Evaluation criteria and ranking supplier raw materials waste paper with the methods ahp and topsis (case study paper company in west java)

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Abstract. The study is done at a paper company in west java by doing evaluation of waste paper supplier of raw materials with the aim of gaining evaluation criteria supplier and ranking supplier. The process of making evaluation criteria supplier is done by using the method hierarchy (AHP) analytical process and ranking with the approach of the supplier technique for order preference by similarity to (TOPSIS) solution of a problem. according data processing by using both the main criterion used this method produced 6, the quality criteria, delivery, the price of, resources, service, and company management and putting quality criteria as the criteria with the weighting for 30.7% of as much as. While the supplier of ranking, the best supplier PT. CMN and PT. AMN supplier as the worst alternative supplier of 5. Made with a model evaluation criteria and ranking supplier is expected to supplier evaluation process useful for other types of businesses the same paper companies.

1. Introduction
PT. Pindo deli is a company working in the area of the production and sale of paper which is housed in west java and caused by its the basis of pulp. The current price of pulp and has increased from early january 2015 up to december 2018. The pulp price hike, all pm (paper machine) will keep trying to improve quantity value its production so that the raw material supply pulp continue to decline. To anticipate the lack of raw materials pulp in frm (fiber recovery machine) payment then the company management decided to buy raw materials of lpg in 3-kg types of waste paper from the huge supplier. The company formerly very difficult to determine the supplier in accordance with the criteria which had been in determined. The supplier is very useful for the company currently, because many suppliers having good products and prices competitive. Suppliers who sends goods into the, the following data suppliers:

| No | Suppliers   |
|----|-------------|
| 1  | PT. ANM    |
| 2  | PT. AMI    |
| 3  | PT. CMN    |
| 4  | PT. KAR    |
| 5  | PT. YAP    |

Source: corporate data

Supplier election is crucial to support company, about penyuplai because the improper can cause loss. It is better for him in huge supplier of less responsive to catch up with demand is the consequence which may arise is out of and excess supplies [1]. In addition when lead time of long it can be huge supplier of disrupting the production process that result in delays in the process product
and shipping of goods on customer. Hence by selecting huge supplier of proper is expected to minimize the risk to occur [2].

| Methods                | Selection Criteria | Multiple Segment Aspiration Levels |
|------------------------|--------------------|-----------------------------------|
|                        | Qualitative        | Quantitative                      |                           |
| Cost-point method      | No                 | Yes                               | No                        |
| Weighted-point method  | Yes                | No                                | No                        |
| Supplier profile analysis | No                | Yes                               | No                        |
| Dimensional analysis   | Yes                | No                                | No                        |
| Categorical models     | Yes                | No                                | No                        |
| Taguchi loss function  | No                 | Yes                               | No                        |
| TOPSIS                 | Yes                | No                                | No                        |
| LP                     | No                 | Yes                               | No                        |
| DEA                    | No                 | Yes                               | No                        |
| CPM                    | No                 | Yes                               | No                        |
| AHP                    | Yes                | No                                | No                        |
| ANP                    | Yes                | No                                | No                        |
| ANP+TOPSIS             | No                 | Yes                               | No                        |
| AHP+MCGP               | Yes                | Yes                               | No                        |
| This proposed (Fuzzy TOPSIS+MSGP) | Yes | Yes                               | Yes                       |

The company has the quality standards that requires the raw material waste paper does not contain levels of impurities up 10 %, and does not contain levels of moisture on 3 %. The solution for the problem the analysis needs to be done to evaluate which suppliers. company as expected

2. Literature Review

In research evaluation suppliers give special attention to the academic and professional in its field. The suppliers can be used for some performance, suppliers of environment, of performance environment and waste management [3].

2.1. Supply Chain Management

Having logistics company in order to give efesiensi, cost of which engages the time shipping and compliance in the shipment of. The logistics to reduce production costs and capital costs to companies, especially the cost of cooperation with other. division. [4]. ‘Supply chain management (scm) is a key factor strategies to improve the effectiveness of the company and the realization of the purpose of the company that better’. Companies are required to choose supply chain and logistics in its operation. Most companies trying to improve efficiency and effectiveness of the supply chain. An increase in business performance of the company can be done with the collaboration, suppliers the performance of shipping, customer service and reducing expenses logistics [5].

Supply chain or supply chain is the relationship between the companies or activities from the supply of goods or services from its place of origin came to the buyers and customers. Supply chain in a continuous, on cost and freight is a process in which a product created and delivered to consumers from the structural. A supply chain refer to an intricate network of relationships that maintains organization with a business to reach a source of production in conveying to consumers[6]

2.2. Decision Support System

Decisions are generally defined as a system that can provide the kind of problem solving skills and the capability to semi-structured issues. Specific communication, defined as a system that supports the work of a semi-structured manager and a group manager in solving problems by means of providing information or proposals lead to certain decisions [7].
2.3. Analytical Hierarchy Process (AHP)

AHP is a method to settle MCDM, an alternative to choose the best and to evaluate the performance criteria which has determined. Comprehensive AHP provides a frame to make the decision-making process and integrate different measures being a value judgment[8], [9].

The first step in a AHP is to determine the selection criteria have been set by the company. AHP based on the assessment of the comparison with using the ratio which we have set. The results of the ratio can be summed up in a matrix use matrix normalization by calculating the Consistency Ratio (CR)[10].

2.4. Technique for Order Preferences by Similarity to Ideal Solution (TOPSIS)

TOPSIS method developed by Hwang Ching-lai and Yoon in 1981, and develop by Yoon in 1987, and Hwang Liu in 1993. According to this technique, the best possible value will be closest to the positive-ideal solution and longest from negative-ideal solution[11].

In a study conducted by [12], the supplier of engineering at levels after using AHP in continue using TOPSIS, 63.14%[12]. That must be considered on method TOPSIS namely performance and the number of alternative [13]. At an election suppliers use the most weight with TOPSIS selection criteria and criteria with the criteria AHP [14].

A method of TOPSIS very popular to assessment has raised the rating with the best choice and travel time that is brief from the choice of ideal and positive from a distance of the negative too far from the ideal at the same time [15].

3. Materials and methods

A method of AHP much in use by researchers who have data, mathematics for including the necessary data on method AHP very easily get in [16]. AHP method used to measure from the qualitative and quantitative in decision-making [17]. This method can be affecting decision making in several levels of the hierarchy and used to measure the qualitative and quantitative some decision-making.

| Primary Criteria | Weight | Sub Criteria | Partial Weight |
|------------------|--------|--------------|----------------|
| Quality          | 0.307  | Raw Materials to Specifications | 0.243           |
|                  |        | The Fulfillment of Standard     | 0.757           |
|                  |        | Timeliness of Deliveries        | 0.250           |
| Delivery         | 0.178  | The distance location suppliers | 0.750           |
|                  |        | Price Fluctuation               | 0.198           |
| Price            | 0.188  | Ease payment methods            | 0.802           |
|                  |        | Machine facilities              | 0.161           |
| Resources        | 0.137  | Experts Competence              | 0.839           |
|                  |        | Ease supplier contact           | 0.492           |
| Service          | 0.094  | Response to the needs and complaint | 0.508       |
|                  |        | The reputation of suppliers     | 0.492           |
| Company Management| 0.039  | Order against taxes             | 0.508           |

In assigning valueto global weight is to do multiplication of partial weight over it with weights
Table 4. The result of weight partial with weights a hierarchy

| Primary Criteria | Weight | Sub Criteria | Partial Weight | Global Weight |
|------------------|--------|--------------|----------------|---------------|
| Quality          | 0.307  | Raw Materials to Specifications | 0.243          | 0.075         |
|                  |        | The Fulfillment of Standard      | 0.757          | 0.232         |
|                  |        | Timeliness of Deliveries         | 0.250          | 0.045         |
| Delivery         | 0.178  | The distance location suppliers  | 0.750          | 0.134         |
|                  |        | Price Fluctuation                | 0.198          | 0.037         |
| Price            | 0.188  | Ease payment methods             | 0.802          | 0.151         |
|                  |        | Machine facilities               | 0.161          | 0.022         |
| Resources        | 0.137  | Experts Competence               | 0.839          | 0.115         |
|                  |        | Ease supplier contact            | 0.492          | 0.046         |
| Service          | 0.094  | Response to the needs and complaint | 0.508        | 0.048         |
| Company Management | 0.039 | The reputation of suppliers      | 0.492          | 0.019         |
|                  |        | Order against taxes              | 0.508          | 0.020         |

3.1. The consistency results in comparison
After the each weight and obtained, the main criterion used subcriteria then afterward calculated the ratio of konsistensinya to know whether the results obtained enough were consistent. As parameterinya is the ratio of consistency to smaller or equal to 10%. After the ratio of consistency or for all criteria and subcriteria, so next one is the consistency whole a hierarchy.

The calculation of the ratio of consistency (CR):

\[
CR = \frac{CI}{RCI}
\]

\[
CI = \frac{\lambda_{maks} - n}{(n - 1)}
\]

CR = Consistency Ratio
CI = Consistency Index
RCI = Random Consistency Indec
N = number of orders

Value RCI depends of the order matrix (om), the size of the cri can be seen in table 4 the following

Table 5. Index consistency random

| OM  | 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  | 13  | 14  | 15  |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| RI  | 0   | 0   | 0.58| 0.9 | 1.12| 1.32| 1.41| 1.45| 1.49| 1.49| 1.51| 1.48| 1.56| 1.57| 1.59|
3.2 The Determination Of Rank Supplier To Calculation TOPSIS
After scoring supplier has been done, the next stage is performing calculations TOPSIS to get rank supplier in order to know supplier assessment which that has the best performance and suppliers which have worst the assessment them to five supplier evaluated.
### Tabel 6. Matrix criteria and sub criteria and weights and the supplier

| Criteria and weight | Quality | Delivery | Price | Resources | Service | Company Management |
|---------------------|---------|----------|-------|-----------|---------|-------------------|
| Raw Materials to Specifications | 0.075   | 0.223    | 0.045 | 0.134     | 0.03    | 0.151             |
| The Fulfillment of Standard | 0.188   | 0.151    | 0.022 | 0.1       | 0.047   | 0.019             |
| Timeliness of Deliveries | 0.134   | 0.045    | 0.137 | 0.094     | 0.096   | 0.020             |
| The distance location suppliers | 0.075   | 0.223    | 0.045 | 0.134     | 0.03    | 0.151             |
| Price Fluctuation | 0.188   | 0.151    | 0.022 | 0.1       | 0.047   | 0.019             |
| Ease payment methods | 0.134   | 0.045    | 0.137 | 0.094     | 0.096   | 0.020             |
| Machine facilities | 0.075   | 0.223    | 0.045 | 0.134     | 0.03    | 0.151             |
| Experts Competence | 0.188   | 0.151    | 0.022 | 0.1       | 0.047   | 0.019             |
| Ease supplier contact | 0.134   | 0.045    | 0.137 | 0.094     | 0.096   | 0.020             |
| Response to the needs and complaint | 0.075   | 0.223    | 0.045 | 0.134     | 0.03    | 0.151             |
| The reputation of suppliers | 0.188   | 0.151    | 0.022 | 0.1       | 0.047   | 0.019             |
| Order against taxes | 0.134   | 0.045    | 0.137 | 0.094     | 0.096   | 0.020             |

#### 3.3 Matrix For Decision Making

After decision made matrix, so the next step has the matrix to minimize the data and loosening in performing calculations topsis.

| Criteria and weight | Raw Materials to Specifications | The Fulfillment of Standard | Timeliness of Deliveries | The distance location suppliers | Price Fluctuation | Ease payment methods | Machine facilities | Experts Competence | Ease supplier contact | Response to the needs and complaint | The reputation of suppliers | Order against taxes |
|---------------------|--------------------------------|-----------------------------|--------------------------|---------------------------------|------------------|----------------------|-------------------|-------------------|------------------------|-----------------------------|--------------------------|----------------------|
| PT. ANM             | 2                               | 3                           | 5                         | 4                               | 3                | 5                    | 5                 | 5                 | 3                      | 1                          | 1                       | 0.0179               |
| PT. AMI             | 3                               | 5                           | 3                         | 4                               | 3                | 5                    | 5                 | 5                 | 3                      | 3                          | 5                       | 0.0269               |
| PT. CMN             | 5                               | 5                           | 4                         | 4                               | 5                | 5                    | 5                 | 5                 | 5                      | 5                          | 3                       | 0.0448               |
| PT. KAR             | 4                               | 5                           | 4                         | 3                               | 3                | 5                    | 5                 | 5                 | 5                      | 3                          | 5                       | 0.0359               |
| PT. YAP             | 4                               | 5                           | 4                         | 3                               | 1                | 5                    | 5                 | 5                 | 5                      | 5                          | 5                       | 0.0359               |

### Table 7. Matrix for decision making

#### 3.4 Determine The Matrix Is A Solution Ideal Positive And Negative Ideal Solution

Results of a solution ideal positive and negative ideal solution has been done by determining the greatest value of the matrix and determine the lowest score of the matrix so the result can be seen in table 6.

Identify the positive ideal solution (PIS) and negative ideal solution (NIS), respectively, as follow:

\[
A^+ = \{(\max v_{ij} \mid j \in J), (\min v_{ij} \mid j \notin J'), i = 1, 2, 3, \ldots, m\} \tag{1}
\]

\[
A^- = \{(\min v_{ij} \mid j \in J), (\max v_{ij} \mid j \notin J'), i = 1, 2, 3, \ldots, m\} \tag{2}
\]
= \{v_1-, v_2-, v_3-, \ldots, v_n-\}

J = \{j = 1, 2, 3, \ldots, n\}

### Table 8. Make the ideal solution of positive and negative ideal solution

| Criteria                          | Raw Materials to Specifications | The Fulfillment of Standards | Timeliness of Deliveries | The Location of Suppliers | Price Fluctuation | Easy Payment Methods | Machine Facilities | Expert Competence | Ease of Payment | Response to the needs and complaint | The Reputation of Suppliers | The Order Against Taxes | Total PT. |
|----------------------------------|---------------------------------|-----------------------------|-------------------------|---------------------------|-------------------|-----------------------|---------------------|------------------|----------------|--------------------------------|---------------------------|---------------------------|-----------|
|                                  | PT. ANM                         | 0.0007                      | 0.0018                  | 0.0001                    | 0                 | 0                     | 0.0012              | 0                | 0.0000         | 0.0001                      | 0.0001                    | 0.0001                   | 0.0649    |
|                                  | PT. AMI                         | 0.0003                      | 0                       | 0                          | 0.0009            | 0                     | 0.0012              | 0                | 0.0000         | 0.0001                      | 0.0001                    | 0.0001                   | 0.0518    |
|                                  | PT. CMN                         | 0                           | 0                       | 0                          | 0                 | 0                     | 0.0000              | 0                | 0              | 0.0001                      | 0.0001                    | 0.0001                   | 0.0043    |
|                                  | PT. KAR                         | 0.0001                      | 0                       | 0                          | 0.0009            | 0                     | 0.0012              | 0                | 0              | 0.0000                      | 0.0001                    | 0.0001                   | 0.0474    |
|                                  | PT. YAP                         | 0.0001                      | 0                       | 0                          | 0.0009            | 0.0002                 | 0.0000              | 0                | 0              | 0.0001                      | 0.0001                    | 0.0001                   | 0.0350    |

#### 3.5. Calculate The Distance Positive Ideal Alternative Solutions

The next stage is calculate the distance an alternative to solution ideal positive the calculation on alternative about a point ideal positive presented in table 7.

\[
D_i^+ = \sqrt{\sum_{j=1}^{n} (y_{ij} - y_i^+)^2}
\]

\[
D_i^- = \sqrt{\sum_{j=1}^{n} (y_i^+ - y_{ij})^2}
\]

#### Table 9. Distance ideal alternative solutions Positive

| Criteria                          | Raw Materials to Specifications | The Fulfillment of Standards | Timeliness of Deliveries | The Location of Suppliers | Price Fluctuation | Easy Payment Methods | Machine Facilities | Expert Competence | Ease of Payment | Response to the needs and complaint | The Reputation of Suppliers | The Order Against Taxes | Total PT. |
|----------------------------------|---------------------------------|-----------------------------|-------------------------|---------------------------|-------------------|-----------------------|---------------------|------------------|----------------|--------------------------------|---------------------------|---------------------------|-----------|
|                                  | PT. ANM                         | 0.0007                      | 0.0018                  | 0.0001                    | 0                 | 0                     | 0.0012              | 0                | 0.0000         | 0.0001                      | 0.0001                    | 0.0001                   | 0.0649    |
|                                  | PT. AMI                         | 0.0003                      | 0                       | 0                          | 0.0009            | 0                     | 0.0012              | 0                | 0.0000         | 0.0001                      | 0.0001                    | 0.0001                   | 0.0518    |
|                                  | PT. CMN                         | 0                           | 0                       | 0                          | 0                 | 0                     | 0.0000              | 0                | 0              | 0.0001                      | 0.0001                    | 0.0001                   | 0.0043    |
|                                  | PT. KAR                         | 0.0001                      | 0                       | 0                          | 0.0009            | 0                     | 0.0012              | 0                | 0              | 0.0000                      | 0.0001                    | 0.0001                   | 0.0474    |
|                                  | PT. YAP                         | 0.0001                      | 0                       | 0                          | 0.0009            | 0.0002                 | 0.0000              | 0                | 0              | 0.0001                      | 0.0001                    | 0.0001                   | 0.0350    |

#### 3.6. Calculate The Distance Negative Ideal Alternative Solutions

The next stage is an alternative to calculate the distance the ideal solution negative alternative the results of about a point ideal negative can be seen in table 9.
Table 10. Distance negative ideal alternative solutions

| Criteria                          | Raw Materials to Specifications | The Fulfillment of Standard | Timeliness of Deliveries | The distance location suppliers | Price Fluctuation | Ease payment methods | Machine facilities | Experts Competence | Ease supplier contact | Response to the needs and complaint | The reputation of suppliers | Order against taxes | Total |
|----------------------------------|---------------------------------|-------------------------------|--------------------------|----------------------------------|-------------------|----------------------|---------------------|-------------------|---------------------|-------------------------|-------------------------|-----------------|-------|
| PT. ANM                         | 0                               | 0                             | 0                        | 0,0009                            | 0,0002            | 0                    | 0                   | 0                 | 0                   | 0                      | 0,0001                 | 0,0338          |
| PT. AMI                         | 0,0001                          | 0,0018                        | 0                        | 0,0000                           | 0,0002            | 0                    | 0                   | 0                 | 0                   | 0                      | 0,0001                 | 0,0474          |
| PT. CMN                         | 0,0007                          | 0,0018                        | 0,0001                   | 0,0009                           | 0,0002            | 0,0012               | 0                    | 0                 | 0,0001             | 0,0001                 | 0,0001                 | 0,0728          |
| PT. KAR                         | 0,0003                          | 0,0018                        | 0,0001                   | 0,0001                           | 0,0001            | 0                    | 0                   | 0                 | 0,0001             | 0                      | 0,0001                 | 0,0516          |
| PT. YAP                         | 0,0003                          | 0,0018                        | 0,0001                   | 0,0012                           | 0,0001            | 0                    | 0                   | 0                 | 0,0001             | 0,0001                 | 0,0001                 | 0,0617          |

Table 11. The calculation on proximity relatively with the methods topsis

| Supplier   | S*I Positive | S'INegative | Relative | Ranking |
|------------|--------------|-------------|----------|---------|
| PT. ANM    | 0,0649       | 0,0338      | 0,3427   | 5       |
| PT. AMI    | 0,0518       | 0,0474      | 0,4779   | 4       |
| PT. CMN    | 0,0043       | 0,0728      | 0,9438   | 1       |
| PT. KAR    | 0,0474       | 0,0516      | 0,5213   | 3       |
| PT. YAP    | 0,0350       | 0,0617      | 0,6382   | 2       |

From table 9 on can be seen that penyuplai with the largest of relatively PT. CMN, so that PT. CMN is rank first suppliers best. Meanwhile PT. ANM have value of least so relatively ranked last.

4. Conclusion

After all stages Analytical Hierarchy Process (AHP), so formed a suppliers evaluation criteria, with the main criterion used 6 the criteria: the quality (30,7 %), delivery (17,8 %), price ( 18,8%), resources ( 13,7 % ), service (9,4 %) and company management (3,9 %). Then based on process with the ranking supplier Technique For Order Preference By Similarity To Ideal Solution (TOPSIS).

Obtained suppliers and value proximity with the order ranging from the best namely PT. Citra Mega Nusantara (0,9438), PT. Yaputra Abadi Perkasa (0,6382), PT. Karya Agung Realty (0,5213), PT. Avfal Mega Indah (0,4779) dan PT. Arga Nusa Mandaya (0,3427)

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