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THE APPLICATION OF ANALYTIC NETWORK PROCESS ANP METHODS FOR COMPANY PROFILE SELECTING (A CASE STUDY)

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ABSTRACT

PT. X is a newspaper publishing company. In publishing newspapers, paper raw materials are needed as the main ingredient. In choosing a supplier of paper suppliers, so far the company still applies conventional methods. Improper supplier selection process will have an impact on the sales of the company because it relates to the production process and also the products to be sold later. Many things must be considered in choosing suppliers. In the decision-making process for selecting suppliers, it must be noted that the factors (criteria) that each other might be interrelated. The Analytic Network Process (ANP) method is a method of decision making with many interrelated criteria. This problem is represented in a system with dependence and feedback. The linkages found in the ANP method are linkages in a set of elements (node comparison) and linkages to different elements (cluster comparison). The use of the ANP method will produce priority value weights on all elements contained in the decision making system. From the research that has been done at PT. X there are 4 consideration criteria consisting of 12 sub-criteria, and 3 alternative choices. Based on the results of data processing, alternative suppliers of CV. A was chosen as the best alternative supplier with the highest weight value of 0.158 then CV. B with 0.145 and CV. C of 0.134. Therefore, alternative suppliers of CV. A is the best alternative supplier for the company.

KEYWORDS*: Decision Making, Selection of Raw Material Suppliers, Many Criteria, Linkages to Criteria, ANP (Analytic Network Process).*

1. INTRODUCTION

PT. X is a newspaper publishing company. This company is part of the middle industry sector in the overall graphic industry group. Inevitably in reality, the existence of newspapers is also threatened with the times and technology and competition between similar media and other media. In order to survive in the competition, companies must try to have a competitive advantage. Therefore, PT. X needs to improve and improve the products offered, so they can compete with other companies.

Raw material problems are the main problem experienced by companies, because raw materials hold a vital or basic role in improving and improving the products offered. The raw material that can be used by companies is paper that can be obtained from various suppliers. Each supplier has its own characteristics related to company selection criteria. Complex supplier selection decisions are the fact that various criteria must be considered in the decision making process. In other words, the supplier selection process not only considers the price of raw materials, but also various factors such as product quality, history of supplier performance, delivery time, and warranty policies used by suppliers (Dickson, 1966). There are many criteria related to decision making taking into account the capabilities of the supplier as a whole. To be able to choose suppliers well, the right solution is needed to solve the existing problem. One way is to use a decision-making model that can involve various supplier selection criteria / factors along with the interrelationships in them, thus making the decision making process clear and more systematic.

In the writing of this journal is also used a lot of literature as a reference to support the research conducted, such as including the following: Analytic network process with feedback influence: a new approach to impact study (Azis, 2003), Decision Making with Dependence And Feedback The Analytic Network Process (Saaty T. L., Decision Making with Dependence And Feedback The Analytic Network Process, 1996), Fundamentals of the Analytic Network Process (Saaty T. L., Fundamentals of the Analytic Network Process, 1999), Personnel Selection Using Analytic Network Process (Dagdeviren, 2007), An analysis of vendor selection : systems and decisions (Dickson, 1966), Supplier Selection And Evaluation in Small Versus Large Electronics Firms (Ellram, 1995), Vendor selection and the buying process (Dempsey, 1978), Analisis Pemilihan Pemasok dengan Metode Analitycal Hierarchy Process di Proyek Indarung VI PT Semen Padang (Zadry, 2016), Manajemen Logistik dan Supply Chain Management (Tunggal, 2009), Analisa Pemilihan Supplier Ramah Lingkungan Dengan Metode Analytical Network Process (ANP) pada PT Kimia Farma Plant Semarang (Yancadianti, 2016), Perancangan Sistem Pemilihan Model Diskon Untuk Buyer Produk Textile PT. ABC Dengan Pendekatan AHP (A. A. Sari, 2013) , Basic methods of policy analysis and planning (C. Patton, 2015), Pemilihan Supplier Menggunakan Metode Analytic Network Process Di PT. UTPE (Pasaribu, 2017), Aplikasi Analytic Network Process (ANP) pada perancangan sistem pengukuran kinerja (Studi Kasus pada PT. X) (Vanany, 2003), Operation Research : Application and Algorithms 3rd (Winston, 1994), Pengambilan Keputusan Bagi para Pemimpin (Saaty T. , 1991), The Total Cost of Logistic in Supplier Selection, under Conditions of Multiple Sourching, Multiple Criteria and Capacity Constrains (Ghoddsypour, 2001).

This research is organized as follows, chapter 1 introduction, chapter 2 shows material and methodology, chapter 3 shows the results of data and discussion, chapter 4 conclusion.

2. MATERIAL/METHODOLOGY

Steps for choosing the best paper supplier for PT. X is started from the identification of decision makers at PT. X. Decision makers are parties who know the characteristics of each supplier in depth and also know what product criteria are eligible for the company. The decision makers referred to here are purchasing managers. After it is clearly known who the decision maker is, the next step is the identification of criteria and subcriteria that are taken into consideration in the selection of paper suppliers at PT. X. This identification process is done by interviewing the purchasing manager. Not only through interviews, as a supporting reference regarding criteria / subcategory for supplier selection, literature studies were also conducted. From the criteria and subcriteria that have been obtained, the relationship that will occur between the criteria and subcriteria will be identified. This is done by interviewing decision makers regarding the interrelationships between existing criteria / subcriteria.

Selection Methodology for Paper Supplier PT. X may occur when choosing a supplier. After the criteria / subcriteria and their relationship are obtained, a model for decision making can be built. Based on this model, an assessment of the importance of criteria / subcriteria is carried out. Values are given by the purchasing manager as a party that is indeed competent in assessing existing suppliers. The results of this assessment will be processed using the ANP concept wherein it involves checking the consistency of the assessment, making the assessment matrix, until finally a weight value can be obtained that can help the decision making of the best paper supplier. Data processing of assessment results is done using a software that can indeed accommodate decision-making models including ANP. More clearly, the flow of research carried out can be seen in Figure 1 below.

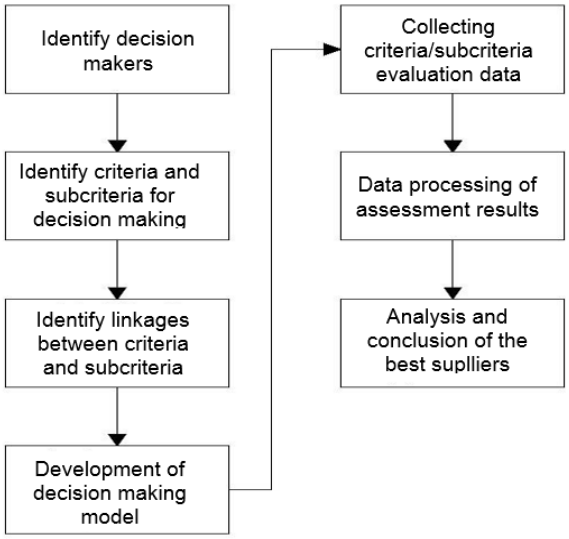

Fig. 1. Research Methodology Flowchart.

2.1. Identification of Criteria and Sub-criteria. In making a decision regarding the best paper supplier for PT X, criteria that do indeed support this decision are needed. The current decision making is still using intuition so that there are no clear criteria for consideration in selecting suppliers. Basically this intuition decision making must involve certain criteria, but the lack of a systematic way of making decisions makes consideration of any existing criteria unclear so that it can result in a wrong decision. The ANP method is proposed as an alternative to a more structured decision-making method. Clear decision-making criteria are needed in this method. Therefore interviews were conducted with decision makers at PT. X regarding what criteria are considered in the selection of suppliers so far.

Based on interviews conducted with decision makers in the company obtained several criteria that are indeed considered in supplier selection. These criteria are paper quality, paper prices, supplier service criteria, and shipping criteria. The quality of paper raw materials is an important criterion that

needs to be considered because the acceptance of certain paper quality supplied by suppliers will affect the quality of the magazine produced. The criteria for paper quality can be divided into 3 more specific subcriteria, namely paper thickness, paper color, and paper pores. Paper thickness sub-criteria related to the ease of the production process. Paper that is too thin is often folded during the printing process so the printing press must be stopped first to make improvements to the condition of the paper raw material.

The second sub-criteria is the color of paper. The company wants white paper colors. But the conditions of paper storage on the supplier are different and often cause the color of the paper to turn yellowish. Therefore suppliers need to be chosen that can provide the best color paper supply. The third sub-criteria is paper pores. Paper with good pores should be able to absorb colors well and not cause translucent printed text on the back of the paper. Translucent printing ink on the back of the paper will certainly make the writing unclear so that a defective product is produced.

In addition to the subcriteria on paper quality criteria, there are also 3 subcriteria from the paper price criteria, namely the paper price level, the discount given, and the method of payment. The paper price level relates to the base price that the supplier provides to the company. Of course, companies want suppliers that can provide the cheapest paper prices. In addition, large discounts given by suppliers are also taken into consideration. The discount on paper prices and the larger discounts given will reduce the cost of purchasing raw materials that must be spent so that it is expected to increase the company's profits. The third sub-criteria in the paper price criteria relates to the ease of payment provided by the supplier. Supplier policies that are more flexible on how to pay for ordered raw materials are certainly the company's choice.

The third criterion is the supplier service criteria. There are 4 sub-criteria considered in this category, namely communication skills, ease of contact, speed of response, and intensity of conveying information. The ability to communicate is not only about the speed of the supplier to understand what is being conveyed, but also the attitudes and ways of speaking of polite suppliers so that it does not cause misunderstanding. The second sub-criteria is convenience to contact. The easier the supplier to contact, the easier it will be for the company to fulfill the desired paper raw material. Response speed is a subcriteria that is also needed to ensure that the raw material orders we want are fulfilled on time. Not only that, this subcriteria is also needed in response to complaints from companies, one of which is about defective products found in the raw materials sent. The fourth sub-criteria in supplier service criteria is the intensity of information delivery. In terms of the company, good suppliers should always provide the latest information about raw materials that are indeed related to their customers. Thus, the company can develop a strategy for better supply of raw materials

The fourth criterion identified from the interview results is the product delivery criteria. This criterion can be further divided into 2 sub-criteria, namely the timeliness of delivery and availability of goods. Every consumer certainly expects fulfillment of orders on time. The delay in fulfilling orders will certainly result in losses, one of which is the delay in the production process which ultimately results in delays in meeting the needs of newspapers produced by PT X. The second subcategory is the availability of goods. These sub-criteria are related to whether or not raw materials are ordered. The unavailability of goods at suppliers certainly requires suppliers to order these raw materials to third parties. This will add to the time

it takes for the company to get the ordered items while it may be necessary to get the raw materials immediately. Of course this is very detrimental to the company so that the company will prefer suppliers who have more raw material supplies and enough to fulfill orders.

2.2. Identification of the linkages between criteria and sub-criteria. One of the advantages of using the ANP model in the decision-making process is that it can be accommodated between the criteria and subcriteria for decision making in the problem at hand. Based on the sub-criteria that have been identified, it is found that the linkages in some of these sub-criteria. This connection can be divided into 2, namely inner dependence and outer dependence (Saaty T. L., Fundamentals of the Analytic Network Process, 1999). Inner dependence is the relationship that occurs between criteria in the same criteria while the outer dependence is the relationship that occurs between criteria in different criteria. Information related to the sub-criteria contained in this study was obtained from the results of interviews with decision makers. One of the linkages occurs between discount sub-criteria and the paper price level subcategory. Large discounts given by suppliers will certainly affect the final price of paper that must be paid by the company to the supplier.

Companies certainly prefer suppliers who provide the cheapest paper final prices. This connection is included in the inner dependence type. Other linkages occur between subcriteria payment methods with discount subcriteria. Discounts are given by suppliers if certain conditions / conditions are met by the company. One example is making cash payments to the total cost of ordered goods compared to installments of goods. In general, the more flexible the payment system desired by consumers, the price of raw materials will be increasingly stringent or in other words the less likely the discount will be given.

The next link is between the ability to communicate with response speed. As discussed earlier, this communication ability is related to the ability of suppliers to understand what consumers want. The higher the ability of suppliers to understand the information conveyed by consumers, the faster the responses will be given. The easy to contact sub-criteria will certainly affect the responsiveness of suppliers. If the supplier can be easily contacted, then the information from the consumer will arrive quickly so that the supplier is expected to respond quickly as well. The ease of contacting sub-criteria will affect the intensity of information delivery. The easier the supplier is contacted, the more information the company will get, especially regarding the current price of paper raw materials. The last link that is included in the inner dependence category occurs between the subcriteria for raw material availability and the delivery accuracy. The availability of order raw materials will certainly make it easier for suppliers to be able to deliver goods ordered by the company on time. On the other hand, the vacuum or lack of raw materials on the supplier side will cause suppliers to wait for the fulfillment of the number of orders supplied by third parties to finally be able to deliver to consumers.

Linkages that occur between other criteria are included in the type of outer dependence. Outer dependence between criteria at the same time shows the correlation between the criteria where the subcriteria is located. The first link in this category occurs between the thickness of the paper and the paper price level. The thicker the paper, the higher the price of paper. The other two sub-criteria on the quality criteria, namely the color and pores of the paper also have the same relationship with the thickness of the paper to the level of paper prices.

Subsequent sub-criteria are ease of contact which has an effect on the timeliness of paper delivery. The easier it is for a supplier to be contacted, the faster the order information will be in the hands of the supplier, so the priority for the delivery of ordered items will be even higher. Not only easy sub-criteria to be contacted, even response speed subcategories will affect the timeliness of delivery. If the order information has reached the supplier but the supplier does not quickly prepare the ordered item and schedules the delivery of the goods, the process of shipping the goods will be disrupted so that it can cause late delivery. Based on each criterion, sub-criteria, and their relationship, a model for decision making that involves each of these things can be built.

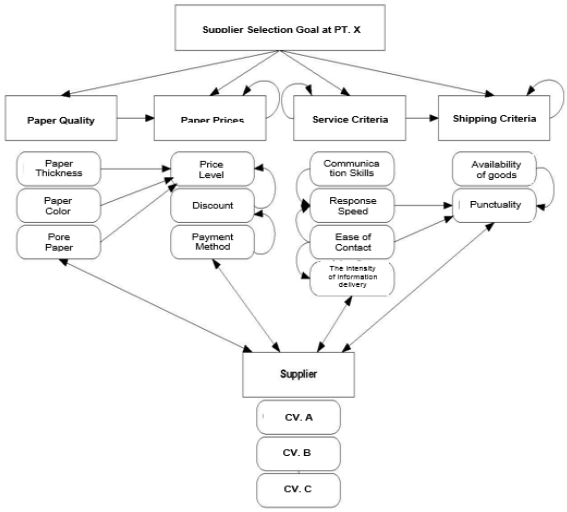

Figure 2: Retrieval Model

Decision of Supplier of PT X Paper

Figure 2 shows the model that will be used in decision making of the best supplier of paper raw materials for PT X. In Figure 2, there is a Goal and supplier criteria. Goal is the goal to be achieved by PT X through the use of this decision-making model. This goal becomes the control criterion for the criterion criteria that are below it or in other words, the existing criteria and subcriteria will be assessed based on how important the criteria or sub-criteria affect the achievement of the desired goals by PT X. other subcriteria. Relationships that occur are marked by 2-way relationships. This shows that the decision-making process will involve a comparison of each alternative supplier based on existing criteria or sub-criteria and a comparison of several subcriteria by specifically referring to certain supplier alternatives.

Target: the aim of this study is to produce a decision support system for decision making of the best paper supplier for PT. X. Steps: steps of this study are step 1 collecting data on the importance of each criterion and subcriteria based on the relationships that occur between these criteria and subcriteria . 2 assessment of the level of importance of each criterion in relation to the objectives to be achieved, step 3 The results of this assessment will be processed using software that can accommodate the ANP model until the assessment weight is generated, step 4 the final results obtained from the Normalization process are divided certain column with the total value of the column. After normalization is done, the eigen value calculation approach can be done by averaging the normalization values of each criterion / sub-criteria row so that the eigen value obtained from each paired comparison matrix will be input in making cluster weight matrix and unweighted supermatrix. Both of these matrices will be input for supermatrix weighted. From the weighted supermatrix then a limiting matrix will be produced that will show the final solution to the problem faced by showing the final weight of each sub-criteria obtained from the limiting matrix.

step 5 provides suggestions for improvement and conclusions.

3. RESULT AND DISCUSSION.

3.1. Results and Discussion. The decision-making model in Figure 2 will be the basis for decision making of the best paper supplier for PT X. To produce this decision it is necessary to collect data on the importance of each criterion and subcriteria based on the relationships that occur between these criteria and subcriteria. Based on Figure 2, it can be exemplified by several ways of assessment that must be done.

Results per Table 1: Goal-Criteria Assessment

	A	B	C	D	Eigen value
A	1	1	4	3	0,351
B	1	1	6	6	0,467
C	1/4	1/6	1	1/2	0,072
D	1/3	1/6	2	1	0,110
Inconsistency Index :					0,030

The assessment in Table 1 is an example of evaluating the importance of each criterion in relation to the objectives to be achieved. The results of this assessment are shown in the form of a comparison matrix in pairs with letters A to D representing the criteria of price, quality, service, and delivery respectively. Based on (Saaty T. , 1991) the value index rules that can be given starts from number 1 which shows that the two elements are compared equally important to number 9 which shows that the absolute element is more important than the other elements. Based on Table 1, it can be seen that the comparison of criteria A (on the line) and criterion D (in the column) produces a value of 3 which shows that the price criteria are more important than the shipping criteria in considering paper suppliers to be chosen, while the price criteria in line A and quality in column B is equally important in supporting the decision making process at PT X.

Assessment of the importance of each criterion based on certain control criteria is carried out by the decision maker. The results of this assessment will be processed using software that can accommodate the ANP model to produce an assessment weight that shows the best paper supplier for PT X. An example of another importance assessment based on the model in Figure 2 is a comparison between the criteria of suppliers with paper color control criteria. This second example can be seen in Table 2 where the Roman numerals I to III respectively represent CV A, CV B, and CV C. Interpretations of the ratings in Table 2 are somewhat different from those in Table 1. For example, the comparison between row II column I shows number 3. This shows that CV B is somewhat superior to CV A in terms of the color of the raw material the paper has. The two-way relationship between the criteria of suppliers and other criteria creates a reverse assessment where the criteria of the supplier are used as control criteria for the assessment of other criteria. After all the assessment processes are carried out, it is necessary to proceed with testing the consistency of the assessment where the inconsistency value produced cannot be more than 0.1, otherwise the assessment must be repeated. All results of the assessment in this study show the level of consistency that meets the requirements.

Eigen value is the value of the processing of pairwise comparison matrices which shows the level of importance of each criterion or subcategory based on the control criteria. certain. Eigen value in Table 1 shows that the quality criteria are the most important criteria in choosing suppliers of paper raw materials. The approach that can be used to calculate the eigen value starts from normalizing the valuation in each column in the pairwise comparison matrix then generates the value of the normalization results of each criterion / sub-criteria row (Winston, 1994). Table 3 shows the value of the normalized valuation in Table 2. Normalization is done by dividing each

component of values in a particular column with the total value of the column. After normalization is done, the eigen value calculation approach can be done by averaging the normalization values of each criterion / sub-criteria row so that the eigen value is obtained as in Table 3.

Eigen values generated from each paired comparison matrix will be input in making cluster weight matrix and unweighted supermatrix. Both of these matrices will be input for supermatrix weighted. From the supermatrix weighted then there will be a limiting matrix. Limiting matrix is what will show the final solution to the problem at hand. Table 4 shows the final weight of each sub-criteria obtained from the limiting matrix.

Based on the weights obtained, it was concluded that CV. A is the best paper supplier for PT. X. This is indicated by the highest weight value that CV A has compared to other suppliers. Based on the weights in Table 3 it can be seen that the PT. X really emphasizes paper thickness in choosing suppliers. The second most important thing to consider when choosing a supplier is the price level of the paper provided. The order of importance for each of these subcriteria can be obtained by sorting the weights in Table 4 from the largest to the smallest. Thus it is also known that the criteria with the lowest priority in choosing a paper supplier are communication skills.

Table 2: Supplier-Color Assessment

	I	II	III	Eigen Value
I	1	1/3	1/2	0,163
II	3	1	2	0,539
III	2	1/2	1	0,296
Inconsistency Index :		0,088		

Table 3: Supplier-Color Normalization Results

	I	II	III	Eigen Value
I	0,167	0,182	0,143	0,164
II	0,500	0,545	0,571	0,539
III	0,333	0,273	0,286	0,297

Table 4: Subcriteria Final Weight

Subcriteria	Weight
CV. A	0,158268
CV. B	0,14526
CV. C	0,13414
PT. X	0
Payment method	0,045718
Discount	0,061293
Price level	0,081221
Thickness	0,087246
Pores	0,079005
Color	0,055545
The intensity of information delivery	0,009724
Response speed	0,022302
Communication skills	0,009146
Ease of contact	0,009318
Punctuality	0,074884
Availability of goods	0,02693

Table 5: Advantages of Supplier

Subcriteria	Supplier
Payment method	CV. B
Discount	CV. A
Price level	CV. A
Thickness	CV. B
Pores	CV. C
Color	CV. B
The intensity of information delivery	CV. C

Response speed	CV. A
Communication skills	CV. B
Ease of contact	CV. C
Punctuality	CV. A
Availability of goods	CV. B

Based on the assessment process that has been carried out, information is also obtained about the advantages possessed by each paper supplier in certain subcriteria. Table 5 shows the information in question. Based on the table, it is known that CV. B actually has the advantage in the field of paper thickness which is precisely the main priority of PT X in choosing suppliers. But in reality the results of data processing show that CV. A was chosen as the best supplier. This indeed makes sense from the advantages of CV. A obtained from several subcriteria that occupy high priority. Most of these subcriteria can be fulfilled by CV. A compared to other alternative suppliers.

4. CONCLUSION

The ANP method can be used to select a supplier of paper suppliers at PT X using the criteria of quality, price, shipping and service. The criteria are outlined into 12 sub criteria, namely payment method, discount, price level, thickness, pore, color, intensity of information delivery, speed of response, communication ability, ease of contact, timeliness, and availability of goods. Supplier CV. A was chosen as the best supplier by getting the greatest weight based on the weighting results of each element in the linkage model, namely 0, 158, followed by the supplier CV. B with 0.145 and supplier CV. C with 0.134.

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