Dynamic supplier selection strategy towards negotiation process in beef industry using K-means clustering

by Paduloh , T Djatna Sukardi And Muslich

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Abstract. Dynamic supplier selection strategy is the actual condition to get the best supplier and selecting supplier based on company condition, in conditions of uncertain demand for beef. The key criteria when choosing suppliers include the Term of Payment, price and quality factor; these criteria are used by the company during the negotiation process. The purpose of this research is to get the most appropriate and profitable supplier, then obtain proof that K-means clustering can be used as a strategy to simplify the negotiation process in supplier selection. The method used for clustering is K-means. From the analysis, the company gets the right cluster supplier to facilitate the process of selecting suppliers and negotiate the price and time offered. The clustering process using K-means shows which supplier is the most profitable with characteristics that are almost the same as the specified centroid. Dynamic demand changes can be solved by changing the number of clusters to make it easier for companies and still earn profitable suppliers. Companies can negotiate with suppliers in clusters; thus, the suppliers can meet the standards given by the company. Further research is suggested to do clustering with more variety of attributes such as lead time of delivery, service, and capital owned by suppliers.

1. Introduction

Dynamic supplier selection strategy is important to be considered by a company to obtain the best suppliers and to balance between customer demand and supply. A common problem that is often encountered in the industry is the inability of suppliers to fulfill demand following company requests such as quality problems and delivery time. Changes in demand for beef in Indonesia are very dynamic, where demand is greatly influenced by many factors such as religious holidays, wedding seasons, and changes in the demand for the food industry. Research on anticipating dynamic demand changes and supplier selection has been done using several methods. Sucky (2005) used fuzzy logic to solve the problem of the supplier's selection, where the results are very suitable for parameter uncertainties of dynamic supplier selection [1]. Xue-zhen (2007) implemented Vendors Selection using AHP and BSC for strategic long-term vendor selection issues [2]. Meanwhile, Sarkis and Talluri, 2002 made an evaluation and selection of suppliers considering multiple factors and the dynamic aspects of the environment using ANP [3].

The negotiation process plays an important role in customer selection. When we have determined which customers are close to the parameters needed by the company, the company negotiates to get

the convenience to support its business. Negotiations are carried out by the company to balance the price, time of payment, product quality as well as to see the supplier's supply capabilities [4,5]. Previous research on the negotiation process has been carried out such as Taluri *et al* who solved problems about supplier selection and negotiation using a combination of data envelopment analysis and multi-criteria decision models [6]. Saorin-Iborra and Cubillo (2019) researched negotiation in supplier selection by relating to supplier behavior and its impact on customer satisfaction [4].

The demand for beef is very much influenced by divine events, such as holidays. During holidays, the demand for beef will increase sharply, while in other months, it can be said that the demand curve tends to be flat and unchanged. As a result, the demand for meat inflation cannot be anticipated by farmers. This affects the demand elasticity becomes more detrimental to consumers, and the farmers have not been able to do much about it. Fluctuation data in beef demand can show in figure 1 below, In terms of negotiation and beef supply as a company goal, companies must have a mutually beneficial strategy, between companies and farmers, both local farmers and importers. For this reason, this study will form a negotiation strategy that can be mutually beneficial among business people.

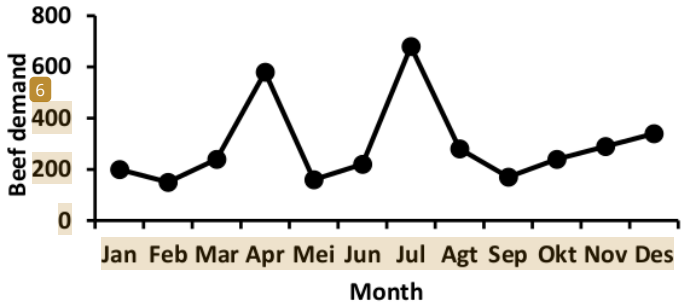

Figure 1. Beef demand in 2018 (PT Cianjur Artha Makmur).

Based on figure 2, the main purpose of supplier selection is to get supplier raw materials at the most optimum cost [7]. The process of obtaining raw materials at the most optimum price is the biggest challenge faced by the procurement department of a company. It is because the process of getting suppliers is able to support the company's production continuity that will greatly determine the quality of the products produced, the company's profits, and supply stability. In the research on negotiation, Talluri *et al* (2009) state that negotiation is a key activity to get all company parameters to get raw materials at prices that benefit the company [6]. In this study, various factors were very influential during negotiation. Effectiveness in negotiations will greatly affect the company's long-term relationship. For strategy in supplier selection, Cakravastia and Takahashi (2004) used the negotiation process by generating a set of effective alternatives in each negotiation period [8]. Mohebbi and Shafaei (2019) conducted research on the dynamic negotiation model, which was then defined based on the protocol, rule of the bargain, proposal generation, and dynamic strategy [5].

State of the art from this paper is to discuss supplier clustering which includes payment terms, price, and quality in supplier selection to get low prices and to increase the total cost of the company. This study shows how clustering using K-means can be a dynamic strategy in managing supplier behavior. The purpose of the research is to get the most appropriate and profitable supplier, then obtain proof that K-means clustering can be used as a strategy to simplify the negotiation process in supplier selection.

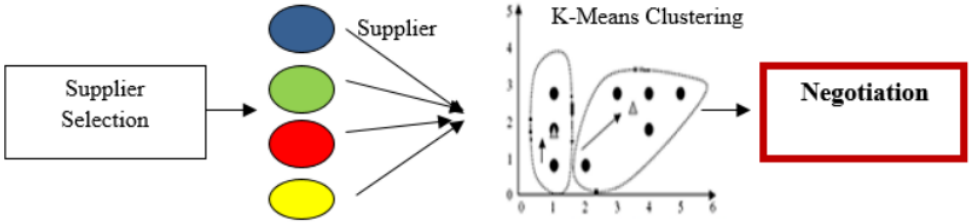

Figure 2. Strategy in supplier selection and negotiation.

2. Methodology

Research on negotiation and supplier selection has been done. Mohebbi and Shafaei (2019) did research on intelligent agent for buyer-supplier dynamic negotiations [5]. Prado and Martinelli (2018) conducted research on the analysis of negotiation strategies between buyers and sellers, an applied study on crop protection products distribution [9]. For cases at the beef industry, Singh (2018) conducted research to improve efficiency and reduce waste for the sustainable beef supply chain [10]. This paper using K-means clustering for supplier selection, based on supplier parameters like the term of payment, price and quality, for research methodology can show in figure 3 below.

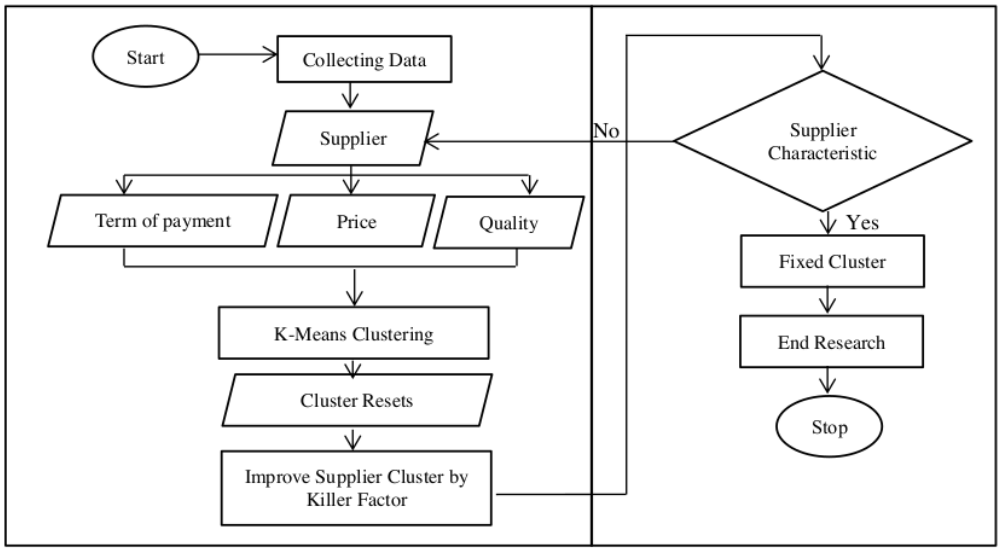

Figure 3. Research methodology.

From figure 3 above this study started with collecting data for suppliers and the criteria for supplier selection, like a term of payment, price, and quality. Based on the parameter K-means clustering was conducted, Supplier selection is the most decisive activity in a company. Mistakes in selecting suppliers will greatly affect the profits the company gets. Other mistakes in selecting suppliers include the company does not carry out the right strategy, does not recognize the supplier's character and does not make the right approach to the suppliers. Research on supplier selection has been carried out and most of them discussed the method of decision making in supplier selection [11-16]. Prado and Martinelli (2018) analyzed strategy for buyer and seller covering three areas, namely: competitive, compromise and collaborative, and real negotiation [9]. The study captured the real situations between buyers and sellers and interaction within a relationship, how the actor made a strategy for negotiation

and motives may influence their use. The use of compromise strategies can be seen as a technique to make the producer more satisfied without harming the relationship between them, seeking the maximization of long-term results. Moreover, compromise approaches were presented as a defense by sellers, since they were willing to lose a little in the current negotiations but to continue their business with the producer in the following year.

The activity process of supplier selection is used to find a new resource; and in the initial stage, the user releases product parameters as a requirement of raw material or product [17]. Based on the requirement, procurement searches the supplier that can accommodate the requirement. After a list of candidates of the supplier has been made, procurement does further stages of supplier selection. Negotiations with the best candidate suppliers are carried out to obtain all product parameters by considering the ability to supply a certain amount, quality and price of raw material or product. On negotiation strategy buyers and sellers studied 13 cases in the same trading, a matrix of buyer-seller negotiation strategies, explored the motives that led negotiators to change strategy throughout the process, as well as other motives that may appear [9].

Talluri *et al* (2008) studied the optimization models for assisting buyer-supplier negotiations by effectively considering multiple factors and interrelationships among them [6]. Design/methodology/approach, data envelopment analysis (DEA) model and multi-criteria decision models were used. Mohebbi and Shafaei (2012) studied negotiation with e-SNC (supply network coordination) [5]. The dynamic negotiation model is then defined based on the protocol, rule of the bargain, proposal generation, and dynamic strategy. Further research may consider more uncertainty in the network. A random number of suppliers and expansion of the network by including more echelons like manufacturers and retailers to extract the optimal strategies are interesting to consider for coordination improvement in an SN. Lee and Ou-Yang (2009) developed an intelligent system for negotiation support in the supplier selection process [18]. An artificial neural network-based predictive model with the application was used to forecast the supplier's bid prices in the supplier selection negotiation process (SSNP).

Research on K-means Clustering was conducted by Chen *et al* (2012), where K Means is a method including partitioned clustering and the objects are categorized into groups or clusters [19]. To do this clustering, the value of K must be determined in advance, and the clusters have a center value called the centroid using a measure of dissimilarity to group objects. Differences are translated into the concept of distance (*d*) [20]. If the distance of two objects or data points is close enough, the two objects are similar, getting closer means higher in the resemblance. The objective of K-means is to minimize the total distance of elements between clusters, the distance between an element in a cluster and the value of the cluster's centroid.

In the K-means algorithm, select the desired number of clusters then initialize the cluster center (centroid) randomly. Place each data or object to the closest cluster. The proximity of two objects is determined by distance. The distance used in the K-means algorithm is *Euclidean distance* (*d*). $\boldsymbol{X} = x_1, x_2, \ldots, x_n$, and $\boldsymbol{Y} = y_1, y_2, \ldots, y_n$ is the number of n attributes (columns) between 2 records. Recalculate the cluster center with the current cluster membership. The cluster center is the average (mean) of all data or objects in a particular cluster [21].

$$d_{Euclidean}(x, y) = \sqrt{\sum_{i=1}^{n} (x_i - y_i)^2}$$

Khan and Ahmad (2013) proposed an application procedure to clustering algorithms for continuous data, and K-means Clustering showed improved and consistent solutions [22]. Zuang (1998) experimented in reducing cost function by demonstrating a K-means clustering performance of the two algorithms [23]. The results show that the two algorithms are efficient when clustering large data sets, which is critical to data mining applications. Wagstaff (2001) conducted research on how the K-means clustering algorithm can be profitably modified with experiments of artificial constraints for

improvements in clustering accuracy [24]. The method can be applied to a real-world problem and increases performance.

3. Results and discussions

The critical objectives of the company in terms of procurement and supply management include conducting a selection of key suppliers, building a long-term relationship with key suppliers, initiating benchmarking program to encourage ineffective suppliers, improve their performance, identify worst suppliers, and keep them out from supply base. In addition, it initiates a strategic sustainable procurement process to the full company's long-term goal, and to initiates strategies by reducing the supply base and willing to apply the supply base reduction method.

The first stage in clustering suppliers which facilitates the negotiation process is to identify the existing suppliers. In the case of selecting suppliers of beef suppliers, it was carried out on 10 suppliers with the main criteria of the term of payment, price, and quality. Whereas, the main criteria were used to determine suppliers and the basis for negotiating. Please see table 1 for the first stage below.

Table 1. First K-means clustering.

Supplier	ToP	Price	Quality	
1	6	4.6	9	
2	5	4.4	8	Cluster 1
3	3	4.3	7	
4	2	4.2	6	Cluster 2
5	1	4.0	9	
6	0.5	3.9	6	Cluster 3
7	4	4.5	8	
8	3	4.1	9	Cluster 4
9	6	4.7	5	
10	2	4.2	6	
Min	0.5	3.9	5	
Max	6	4.7	9	
Median	3	4.25	7.5	

The preliminary data obtained 4 clusters formed based on the assessment carried out on suppliers. From these results, the centroid was determined to make iteration so that the distance closest to the value could be obtained.

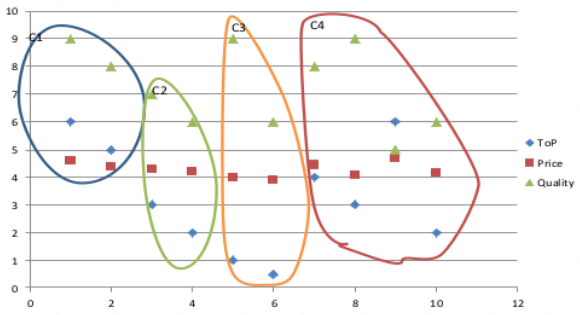

Figure 4. Clustering by original data.

Based on table 2, a chosen iteration as centroid for cluster 1 is supplier 2, the centroid for cluster 2 is supplier 4, the centroid for cluster 3 is supplier 6, and the centroid for cluster 4 is supplier 8. Clustering based on centroid can be seen in figure 4 where each supplier is categorized based on proximity to the centroid. The next step is to carry out iteration until the right cluster is found for each supplier. In table 4, you can see the calculation process to determine the closest actual distance.

Table 2. Iteration from clustering 1.

Supplier	ToP	Price	Quality
1	6	4.6	9
2	5	4.4	8
Different	1	0.2	1
Squared	1	0.04	1
		1.43	

The value of differences is obtained from the value in supplier 1 minus the center of the initial centroid, which is supplier 2 after all numbers are squared, and then the value for cluster 1 is the result of the iteration. The calculation is as follow:

R Squared = (Term of Payment)^2+(Price)^2+ (Quality)^2
= 1^2 + 0.04^2 + 1^2
= 1.43

Where the value of 1.43 is the initial value for supplier 1 for cluster 1 as shown in table 3 below.

Table 3. First iteration.

1st Data	C1	C2	C3	C4	Cluster
1	1.43	5.02	6.30	3.04	1
2	-	3.61	4.95	2.26	1
3	2.24	1.42	2.72	2.01	2
4	3.61	-	1.53	3.16	2
5	4.14	3.17	3.04	2.00	4
6	4.95	1.53	-	3.91	3
7	1.00	2.84	4.07	1.46	1
8	2.26	3.16	3.91	-	4
9	3.18	4.15	5.65	5.04	1
10	3.61	0.05	1.52	3.16	2

The iterations carried out, as seen in table 4, obtained members of each cluster, where Cluster 1 consists of 4 suppliers, Cluster 2 consists of 3 suppliers, Cluster 3 consists of 4 suppliers and Custer 4 has 2 suppliers. The value of each cluster can be seen in table 6.

From table 4, it can be seen that cluster 1 contains suppliers with Term of payment (ToP) ranging from 4 to 6 months and an average value of 5.25. The price of raw materials ranges from Rp44 to Rp47.- (in thousand rupiahs) with a median price of Rp45,4. Cluster 2 has a lower term of payment than cluster 1, has 3 suppliers, a term of payment ranges from 2 to 3 months, prices range from Rp41,5 –43.- and quality ranges from 6 to 7. Cluster 3 has 1 supplier with a term of payment of 0.5 months, the price of Rp39.- and a quality of 6. Finally, cluster 4 has 2 suppliers with terms of payment for 1 and 3 months, prices range from Rp40–Rp41 with the value of product quality of 9. With this clustering, the company can make a strategy to increase company profits. Identification of suppliers can also help the company be able to push suppliers to adjust according to the needs of the company.

Table 4. The cluster formed from the first iteration.

1st Data	Cluster1			Cluster2			Cluster3			Cluster4		
	ToP	Price	Quality	ToP	Price	Quality	ToP	Price	Quality	ToP	Price	Quality
1	6.00	4.60	9.00	-	-	-	-	-	-	-	-	-
2	5.00	4.40	8.00	-	-	-	-	-	-	-	-	-
3	-	-	-	3.00	4.30	7.00	-	-	-	-	-	-
4	-	-	-	2.00	4.20	6.00	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	1.00	4.00	9.00
6	-	-	-	-	-	-	0.50	3.90	6.00	-	-	-
7	4.00	4.45	8.00	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	3.00	4.10	9.00
9	6.00	4.70	5.00	-	-	-	-	-	-	-	-	-
10	-	-	-	2.00	4.15	6.00	-	-	-	-	-	-
Total	21.0	18.15	30.00	7.00	12.65	19.00	0.50	3.90	6.00	4.00	8.10	18.00
Number	4.00	4.00	4.00	3.00	3.00	3.00	1.00	1.00	1.00	2.00	2.00	2.00
Average	5.25	4.54	7.50	2.33	4.22	6.33	0.50	3.90	6.00	2.00	4.05	9.00

Note: Price in thousand rupiahs, ToP in Month, Quality in item case.

Table 5. Result of the 3rd iteration.

1st Data	C1	C2	C3	C4	Cluster
1	1.68	4.55	6.30	4.04	1
2	0.58	3.15	4.95	3.18	1
3	2.32	0.95	2.72	2.25	2
4	3.60	0.47	1.53	3.00	2
5	4.54	2.99	3.04	1.00	4
6	5.02	1.89	-	3.36	3
7	1.35	2.37	4.07	2.27	1
8	2.74	2.75	3.91	1.00	4
9	2.62	3.93	5.65	5.69	1
10	3.60	0.48	1.52	3.00	2

Table 6. The cluster formed from the 3rd iteration.

1st Data	Cluster1			Cluster2			Cluster3			Cluster4		
	ToP	Price	Quality	ToP	Price	Quality	ToP	Price	Quality	ToP	Price	Quality
1	6.00	4.60	9.00	-	-	-	-	-	-	-	-	-
2	5.00	4.40	8.00	-	-	-	-	-	-	-	-	-
3	-	-	-	3.00	4.30	7.00	-	-	-	-	-	-
4	-	-	-	2.00	4.20	6.00	-	-	-	-	-	-
5	-	-	-	-	-	-	-	-	-	1.0	4.00	9.00
6	-	-	-	-	-	-	0.50	3.90	6.00	-	-	-
7	4.00	4.45	8.00	-	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	-	-	3.0	4.10	9.00
9	6.00	4.70	5.00	-	-	-	-	-	-	-	-	-
10	-	-	-	2.00	4.15	6.00	-	-	-	-	-	-
Total	21.0	18.15	30.00	7.00	12.65	19.00	0.50	3.90	6.00	4.0	8.10	18.00
Score	4.00	4.00	4.00	3.00	3.00	3.00	1.00	1.00	1.00	2.0	2.00	2.00
Average	5.25	4.54	7.50	2.33	4.22	6.33	0.50	3.90	6.00	2.0	4.05	9.00

To see the closeness to supplier characteristics, iteration is carried out 3 times. Table 5 and 6 show the third iteration result for suppliers based on 3 aspects, namely: term of payment, price, and quality. From table 6, it can be seen that cluster 1 contains 4 members of suppliers with the characteristics of suppliers based on the term of payment. Suppliers provide a payment term of 4 to 6 months, the

offering price of raw materials is Rp44–Rp47 (in thousand Rupiah) and quality range from 8 to 9 and 5. Meanwhile, cluster 2 contains 3 members just like the previous statement. Cluster 3 contains 1 member and cluster 4 contains 2 members.

Figure 5 shows the division of suppliers based on the proximity of the characteristics of the term of payment, price, and quality. From the clustering results obtained 4 clusters, the cluster is formed based on the closest centroid point. From the cluster will be seen suppliers with almost the same character in accordance with the parameters owned by the supplier. So the company will easily conduct analysis, which cluster is the most suitable and profitable for the company. for suppliers that approach or there are some parameters that are not appropriate and can be negotiated to reduce prices, increase quality or extend the payment period to the supplier. The results of negotiations conducted by the company will change the supplier cluster, thus priority can be given to suppliers who want to work well with the company.

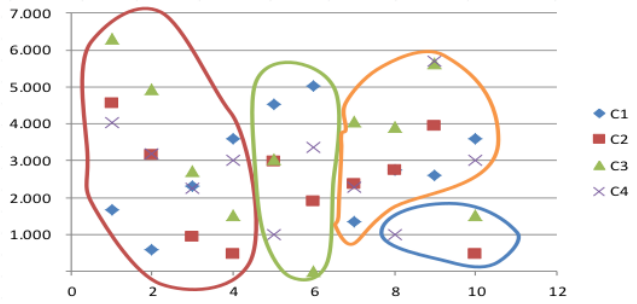

Figure 5. Final clustering.

K-means dynamic strategy

Dynamic demand changes require continuous clustering every month or every period. Determining how many clusters the company wants depends on market demand conditions. If the demand is high, the condition of the supplier does not change and the company must reduce the standard so that the requirements given to suppliers will be more easily fulfilled. In the opposite condition, when demand decreases, companies must increase the number of clusters so that companies can get the best suppliers following company policies and keep being able to maintain company profits.

Table 7. Parameter comparison of company standard versus supplier proposal.

Factor	Company Standard	Cluster 1	Cluster 2	Cluster 3	Cluster 4
Term of Payment (Month)	‘> 3.0	4 – 6	2 – 3	0.5	1 – 3
Price (/Rupiah/Kg)	< 4.4	4.4 – 4.7	4.15 – 4.3	3.9	4 – 4.1
Quality (Rate 1 – 10)	‘> 7.0	5 – 9	6 – 7	6	9
Number Supplier	~	4	3	1	2

Based on table 7, if the killer factor in supplier selection is the factor of payment, the cluster that is included in the criteria is in accordance with the company standard and the supplier in cluster 1. However, from 4 suppliers of cluster 1, there is 1 supplier who does not meet the quality standards requested by the company, where the company standard for quality must be greater than 7 while the company has a value of 5. During the procurement negotiations, companies must be able to ask the supplier to improve its quality to a minimum of 7. For the price of beef from 4 suppliers, there is only 1 supplier which meets the standard, i.e. the price below 4.4, while the other 3 suppliers do not meet company standards, i.e. the task of the procurement Dept. To negotiate to reduce prices, other options

that the company can do is a negotiation to the suppliers in clusters 3 and 4 to extend the payment terms provided.

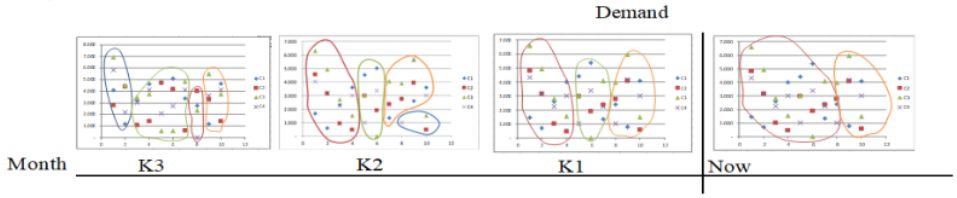

Figure 6. Dynamic K-means clustering.

Figure 6 shows the cluster changes from each period. These changes also relate to changes in suppliers to meet company demands. Supplier changes in each cluster will make it easier for companies to control supplier performance.

4. Conclusion

The results of the study on supplier selection by considering factor terms of payment, price, and quality, using K-means Clustering show that the company gets the right cluster supplier to facilitate the process of selecting suppliers and negotiate the price and time offered. The clustering process using K-means shows which supplier is the most profitable with characteristics that are almost the same as the specified centroid. The study also shows that by changing the number of clusters that the company wants, there will be a group of suppliers with characteristics that are close to and profitable for the company. Negotiations can be made so that suppliers in the cluster that enter the cluster becomes the killer factor to follow the parameters set by the company earlier. From this study, it is also found that there is an opportunity for further research on supplier selection by using more various parameters such as service performed by suppliers, capital, and the length of time of delivery and service to the company so that the company will get more accurate results.

References

[1] Sucky E 2005 A dynamic model for strategic supplier selection *Operations Research Proceedings 2004*, ed H Fleuren (Berlin: Springer) p 118–26
[2] Xue-zhen Z 2007 A Dynamic Model for Vendor Selection *China-USA Bus. Rev.*, **6**(2) 75–80
[3] Sarkis J and Talluri S 2002 A Model for Strategic Sulier Selection *J. Supply Chain Manag.*, **38**(4) 18–28
[4] Saorín-Iborra M C and Cubillo Sulier G 2019 *J Purch Suly Manag* **25**(1) 53–68
[5] Mohebbi S and Shafaei R 2012 *J Intell Manuf* **23**(3) 375–91
[6] Talluri S, Vickery S K and Narayanan S 2008 *Int. J. Physical Distribution and Logistics Management* **38**(7) 551–561
[7] K Mukherjee 2017 Sulier Selection **88** 1–13
[8] Cakravastia A and Takahashi K 2004 Integrated model for sulier selection and negotiation in a make-to-order environment *Int J Prod Res* **42** (2) 4457–74
[9] Prado L S and Martinelli D P 2018 Analysis of negotiation strategies between buyers and sellers: an alied study on crop protection products distribution *RAUSP Manag J* **53**(2) 225–40
[10] A Singh 2018 Improving efficiency and reducing waste for sustainable beef suly chain *degree Dr Philos rwich Bus Sch*
[11] Chamodrakas I, Batis D and D Martakos 2010 Sulier selection in electronic marketplaces using satisficing and fuzzy AHP *Expert Syst Al* **37** (1) 490–8
[12] Sivrikaya B T, Kaya A, Dursun E and Çebi F 2015 Fuzzy Ahp – Goal Programming Aroach for a Sulier Selection Problem **5**(3) 271–85
[13] Kilincci O and Onal S A 2011 Fuzzy AHP aroach for sulier selection in a washing machine

company *Expert Syst Al* **38** (8) 9656–64
[14] Ayhan M B 2013 A Fuzzy Ahp Aroach For Sulier Selection Problem: A Case Study In A Gearmotor Company *Int J Manag Value Suly Chain* **4**(3) 11–23
[15] Shaw K, Shankar R, Yadav S S and L S Thakur 2012 Sulier selection using fuzzy AHP and fuzzy multi-objective linear programming for developing low carbon suly chain *Expert Syst Al* **39**(9) 8182–92
[16] Kahraman C, Cebeci U and Ulukan Z 2003 Multi-criteria sulier selection using fuzzy AHP *Logist Inf Manag* **16**(6) 382–94
[17] Mohammed A, Harris I, Soroka A, Mohamed N and Ramjaun T 2018 Evaluating Green and Resilient Sulier Performance: AHP-Fuzzy Topsis Decision-Making Aroach *Proc 7th Int Conf Oper Res Enterp Syst* Icores 209–16
[18] Lee C and Yang C Ou- 2009 A neural networks aroach for forecasting the sulier's bid prices in sulier selection negotiation process *Expert Syst Al* **36** (2)PART 2 2961–70
[19] Chen Y S, Chen C H and Lai C J 2012 Extracting performance rules of suliers in the manufacturing industry: An empirical study *J Intell Manuf* **23** (5) 2037–45
[20] Gao J, Fan W, Sun Y and Han J 2009 Heterogeneous source consensus learning via decision propagation and negotiation 339
[21] Darken C and Moody J 2002 Fast adaptive K-means clustering: some empirical results **2** 233–8
[22] Khan S S and Ahmad A 2013 Cluster center initialization algorithm for K-modes clustering *Expert Syst Al* **40**(18) 7444–56
[23] Z Huang 1998 Extensions to the k-Means Algorithm for Clustering Large Data Sets with Categorical Values *Data Min Kwl Discov 2* **2** (3) 283–304
[24] K Wagstaff, C Cardie, S Roger and S Schroedl 2001 Constrained K-means with background kwledge *Proc Eighteenth Int Conf Mach Learn* 577–84

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