ESS 2021_4347_The application of Factor.docx

by

Submission date: 25-Aug-2021 08:19PM (UTC+0700)
Submission ID: 1635748215
File name: ESS 2021_4347_The application of Factor.docx (163.04K)
Word count: 4116
Character count: 22285

The application of Factor Analysis (FA) in evaluating suppliers selection criteria in PT. Wijaya Karya Beton Tbk Indonesia and ranking suppliers using Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS)

Abstract

The largest factories of the cocrete iron industry in Indonesia is PT. Wijaya Karya Beton Tbk. The company is faced with supplier selection problem. Each supplier has its own advantages and disadvantages, making it difficult for the company to choose the right supplier. There are many criteria that can be used in supplier selection. Based on previous research, all of the criteria are selected using factor analysis, to determine suitable criteria in the cocrete iron industry in Indonesia. Then after obtaining the criteria used, the supplier assessment is carried out using Technique for Order Preference by Similarity to Ideal Solutions *(TOPSIS). The results showed that the use of factor analysis and TOPSIS methods can be used to select the right suppliers for the cocrete iron industry in Indonesia. Then there are 13 sub-criteria that are considered in selecting the right supplier at PT Wijaya Karya Beton Tbk. These sub-criteria are divided into four criteria. Azuma Co., Ltd. selected for the first best supplier and Mastex Inc. was ranked second.*

Keywords: Technique for Order Preference by Similarity to Ideal Solutions *(TOPSIS)*, supplier selection, main-criteria, factor analysis (FA)

I. INTRODUCTION

The inability of a business or industry to handle all the needs for the smooth running of the business is often found considering the many and complex things that must be considered. The increasing demands from end customers force companies to focus on their core competencies and let suppliers do some of the work (Jain et al., 2016). Supplier selection becomes very important when used in the context of strategic partnerships because of the long-term orientation relationship (Govindaraju et al., 2014).

The concrete iron industry has an important role in the Indonesian economy. The largest factory of the concrete iron industry in Indonesia is PT. Wijaya Karya Beton Tbk. The company have some suppliers. There is no perfect supplier, such as a supplier has a good performance in one criterion but in another criterion has a bad score. On the other hand, choosing the wrong supplier can disrupt the company's productivity. So that research was conducted to create a supplier selection model that can be applied to the concrete iron companies in Indonesia.

The involvement of multiple criteria, multiple alternatives and different perspectives of decision makers further complicate the supplier selection process (Nakiboglu & Bulgurcu, 2020). Therefore, choosing the best supply chain is an important strategic decision and will increase the company's competitiveness (Eleren & Yilmaz, 2011). So this research helps PT. Wijaya Karya Beton Tbk in unifying opinions about what the good performance of suppliers are, with the aim of evaluating suppliers, so that the the company can give ratings to suppliers.

One of the MCDM methods, namely the Technique For Order Preference by Similarity To Ideal Solutions (TOPSIS) is claimed to be one of the best methods, and is also suitable for large-scale problems consisting of a number of criteria and alternatives (Sureeyatanapas et al., 2018). Therefore, this study proposes the use of the TOPSIS method which has been popularly used in supplier selection problem related to the many industry, such as construction projects (Marzouk and Sabbah, 2021), steel industry (Azimifard et al., 2018), agri-food industry (Banaeian et al., 2018), automotive industry (Gubta et al., 2019), and so on.

The purpose of this study is application of Factor Analysis (FA) in evaluating suppliers selection criteria and ranking suppliers using Technique for Order Preference by Similarity to Ideal Solutions (TOPSIS) in the concrete iron industry in Indonesia. The advantage of the factor analysis method and TOPSIS used in this research is that it has the flexibility to be used in supplier selection in different businesses and sectors by taking the appropriate criteria and weights into consideration. In addition, this method approach is easy to adapt and can be applied in practice. This study considers the preferences, experiences and differences of decision makers in organizations.

II. RESEARCH METHODOLOGY

There are three stages in this research. In the first phase is supplier criteria selection. Factor analysis is used in this stage. Principal of the factor analysis is finding the interdependence between variables, and then finding a new set of variables. This new set of variables are fewer in number than the original variable, and shows which ones of the original variables are common factors. This means that factor analysis can also describe the data structure of a study. The second stage is criteria weighting stage. The criteria from the result of factor analysis method were used for the preparation and filling of the second stage of the questionnaire.

The last stage is the assessment of the supplier assessments carried out by the decision makers of each company using second questionnaire. In this stage is also supplier selection using TOPSIS. TOPSIS aims to determine positive ideal solution and negative ideal solution. The positive ideal solution maximizes the benefit criteria and minimizes the cost criteria, while the negative ideal solution maximizes the cost criteria and minimizes the benefit criteria. TOPSIS uses the principle that the chosen alternative not only has the shortest distance from the positive ideal solution, but also has the longest distance from the negative ideal solution. The concept of three stages in this study is presented in Figure 1.

The study began with the collection of criteria conducted by studying literature in accordance with the theme and research topic, namely the selection of suppliers using the TOPSIS method. In searching the literature that was suitable to the research topic and obtained some appropriate journals. There are 54 criteria from the previous reserach. All of criteria can be seen in Appendix 1. Based on those criteria, questionnaire is used to determine the supplier selection criteria. After the questionnaires were distributed to all decision maker in PT. Wijaya Karya Beton Tbk, filled out and collected again, then the results of the questionnaire were tested using the normality test and then processed using factor analysis with the Kaiser Meyer Oikin (KMO) test.

The purpose of the normality test is to find out whether a variable is normal or not. Data that is normally distributed means that it has a normal distribution as well. With this kind of data profile, the data is considered to be representative of the population. The normality test technique used is One Sample Kolmogorov-Smirnov (K-S). The data is said to be normally distributed if the significance value is greater than 0.05 at the significance level = 0.05.

KMO test aims to determine whether all the data that has been taken is sufficient to be factored. The factor analysis technique used is Confirmatory Factor Analysis (CFA). The factor rotation method used is varimax. The validity of the correlation between variables in measuring a concept is done by analyzing the result of Kaiser-Mayer-Oklin Measure of Sampling Adequancy (KMO MSA) test. The desired KMO MSA value must be > 0.50 for factor analysis to be carried out and the significance coefficient of Barrtlett's Test of Sphericity is less than 5% or 0.05.

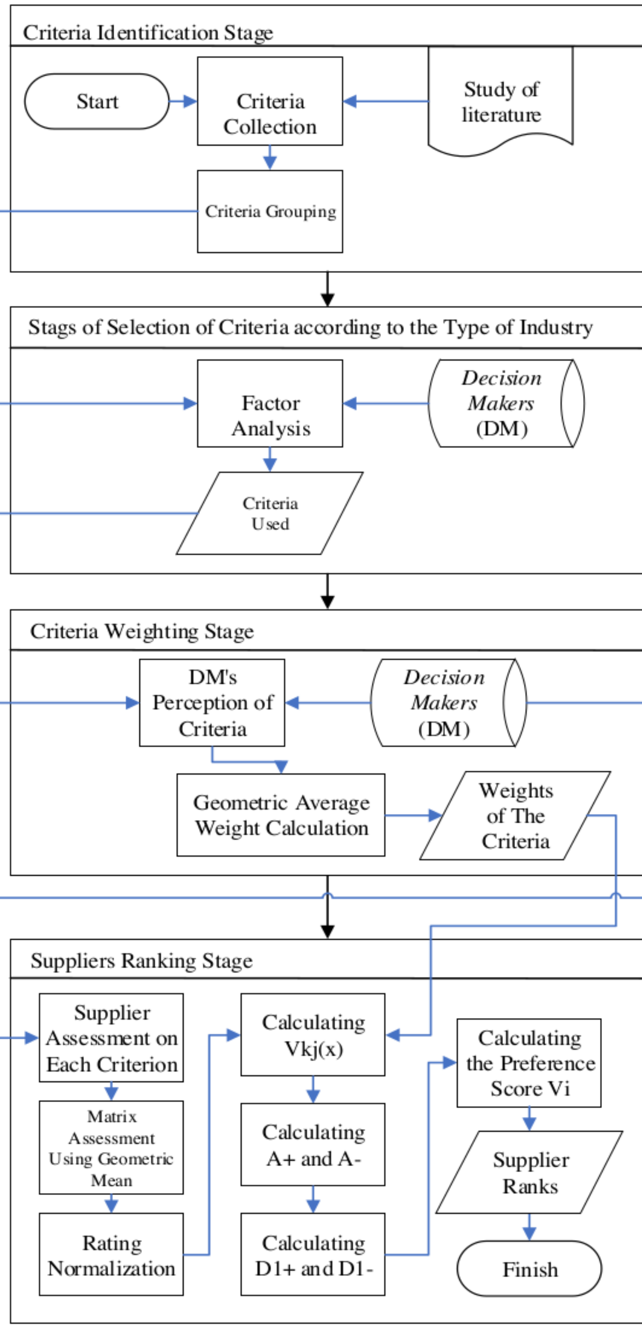

Figure 1 The concept of three stages method in this study

III. FINDING AND DISCUSSION

3.1. Finding

In the first iteration, only one criterion has an MSA value > 0.5. Then the process must be repeated by investigating the Anti-image Correlation table and issuing the sub-criteria with the smallest Measures of Side Adequacy (MSA) value in the Anti-image Matrices table and below 0.5. Processing is carried out continuously until all the conditions for factor analysis have been met. So the processing stops at the fifth iteration. In iteration 5 there are 13 criteria analyzed. In the SPSS output results in the Appendix 2, there are four criteria formed from the 13 criteria analyzed. The requirement to become a criterion is that the Eigenvalue must be greater than 1. The Eigenvalue Component 1 is 4.845 or >1 then it becomes criterion 1 and is able to explain 37.268% variation and forth.

To find out a criterion or a variable is included in a main-certain or criteria group, it can be determined with the largest correlation between the variables and the main-criteria formed. How to read the results of the rotational model factor analysis in Appendix 3 is to compare the scores of the min-criteria for each criterion and then take the largest score among the others. Criterion 4 has the largest score on main-criterion 1, which is 0.766 (compared to main-criterion 2, which is -0.250, main-criterion 3 is 0.153 and main-criterion 4 is -0.56) so that the criterion 4 is included in main-criterion 1, and so on. In the same way, that is, the largest criterion value is taken, the Flexibility, Location, Organization & Management, and Social Assistance Community are included in main-criterion 1. As for the Accesibility, Human Resources Development (HRD), Production Planning, and Facility Support System are included in main-criteria 2. Reputation & Experience, Disaster Prone, Technology Capability, and Green Competence are included in main-criterion 3. Lastly, Relationsgip is included in main-criteria 4.

In the stage of criteria weighting by using the geometric mean theory (Saaty, 1993), the average weight of criteria and suppliers was sought. This calculation is intended to determine the average rating given by the some decision maker in PT. Wijaya Karya Beton Tbk. The supplier's priority weight of the geometric average are calculated by the same method as the calculation of the average weight of the criteria. The input to this calculation is second questionnaire data. The results of the calculation of the supplier's geometric average priority weight can be seen in Appendix 4.

In the stage of supplier assesment, the input data is the geometric mean weight of the criteria and the geometric average priority weight of the suppliers which has been calculated in the previous stage. The steps used follow the TOPSIS method procedure which can be seen in Appendix 5 until Appendix 10. The result of the suppliers ranking can be seen in Figure 2.

The research problem stated in this study can be solved by determining the supplier selection criteria for the company first. The criteria considered important by decision makers is collected by factor analysis method. Factor analysis processing is carried out first and aims to unite all respondents' opinions from the the company precisely. The final results of iteration 5 in factor analysis calculations show that there are four criteria to consider in supplier selection.

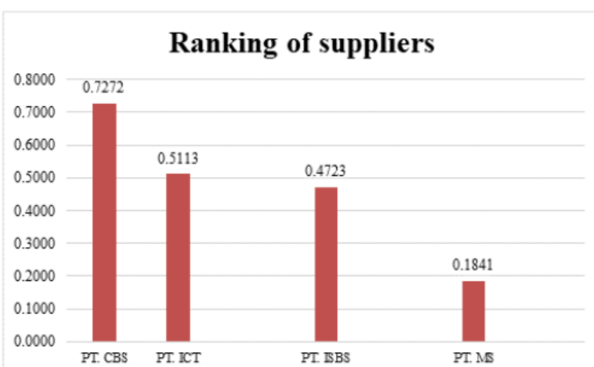

Figure 2 Ranking of suppliers in PT. Wijaya Karya Beton Tbk

3.2. Discussion

The results of the geometric mean priority weight calculation in Appendix 2 of the four most influential and most considered criteria in supplier selection are criterion 1 because they have the highest weight, which is 26.4.5 %. This is because main-criterion 1 includes the most important criteria considerations, namely Flexibility, Location, Organization & Management, and Social assistance community.

Flexibility is the most important thing in choosing a supplier because the raw materials quality is one of the final product quality biggest determinants. If the quantity of raw materials decreases or increase because of covid pandemic, so the supplier will also allowed. Meanwhile, the location is also an important factor in determining suppliers because it relates to industries that can survive in the future in addressing environmental situation. Location include improper geographic site, as well as the many constraints in covid pandemic period. In recent years, criteria of social assistance community has become the main focus of concrete iron business operations because the development of the concrete iron industry causes harmful effects to the social environment, both indirectly and directly. If suppliers pay close attention to the social environment, then suppliers will get support from many parties and be more sustainable in the future.

The next criterion included in main-criterion 1 is Organization & Management. Good management in the suppliers will be adapt many improvements in the production, such as robot-aided production, 3D printing and scanning, automation, and simulation. Suppliers who adapt Digital Production Systems tend to have production processes that are effective, efficient, controlled, and have minimum defects (Özbek and Yıldız, 2020). Suppliers who adapt Digital Production Systems are preferred by companies because it is easier for companies to put their trust in suppliers who already use leading-edge technology. Besides, good management in supplier will be maintain to the availability of inventory. Because availability of inventory is an important consideration in the selection of suppliers because companies really need sufficient quantities to produce products.

The second most important criteria are main-criterion 2 (Accessibility, HRD, Production planning, Facilities support system), main-criterion 3 (Reputation & Experience, Disaster prone, Technology capability, Green competence) and main-criterion 4 (relationship). These three factors are ranked 2 because the three main-criteria have the same weight scores of 0.245 (24.5%). It can be seen that Accessibility, HRD, Production planning, Facilities support system, Reputation & Experience, Disaster prone, Technology capability, Green competence, and relationship are equally important in determining suppliers for companies and for strategic partnerships. These aspects are important for the sustainability of the company. Sustainable development is very important in the modern business. By forming strategic partnerships, both company and supplier have the potential to significantly improve the sustainability of the business.

PT. CBS has the highest score which is chosen as the first choice as the best supplier. PT. CBS has the highest score on the geometric average priority weight on main-criterion 1 and main-criterion 2. Main-criterion 1 has the highest weight, so it becomes the priority of selection. This is proven by the answers to the questionnaire that rated PT. CBS with the highest score on priority main-criteria than other suppliers.

Then in the second place followed by PT. ICT. This supplier has the second highest of the geometric mean priority weight score. PT. ICT got the highest score on main-criteria 4 and the second highest score on main-criteria 2 after PT. CBS. The third rank is PT. ISBS which has the second highest score on main-criteria 3 and main-criteria 4 and has the third highest score on main-criterion 2. In the fourth rank there is PT. MS. This supplier received the highest score on main-criterion 3 and the third highest score on main-criterion 2

The TOPSIS method uses the principle that the chosen alternative must has the closest distance from the positive ideal solution and the farthest from the negative ideal solution, from a geometric point of view by using the Euclidean distance to determine the relative proximity of an alternative to the optimal solution. The positive ideal solution is defined as the sum of all the best scores that can be achieved for each criterion, while the negative ideal solution consists of all the worst scores achieved for each criterion.

TOPSIS considers both the distance to the positive ideal solution and the distance to the negative ideal solution by taking relative proximity to the positive ideal solution. Based on the comparison to the relative distances, an alternative priority arrangement can be achieved. The TOPSIS method is based on the concept that the best chosen alternative not only has the shortest distance with a positive ideal solution, but also has the longest distance from the negative ideal solution and considers holistically (all subcriteria and other alternative values).

The supplier with the shortest distance from the positive ideal solution on the first rank is PT. CBS and followed by PT. ICT. Based on the scores of the distance between the supplier and the negative ideal solution shows that the supplier with the longest distance from the negative ideal solution is PT. CBS and also followed by PT. ICT. Therefore PT. CBS was chosen to be the first supplier and PT. ICT became the second. So that the biggest priority order can be allocated to PT. CBS and then the second biggest allocation order can be assigned to PT. ICT.

The result of PT. CBS as the main supplier shows that the application of factor analysis and TOPSIS methods can be used in answering the company's problems to choose the right supplier. This is proven by the research in second questionnaire data described and combined with the weights of each main-criterion to obtain results that are in accordance with the final results of factor analysis and TOPSIS.

IV. CONCLUSION AND FURTHER RESEARCH

The result of processing and analyzing data using the TOPSIS method, the best supplier for PT. Wijaya Karya Beton Tbk was selected, PT. CBS. Then followed by PT. ICT who was in second place. In the third and fourth positions respectively are PT. ISBS and PT. MS.

Acknowledgment

The authors thank UPN "Veteran" Yogyakarta for their funded according to the agreement number **B/41/UN.62/PT/IV/2021**.

REFERENCES

Azimifard, A., Moosavirad, S. H., and Ariafar, S. (2018). Selecting sustainable supplier countries for Iran's steel industry at three levels by using AHP and TOPSIS methods. *Resources Policy* 57, 30–44.

Banaeian, N., Mobli, H., Fahimnia, B., Nielsen, I.E., dan Omid, M. (2018). Green supplier selection using fuzzy group decision making methods: A case study from the agri-food industry. *Computers & Operations Research* 89: 337-347.

Dweiri, F., Kumar, S., Khan, S.A., dan Jain, V. (2016). Designing an integrated AHP based decision support system for supplier selection in automotive industry. *Expert Systems with Applications* 62: 273–283.

Eleren, A. dan Yilmaz, C. (2011). Selection of Suppliers by Fuzzy Topsis Model; Sample Study from Turkey. *International Journal of Business and Social Science*, 2 (22), 189-200.

Erginel, N., and Gecer, A. (2017). Fuzzy Multi-Objective Decision Model for Calibration Supplier Selection Problem. *Computers & Industrial Engineering* 102: 166-174.

Galankashi, M.R., Helmi, S.A., dan Hashemzahi, P. (2016). Supplier selection in automobile industry: A mixed balanced scorecard–fuzzy AHP approach. *Alexandria Engineering Journal* 55: 93–100.

Govindaraju, R., Akbar, M.I., Gondodiwiryo, L., dan Simatupang, T. (2015). The Application of a Decision-making Approach based on Fuzzy ANP and TOPSIS for Selecting a Strategic Supplier. *ITB Journal Publisher*, 47, 406-425.

Gupta, S., Soni, U., and Kumar, G. (2019). Green supplier selection using multi-criterion decision making under fuzzy environment: A case study in automotive industry. *Computers & Industrial Engineering* 136, 663–680.

Hashemi, S.H., Karimi, A., dan Tavana, M. (2015). An integrated green supplier selection approach with analytic network process and improved Grey relation analysis. *International Journal of Production Economics* 159: 178 – 191.

Heidarzade, A., Mahdavi, I., dan Amiri, N.M. (2016). Supplier selection using a clustering method based on a new distance for interval type-2 fuzzy sets: A case study. *Applied Soft Computing* 38: 213 – 231.

Jain, V., Sangaiah, A.K., Sakhuja, S., Thoduka, N., dan Aggarwal, R. (2016). Supplier selection using fuzzy AHP and TOPSIS: a case study in the Indian automotive industry, *Neural Computing and Applications*, 29, 555–564.

Luthra, S., Govindan, K., Kannan, D., Mangla, S.K., and Garg, C.P. (2017). An integrated framework for sustainable supplier selection and evaluation in supply chains. *Journal of Cleaner Production* 143(3): 1686-1698.

Marzouk, M. and Sabbah, M. (2021). AHP-TOPSIS social sustainability approach for selecting supplier in construction supply chain. *Cleaner Environmental Systems* 2, 100034.

Memon, M.S., Lee, Y.H., and Mari, S.I. (2015). Group multi-criteria supplier selection using combined grey systems theory and uncertainty theory. *Expert Systems with Applications* 42(21): 7951 – 7959.

Nakiboglu, G. and Bulgurcu, B. (2020). Supplier selection in a Turkish textile company by using intuitionistic fuzzy decision-making. *The Journal of The Textile Institute*, 112(2), 322-332.

Özbek, A. and Yıldız, A. (2020). Digital Supplier Selection for a Garment Business Using Interval Type-2 Fuzzy TOPSIS. *Tekstil ve Konfeksiyon*, 30 (1), 61-72.

Rezaei, J., Nispeling, T., Sarkis, J., and Tavasszy, L. (2016). A supplier selection life cycle approach integrating traditional and environmental criteria using the best worst method. *Journal of Cleaner Production* 135: 577-588.

Sureeyatanapas, P., Sriwattananusart, K., Niyamosoth, T., Sessomboon, W., and Arunyanart, S. (2018). Supplier selection towards uncertain and unavailable information: An extension of TOPSIS method. *Operations Research Perspectives*, 5, 69-79.

Wu, Y., Chen, K., Zeng, B., Xu, H., and Yang, Y. (2016). Supplier selection in nuclear power industry with extended VIKOR method under linguistic information. *Applied Soft Computing* 48: 444–457.

Yadav, V., and Sharma, M.K. (2016). Multi-criteria supplier selection model using the analytic hierarchy process approach. *Journal of Modelling in Management* 11(1): 326 – 354.

Appendix 1.

Table 1.
The results of the K-S normality test of the first questionnaire

Criteria	Sig.	Normal Distributed Data
Price (Azimifard et al., 2018)	0,024	X
Discount (Yadav and Sharma, 2016)	0,087	√
Payment term (Erginel and Gecer, 2017)	0,033	X
Quality (Luthra et al., 2017)	0,211	√
Sertification (Azimifard et al., 2018)	0,01	X
Delivery (Dweiri et al, 2016)	0,078	√
Packaging (Erginel and Gecer, 2017)	0,007	X
Flexibility (Luthra et al., 2017)	0,113	√
Shipment (Banaeian et al., 2018)	0,034	X
Location (Galankashi et al., 2016)	0,255	√
Accesibility (Erginel and Gecer, 2017)	0,156	√
CS & Warranty (Banaeian et al, 2018)	0,168	√
Relationship (Wu et al, 2016)	0,224	√
Finance & Capital (Galankashi et al., 2016)	0,205	√
Reputation & Experience (Erginel and Gecer, 2017)	0,170	√
Organization & Management (Erginel and Gecer, 2017)	0,063	√
HRD (Banaeian et al, 2018)	0,073	√
Company Culture (Heidarzade et al., 2016)	0,358	√
Production Planning (Galankashi et al., 2016)	0,070	√
Facilities Support System (Rezaei et al., 2016)	0,183	√
Production Capacity (Luthra et al., 2017)	0,015	X
R & D (Wu et al., 2016)	0,106	√
Technology Capability (Banaeian et al., 2018)	0,334	√
Health & Safety (Marzouk and Sabbah, 2021)	0,092	√
Welfare, equity & Stakeholder's right (Marzouk and Sabbah, 2021)	0,060	√
Social assistance community (Marzouk and Sabbah, 2021)	0,061	√
Disaster prone (Memon et al, 2015)	0,289	√
Unrest social, economy & politic (Hashemi et al., 2015)	0,075	√
Legality (Luthra et al., 2017)	0,012	X
Pollutant (Gubta et al., 2019)	0,371	√
Green Competence (Azimifard et al., 2018)	0,378	√

Appendix 2.

Table 2.
Total variance explained

Criteria	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4,845	37,268	37,268	4,845	37,268	37,268
2	1,838	14,140	51,409	1,838	14,140	51,409
3	1,397	10,749	62,158	1,397	10,749	62,158
4	1,230	9,460	71,618	1,230	9,460	71,618
5	,989	7,611	79,228			
6	,657	5,056	84,284			
7	,557	4,283	88,567			
8	,438	3,371	91,938			
9	,330	2,539	94,478			
10	,268	2,063	96,541			
11	,193	1,484	98,024			
12	,146	1,123	99,147			
13	,111	,853	100,000			

Extraction Method: Principal Component Analysis.

Appendix 3.

Table 3.
Rotated component matrix(a)

Criteria	Main-criteria			
	1	2	3	4
K1	0,766	-0,250	0,153	-0,056
K2	0,729	-0,029	-0,275	0,338
K3	-0,366	0,394	0,350	-0,213
K4	0,073	-0,153	-0,107	0,911
K5	-0,091	0,381	0,760	-0,015
K6	0,863	-0,041	-0,114	-0,013
K7	-0,139	0,778	0,224	-0,317
K8	0,012	0,858	0,103	-0,011
K9	-0,280	0,723	0,162	0,028
K10	-0,533	0,184	0,554	-0,108
K11	0,582	-0,514	-0,051	-0,343
K12	0,112	0,018	0,907	-0,207
K13	-0,415	0,202	0,604	0,363

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 6 iterations.

Appendix 4.

Table 4.
Supplier geometric average priority weight

Supplier	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Sum	Priority
PT. ISBS	3.6342	3.3019	2.8845	3.3019	0.9810	0.2452
PT. MS	2.6207	3.5569	3.3019	2.6207	0.8974	0.2244
PT. CBS	3.3019	3.9149	3.3019	4.3089	1.1000	0.2750
PT. ICT	2.6207	3.6342	3.9149	3.6342	1.0216	0.2554

Appendix 5. Normalized decision R in TOPSIS method

Supplier	Criterion 1	Criterion 2	Criterion 3	Criterion 4
PT. ISBS	0.1560	0.1121	0.1048	0.1149
PT. MS	0.1125	0.1207	0.1200	0.0912
PT. CBS	0.1417	0.1329	0.1200	0.1500
PT. ICT	0.1125	0.1234	0.1423	0.1265

Appendix 6. Normalized decision R times with each weight

Supplier	Criterion 1	Criterion 2	Criterion 3	Criterion 4
PT. ISBS	3.6342	3.3019	2.8845	3.3019
PT. MS	2.6207	3.5569	3.3019	2.6207
PT. CBS	3.3019	3.9149	3.3019	4.3089
PT. ICT	2.6207	3.6342	3.9149	3.6342

Appendix 7. Positive ideal solution and negative ideal solution

Supplier	Criterion 1	Criterion 2	Criterion 3	Criterion 4
Positive Ideal Solution	0.1560	0.1329	0.1423	0.1500
Negative Ideal Solution	0.1125	0.1121	0.1048	0.0912

Appendix 8. The distance between the values of each alternative and the positive ideal solution

Supplier	Criterion 1	Criterion 2	Criterion 3	Criterion 4
PT. ISBS	0.0000	0.0004	0.0014	0.0012
PT. MS	0.0019	0.0001	0.0005	0.0035
PT. CBS	0.0002	0.0000	0.0005	0.0000
PT. ICT	0.0019	0.0001	0.0000	0.0006

Appendix 9. The distance between the values of each alternative and the negative ideal solution

Supplier	Criterion 1	Criterion 2	Criterion 3	Criterion 4
PT. ISBS	0.0019	0.0000	0.0000	0.0006
PT. MS	0.0000	0.0001	0.0002	0.0000
PT. CBS	0.0009	0.0004	0.0002	0.0035
PT. ICT	0.0000	0.0001	0.0014	0.0012

Appendix 10. Preference values of each alternative

Supplier	D_i^+	D_i^-	$D_i^+ + D_i^-$	V_i
PT. ISBS	0.0553	0.0495	0.1049	0.4723
PT. MS	0.0774	0.0175	0.0948	0.1841
PT. CBS	0.0264	0.0705	0.0969	0.7272
PT. ICT	0.0503	0.0527	0.1030	0.5113

ESS 2021_4347_The application of Factor.docx

ORIGINALITY REPORT

10%	10%	7%	%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	mafiadoc.com Internet Source	3%
2	D M D U Putra, P A Pratama. "Decision support system selection of tender winners project development building of STMIK STIKOM Indonesia with TOPSIS method", Journal of Physics: Conference Series, 2020 Publication	1%
3	Gulsun Nakiboglu, Berna Bulgurcu. "Supplier selection in a Turkish textile company by using intuitionistic fuzzy decision-making", The Journal of The Textile Institute, 2020 Publication	1%
4	worldwidescience.org Internet Source	1%
5	eprints.uny.ac.id Internet Source	1%
6	repository.ubaya.ac.id Internet Source	1%
7	www.ijcaonline.org	

Internet Source

1%

8	ikee.lib.auth.gr	Internet Source	1%
9	www.jatit.org	Internet Source	1%

Exclude quotes	On	Exclude matches	< 1%
Exclude bibliography	On		