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Supplier Selection Criteria Using the *Analytical Network Process* Method

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Abstract:- Decision making is an important thing that must be done by a company, because companies that do not carry out decision-making activities appropriately can result in high maintenance costs, causing complaints from customers. There are many decisions made by a company, one of which is making decisions regarding the selection of suppliers of goods to be used by a company. Selection of suppliers is important, where the selection of the right supplier of goods, not only suppliers who can provide quality material, on time, and affordable prices but also must provide quality, optimal service both in terms of responsiveness, flexibility, smooth communication and information .The method used to determine supplier alternative solutions based on several factors can be done using ANP. ANP or Analytic Network Process is a mathematical theory that allows a decision maker to face factors that are interconnected (dependence) and systematic feedback (feedback).This research was conducted at PT. UT. This study begins with a literature study first, and then proceed with giving a questionnaire to the company, where the results of the questionnaire are used as a reference factor of this study. After distributing the questionnaire, it can be seen that there are several criteria, namely price, delivery, quality, flexibility, responsiveness, service, guarantee and performance history and obtained sub-criteria namely giving discounts, bid prices, payment grace, component strength and others . Supplier cylinder itself has 3 choices of suppliers, namely PT. DU, PT. HT and PT. TR. After doing calculations using the ANP method with the help of Super Decisions software and manual calculations, the results of the selected supplier are obtained from the supplier of PT. TR with manual calculation priority value 0.4561 and super decision software 0.43612.

Keywords:- *Decision Making, Selection of Supplier, ANP.*

I. INTRODUCTION

➢ *Background*

In the competitive era, the selection of effective suppliers plays an important role in the success of an industry. Choosing the right supplier helps an industry to control costs and improve the competitive side of the industry. In addition to the decisions taken are logical, decisions must also be based on certain theories. We often encounter supplier selection problems, but often we are confused to choose the best object, if all the demands of the criteria appear to be equally important. Even from several objects have the opposite criteria. For example for the best price criteria is object A, but for the best quality criteria is object B and for the best function criteria is object C. Supplier selection is a very critical activity in purchasing management in the supply chain, because supplier performance plays an important role in cost, quality, delivery and services in achieving the objectives of a supply chain (Amiri et al. 2018). According to (Blocher et al. 2002), purchasing managers of an industrial company more often use consideration of the lowest price supply factor to choose suppliers among suppliers. One other factor that is also dominantly used is the desire to immediately own and meet the raw material inventory needs. Decision making in supplier selection like this can be at great risk for raw material use when the company will start its production process activities.

PT. UT is a distributor company engaged in mining that prioritizes the quality of its products. According to observations in the service section, besides good quality, unit work performance is also an important thing to get a quality unit. Therefore, PT. UT has a cylinder component supplier that can supply components to mining production units managed by PT. UT service. Some of the products in the UT Company are dump trucks, excavators, and Scania. In the service process several parts of the company bring in 70% of components from suppliers. That is the cylinder and engine. In fact, it often experiences delay in cylinder component supply, PT. UT has sent a plan for changing parts to suppliers 3 months before the change is made. So that PT. UT has a loss on unit service costs which is caused by the low lifetime of the cylinder component. In addition to the surcharge costs incurred to rebuild the used components, the prices offered are careless and do not follow the price of the current agreement. From the side seal side, the supplier uses a part that is not genuine from Komatsu. cost loss experienced by PT. UT can be shown by the table below:

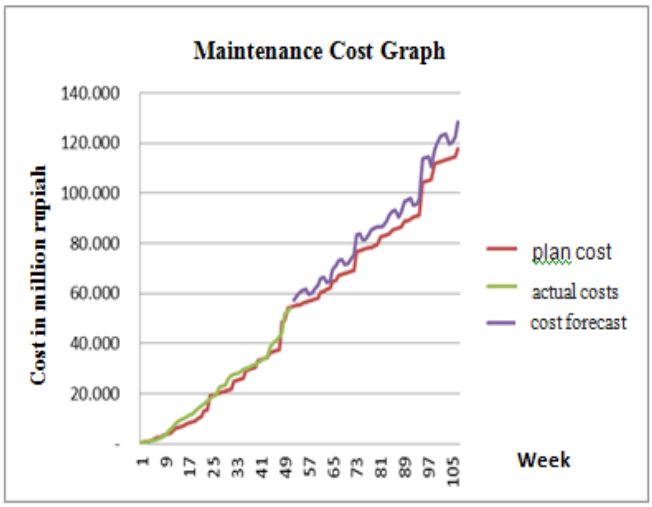

Fig 1:- Maintenance Cost Graph

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COMPONENTS	Life Time Target	Life Time Pergantian							Average	Achievement Lifetime
		1	2	3	4	5	6	7		
CYLINDER BOOM LH	10000	10749	11303						11.026	110%
CYLINDER BOOM RH	10000	11302	9749						10.526	105%
CYLINDER BUCKET LH	8000	5553	7956	2026	4868				5.101	64%
CYLINDER BUCKET RH	8000	3019	2744	8560	4080				5.101	64%
CYLINDER ARM LH	10000	11841	4185						8.013	80%
CYLINDER ARM RH	10000	11302	9101						10.202	102%
CYLINDER BOOM LH	12000	9905	7965	11762					9.677	81%
CYLINDER BOOM RH	12000	7889	7259	10392					8.497	71%
CYLINDER ARM LH	10000	11089	8191	6985					8.755	88%
CYLINDER ARM RH	10000	11089	7303	6130					8.241	82%
CYLINDER BUCKET LH	8000	6872	3660	6532	1712	1954	549	4211	3.641	46%
CYLINDER BUCKET RH	8000	6872	4217	4061	7343				5.623	70%

Table 1:- Average Cylinder Substitution Lifetime Performance

Data from Table 1 can be concluded the phenomenon of the problem that occurs is that there are many components supplied by supplier A who cannot reach the lifetime performance targets that have been agreed at the beginning of the contract, which affects service costs and unit performance. The observation results provide information that PT. UT needs to rearrange the supplier selection evaluation system. The selection of suppliers also functions as an evaluation material that can later be used to increase supplier selection or as a consideration of whether or not to find alternative suppliers. The criteria used must be adjusted to the needs, objectivity and existence of company resources. Criteria used by PT. UT has an interrelated relationship with each other so the right method to use is ANP. In addition ANP can also be used to predict the form of relationships between the criteria reviewed. The Analytical Network Process (ANP) method is a sequence of the Analytical Hierarchy Process (AHP) method. ANP's strengths from other methodologies are its ability to help us measure and synthesize a number of factors in a hierarchy or network. The advantages of ANP over AHP are that this method is more detailed in analyzing criteria, with more objective results, more accurate predictions, and more stable results.

➢ *Research Objectives*

The objectives in conducting this research and writing are:

1. Get the supplier cylinder criteria.
2. Knowing the order of priority factors that influence supplier selection at PT. UT.
3. Determine supplier indicators that best meet supplier selection criteria that should be chosen by PT. UT based on the Analytic Network Process (ANP) method.

➢ *Benefits of Research*

The benefits of research and writing are:

1. As input for the company in an effort to increase productivity through the perspective of company resources, namely material that is good from suppliers.
2. As a reference for companies in evaluating increasing supplier selection or as a consideration for finding alternative suppliers

➢ *Limitation of Research*

The scope of the study is limited to:

1. Research was taken at the cylinder component supplier selection activity by a multi-supplier service division.
2. Determination of criteria and sub-criteria obtained from literature studies that are tailored to company policy.
3. Solving the problem is limited only to provide suggestions that can be implemented by the company.

II. LITERATURE REVIEW

A. *Analytic Network Process (ANP)*

The Analytic Network Process (ANP) method is the development of the Analytical Hierarchy Process (AHP) method. The ANP method is able to improve AHP weaknesses in the form of the ability to accommodate the interrelationships between criteria or alternatives. Linkages to the ANP method are of 2 types, namely the interrelationships in a set of elements (inner dependence) and the interrelationships between different elements (outer dependence). The existence of this link causes the ANP method to be more complex than the AHP method (Saaty, 1998). Weighting with ANP requires a model that represents the interrelationships between the criteria and the subcriteria it has. There are 2 controls that need to be considered in modeling the system that you want to know the weight of. The first control is a hierarchy control that shows the relevance of the criteria and sub-criteria. In this control does not require a hierarchical structure as in the AHP method. Other controls are related controls that indicate the existence of interrelationships between criteria or clusters (Saaty, 1996).

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B. Basic Principles of the Analytic Network Process (ANP)Method

Decision making using the ANP method is based on several basic principles, namely (Yurdakul, Mustafa, 2002).

➢ *Structure of a network shaped problem.*

The structure of the problem in ANP does not have to have a linear structure from top to bottom as well as hierarchy, but it is more similar to a network, with a cycle of relationships from its clusters. Comparison of hierarchical and network structures is shown in the following figure :

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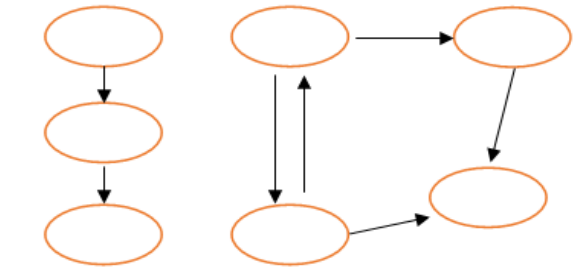

Fig 2:- Differences in Linear and Nonlinear Network Structures(Saaty, 1996)

From the picture above, it appears that the structural differences occur between linear network models (hierarchy) and non-linear networks. The hierarchy model only has a one-way functional dependency relationship, namely the dependence of the component (level) on the bottom of the component (level) at the top. The network model is able to accommodate reciprocal functional dependence (two-way), namely interdependent relationships between components (levels) up and down.

- *Determination of the weight of the element against the reference component*

Determination of weights is done using a paired comparison matrix. With this comparison matrix, we will get the weight of the comparison between the elements in a component (level) of the element that becomes the reference for assessment. As by using the AHP method, with this comparison matrix can be tracked the consistency of the assessment of a user. To get the priority sequence between elements of a component (level), the value of the comparison matrix is searched for the eigenvalue of the vector. Then the vector eigenvalue is input into the supermatric. If the matrix is multiplied by the supermatric itself (raised) until a stable weight is obtained, the Steady state matrix will be obtained, where the values of each element show priority weights that have accommodated all interactions between components (levels).

- *Steps in the Analytic Network Process (ANP)Method*

The following are the steps for making ANP according to Saaty (Saaty, 1999) :

1. Step 1: Construction of the model and structuring the problem The main objective is to identify alternatives that will be most significant in decision making. For more details, the sequence of model development can be described as follows (Sarkis, Joseph, 2003) :

a) Describe the elements of a problem (system). The principle of decomposing and defining elements is the same as AHP, which is minimum, complete and operational.

b) Formation of components (levels). If there are elements that have equal quality grouped into a component (level or cluster) of the same.

2. Step 2: Pairwise comparison matrix that shows relevance. In ANP the approach in making permanent decisions is based on the decision to get priority as well as the AHP method. A group of experts develop a scale that can describe a decision process so that it can produce the best decisions. Saaty (1980) sets quantitative scales 1 to 9 to assess the comparison of the importance of an element to other elements (Saaty, 1996).

Interests	Definition	Explanation
1	Just as important	Both elements have the same effect
3	A little more important	Experience and judgment favor one element compared to the other
5	More Important	Experience and judgment favor one element compared to the other
7	Very Important	One element is very popular and practically its dominance is very real compared to its partner
9	Absolute more important	One element proved to be absolutely preferred compared to its partner, at a high level of confidence
2,4,6,8	Middle value	This value is given if there is doubtful judgment between two adjacent assessments
The opposite	$A_{ij} = 1/A_{ij}$	If activity i obtains a number when compared to activity j, then j has the opposite value when compared to i

Table 2:- Guidelines for Granting Values in Pairwise Comparison

Score 1 Indicates two choices have the same or no difference of interest and score 9 shows a very large dominance of a component being considered (line component) of the comparison component (column component). If a component has a weak level of influence, the range of scores ranges from 1 to 1/9 (one ninth), where 1

shows no difference and 1/9 shows the strong dominance of the column element against the row element. When rating a score is done for a pair, an inverse value is automatically the inverse ratio in the matrix. The order of the pairwise comparison matrix is described as follows (Saaty, 1996):

1. Compare all elements for each level in pairs. The comparison is transformed into a matrix.
2. Comparison is done based on "judgment" from the experts of the parties or who have an interest in decision making.
3. Conducted directly (with discussion) or with a questionnaire the total amount of judgment amounts to n x. [N - I] / 2, n is the number of elements compared.

C	A_1	A_2	A_3	...	A_n
A_1	a_{11}	a_{12}	a_{13}		a_{1n}
A_2	a_{21}	a_{22}	a_{23}		a_{2n}
A_3	a_{31}	a_{32}	a_{33}		a_{3n}
....					...
A_n	a_{n1}	a_{n2}	a_{n3}	...	a_{nn}

Table 3:- Pairwise Comparison Matrix

The matrix above is a pairwise comparison matrix. The matrix is generated from a comparison between elements of certain criteria (in this case C). Aij value is the comparison value of the Ai element to the Aj element which states the relationship:

a. How far is the level of interest of Ai when compared to Aj, or
b. How much is Ai's contribution to criterion C compared to Aj, or
c. How much characteristic C is found in Ai compared to Aj or
d. How far is the dominance of Ai compared to Aj.

If the value of aij is known then theoretically the value of aij = l / au 'While the value of aij in situation i = j is mutak 1. The numerical value imposed for the comparison above is obtained from the scale of the comparison made by Saaty.

3. Step 3: Comparison of element weights

The weight sought is expressed in vectors W = [WI, W2, W3, ..., Wn]. The Wn value states the relative weight of An criterion for the entire set of criteria in the sub-system. In a perfect (theoretical) assessment situation a relationship is obtained:

$a_{ik} = a_{ij} \, . \, a_{jk}$ for all i, j, k

The matrix obtained is a consistent matrix. Thus the comparison value is obtained from the participant based on the table, ie aij can be expressed in vector W as:

$a_{ij} = wi/wj \, . \; ij = 1,2,3,\dots,n$

From the above equation can be made the following equation:

$a_{ij} \, . wi/wj = l, \quad i = 1,2,3,\dots . n$

$$\sum_{j=1}^{n} a_{ij} \, . wi/wj = l, \quad i = 1,2,3,\dots . n$$

$$\sum_{j=1}^{n} a_{ij} \, . wj = nwi \quad i = 1,2,3,\dots . n$$

What is stated by:

AW = nW

In the matrix theory the formula above is a characteristic equation with W which is an Eigen vector of matrix A with an eigen value of n. When written in full, the equation will look like in the following equation:

$$\begin{pmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \dots\dots & \frac{w_1}{w_3} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \dots\dots & \frac{w_2}{w_3} \\ \dots & \dots & & \dots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \dots\dots & \frac{w_n}{w_3} \end{pmatrix} \begin{pmatrix} W_1 \\ W_2 \\ \dots\dots \\ W_n \end{pmatrix} = n \begin{pmatrix} W_1 \\ W_2 \\ \\ W_n \end{pmatrix}$$

In general there are several corresponding eigenvector values that meet the above equation. The variable n in the above equation can be replaced with a vector A, as follows:

Aw = λw

Where $\lambda = (\lambda 1, \lambda 2, \dots, \lambda n)$every$\lambda$ the one that fulfills the above equation is called the eigen value, while the vector that satisfies equation 2.30 is called the eigenvector. If the matrix A is known and wants to be obtained W, then it can be solved through the following equation:

$[A - n] \, W = 0$

This equation can produce a solution that is not zero (if and only if) n is an eigenvalue of A and W is the eigenvector. After the eigenvalue matrix A comparison is obtained. For example :

$\lambda 1. A2, \lambda n$and based on matrix A which is unique, that is$a_{ij} = 1$. Dengan 1=1.2, ….,n,than :

$$\sum_{i=1}^{n} \lambda_i = n$$

Here all eigenvalues are zero except for one that is not zero, that is maximum eigenvalue, then if the assessment carried out consistently will get the maximum eigenvalue of A which is worth n. to get W, it can be done by substituting the maximum eigenvalue price in the equation:

AW = $\lambda max \, W$

Then the equation can be changed to:

A- $\lambda max \; 1 \; W = 0$

To get a zero price, what you have to do is :

A- $\lambda max \; I = 0$

Based on the equation, the price of λmax can be obtained by entering the equation λmax and adding the equation $\sum_{i=1}^{n} W \; 1 \; 2 = 1$, then we will get the weight of each element of the Wi operation, with i=1, 2, …, n) which is an eigenvector that corresponds to the maximum eigenvalue.

4. Step 4: Calculation of the consistency ratio level of inconsistency

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the response is called the inconsistency ratio (CI) whose calculation is as follows:

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

where :

$\lambda maks$ = *eigenvalue maximum*

$n = matrix\ size$

CI = consistency index

Based on Saaty calculations using 500 samples. Judgment matrix is taken randomly from scale, 1/9. 1/8, ..., 1, 2, 9 will get the consistency average for different size matrices, as follows :

Matrix Size	1,2	3	4	5	6	7	8	9
Random Index	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45

Table 3:- Random Index Value

A comparison between CI and RI for a matrix is identified as a consistency ratio (CR)

CR = RI / CI

Vector calculation results are accepted if CR is around 0.1 or less (0.2 can be tolerated, but not more). If the CR is not less than 0.1 the problem is studied again and a reassessment is carried out.

e. Step 5: Choose the best alternative

III. RESEARCH METHODS

In conducting this research, several stages of research methodology are needed from the initial to the final stages, along with the stages of the research methodology:

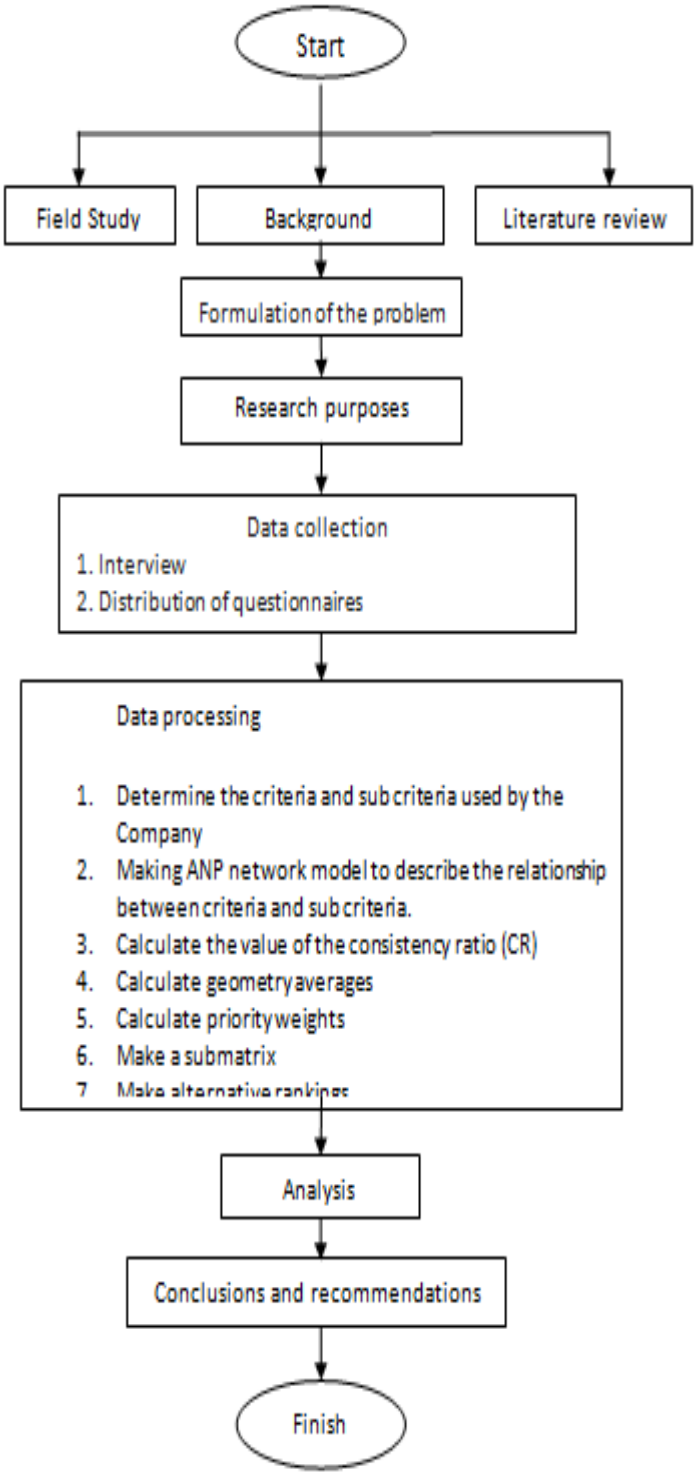

Fig 3:- Research Method

IV. RESEARCH RESULTS AND DISCUSSION

Determination of Criteria, Sub Criteria, Alternative

Criteria	Sub Criteria
Cost (C)	Discounted rates (C2)
	Bid price (C3)
	Surcharge according to damage (C4)
	Payment period (C5)
Delivery (D)	Delivery period (D1)
	Delivery of goods on time (D2)
	The accuracy of shipping parts (D5)
Quality (Q)	Suitability of goods with specified specifications (Q1)
	Ability to provide consistent quality (Q2)
	The completeness of document (Q3)
	Provision of goods without defects (Q4)
	Component strength (*lifetime*) (Q5)
Responsive (R)	Ease of changing defective products (R1)
	Speed in responding to customer desires (R2)
Service (S)	Convenience to contact (S1)
	The ability to provide information clearly (S2)
	Speed in response to customer requests (S3)
	Respond quickly in resolving customer complaints (S4)
Warranty (W)	Provide a guarantee or guarantee to the customer (W1)
	Can provide assistance in an emergency (W2)
Performance History (P)	Ability to maintain contract agreements (P1)
	Ability to fulfill the number of orders (P2)
	Ability to fulfill scheduled schedules (P3)
	Total supply in one year (P4)
	Experience related to claims or claims (P5)
	The frequency of company failures in fulfilling orders on time (P6)

Table 4:- Criteria and Sub Criteria

Criteria	Supplier Name
Alternative	PT. TR
	PT. HT
	PT. DU

Table 5:- Supplier Data of PT. UT

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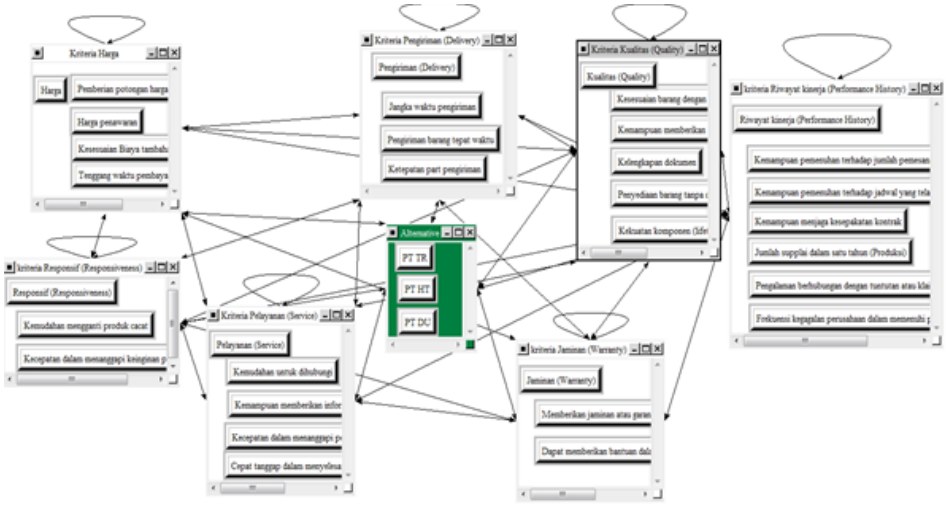

Fig 4:- Network ANP supplier cylinder selection

Analysis of Weight of Criteria, Sub Criteria, and Alternatives

Criteria	Cost (C)	Delivery (D)	Quality (Q)	Responsiveness (R)	Service (S)	Warranty (W)	Performance History (P)
Cost (C)	1	4 1/3	2/7	1	1/2	5/6	2 1/3
Delivery (D)	2/9	1	1/2	4/5	3/4	3/5	2 2/5
Quality (Q)	3 2/3	2	1	4 4/5	4/5	1 1/3	2 1/2
Responsiveness (R)	1	1 1/4	1/5	1	5/6	1	3 2/3
Service (S)	2	1 1/3	1 1/4	1 1/5	1	1 1/7	2 1/3
Warranty (W)	1 1/5	1 5/7	3/4	1	7/8	1	4
Performance History (P)	3/7	2/5	2/5	2/7	3/7	1/4	1

Table 6:- Calculation of criteria weight values

	Number of Rows	Priority Results	Priority to
Cost (C)	2.31896E+28	0.141660	4
Delivery (D)	1.51598E+28	0.092608	6
Quality (Q)	4.29933E+28	0.262636	1
Responsiveness (R)	1.97931E+28	0.120912	5
Service (S)	2.91374E+28	0.177994	2
Warranty (W)	2.48036E+28	0.151520	3
Performance History (P)	8.62208E+27	0.052670	7
	1.63699E+29	1	

Table 7

	Discounted rates (C2)	Bid price (C3)	Surcharge according to damage (C4)	Payment period (C5)	Number of Rows	Priority Results	Priority to
Discounted rates (C2)	1	2	6	6 5/7	9.7254E+19	0.5470	1
Bid price (C3)	1/2	1	4 1/3	2 3/8	4.928E+19	0.2772	2
Surcharge according to damage (C4)	1/6	1/4	1	2/3	1.3154E+19	0.0740	4
Payment period (C5)	1/7	3/7	1 1/2	1	1.8115E+19	0.1019	3
					1.778E+20	1.0000	

Table 8:- Weighting sub Cost criteria

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	A	B	C	Number of Rows	Priority Results	Priority to
PT TR	1	1	1 5/8	53830158	0.37843	2
PT HT	1	1	2	57359905	0.40324	1
PT DU	3/5	1/2	1	31057635	0.21833	3
				142247698	1	

Table 9:- Alternative weighting of cost criteria (C)

	PT TR	PT HT	PT DU	Number of Rows	Priority Results	Priority to
PT TR	1	1 1/5	1 2/3	9193.095	0.404294	1
PT HT	5/6	1	2 1/7	8804.12	0.387187	2
PT DU	3/5	1/2	1	4741.439	0.208519	3
				22738.65	1	

Table 10:- Weighting alternative criteria for discounting (C2)

Test ForConsistency Ratio (CR)

Sub Criteria	Discounted rates	Suitability of goods with specified specifications	Amount in column	Eigen vector
Discounted rates (C2))	1	6 1/2	1.1535	0.866907
Suitability of goods with specified specifications (Q1)	1/7	1	7.5136	0.133093

Table 11:- Average pairwise comparison of Cost criteria (C) with sub quality criteria (Q)

Based on the comparison table above, eigenvalue vector can be calculated, maximum lamda (λmaks), consistency index (CI) and index ratio (CR). Here's the calculation:

Value of λmax = (1,1535*0,86690) + (7,5136*0,13330) = 2

CI $= \frac{2-2}{2-1} = 0$

CR = CI/RI (table Wharton)

$= \frac{0}{0,58} = 0$

Data is said to be consistent if CR is around 0.1 or less (0.2 can be tolerated, but not more). If the CR is not less than 0.1 the problem is studied again and a reassessment is carried out.

ANP Method Weighting Analysis

The weighting results for each criterion, sub-criteria and alternatives are as follows:

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Level 1 Criteria	Weight (Criteria)	Alternative (Criteria)	Weight Alternative Criteria	Level 2 (Sub Criteria)	Weight (Sub Criteria)	Alternative (Sub Criteria)	Weight Alternative Sub Criteria
Cost (C)	0,14166	PT TR	0,378425514	C2	0,54700	PT TR	0,404293705
						PT HT	0,387187391
						PT DU	0,208518904
		PT HT	0,403239602	C3	0,27720	PT TR	0,395672033
						PT HT	0,360816901
						PT DU	0,243511067
		PT DU	0,218334885	C4	0,07400	PT TR	0,23621329
						PT HT	0,379063144
						PT DU	0,384723566
				C5	0,10190	PT TR	0,416196002
						PT HT	0,261199677
						PT DU	0,322604321
Warranty (W)	0,15152	PT TR	0,245118669	W1	0,63397	PT TR	0,417814724
						PT HT	0,315230525
						PT DU	0,266954751
		PT HT	0,66384831	W2	0,36603	PT TR	0,662971462
						PT HT	0,191175078
		PT DU	0,091033021			PT DU	0,14585346
Quality (Q)	0,262636	PT TR	0,416327319	Q1	0,20572	PT TR	0,21815609
						PT HT	0,369158658
						PT DU	0,412685252
		PT HT	0,424359398	Q2	0,33221	PT TR	0,452465601
						PT HT	0,371463809
						PT DU	0,17607059
		PT DU	0,099313282	Q3	0,07083	PT TR	0,572067808
						PT HT	0,273001066
						PT DU	0,154931125
				Q4	0,14367	PT TR	0,580914921
						PT HT	0,226670253
						PT DU	0,192414826
				Q5	0,24757	PT TR	0,413953987
						PT HT	0,351525862
						PT DU	0,234520151
Service (S)	0,177994	PT TR	0,463936244	S1	0,06793	PT TR	0,667836954
						PT HT	0,199345816
						PT DU	0,132817229
		PT HT	0,412778135	S2	0,20226	PT TR	0,284461562
						PT HT	0,371841093
						PT DU	0,343697345
		PT DU	0,123285621	S3	0,20226	PT TR	0,52681279
						PT HT	0,313539714
						PT DU	0,159647496
				S4	0,49463	PT TR	0,469943106
						PT HT	0,205749003
						PT DU	0,324307891
Delivery (D)	0,092608	PT TR	0,548442117	D1	0,11514	PT TR	0,550491576
						PT HT	0,255946093
						PT DU	0,19356233
		PT HT	0,359164104	D2	0,61193	PT TR	0,367593333
						PT HT	0,414290588
						PT DU	0,21811608
		PT DU	0,092393779	D5	0,27294	PT TR	0,547786829
						PT HT	0,28090735
						PT DU	0,171305821
Responsiveness (R)	0,120912	PT TR	0,340639146	R1	0,41590	PT TR	0,489175377
						PT HT	0,338592967
						PT DU	0,172231656
		PT HT	0,50373763	R2	0,58410	PT TR	0,550256693
						PT HT	0,274914625
		PT DU	0,155623224			PT DU	0,174828682
Performance History (P)	0,05267	PT TR	0,625391814	P1	0,39822	PT TR	0,24300112
						PT HT	0,251094882
						PT DU	0,325903998
				P2	0,18297	PT TR	0,519189385
						PT HT	0,289217323
						PT DU	0,191593292
		PT HT	0,240415754	P3	0,17815	PT TR	0,413841253
						PT HT	0,276855074
						PT DU	0,309303673
				P4	0,09115	PT TR	0,459555048
						PT HT	0,289586232
						PT DU	0,250858329
		PT DU	0,134192432	P5	0,08494	PT TR	0,365075712
						PT HT	0,332355828
						PT DU	0,302568461
				P6	0,06456	PT TR	0,567322755
						PT HT	0,220614882
						PT DU	0,212062364

Tabel 12:- Analisis Pembobotan Metode ANP

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V. CONCLUSION

Based on the final project research that has been done, conclusions can be taken as follows:

1. There are several criteria used as a basis for determining the alternative cylinder component supplier selection carried out at PT. UT. These criteria include :
   A. Cost (C)
   This criterion has several sub criteria, namely:
   a. Discounted price (C2)
   b. Bid price (C3)
   c. Compatibility (surcharge) (C4)
   d. Payment grace period (C5)

   B. Delivery (D)
   This criterion has several sub criteria, namely:
   a. Delivery period (D1)
   b. Delivery of goods on time (D2)
   c. Part delivery accuracy (D5)

   C. Quality (Q)
   This criterion has several sub criteria, namely:
   a. Suitability of goods with specified specifications (Q1)
   b. Ability to provide consistent quality (Q2)
   c. Completeness of documents (Q3)
   d. Provision of defective goods (Q4)

   D. Responsiveness (R)
   This criterion has several sub criteria, namely:
   a. Ease of changing defective products (R1)
   b. Speed in response to customer desires (R2)

   E. Service (S)
   This criterion has several sub criteria, namely:
   a. Convenience to contact (S1)
   b. The ability to provide information clearly (S2)
   c. Speed in responding to customer requests (S3)
   d. Respond quickly in resolving customer complaints (S4)

   F. Warranty (W)
   This criterion has several sub criteria, namely:
   a. Provide a guarantee or guarantee to the customer (W1)
   b. Can provide assistance in an emergency (W2)

   G. Performance History (P)
   This criterion has several sub criteria, namely:
   a. Ability to maintain contract agreements (P1)
   b. Ability to fulfill the number of orders (P2)
   c. Ability to fulfill the scheduled schedule (P3)
   d. Total supply in one year (Production) (P4)
   e. Experience related to claims or claims (P5)
   f. Frequency of company failure to fulfill orders on time (P6)

2. The order of priority criteria and sub criteria in the selection of suppliers at PT. UT, namely:
   A. The order of priority criteria is:
      1. Quality Q (0.2626)
      2. Service S (0.177994)
      3. Warranty W (0.15152)
      4. CostC (0.14166)
      5. Responsive R (0,12091)
      6. Delivery D (0.0926) and
      7. Performance history P (0.0526)

   B. The priority order of the sub quality criteria is:
      1. Ability to provide consistent quality
      2. Strength of components
      3. Suitability of goods with specified specifications
      4. Provision of goods without defects and
      5. Completeness of documents

   C. The priority order of the service sub criteria is:
      1. Respond quickly in resolving customer complaints
      2. Speed in response to customer requests
      3. The ability to provide information clearly and
      4. Convenience to contact

   D. The priority order of the guarantee sub criteria is:
      1. Provide guarantees or guarantees to customers and
      2. Can provide assistance in an emergency (2).

   E. The priority order of the Cost sub criteria is:
      1. Giving discounts
      2. Bid price
      3. Payment period and
      4. Compliance with surcharge

   F. The priority sequence of responsive sub criteria is:
      1. Speed in responding to customer desires and
      2. Ease of changing defective products

   G. The priority order for the delivery sub criteria is:
      1. Delivery of goods on time
      2. The accuracy of shipping parts and
      3. Delivery period

   H. The priority sequence of the performance history sub criteria is :
      1. Ability to maintain contract agreements
      2. Ability to fulfill the number of orders
      3. Ability to fulfill the scheduled schedule
      4. Total supply in one year (Production)
      5. Experience related to claims or claims and
      6. The frequency of company failures in fulfilling orders on time.

3. The chosen alternative between PT. DU, PT. HT and PT. TR is PT. TR is the priority value of manual calculation 0.4561 and super decision software 0.43612. While PT DU's manual calculation value is 0.21635 and super decision software 0.21396, PT HT calculation is 0.32754 and super decision software is 0.34993.

REFERENCES

[1]. Amiri, M., S.S. Jamshid, P. Nafiseh and S. Mahdi,(2011) Developing a EMATEL method toprioritize distribution centers in supply chain.Manage. Sci. Lett., vol.10, no.3-4, 279-288.
[2]. Blocher, Edward J., K. H. Chen, T. W. Lin, 2002, Management Compensation on Cost Management 2e: A Strategic Emphasis, Mc. Graw-Hill Irwin.
[3]. Marimin. (2004), Teknik dan Aplikasi Pengambilan Keputusan Kriteria Majemuk, Cetakan Kedua, PT GRASINDO, Jakarta.
[4]. Ngatawi. Setyaningsih, Ira. 2011. "Analisis Pemilihan Supplier Menggunakan Metode Analytic Hierarchy Process (AHP)". Semarang.UIN Sunan Kalijaga.
[5]. Pratama, Septian R.A. dkk. 2015. "Penentuan Supplier Resin Dengan Menggunakan Analytical Network Process"Probolinggo: Universitas Panca Marga Probolonggo.
[6]. Rusydiana, Aam Salamet., Devi, Abrista. 2013. "Analytic Network Process: Pengantar Teori dan Aplikasi". Bogor: smart publishing.
[7]. Saaty, T. L. (1996). Decision Making With Dependence and Feedback: The Analytic Network Process. Pittsburgh: RWS Publications.
[8]. Saaty, T. L. (1994). Fundamentals of Decision Making And Priority Theory With The Analytic Hierarchy Process Vol. VI. Pittsburgh: RWS Publications.
[9]. Saaty T.L. 2008. The Analytic Network Process. Pittsburgh: Ellsworth Avenue.
[10]. Saaty, T. L. and Vargas, L. G. (2006). Decision Making With The Analytic Network Process: Economic, Political, Social and Technological Application with Benefits, Opportunities, Costs and Risks. New York: Springer.
[11]. SuperDecisions. 2017. anuals.(online):https://www.superdecisions.com/manuals/ (22 November 2017)
[12]. Wibisono, Yogi Y. Gondo, Kristi D.A. 2013. "Pemilihan Pemasok Dengan Metode Analytic Network Process (ANP): Studi Kasus Di PT.AI". Banding: Universitas Katolik.