continuous pair comparisons. These comparisons can be taken from actual measures or from a basic scale that reflects the strength of feelings and relative preferences. ANP has particular concern about deviations from consistency, measurement and dependability and between groups of structural elements. Analytic Network Process One of the methods in making decisions based on many criteria (MCDM) was developed by Thomas L Saaty. This method is a new approach to the qualitative method which is the development of the Analytic Hierarchy Process (AHP) method. The advantage of ANP is that the decision-making method is a simple process so that it can be used in complex problems.

According to Saaty, ANP is used to solve problems that depend on existing alternatives. In its analysis technique, ANP uses pairwise comparisons on alternatives and criteria. In the AHP network there are levels of objectives,

criteria, sub-criteria, and alternatives, where each level has an element. Meanwhile, the levels in AHP are called clusters in the ANP network which can have criteria and alternatives in them, which are now called nodes. Figure 2.1 shows the analysis using a hierarchical network approach.

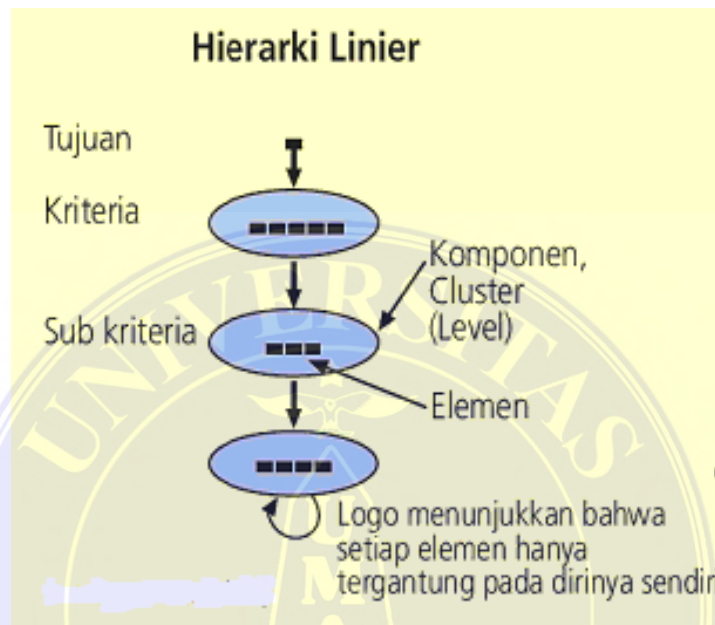


Figure 2.1 Hierarchical Network

Hierarchy is a very basic tool of the human mind by identifying the elements of a problem, then these elements are grouped in the form of homogeneous collections (components) and formulated in the form of different levels. There are no standard rules in the preparation of a hierarchical network, however, the arrangement of a hierarchical network must still be adapted to the situation the decisions are made.

In addition to using a hierarchical network, decision making can also be made by creating a feedback network. This network more accurately describes the conditions of a very complex research problem as stated earlier. In summary, the feedback network is depicted in Figure 2.2.

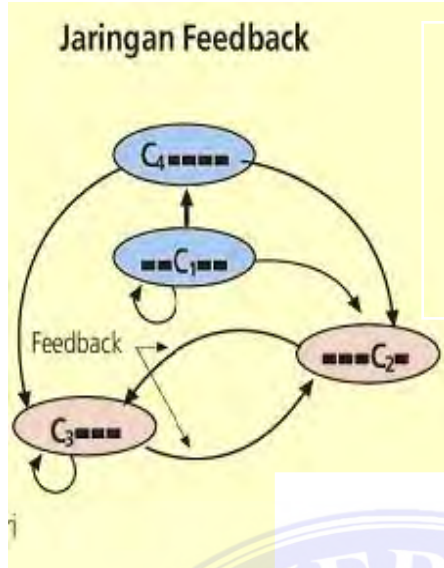


Figure 2.2 Feedback Network

By using a feedback network, elements can depend on or be bound to components as in a hierarchical network but can also depend on other elements. Furthermore, an element can depend on other elements present in a component. The other components as shown in the line that connects C4 to other clusters (i.e. C2 and C3) are called outer dependencies. While the elements to be compared are on the same component, so that these elements form a "round line" relationship, it is called inner dependence.

2.6 ANP Indicator

ANP is a method with a qualitative approach where the data to be used as material for analysis is not available, so the research must search for data primarily. Therefore, ANP has three axioms that form the basis of its theory.

Axioms or postulates serve to strengthen a statement so that it can be seen to be true without the need for evidence.

1. Reciprocal

If activity X has a level of importance 6 times greater than activity Y, then activity Y is 1/6 of activity X.

2. Homogeneity

This axiom states that the elements to be compared are not very different. If the comparison is too large, it will result in a larger error of judgment. The scale used in the AHP and ANP is different from the scale used on the Likert scale generally (1 to 5). The scale used in the ANP has a larger range, which is 1 to 9 and even more. The following is the scale used in the ANP which can be seen in table 2.2

Table 2.2 Scale in ANP

Pairwise Comparison Rating Scale		
Numeric Scale	Definition	Description
1	Equally important	Two elements with equal effect in decision making.
3	A little more important	Experience and judgment slightly favor one element in comparison the other elements.
5	More important	Experience and

		judgment strongly favor one element over another.
7	Much more important	One activity is considered to be more influential than other activities
9	Absolutely more important	One activity is considered absolutely more important influential compared to other activities
2, 4, 6, 8	Middle value	Values between two consideration values which are close each other
Inverse	$a_{ij} = 1/a_{ji}$	Values between two consideration values which are close each other

3. The third axiom is that every element and component described in the framework network, both hierarchical and feedback, can truly represent in accordance with existing conditions and the results are also as expected.

2.7 Basic Principles of ANP

The basic principles in AHP and ANP are divided into three, namely decomposition, comparative assessment, and hierarchical composition (synthesis).

A more complete explanation of the three principles is as follows:

1. Decomposition. The problems collected by conducting field studies while the research is in progress are complex problems. To structure these complex problems, it is necessary to decompose them into a network in the form of components, clusters, sub-clusters, and alternatives. Decomposing the problem into a hierarchical framework or feedback can also be said to make a model with the ANP approach.

2. Comparative Assessment. This principle is applied to see a pairwise comparison of all networks/relationships/influences formed in a framework. The relationship can be in the form of a relationship between elements in a different component or a relationship between one element and other elements in the same component. All pair comparisons are used to obtain "local" priority results for the elements in each component. To perform this comparative assessment, the reciprocal axiom applies. If there are elements, then the matrix is $n \times n$. The question used to assess this pairwise comparison is different between the AHP and ANP approaches, someone asks "which element is preferred or more important?", while in the ANP someone asks "Which element has the greater influence?". to obtain "local" priority results, from each pairwise comparison assessment matrix, the eigenvector values are searched.

3. Hierarchical composition or synthesis. This principle is applied to shift the local priority of the elements in the cluster to the global priority of the parent element

which will result in the global priority of the entire hierarchy and sum them up to produce the global priority for the lowest level element (usually an alternative).

2.8 Main Functions of ANP

There are three main functions of ANP, which are as follows:

1. Structure Complexity

Complex problems if not structured properly it will be difficult to decipher the problem. No matter how complicated and complex the problem is, ANP helps in structuring the problem.

2. Measurement in Ratio Scale

Measurements into this ratio scale are needed to reflect promotions. Any method with a hierarchical structure must use a ratio scale priority for elements above the lowest level of the hierarchy. This is important because the priority (weight) of an element at any level of the hierarchy is determined by multiplying the priority of the parent element. Since the product of two interval level measurements is mathematically meaningless, a ratio scale is required for this multiplication. ANP uses a ratio scale at all the lowest levels of the hierarchy or network, including the lowest level (alternative in the choice model). The scale of this ratio becomes even more important if the priority is not only used for selected applications, but for other applications such as resource allocation applications.

3. Synthesis

Synthesis means bringing all the parts together into a single whole. Because complexity, critical decision situations, or forecasts, or resource allocation, often involve too many dimensions for humans to be able to synthesize intuitively, we

need a way to synthesize from many dimensions. A more important function in ANP is its ability for decision makers to make decisions in measuring and synthesizing a number of factors in a hierarchy or network.

2.9 Consistency In ANP

Consistency assessment in both AHP and ANP is divided into two types. First, consistency is measured based on the objects (elements) to be compared. A simple example is longans and marbles can be grouped into a uniform set if the criteria used are "round". However, kleengkeng and marbles cannot be combined into one uniform group if the criteria used are "taste". Because it is clear between these two elements namely longan fruit and marbles are different in terms of taste but the same in terms of shape. Therefore, a researcher must be able to group elements in a certain criterion (component) and minimize ambiguity so that there is no harmony of interpretation by the reader (respondent). Second, there is also consistency when doing pair comparisons. The pair comparison assessment will always be consistent if only two elements are used. However, it will be more difficult to be consistent if more than two components are compared. For example, if X is six times greater than Y, Y is three times greater than Z, then X should be 10 times greater than Z, the comparative assessment of the comparison will be inconsistent, so the assessment process needs to be repeated until the resulting assessment is consistent.

2.10 Network Forms in ANP

In general, there are several ANP networks that have been developed to be more varied. This is because ANP is not limited to a hierarchical structure like AHP, so that the network created in ANP becomes more diverse. Several forms of ANP networks introduced by Ascarya include hierarchies, holarkies, BORCR (Benefit-Opportunity-Cost-Risk), and networks in general, from simple networks to more complex networks.

1. Hierarchical Network

The hierarchical network is the most common and simple network. This network is often used in AHP. In general, the structure of a linear hierarchy consists of components (clusters) and in each cluster there are elements. The highest level of the hierarchical network is the destination cluster, then the criteria cluster (and sub-criteria if any), and the lowest is the alternative. The application of the ANP network in the form of a linear hierarchy has three clusters, namely the cluster of objectives, criteria, and alternatives. Elements can also be called nodes. Each cluster has its own node.

2. Holarchy Network

This network is a form of network in which the elements in a cluster at the highest level are bound or dependent on elements in the cluster at the lowest level. This network automatically forms a relationship line between the lowest-level cluster and the highest-level cluster. The difference between the form of the holarchy network and the hierarchical network lies in the feedback relationship between the alternative clusters and the main factor cluster.

3. BORCR Network (Benefit-Opportunity-Cost-Risk)

Each of the criteria that are taken into consideration in decision making certainly has several advantages and disadvantages for the decision maker. Some of these criteria can be something that is certain or not certain to occur. Therefore, in general, the gain for something that is certain is called a benefit, while the disadvantage is a cost. While the advantage for something that is uncertain is known as opportunities and the disadvantage is risk, which is something that is uncertain and is likely to be faced by decision makers. Basically this theory is in line with the SWOT (Strength, Weakness, Opportunity, Treats) analysis.

The simplest form of the BORC analysis network is the impact network, as in the general form of the ANP network. This network has two separate networks chart, one for positive influence, and one for negative influence. As it is known that positive influences include things that provide benefits to decision makers, namely benefits (definitely) and opportunities (uncertain), while negative influences include things that provide benefits to decision makers, namely costs (definite) and risk (uncertain). To analyze benefits, opportunities, costs, and risks as strategic analysis, the calculation uses the pairwise comparison method. Structurally, a decision is divided into three parts, the first is a judgment system, the second is a consideration for making decisions, and the third is a hierarchy or network of linkages, facts (objectives) that make a decision alternative more desirable than others. The results of several prioritized alternatives, obtained three results, general conditions (standard conditions) B/C, pessimistic B/(CxR), and realistic (BxO)/(CxR). The best alternative is chosen with a high realistic value

and the selected alternative is considered as a decision determined from other alternatives.

4. Public Network

Another form of network in ANP and is very commonly used is the general network, which has no special form. This public network can be simple or even complex as long as it meets the applicable ANP requirements where there are several clusters and nodes, dependency networks, and feedback networks. The general network shows that one cluster to another has a dependency relationship (inner dependence) as well as from the feedback network. The inner dependence relationship shows that nodes in one cluster have a relationship with other nodes in the same cluster. While the feedback network shows that one cluster to another has a mutually influencing relationship.

2.11 Supermatrix Of Feedback System

If it is assumed that a system has N clusters where the elements in each cluster interact or have an influence on some or all of the existing clusters. The influence of one element in a cluster on other elements in a system can be represented through a ratio-scaled priority vector taken from pairwise comparisons. The effect of an element on other elements in a network can be shown in the following supermatrix:

$$W = \begin{matrix} & \begin{matrix} C_1 & C_2 & \dots & C_N \\ e_{11}e_{12} \dots e_{1r_1} & e_{21}e_{22} \dots e_{2r_2} & & e_{N1}e_{N2} \dots e_{Nr_N} \end{matrix} \\ \begin{matrix} C_1 \\ e_{11} \\ e_{12} \\ \vdots \\ e_{1r_1} \\ C_2 \\ e_{21} \\ e_{22} \\ \vdots \\ e_{2r_2} \\ \vdots \\ C_N \\ e_{N1} \\ e_{N2} \\ \vdots \\ e_{Nr_N} \end{matrix} & \begin{bmatrix} W_{11} & W_{12} & \dots & W_{1N} \\ W_{21} & W_{22} & \dots & W_{2N} \\ \vdots & \vdots & \dots & \vdots \\ W_{N1} & W_{N2} & \dots & W_{NN} \end{bmatrix} \end{matrix}$$

Figure 2.3 Super Matrix Basic Format

Each column is a major eigenvector of the influence (importance) of an element in the i th component of the network on an element in the j th component.

j. Some entries that show a zero value on an element means that there is no interest in that element. If this happens, then the element is not used in pairwise comparisons to derive the eigenvector (Saaty, 2008:10 in Mega Yulianti, 2013).

2.12 Stages of Analytic Network Process (ANP)

Saaty explained the stages in making decisions with the Analytic Network Process (ANP) as follows:

1. Defining the Problem

Develop a problem structure and develop a linkage model to determine the desired goals or objectives, determine criteria referring to control criteria and determine alternative choices. If there are elements that have equal quality then they are grouped into the same component.

2. Forming a comparison matrix

ANP assumes that the decision maker must make a comparison of the interests of all elements for each level in the form of pairs. The comparison is transformed into the form of matrix A .

3. Calculating Elemental Weight

If the pairwise comparison is complete, the priority vector w which is called the eigenvector is calculated by the formula:

$$A \cdot w = \lambda_{\max} \cdot W \dots\dots\dots 2.1$$

Where: A is a pairwise comparison matrix λ_{\max} is the largest eigenvalue of A .

The eigenvector is the priority weight of a matrix which is then used in the preparation of the supermatrix.

Table 2. 3 Pairwise Comparison Rating Scale (Saaty 1999)

Numeric Scale	Comparison of Pair Scale ANP	
	Definition	Description
1	Equally important	Two elements with equal effect in decision making.
3	A little more important	Experience and judgment slightly favor one element in comparison the other elements.
5	More important	Experience and judgment strongly favor one element over another.
7	Much more important	One activity is considered to be more influential than other activities
9	Absolutely more important	One activity is considered absolutely more important

		influential compared to other activities
2, 4, 6, 8	Middle value	Values between two consideration values which are close each other
Inverse	$a_{ij} = 1/a_{ji}$	Values between two consideration values which are close each other

4. Calculate the consistency ratio.

The consistency ratio should be 10% or less. If the value is more than 10%, then the assessment of the decision data must be corrected. In practice, such consistency is not possible. In the consistency matrix, practically $\lambda_{max} = n$, while in the matrix not every variation of w_{ij} will bring a change to the value of λ_{max} .

Deviation λ_{max} of n is a parameter Consistency Index (CI) as follows:

$$CI = \frac{(\lambda_{max} - n)}{(n - 1)} \dots\dots\dots 2.2$$

Where : CI = Consistency Index

λ_{max} = largest eigenvalue

n = number of elements compared

The CI value will be meaningless if there is a standard to state whether the CI shows a consistent matrix. provide a benchmark by doing a random comparison of 500 samples. that a matrix resulting from comparisons made at random is a matrix that is absolutely inconsistent. From the random matrix, the Consistency Index value is also obtained, which is called the Random Index (RI).

Table 2. 4 Random Index Values (Saaty, 1999)

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0,00	0,00	0,58	0,90	1,12	1,24	1,32	1,41	1,45	1,49	1,51	1,48	1,56	1,57	1,59

By comparing CI and RI, a benchmark is obtained to determine the level of consistency of a matrix, called Consistency Ratio (CR), with the formula:

$$CR = \frac{CI}{RI} \dots\dots\dots 2.3$$

Where: CR = Consistency Ratio

CI = Consistency Index

RI = Random Index RI value is a random index value issued by Oarkridge Laboratory.

2.13 Creating the Supermatrix

Supermatrix is the result of priority vector from pairwise comparisons between clusters, criteria and alternatives. The supermatrix consists of three stages, namely the unweighted supermatrix, the weighted supermatrix and the limit supermatrix.

- a. Unweighted Supermatrix Stage. The Unweighted Supermatrix is made based on pairwise comparisons between clusters, criteria and alternatives by entering the column priority vector (eigenvector) into the appropriate matrix for the cell.
- b. Weighted Supermatrix stage. The Weighted Supermatrix is obtained by transferring all the elements in the unweighted supermatrix with the values contained in the appropriate cluster matrix so that each column has a sum of one.
- c. Limiting Supermatrix Stage Next to obtain the limiting supermatrix, the weighted supermatrix is increased. Increasing the weighted supermatrix is done by multiplying the supermatrix by itself several times. When the weights in each column have the same value, the limiting supermatrix has been obtained.

2.14 Steps to Determine Supermatrix Using Super Decisions Software

Following are the steps in supermatrix calculation:

1. Using the Super Decisions software.
2. Build connectivity or structure relationships within the network.
3. Comparing clusters and nodes.

2.15 Definition of Variable

Based on the opinion of these experts, a variable is a concept with varying values. Any concept, if it has a value, can be called a variable, and vice versa, if there is no change in the value of the concept, it is not included in the variable category.

Concepts that do not contain changes in value can be turned into variables by focusing on certain aspects or by adding certain attributes to the concept.

1. Dependent Variable

The dependent variable is what is being measured in the experiment. This is a change due to a change in the independent variable. The dependent variable is also called the output variable, criterion, or consequential. It is the result or influence caused by the independent variable. This study observes and measures the dependent variable to determine the effect of the independent variable.

2. Independent Variable

Independent variables are variables that cause or affect changes in the dependent variable or which cause changes in the dependent variable. If the independent variable changes, the dependent variable also changes. This variable is measured, manipulated, or selected by the researcher to determine its relationship with the observed symptoms. The independent and dependent variables shown on the graph are always in the same place. This will help to quickly see which variables are independent and which are dependent when viewing a graph or chart.

CHAPTER III

RESEARCH METHOD

3.1 Company Location

In this study, the researcher conducted a research at Ukindo Blankahan Oil Mill company which is located on Jalan Desa Blankahan, Kuala District, Langkat Regency.

3.2 Research Tool

The research tool is a computer/laptop that will be used in processing the data that has been implemented in the form of numbers.

3.3 Data Collection Method

To collect the required data, the following data collection methods are used:

1. Interview is a way to obtain data by conducting direct interviews with competent company employees.
2. Documentation, which is a data collection method whose investigation is aimed at deciphering and explaining, through document sources such as making questionnaires. From this method is expected to obtain data about:
 1. Supplier Selection Criteria
 2. Relationship between Sub-criteria
 3. Weighting between criteria and sub-criteria
 4. Supplier performance assessment

3.4 Data Analysis

From the data collection that has been obtained, then data processing is carried out with the following data:

1. Testing for Consistency
2. Calculating the weight of criteria and sub-criteria using the ANP . method
3. Calculating alternative weights using the ANP method
4. Make Supermatrix using super decision software

3.5 Framework of Thinking

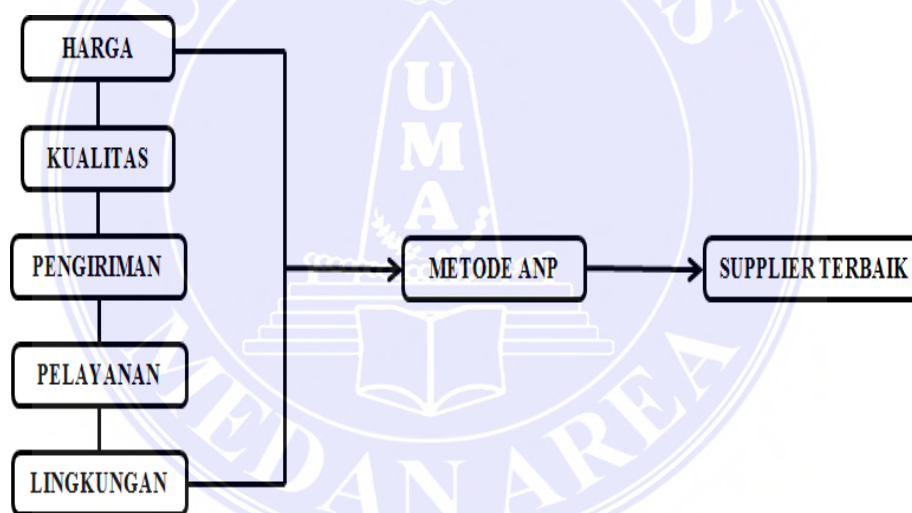


Figure 3.1 Framework of Thinking

The framework above explains that the input data or independent variables, intervening variable data and the dependent variable (output) are taken from the data.

A. Independent Variable

1. Price
2. Quality
3. Shipping
4. Service
5. Environment

B. Intervening variables are variables that use the analytic network process (ANP) method to complete the process of selecting the selected supplier

C. Dependent Variable is the Best Supplier

3.6 Research Method

Research methodology is a systematic procedure to determine the performance of a project more quickly and accurately which is used as a guide in conducting a research. The stages and steps of this research are presented in the form of a flowchart in Figure 3.2



Figure 3.2 Research Methodology

CHAPTER V

CONCLUSION AND SUGGESTION

5.1 Conclusion

1. The main criteria that will be used in the selection of suppliers at Ukindo Blankahan Oil Mill company has 5 criteria and 15 sub-criteria, namely:

- a) Quality Criteria with sub-criteria for conformance to the desired standard, providing consistent quality, level of defect.
- b) Price criteria with sub-criteria for payment methods, low prices, price stability, convenience in determining price agreements.
- c) Delivery criteria with sub-criteria delivery speed, determination of the number of shipments.
- d) Service criteria with sub-criteria providing guarantees and guarantees for goods, can provide assistance, responsiveness.
- e) Environmental Criteria with sub-criteria for delivery distance, road/terrain conditions, weather climate.

The criterion weight value is 0.449 by calculating the Eigen Vector, Consistency index and Consistency Ratio values at the criterion level.

$$\begin{aligned}\lambda_{max} &= (0,090 \times 11,000) + (0,362 \times 2,866) + (0,133 \times 9,000) + \\ & (0,142 \times 8,333) + (0,273 \times 3,666) \\ &= 0,988 + 1,038 + 1,196 + 1,185 + 1,001 \\ &= 5,408\end{aligned}$$

$$CI \text{ value} = 0,102$$

$$CR \text{ value} = 0,091$$

Sub-criteria value is 1.136 by calculating the value of Eigen Vector,

Consistency index and Consistency Ratio at the criterion level.

$$\begin{aligned}\lambda_{max} &= (0.076 \times 17.00) + (0.053 \times 19.00) + (0.056 \times 20.33) + (0.049 \times 23.00) + (0.056 \times 22.33) \\ &+ (0.056 \times 20.33) + (0.063 \times 16.33) + (0.065 \times 17.67) + (0.056 \times 17.00) + (0.069 \times 17.67) + \\ &+ (0.072 \times 17.00) + (0.105 \times 12.33) + (0.085 \times 14.33) + (0.082 \times 13.00) + (0.059 \times 15.00) \\ &= 1,292 + 1,007 + 1,138 + 1,127 + 1,250 + 1,138 + 1,029 + 1,149 + 0,952 + 1,219 + 1,224 + 1,129 \\ &+ 1,218 + 1,066 + 0,885 \\ &= 16.990\end{aligned}$$

CI value = 0,1421

CR value = 0,089398

2. The supplier selected based on the assessment of decision making using the Analytical Network Process (ANP) method is Supplier of CV. LANGKAT MAKMUR with a value of 0.056844.

5.2 Suggestions

Based on the results of research that has been done by the researcher, the suggestions given are:

1. These criteria and sub-criteria can be considered to be used at Ukindo Blankahan Oil Mill company as a consideration in selecting the right supplier for Ukindo Blankahan Oil Mill company.
2. Ukindo Blankahan Oil Mill company can also consider the method of writing, namely the Analytical Network Process (ANP) to be used in the selection of suppliers for the company itself.
3. The researcher provides a reference for further development, preferably

research that will be carried out in the future, the number of criteria and sub-criteria used as a reference can be added so that the results are more optimal.

