

# Integration Dematel and ANP for The Supplier Selection in The Textile Industry: A Case Study

Dana Marsetiya Utama<sup>1a♦</sup>, Bianca Maharani<sup>1</sup>, Ikhlasul Amallynda<sup>1</sup>

**Abstract.** Currently, companies are required to improve supply chain performance. One of the main problems in the supply chain is the proper supplier selection. Supplier selection has an essential role in improving supply chain management performance. Supplier selection requires the proper criteria. However, the relationship between criteria is rarely considered in the selection of suppliers in the textile industry. This study tries to propose integrating the Decision Making Trial and Evaluation Laboratory (DEMATEL) and the Analytic Network Process (ANP) for supplier selection in the textile industry. Both methods are multi-criteria decision making (MCDM) tools DEMATEL is used to assess the relationship between criteria. Furthermore, ANP is used to evaluate and weigh the importance of criteria and suppliers. A case study was carried out in a textile company located in Indonesia. The results show that this procedure can identify the relationship and effect of each criterion. The results show that the product price criteria are the criteria that have the most significant weight. The criteria for conformity to specifications and consistency of quality are in second and third place. Finally, suppliers are selected based on weight assessment on each criterion by ANP.

**Keywords:** Supplier selection, DEMATEL, MCDM, ANP

## I. INTRODUCTION

In the past decade, supply chain management has received much attention from the world, both researchers and industry players (Ibrahim, Putri, & Utama, 2020). The primary purpose of supply chain management is to reduce risk, improve company performance, and obtain maximum benefits (Boran, Genç, Kurt, & Akay, 2009). To achieve those, suppliers contribute significantly to supply chain management. The right supplier's selection can reduce purchase costs, increase competitiveness, and reduce risk (Alyanak & Armaneri, 2009) (Utama, 2021a). Improper supplier selection causes significant losses to the company, such as shortages of raw material inventory and delays in the production process (Baroto & Utama, 2021) (Utama, 2021b). Therefore, choosing the right supplier is expected to minimize the risks that

occur in the company (Limansantoso, 2013) (Utama, Baroto, Ibrahim, & Widodo, 2021).

In recent years, there has been increasing interest in supplier selection issues. One of them is in the textile industry. Several researchers have researched supplier selection in the textile and garment industry. Each study uses different criteria and methods. Several previous studies include Koprulu and Albayrakoglu (2007), which used the Analytical Hierarchy Process (AHP) method with economic aspects (quality, cost, delivery, flexibility, innovation) and social (trust). GÜNGÖR, COŞKUN, DURUR, and GÖREN (2010) used the AHP by considering economic aspects. Triple bottom elements (economic, social, and environmental) are also observed by Chan and Chan (2010). They proposed the AHP method for supplier selection. Y.-J. Chen (2011) used the Technique For Order Preference By Similarity Ideal Solution (Topsis) method. In addition, the adaptive neuro-fuzzy inference systems (Anfis) method was proposed by GüNeri, Ertay, and YüCel (2011) for supplier selection by considering economic and social aspects.

Several other procedures have proposed by the researchers include the gray system approach (Baskaran et al., 2012), Topsis and Fuzzy AHP (Kar et al., 2014), fuzzy Topsis (Jia et al., 2015) (Kargi, 2016) (Yildiz, 2016) (Fallahpour et al., 2017). The researcher also offered several integrated

---

<sup>1</sup> Industrial Engineering Department, Faculty of Engineering, Universitas Muhammadiyah Malang, Jalan Raya Tlogomas 246, Malang, Indonesia

<sup>a</sup> email: [dana@umm.ac.id](mailto:dana@umm.ac.id)  
♦ corresponding author

Submitted: 28-02-2021    Revised: 28-05-2021  
Accepted: 26-06-2021

procedures. Guarnieri and Trojan (2019) integrated AHP and Electre-Tri by considering economic and social aspects. In addition, Çalı and Balaman (2019) developed the integration of Electre and Vikor for supplier selection. Based on several previous studies, the AHP procedures are popular procedures used by researchers to weight criteria and supplier selection in the textile industry. Unfortunately, this method does not consider the relationship between criteria in supplier selection. In the supplier selection on the textile industry, to the best of our knowledge, only Li, Diabat, and Lu (2019) study used the Decision Making Trial and Evaluation Laboratory (Dematel) method to identify criteria relation. However, this study only considers the economic aspects of supplier selection.

Dematel has been applied to supplier selection problems in several industrial sectors. Büyüközkan and Çifçi (2012) and Tirkolaee, Mardani, Dashtian, Soltani, and Weber (2019) have offered combination fuzzy Dematel, fuzzy Analytic Network Process (ANP), and fuzzy Topsis in the automotive industry. Hsu, Kuo, Chen, and Hu (2013) used Dematel in the electronic industry. The integration of Dematel, Quality Function Deployment, and Copras was proposed by Yazdani, Chatterjee, Zavadskas, and Zolfani (2017) in the food industry. Rough Dematel, ANP, and MAIRCA were proposed by Chatterjee, Pamucar, and Zavadskas (2018) in the electronics industry. Recently, Z. Chen, Ming, Zhou, and Chang (2020) proposed rough-fuzzy Dematel-Topsis in the automotive industry.

Based on previous research, very few approaches that consider the effects of criteria are investigated in the supplier selection problems. Even to the best of our knowledge, we found only one research study using dematel in the textile industry (Li et al., 2019). Unfortunately, that study only focussed on identifying the relationship between supplier selection criteria. The identification of the best supplier was not discussed in the study. Therefore, an approach is needed to solve the problem by considering the relationship between the criteria and the best supplier in the textile industry. This study proposes the Dematel and Analytic Network

Process (ANP) method to solve supplier selection in the textile industry. Dematel is used to determine the effect between criteria. ANP is an effective weighting procedure that considers relations (Yang, Shieh, Leu, & Tzeng, 2008). Using the Dematel-ANP method has been proven effective for solving MCDM problems. This method has been successfully applied to various problems such as energy resources selection (Büyüközkan & Gülerüz, 2016), Risk Assessment (Dehdasht et al., 2017), risk management (Fazli, Mavi, & Vosooghizaji, 2015), and evaluate the critical success factors (Nilashi et al., 2015)

This study aims to integrate the Decision Making Trial and Evaluation Laboratory (DEMATEL) and the Analytic Network Process (ANP) for supplier selection in the textile industry. In this study, researchers proposed the Dematel method to measure the effect of the relationship between criteria. ANP is proposed to measure the importance of criteria based on the relationship between the criteria generated by Dematel. Compared to other techniques, this method has the advantage that Dematel provides a systematic approach to identify criteria, the relationship between criteria. Furthermore, ANP allows weighting based on interdependent relationships between criteria for decision-making. This study used triple bottom aspects such as economic, social, and environmental aspects for identifying criteria.

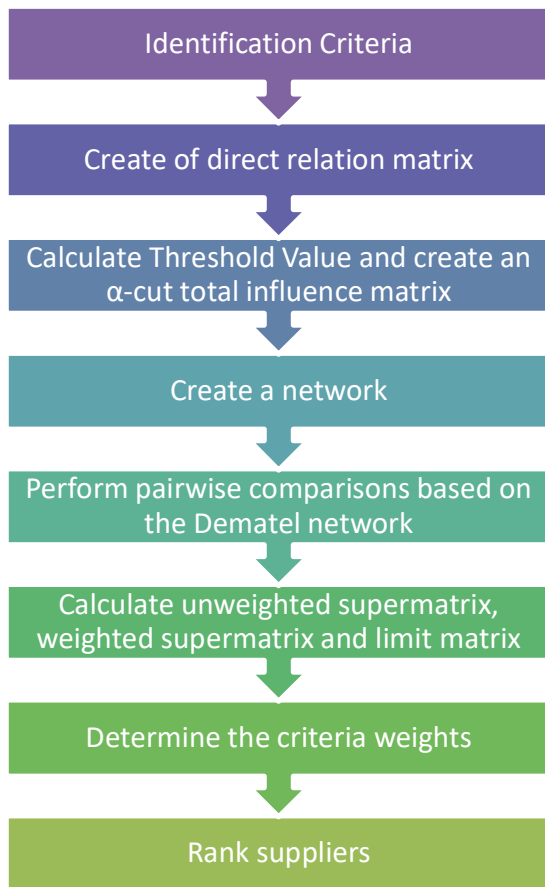
## II. RESEARCH METHOD

This section presents a procedural framework for the proposed method in selecting textile industry suppliers and data collection for case studies.

### Proposed Method Framework

This section proposes a procedure for selecting suppliers in the textile industry. This study integrates Dematel and ANP as a proposed method for solving problems. The Dematel method was first proposed by Fontela and Gabus (1974) based on the influence between criteria. In this study, Dematel was used to assess the effect of a criterion on the other criterion. Furthermore,

the weighting of the importance level of the ANP criteria is based on the relationship between the criteria in the Dematel procedure. The ANP method is coined by Saaty (Saaty, 2004) based on a reciprocal relationship between criteria. The following is a supplier selection framework with Dematel-ANP integration, which can be seen in Figure 1. This procedure is modified from the framework proposed by Yang et al. (2008).



**Figure 1.** Supplier selection framework with Dematel-ANP integration

Based on the supplier selection framework (Figure 1), Stage (1) is to identify the criteria. The determination of the criteria is carried out through the discussion by several experts from the company. Stage (2) is the making of a direct relation matrix. Direct relation assessment is carried out using a scale of 0,1,2,3, and 4. 0 represents not influencing, one is less influencing, two moderately affecting, three strongly

influencing, and four are very influential. The assessment results of the relationship between the criteria are made into a direct relation matrix (matrix B) as presented in equation (1), where  $b_{ij}$  assesses the relationship between criterion  $i$  on criterion  $j$ .

Stage (3) is to calculate the Tresh Hold Value and create an  $\alpha$ -cut total influence matrix. Based on the direct relation matrix, the following procedure normalizes the direct relation matrix using equations (2) and (3). Where  $X$  is the direct relation normalization matrix. The following procedure calculates the total relation matrix (T) based on equation (4). The threshold value is based on the average value of the normalization relation matrix. After the threshold value is found, the next step compares the value with the total relation matrix's value. Suppose the total relation matrix value is below the threshold value. In that case, it is considered that the effect of the criterion is low or negligible. It is considered to have a value of 0. The matrix formed from the comparison is called the  $\alpha$ -cut total influence matrix. It is based on research by Yang et al. (2008).

Stage (4) is to create a Dematel network formed from an  $\alpha$ -cut total influence matrix. Stage (5) performs a pairwise comparison based on the Dematel network. The pairwise comparison assessment uses a scale of 1, which shows that both criteria are equally important; 3 describes the criteria of Medium importance; 5 explains the criteria for Strong importance; 7 indicates Extreme importance; 9 describes the criteria of Extreme importance; and the values 2, 4, 6, 8 indicate the Intermediate scale. The pairwise comparison results are presented in a matrix as in equation (5), where  $a_{ij}$  is the result of assessing pairwise comparison between criterion  $i$  on criterion  $j$ .

Stage (6) is calculating the weighted supermatrix and limit matrix. The equation used to perform calculations can be seen in equations (6) and (9). Where  $TA$  is the unweight supermatrix from the pairwise comparison.  $d_i$  is the sum on row  $i$  unweight supermatrix.  $Ts$  is the normalized unweighted supermatrix.  $Ww$  is a weighted supermatrix.

Step (7) determines the criteria weights obtained from the normalization limit matrix using equation (10). Finally, step (8) ranks suppliers obtained from the normalization limit matrix.

$$B = \begin{bmatrix} b_{11} & b_{1j} & b_{1n} \\ b_{i1} & b_{ij} & b_{in} \\ b_{n1} & b_{nj} & b_{nn} \end{bmatrix} \quad (1)$$

$$s = \min \left[ \frac{1}{\max_i \sum_{j=1}^n |b_{ij}|}, \frac{1}{\max_j \sum_{i=1}^n |b_{ij}|} \right] \quad (2)$$

$$X = s \times B \quad (3)$$

$$T = X(I - X)^{-1} \quad (4)$$

$$A = \begin{matrix} & C1 & C2 & \dots & Cn \\ C1 & a_{11} & a_{12} & \dots & a_{1n} \\ C2 & a_{12} & a_{22} & \dots & a_{2n} \\ Cn & a_{n1} & a_{n2} & \dots & a_{nn} \end{matrix} \quad (5)$$

$$TA = \begin{bmatrix} t_{11}^\alpha & t_{1j}^\alpha & t_{1n}^\alpha \\ t_{i1}^\alpha & t_{ij}^\alpha & t_{in}^\alpha \\ t_{n1}^\alpha & t_{nj}^\alpha & t_{nn}^\alpha \end{bmatrix} \quad (6)$$

$$d_i = \sum_{j=1}^n t_{ij}^\alpha \quad (7)$$

$$Ts = \begin{bmatrix} t_{11}^\alpha/d1 & t_{1j}^\alpha/d1 & t_{1n}^\alpha/d1 \\ t_{i1}^\alpha/di & t_{ij}^\alpha/di & t_{in}^\alpha/di \\ t_{n1}^\alpha/d3 & t_{nj}^\alpha/d3 & t_{nn}^\alpha/d3 \end{bmatrix} =$$

$$Ts = \begin{bmatrix} t_{11}^s & t_{1j}^s & t_{1n}^s \\ t_{i1}^s & t_{ij}^s & t_{in}^s \\ t_{n1}^s & t_{nj}^s & t_{nn}^s \end{bmatrix} \quad (8)$$

$$Ww = \begin{bmatrix} t_{11}^s \times w_{11} & t_{1j}^s \times w_{12} & \dots & t_{1n}^s \times w_{1n} \\ t_{i1}^s \times w_{12} & t_{ij}^s \times w_{22} & \dots & t_{in}^s \times w_{2n} \\ t_{n1}^s \times w_{n1} & t_{nj}^s \times w_{n2} & \dots & t_{nn}^s \times w_{nn} \end{bmatrix} \quad (9)$$

$$\lim_{k \rightarrow \infty} W_w^k \quad (10)$$

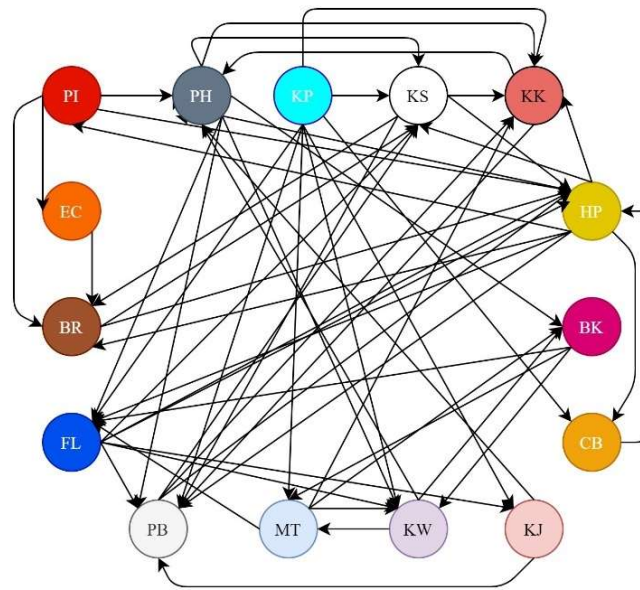
### Case Studies and Data Collection

**Table 1.** Identifies the criteria for selecting suppliers in the textile industry

No	Factors	Aspect	Criteria	Code
1	Company Profile (Merry, Ginting, & Marpaung, 2014)	Economic	permittance (Gustian, Slamet, & Maylawati, 2018)	PI
			Performance history (Merry et al., 2014)	PH
			Company capabilities (Merry et al., 2014)	KP
2	Quality (Amindoust & Saghafinia, 2017)	Economic	Compliance of material with specifications (Kurniawati, Yuliando, & Widodo, 2013)	KS
			Ability to provide consistent quality (Merry et al., 2014)	KK
3	Cost (Guo, Liu, Zhang, & Yang, 2017)	Economic	Price (Widiyanesti, 2012)	HP
			Delivery Cost (Widiyanesti, 2012)	BK
			Payment method (Merry et al., 2014)	CB
4	Delivery (Kargi, 2016)	Economic	The accuracy of the order quantity (Merry et al., 2014)	KJ
			On-time delivery (Sulistiyan, Amir, Yusuf, & Nasrullah, 2017)	KW
			Types of transportation modes (Taufik, Sumantri, & Tantrika, 2014)	MT
5	Service (Y.-J. Chen, 2011)	Social	Replacement of items product (Kurniawati et al., 2013)	PB
			Flexible (Merry et al., 2014)	FL
6	Environmental Issues	Environment	Eco-friendly material (Yancadianti, Puspitasari, & Arvianto, 2015)	BR
			Environment-related certificates (ERC) (Sidjabat & Runtuk, 2019)	EC

**Table 2.** Matrix of direct relations between the criteria based on the FGD

Criteria	PI	PH	KP	KS	KK	HP	BK	CB	KJ	KW	MT	PB	FL	BR	EC
PI	0	2	0	0	1	4	3	1	0	0	1	0	1	3	4
PH	1	0	1	3	3	0	0	2	4	4	1	1	3	0	0
KP	1	1	0	3	4	1	0	3	3	3	2	1	3	1	3
KS	1	3	1	0	3	3	0	1	0	1	1	3	2	3	1
KK	1	3	1	1	0	4	2	1	1	1	1	3	0	3	0
HP	3	2	2	3	4	0	1	1	0	1	0	3	2	3	1
BK	1	0	0	1	1	1	0	0	1	4	4	1	3	1	0
CB	1	1	1	1	1	3	0	0	1	1	1	1	1	1	1
KJ	1	3	1	1	1	1	1	1	0	1	1	3	1	1	1
KW	1	3	1	0	1	1	4	1	0	0	3	1	1	1	0
MT	1	0	1	0	2	0	4	1	1	4	0	1	1	1	0
PB	1	2	1	3	4	2	0	1	2	1	2	0	2	0	0
FL	1	1	1	3	1	2	1	1	4	4	1	1	0	1	0
BR	2	0	1	1	1	4	4	0	0	0	1	0	0	0	2
EC	1	1	1	0	0	0	0	0	0	0	0	0	0	3	0

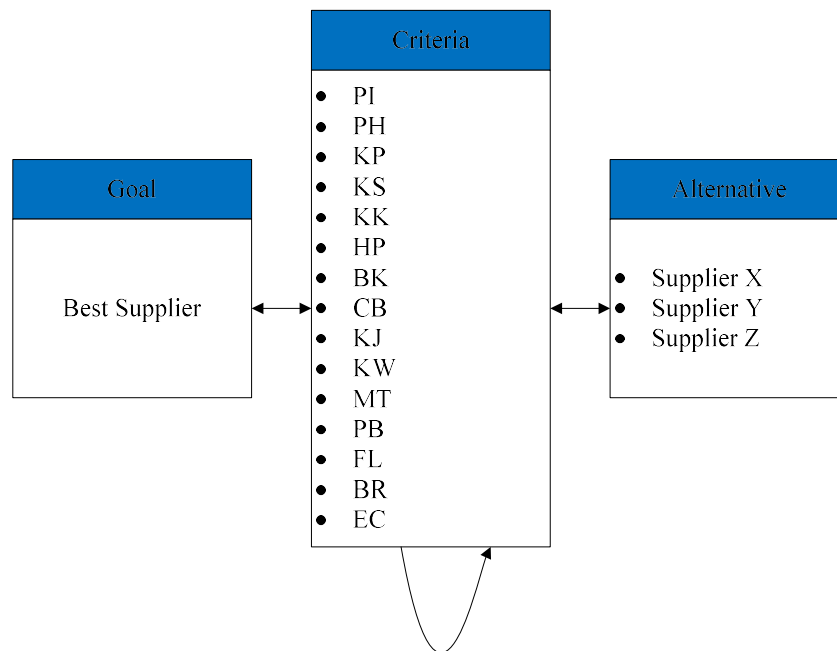


**Figure 2.** DEMATEL network

A case study was conducted in the textile industry in Cianjur, West Java, Indonesia. The data collected is based on Focus Group Discussion (FGD). FGD is a process of gathering information on a problem that is specifically researched. In the FGD, discussions were held with parties involved in selecting suppliers of raw materials for companies. These parties can assess the relationship between criteria and suppliers. 4 Respondents were selected to determine the

Criteria, determine relationship criteria and evaluate the pairwise comparison matrix. The four respondents are the general manager, head of purchasing, head of the production, and logistics head.

Based on the FGD, the identification of supplier selection criteria in the textile industry is presented in Table 1. Measurement of the relationship between criteria was carried out using the DEMATEL questionnaire. The results of



**Figure 3.** ANP Network Diagram

the direct relation assessment between the criteria from the FGD are presented in Table 2. The results of the direct relations from Dematel are made a network that is presented in Figure 2. From the dematel network, it is then used in ANP to separate suppliers. The ANP network for supplier selection problems in the textile industry is presented in Figure 3. In selecting suppliers, there are three pairwise comparison clusters used. Cluster 1 is used to assess the importance of criteria. Cluster 2 is used to determine the importance between criteria based on the relationship between the criteria produced by the Dematel procedure. Furthermore, the last (cluster 3) pairwise comparison to the supplier selection criteria for each alternative supplier. In this study, researchers used super decision software for weighting solutions using ANP.

### III. RESULT AND DISCUSSION

#### Criteria relation Analysis

The  $\alpha$ -cut total influence matrix value is shown in table 3. The average value of the total relationship matrix for the criteria is  $\alpha = 0.157$ . Each value in the total relationship matrix is compared to the threshold value. These results

indicate that the company capability (KP) has the highest number of relationships than other criteria followed by Price (HP), Compliance of material with specifications (KS), Ability to provide consistent quality. The results of this study contradict Li et al. (2019), who found quality criteria had the most significant influence. In this research, Company capability (KP) can determine other criteria. If the capability is low, then the consistency of quality, the accuracy of the number of orders, punctuality also decrease. The company capability (KP) criterion has the most number of relationships.

Furthermore, the permittance criteria (PI) have many implications for other criteria. Company suppliers are suppliers that come from abroad. Therefore, licensing has many links with other criteria. In flexibility (FL), this criterion assesses the supplier's ability to meet the demand for changes in quantity and time. These, of course, greatly influence other criteria. When the flexibility (FL) of the supplier is good, then other criteria such as accuracy of quantity and time are also good.

The criteria for On-time delivery (KW) are influenced by Delivery Cost (BK) and the type of transportation mode used (MT). The product price

criterion (HP) is included in the receiver group because the product's price is affected by the Compliance of material with specifications (KS) and services provided. When the product quality is good, the product price is high. Furthermore, if supplier licensing is well documented, then the product's cost will increase.

### **Influence between criteria**

The assessment of the effect between criteria used the ANP method. The results of the impact between criteria are presented in the Unweighted Supermatrix table in table 4. For example, the criteria for Eco-friendly material (BR) affect product prices (HP) and Compliance of material with specifications (KS). Eco-friendly materials (BR) have a higher price than common raw materials. The Delivery Cost criterion (BK) influences On-time delivery (KW) and mode of transportation (MT). Shipping costs affect the type of transport used. These also affect the speed of delivery. The higher the costs incurred in delivery, the better the mode of transportation used. So, the product comes on time.

The payment method (CB) criteria affect the product price (HP) because payments from abroad to Indonesia are taxed. Therefore, the process of payment involves the cost of the product. Environmental-related certificate (EC) criteria affect the criteria for Eco-friendly material (BR). Suppliers who already have EC show that the materials used are safe for the environment. In the criteria for flexibility (FL), this criterion has the most significant influence on the criteria for accuracy of the order quantity (KJ). It is followed by the criteria for On-time delivery (KW). The criteria for flexibility assess suppliers in terms of suppliers' ability to meet changes in quantity and time requests. Product price criteria (HP) have the most significant influence on quality consistency criteria (KK). High product prices are directly proportional to product quality. In the company capability criteria (KP), this criterion significantly influences the specification conformity criteria. In addition, the criteria for Compliance of material with specifications (KS) have the most significant impact on the product price criteria.

The criterion for the accuracy of the number of orders (KJ) has the most significant effect on the Replacement of items product (PB). This criterion assesses the supplier's response to damaged materials and shortages. So, if the number of orders does not match, it will affect the change of goods. The on-time delivery (KW) criterion has the most significant effect on Delivery Cost (BK). The faster the delivery time, the greater the shipping cost. In the criteria of ability to provide consistent quality (KK), the product price (HP) is the most significant effect. It is because the better the quality of raw material, the higher the product price.

Some of the effects of other criteria are as follows: Criteria for the mode of transportation (MT) affect the accuracy of delivery costs (BK) and on-time delivery (KW). Performance history (PH) criteria have an impact on product prices (HP). The criterion for Replacement of items product (PB) affects The accuracy of the order quantity (KJ) and the ability to provide consistent quality (KK). Furthermore, the permittance (PI) impact Eco-friendly material (BR). It is because good and environmentally friendly raw materials indicate good licensing from the supplier.

### **Criteria Weight**

Based on the ANP method, the supermatrix limit is obtained based on the results of the unweight supermatrix. The results of the limit matrix calculated based on the super decision software can be seen in table 5. Furthermore, the limit matrix must be normalized to become a global weight. The global weight and rank of the supplier selection criteria are shown in table 6.

These results show that the product price criterion (HP) has the most significant weight with a global weight of 0.1385 or 13.85%. The criteria of ability follow them to provide consistent quality (KK) and Compliance of material with specifications (KS) with global weights of 11.35% and 11.08%. This result is different from previous research conducted by Koprulu and Albayrakoglu (2007), Utama (2021a), and Utama et al. (2021). Their research shows that the criterion that has the highest weight is Quality. This is due to the different problems and conditions of the

company. If the analysis is further, the product price criteria have many relationships with other criteria. In addition, product price (HP) has the highest weight because the company wants to minimize operations.

The criterion with the lowest weight is the

Payment Method (CP) criterion. The payment method affects other criteria a little. In addition, this criterion is not influenced by other criteria. The company continues to want to improve its performance by providing various payment methods. Therefore, the method of payment is

**Table 3.**  $\alpha$ -cut total influence matrix

Criteria	PI	PH	KP	KS	KK	HP	BK	CB	KJ	KW	MT	PB	FL	BR	EC
PI	0.000	0.000	0.000	0.000	0.000	0.272	0.186	0.000	0.000	0.000	0.000	0.000	0.000	0.223	0.194
PH	0.000	0.000	0.000	0.258	0.285	0.000	0.000	0.000	0.253	0.303	0.000	0.214	0.245	0.000	0.000
KP	0.000	0.226	0.000	0.260	0.313	0.240	0.000	0.203	0.223	0.274	0.200	0.214	0.244	0.209	0.000
KS	0.000	0.258	0.000	0.161	0.273	0.291	0.000	0.000	0.000	0.000	0.000	0.250	0.198	0.245	0.000
KK	0.000	0.249	0.000	0.186	0.175	0.307	0.000	0.000	0.000	0.000	0.000	0.273	0.000	0.232	0.000
HP	0.221	0.242	0.000	0.261	0.313	0.000	0.000	0.000	0.000	0.000	0.000	0.257	0.205	0.262	0.000
BK	0.000	0.000	0.000	0.000	0.184	0.000	0.000	0.000	0.000	0.000	0.250	0.000	0.227	0.000	0.000
CB	0.000	0.000	0.000	0.000	0.000	0.215	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
KJ	0.000	0.210	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.197	0.000	0.000	0.000
KW	0.000	0.221	0.000	0.000	0.000	0.000	0.226	0.000	0.000	0.000	0.204	0.000	0.000	0.000	0.000
MT	0.000	0.000	0.000	0.000	0.223	0.172	0.251	0.000	0.000	0.293	0.000	0.242	0.201	0.201	0.000
PB	0.000	0.226	0.000	0.240	0.295	0.242	0.000	0.000	0.174	0.184	0.000	0.000	0.000	0.000	0.000
FL	0.000	0.189	0.000	0.223	0.000	0.214	0.000	0.000	0.224	0.270	0.000	0.172	0.000	0.000	0.000
BR	0.000	0.000	0.000	0.000	0.000	0.251	0.207	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EC	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.136	0.000

**Table 6.** Rank Criteria Weight

Criteria	Weight	Percentage
product prices	0.139	13.85%
Quality consistency	0.114	11.35%
conformance to specifications	0.111	11.08%
On-time	0.085	8.46%
appropriateness of quantities	0.074	7.36%
replacement of damaged goods	0.069	6.91%
performance history	0.067	6.69%
Flexibility	0.058	5.84%
eco-friendly material	0.055	5.50%
Permittance	0.054	5.43%
Delivery cost	0.042	4.20%
mode of transportation	0.040	4.04%
Capability	0.037	3.71%
environmental certificate	0.031	3.10%
Payment Method	0.025	2.47%
Total	1.00	100%

**Table 7.** Ranking of Supplier Weights

Supplier Alternative	Global Wight	Percentage	Ranking
supplier Y	0.38423	38.42%	1
supplier Z	0.33642	33.64%	2
supplier X	0.27934	27.93%	3
Total	1	100%	



not a crucial problem in the company. In addition to the payment method criteria, the low weight criterion is the environmental certificate (EC). This criterion has little relationship with other criteria.

Even though the weight of this criterion is low, EC should still be an aspect that needs to be considered by companies.

Table 4 Unweighted Supermatrix

Cluster	Nodes	Sp X	Sp Y	Sp Z	Sp T	BR	BK	CB	EC	F	HP	KP	KS	KJ	KW	KK	MT	PH	PB	PI
Alternatif	Sp X	0.000	0.000	0.000	0.000	0.137	0.163	0.540	0.200	0.528	0.540	0.163	0.250	0.163	0.137	0.163	0.297	0.122	0.200	0.500
	Sp Y	0.000	0.000	0.000	0.000	0.625	0.297	0.163	0.400	0.333	0.297	0.297	0.250	0.297	0.625	0.540	0.163	0.558	0.400	0.250
	Sp Z	0.000	0.000	0.000	0.000	0.238	0.540	0.297	0.400	0.140	0.163	0.540	0.500	0.540	0.238	0.297	0.540	0.320	0.400	0.250
Goal	Sp T	0.000	0.000	0.000	0.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
	BR	0.038	0.068	0.044	0.044	0.000	0.000	1.000	0.000	0.000	0.096	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.459
	BK	0.029	0.026	0.059	0.024	0.429	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.467	0.000	0.000	0.000	0.172
Kriteria	CB	0.093	0.020	0.021	0.022	0.000	0.000	0.000	0.000	0.072	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	EC	0.045	0.040	0.040	0.039	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.226
	FL	0.109	0.057	0.036	0.045	0.000	0.143	0.000	0.000	0.000	0.155	0.139	0.137	0.000	0.000	0.000	0.160	0.177	0.000	0.000
	HP	0.144	0.096	0.071	0.112	0.500	0.000	1.000	0.000	0.081	0.000	0.000	0.519	0.000	0.000	0.630	0.000	0.000	0.125	0.144
	KP	0.040	0.041	0.086	0.055	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	KS	0.077	0.113	0.121	0.145	0.500	0.000	0.000	0.000	0.133	0.219	0.181	0.000	0.000	0.000	0.000	0.000	0.096	0.125	0.000
	KJ	0.065	0.087	0.109	0.066	0.000	0.000	0.000	0.000	0.295	0.000	0.154	0.000	0.000	0.000	0.000	0.000	0.158	0.375	0.000
	KW	0.070	0.124	0.067	0.101	0.000	0.429	0.000	0.000	0.240	0.000	0.154	0.000	0.000	0.000	0.000	0.277	0.225	0.000	0.000
	KK	0.081	0.125	0.109	0.122	0.000	0.000	0.000	0.000	0.000	0.316	0.162	0.150	0.000	0.000	0.000	0.095	0.202	0.375	0.000
	MT	0.023	0.030	0.034	0.061	0.000	0.429	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.429	0.000	0.000	0.000	0.000	0.000
	PH	0.046	0.092	0.047	0.074	0.000	0.000	0.000	0.000	0.125	0.000	0.065	0.000	0.333	0.143	0.151	0.000	0.000	0.000	0.000
PB	0.028	0.032	0.032	0.047	0.000	0.000	0.000	0.000	0.125	0.091	0.088	0.194	0.667	0.000	0.218	0.000	0.143	0.000	0.000	
PI	0.113	0.050	0.075	0.080	0.000	0.000	0.000	0.000	0.051	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Tabl Super matrix

Cluster	Nodes	Sp X	Sp Y	Sp Z	Sp T	BR	BK	CB	F	HP	KP	KS	KJ	KW	KK	MT	PH	PB	PI
Alternatif	Sp X	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055	0.055
	Sp Y	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
	Sp Z	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
Goal	Sp T	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.200
	BR	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033
	BK	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025
Kriteria	CB	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015
	EC	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019
	F	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035	0.035
	HP	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083	0.083
	KP	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022	0.022
	KS	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066	0.066
	KJ	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044
	KW	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051	0.051
	KK	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068	0.068
	MT	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024
	PH	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040	0.040
PB	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	
PI	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	0.033	

### Rank Supplier

From the supplier weight ranking (Table 7), it is found that supplier Y has the highest weight, namely 0.3885 or 38.85%. Supplier Y is the first ranked supplier. The second alternative is supplier Z, with a weight of 33.64%, followed by supplier X with a weight of 27.93%. This makes perfect sense based on pairwise comparisons because supplier Y has a better level of importance than other suppliers in each of the criteria.

### IV. CONCLUSION

This research discussed supplier selection in the textile industry using Dematel and ANP. There are 15 criteria used in this study. Based on Dematel, the Company capabilities (KP) have the most significant influence than other criteria. Based on the ANP, the criteria that have the highest weight are product price (HP) followed by Compliance of material with specifications (KS) and Ability to provide consistent quality (KK). The supplier ranking results show that Supplier Y is in the first order, followed by supplier Z and supplier X. Some limitations in this study are definite information characteristics. In further research, it is necessary to consider the characteristics of uncertain information.

### REFERENCES

- Amindoust, A., & Saghafinia, A. (2017). Textile supplier selection in sustainable supply chain using a modular fuzzy inference system model. *The Journal of The Textile Institute*, 108(7), 1250-1258.
- Baroto, T., & Utama, D. M. (2021). Integrasi AHP dan SAW untuk Penyelesaian Green Supplier Selection. *Prosiding SENTRA (Seminar Teknologi dan Rekayasa)*(6), 38-44.
- Baskaran, V., Nachiappan, S., & Rahman, S. (2012). Indian textile suppliers' sustainability evaluation using the grey approach. *International Journal of Production Economics*, 135(2), 647-658.
- Boran, F. E., Genç, S., Kurt, M., & Akay, D. (2009). A multi-criteria intuitionistic fuzzy group decision making for supplier selection with TOPSIS method. *Expert Systems with Applications*, 36(8), 11363-11368.
- Büyüközkan, G., & Çifçi, G. (2012). A novel hybrid MCDM approach based on fuzzy DEMATEL, fuzzy ANP and fuzzy TOPSIS to evaluate green suppliers. *Expert Systems with Applications*, 39(3), 3000-3011.
- Büyüközkan, G., & Güteryüz, S. (2016). An integrated DEMATEL-ANP approach for renewable energy resources selection in Turkey. *International Journal of Production Economics*, 182, 435-448. doi: <https://doi.org/10.1016/j.ijpe.2016.09.015>
- Çalı, S., & Balaman, Ş. Y. (2019). A novel outranking based multi criteria group decision making methodology integrating ELECTRE and VIKOR under intuitionistic fuzzy environment. *Expert Systems with Applications*, 119, 36-50.
- Chan, F. T., & Chan, H. K. (2010). An AHP model for selection of suppliers in the fast changing fashion market. *The International Journal of Advanced Manufacturing Technology*, 51(9-12), 1195-1207.
- Chatterjee, K., Pamucar, D., & Zavadskas, E. K. (2018). Evaluating the performance of suppliers based on using the R'AMATEL-MAIRCA method for green supply chain implementation in electronics industry. *Journal of Cleaner Production*, 184, 101-129. doi: <https://doi.org/10.1016/j.jclepro.2018.02.186>
- Chen, Y.-J. (2011). Structured methodology for supplier selection and evaluation in a supply chain. *Information Sciences*, 181(9), 1651-1670.
- Chen, Z., Ming, X., Zhou, T., & Chang, Y. (2020). Sustainable supplier selection for smart supply chain considering internal and external uncertainty: An integrated rough-fuzzy approach. *Applied Soft Computing*, 87, 106004.
- Dehdasht, G., Mohamad Zin, R., Ferwati, M. S., Mohammed Abdullahi, M. a., Keyvanfar, A., & McCaffer, R. (2017). DEMATEL-ANP Risk Assessment in Oil and Gas Construction Projects. *Sustainability*, 9(8). doi: 10.3390/su9081420
- Fallahpour, A., Olugu, E. U., Musa, S. N., Wong, K. Y., & Noori, S. (2017). A decision support model for sustainable supplier selection in sustainable supply chain management. *Computers & Industrial Engineering*, 105, 391-410.
- Fazlı, S., Mavi, R. K., & Vosooghizaji, M. (2015). Crude oil supply chain risk management with DEMATEL-ANP. *Operational Research*, 15(3), 453-480.
- Fontela, E., & Gabus, A. (1974). DEMATEL: Progress achieved: Pergamon.
- Guarnieri, P., & Trojan, F. (2019). Decision making on supplier selection based on social, ethical, and environmental criteria: A study in the textile industry. *Resources, Conservation and Recycling*, 141, 347-361.
- GüNeri, A. F., Ertaş, T., & YüCel, A. (2011). An approach based on ANFIS input selection and modeling for

- supplier selection problem. *Expert Systems with Applications*, 38(12), 14907-14917.
- GÜNGÖR, A., COŞKUN, S., DURUR, G., & GÖREN, H. G. (2010). A supplier selection, evaluation and re-evaluation model for textile retail organizations. *Tekstil ve Konfeksiyon*, 20(3), 181-187.
- Guo, Z., Liu, H., Zhang, D., & Yang, J. (2017). Green supplier evaluation and selection in apparel manufacturing using a fuzzy multi-criteria decision-making approach. *Sustainability*, 9(4), 650.
- Gustian, S., Slamet, C., & Maylawati, D. S. a. (2018). Pemilihan Supplier pada Perusahaan Redbean Berbasis Mobile Menggunakan Hybrid Metode ANP dan Oreste. *INSIGHT*, 1(1), 9-14.
- Hsu, C.-W., Kuo, T.-C., Chen, S.-H., & Hu, A. H. (2013). Using DEMATEL to develop a carbon management model of supplier selection in green supply chain management. *Journal of Cleaner Production*, 56, 164-172.
- Ibrahim, M. F., Putri, M. M., & Utama, D. M. (2020). A literature review on reducing carbon emission from supply chain system: drivers, barriers, performance indicators, and practices. *IOP Conference Series: Materials Science and Engineering*, 722, 012034. doi: 10.1088/1757-899x/722/1/012034
- Jia, P., Govindan, K., Choi, T.-M., & Rajendran, S. (2015). Supplier selection problems in fashion business operations with sustainability considerations. *Sustainability*, 7(2), 1603-1619.
- Kar, M. B., Chatterjee, K., & Kar, S. (2014). A network-TOPSIS based fuzzy decision support system for supplier selection in risky supply chain. Paper presented at the 2014 Seventh International Joint Conference on Computational Sciences and Optimization.
- Kargi, V. S. A. (2016). Supplier selection for a textile company using the fuzzy TOPSIS method. *Yönetim ve Ekonomi*, 23(3), 789-803.
- Koprulu, A., & Albayrakoglu, M. M. (2007). Supply chain management in the textile industry: a supplier selection model with the analytical hierarchy process. Paper presented at the Proceeding of the International Symposium on the Analytic Hierarchy Process. Viña del Mar, Chile.
- Kurniawati, D., Yulianto, H., & Widodo, K. H. (2013). Kriteria Pemilihan Pemasok Menggunakan Analytical Network Process. *Jurnal Teknik Industri*, 15(1), 25-32.
- Li, Y., Diabat, A., & Lu, C.-C. (2019). Leagile supplier selection in Chinese textile industries: a DEMATEL approach. *Annals of Operations Research*, 1-20.
- Limansantoso, M. F. (2013). Pemilihan Supplier produk calista dengan metode analytical hierarchy process (AHP) pada PT. Buana tirta Utama-Gresik. *Calyptra*, 2(1), 1-20.
- Merry, L., Ginting, M., & Marpaung, B. (2014). Pemilihan supplier buah dengan pendekatan metode Analytical Hierarchy Process (AHP) dan TOPSIS: Studi kasus pada perusahaan retail. *Teknik dan Ilmu Komputer*, 3(9), 48-58.
- Nilashi, M., Zakaria, R., Ibrahim, O., Majid, M. Z. A., Zin, R. M., & Farahmand, M. (2015). MCPCM: a DEMATEL-ANP-based multi-criteria decision-making approach to evaluate the critical success factors in construction projects. *Arabian Journal for Science and Engineering*, 40(2), 343-361.
- Saaty, T. L. (2004). Decision making—the analytic hierarchy and network processes (AHP/ANP). *Journal of systems science and systems engineering*, 13(1), 1-35.
- Sidjabat, F. M., & Runtuk, J. K. (2019). Pengembangan Model Pemilihan Green Supplier di Kawasan Industri Cikarang. *Journal of Environmental Engineering and Waste Management*, 4(1), 9-20.
- Sulistiyani, E., Amir, M. I. H., Yusuf, K., & Nasrullah, D. I. (2017). Implementasi Metode Analytical Hierarchy Process (AHP) Sebagai Solusi Alternatif Dalam Pemilihan Supplier Bahan Baku Apel Di PT. Mannasatria Kusumajaya. *Technology Science and Engineering Journal*, 1(2).
- Taufik, R., Sumantri, Y., & Tantrika, C. F. M. (2014). Penerapan pemilihan supplier bahan baku ready mix berdasarkan integrasi metode AHP dan TOPSIS (Studi kasus pada PT Merak Jaya Beton, Malang). *Jurnal Rekayasa dan Manajemen Sistem Industri*, 2(5), p1067-1076.
- Tirkolaee, E. B., Mardani, A., Dashtian, Z., Soltani, M., & Weber, G.-W. (2019). A novel hybrid method using fuzzy decision making and multi-objective programming for sustainable-reliable supplier selection in two-echelon supply chain design. *Journal of Cleaner Production*, 119517. doi: <https://doi.org/10.1016/j.jclepro.2019.119517>
- Utama, D. M. (2021a). AHP and TOPSIS Integration for Green Supplier Selection: A Case Study in Indonesia. *Journal of Physics: Conference Series*, 1845(1), 012015. doi: 10.1088/1742-6596/1845/1/012015
- Utama, D. M. (2021b). Penyelesaian Green Supplier Selection Menggunakan Integrasi AHP dan VIKOR. *Prosiding SENTRA (Seminar Teknologi dan Rekayasa)*(6), 31-37.
- Utama, D. M., Baroto, T., Ibrahim, M. F., & Widodo, D. S. (2021). Evaluation of Supplier Performance in Plastic Manufacturing Industry: A Case Study. *Journal of Physics: Conference Series*, 1845(1), 012016. doi: 10.1088/1742-6596/1845/1/012016

- Widiyanesti, S. (2012). Penentuan kriteria terpenting dalam pemilihan supplier di family business dengan menggunakan pendekatan analytic hierarchy process (AHP)(Studi kasus pada Perusahaan Garmen PT. X). *Image: Jurnal Riset Manajemen*, 1(1).
- Yancadianti, K. H., Puspitasari, N. B., & Arvianto, A. (2015). Analisa Pemilihan Supplier Ramah Lingkungan dengan Metode Analytical Hierarchy Process (AHP) Pada PT X. *Industrial Engineering Online Journal*, 4(4).
- Yang, Y.-P. O., Shieh, H.-M., Leu, J.-D., & Tzeng, G.-H. (2008). A novel hybrid MCDM model combined with DEMATEL and ANP with applications. *International journal of operations research*, 5(3), 160-168.
- Yazdani, M., Chatterjee, P., Zavadskas, E. K., & Zolfani, S. H. (2017). Integrated QFD-MCDM framework for green supplier selection. *Journal of Cleaner Production*, 142, 3728-3740.
- Yildiz, A. (2016). Interval type 2-fuzzy TOPSIS and fuzzy TOPSIS method in supplier selection in garment industry/Metoda fuzzy TOPSIS Interval tip 2 si metoda fuzzy TOPSIS în selectarea furnizorului din industria de confectii. *Industria Textila*, 67(5), 322.