International Journal on Emerging Technologies **11**(3): 26-32(2020)

**ISSN No. (Print): 0975-8364**
**ISSN No. (Online): 2249-3255**

# Customer-Centric Prioritization using Multi-Criteria Decision Making Method

***S. Sidhartha[1] and M. Thenarasu[2]***
*[1]Undergraduate student, Department of Mechanical Engineering,*
*Amrita School of Engineering, Coimbatore, Tamil Nadu, Amrita Vishwa Vidyapeetham (Tamil Nadu), India.*
*[2]Assistant Professor, Department of Mechanical Engineering,*
*Amrita School of Engineering, Coimbatore, Tamil Nadu, Amrita Vishwa Vidyapeetham (Tamil Nadu), India.*

*(Corresponding author: M. Thenarasu)*
*(Received 02 March 2020, Revised 25 March 2020, Accepted 02 April 2020)*
*(Published by Research Trend, Website: www.researchtrend.net)*

**ABSTRACT: Customer Relationship Management (CRM) is a new competitive way or approach for organizations that serve both internal and external customers. Organizations today focus on conquering the customers' minds, by giving them the "WOW FACTOR" - customer satisfaction which makes them delighted. This work explores how CRM can be used to increase the effectiveness of the organizational interface towards customer satisfaction, loyalty, and decrease the customer defection rate. To study this, a manufacturing company has been selected as our objective company. An exponential increase in customer defection rate was identified as the major issue. From a series of surveys conducted along with the company and clients, it was found "Delayed Delivery" was the major reason for the increasing customer defection rate. To decrease customer defection rate, a mathematical model has been developed to rank the orders using Fuzzy Analytical Hierarchy Process (FAHP) which is then used to find weights of the criteria by constructing pair wise comparison matrix and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) with four different methods of normalization. The same was implemented in the company and the results were evaluated and analyzed. After implementing the model, it was found that there has been a substantial increase in customer satisfaction rate of 37% compared to the previous month.**

**Keywords:** TOPSIS, FAHP, CRM, Customer Defection Rate.

**Abbreviations:** CRM, Customer Relationship Management; TOPSIS, Technique for order preference by similarity to ideal solution; FAHP, Fuzzy Analytical Hierarchy Process.

## I. INTRODUCTION

In a fast-growing world, businesses started flourishing and the industries grew in a very fast manner. As the Industries grew the competition in the big stages intensified leading to them focusing more on the market share. This led to these Industries to focus more on Customers, thus, moving towards CRM, which could optimize and increase the effective communication with the stakeholders.

At its core, Customer relationship management is the basement to all its service and technological advancements to retain its customers and to develop new relationships to value-adding customers. It helps the company to build its business in return to increase the loyalty and satisfaction of the customer. Simply, by collecting data it could forecast the market and also helps to keep in track with the customers for better communication. Also, the feedback from the customers is stored for the effective analysis of the personalized customer service and to develop the "WOW factor". Three most final delivery from the CRM platform is learning, organization, optimization. Learning helps the business to understand the customers and act accordingly. It activates to better anticipate the customer's needs in the future thus enabling the company to forecast its market.

Next to being an organization, it allows the business to become more organized and automated in nature, many in-between communication transfers can be avoided which could reach a fast time delivery advantage. Also, it processes the data to be in a simpler version to understand the data. Finally, it also allows the business to optimize their interactions with the customers in a very effective manner. Also by simplifying and streamlining more complex customer feedback, CRM simplifies the work intensity and increases the customer retention rate by thus reducing the rate of customer defections.

In the objective company previously they used to follow first in first out rule to manufacture and dispatch the products, where customers were not given importance according to their order history, which was the reason why they have lost some key clients.

The proposed system weighs the customers according to their value to the company considering factors such as the number of existing orders given, no of orders expected in future, order value, etc., so the customers with higher importance will be ranked top.

## II. PROBLEM STATEMENT

The Operational CRM has played a single important role in the outstanding success of an Industry. This is imminent in the field of manufacturing. At the start of the era of Industrialization, the relationship between the customers and the industries were one to one. The attention that an end-user gets from a company was so great that the companies were never worried about customer defection. The loyalty of the customer was an important asset that the company earned. They were able to accurately address the customer's wants and

needs leading to a successful course. The increase in the scale of the Industries had its advantages and disadvantages. Even though scaling up the industries led to the increase in the customer base, it also led to a drastic decrease in the attention towards the customer Industry relationship which in turn led to the increase in the customer defection rate. It also had a significantly large impact on customer retention which became the immediate reason for the increase in the customer defection rate. The understanding of what the customer wants and needs disrupting which led to a drastic decrease in the sales of the company.

The exact problem of the manufacturing company is the increasing customer defection rate every year. Initially, the defection rate was quite low and can be managed. But eventually, this has become a festering problem and increased. Fig. 1 shows us how scalable the problem is as time goes by Customer Defection Rate = ((S-E+N)/S) *100.

where,

E = Number of customers at the end of a period

N = Number of new customers acquired during that period

S = Number of customers at the start of that period.

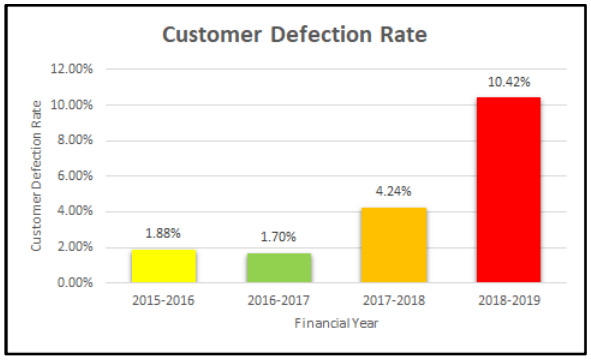


**Fig. 1.** Customer Defection Rate.

*A. Literature Survey*

Astra motors Indonesia is a car (Honda) manufacturing company. Astra motors' issues were comprised of item dispersions of item data through the utilization of brochures causing the mistake within the data conveyed to the clients, and another issue was there were delays to either book the bike or the spare parts. Manufacturing industry case studies for improving productivity are reviewed by reference [1-3]. Centers on the discoveries of the unused endeavor that was being made by analysts, which was to create a computer program by making utilize of SOA (Service Oriented Architecture) and by leveraging the net administration innovation [4]. Dewnarain *et al*., (2019) proposed a conceptual model which was well characterized that addresses the close relations between client relationship administration (CRM), innovations of social media, engagement of clients, devotion and word of mouth (positive), bringing critical commitments to the hypothesis of promoting communication in Client relationship administration [5]. The re-confirmation of the impacts on brand value due to the customer-centric community online was examined. Also gives recommendations that administrators when utilizing brand community which are online ought to consider the impacts that are unexpected in terms of the social media characteristic industry, in this manner improving the brand prevalence within markets [6].

Çelen (2014) assesses the impacts of normalization strategies on choice results of a given Multiple Attribute Decision Making (MADM) strategy. Utilizing these proper weights of an extra-large number of the properties calculated from the Fuzzy Analytical Hierarchy Process (FAHP) strategy, connected TOPSIS strategy in assessing budgetary execution of 13 Turkish store banks. The foremost prevalent normalization strategies were utilized. Studies uncovered that the normalization method (vector normalization), which generally is used within the MCDM TOPSIS strategy in the default manner, created the foremost reliable outcomes. Also among the direct or upfront normalization strategies, max (only taking the maximum) and max-min (considering both maximum and minimum) strategies showed up as the conceivable options to the normalization (vector normalization) strategy [7]. Parsaei *et al.,* (2012) ponders the choices similar in acknowledgment and dismissal of orders that play an imperative part in companies where the products are to order. Incoming requests have a particular conveyance period before which the product has to be delivered to the client. In a few cases, the amount of input requests surpasses past the existing ability to fulfill the request [8]. During such circumstances, the foremost concern is always to select which of the orders must be properly recognized and which of the ones are to be wholeheartedly rejected. The input orders are organized concurring to a highly comprehensive and quite efficient MCDM (Multi-Criteria Decision Making) demonstrate and is continued within the making of the choices to either acknowledge or dismiss the orders agreeing to the accurately calculated generation limitations. An ideal list of orders to be acknowledged is made. The proposed model could be a proper combination of the two methods of the FAHP (Fuzzy Analytical Hierarchy Process) and the other one being TOPSIS. In this conceptual model of FAHP (Fuzzy Analytical Hierarchy process) mostly is used in the finding of proper weights of a derived or known criterion and the model of TOPSIS is used here to rank the orders in the right way. The proposed demonstration is then tried for its productivity by its application to a genuine case. Sun (2010) states that MCDM (Multi-criteria decision making) has grown rapidly and has also gotten to be in the primary stage of the research for the management of the choice issues which is quite complex [9]. Execution assessment models are being investigated. An assessment demonstrates based on FAHP and TOPSIS, it is created to assist the mechanical specialists for the execution assessment in a proper environment which is fuzzy where the subjectivity and the inaccuracy are dealt with the etymological values that are ranked by fuzzy numbers (triangular). The strategy empowers choice investigators to make a better total assessment and give a more exact, compelling, and precise decision support tool [10-11]. Sun and Lin (2012) taking into thought innovation acknowledgment variables, site benefit quality, and particular toll factors, explore how shopping websites build up their competitive

advantages. A Conceptual system is set up based on a fuzzy AHP model as the explanatory device that decides the importance (weights) of each model. Fuzzy hypothesis gives a legitimate apparatus to come across with vulnerabilities and a complex environment. The research comes about states that security and belief are the foremost critical variables for making strides in the competitive advantage of e-commerce sites. Additionally, 'Yahoo Taiwan' and 'PCHome' occupy the top two positions for e-commerce sites. The importance is drawn on the research that comes about for suggestions of administrative hone, and after that recommends a few experimental strategies in arrange to upgrade administration execution for the website shopping industry [12].

Chakraborty and Yeh (2009) says that the Multi-attribute decision making (MADM) utilizes a proper normalization method that is used to properly convert the execution evaluations with the diverse information estimation of units in the choice lattice into the consistent unit [13]. The MADM strategies, for the most part, utilize one specific normalization method without defending its reasonableness. The strategy for arranging inclination by closeness to the perfect arrangement (TOPSIS) is also one of the foremost prevalent and also broadly connected to the MADM strategies [14]. This ponder compares the four most commonly known of the normalization methods in the terms of their positioning of the consistency and the weight affectability to when utilized with the TOPSIS then to fathom to the common in MADM issue with the different choice of settings [15-18]. The proper comparison of pondering is then approved utilizing two of the execution of the measures: positioning of the consistency and the weight affectability. An expansive number of the MADM problems in line with the changing traits and also the options are also produced employing in a modern recreation procedure. And, the think about comes about legitimizing the utilization of the normalization method (vector normalization) for the valuable TOPSIS and also to give experiences that are suggestive for utilizing other normalization methods.

*B. Objective*

To decrease the customer defection rate by developing an algorithm for production planning and control which would take into account customer criteria for ranking orders.

## III. METHODOLOGY

The methodology shown in Fig. 2 has been followed to address the problem statement and achieve the objective.

*A. Internal Company Survey*

The survey was conducted in the target company and the data was collected. Their collective responses were collected and they are attached below. Delphi method was used to analyze the required information on the target company which served as a building block for the creation of the system unique to the target company.

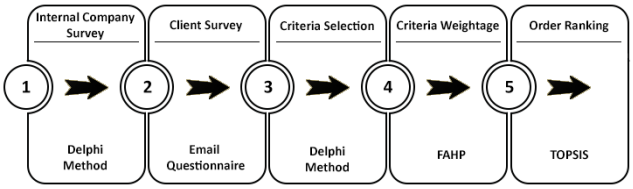


**Fig. 2.** Pictorial representation of the methodology.

*B. Implementation of Delphi Method*

To get the group opinion of the company's employees three rounds of the survey was designed according to the Delphi method and distributed to the selected employees of the company. The first round of the survey was mainly concentrated on getting knowledge about the company, the second round was concentrated on knowing the work structure of the company and the main problems faced by the existing CRMs and third round was concentrated on knowing their requirements of CRM and criteria for evaluation of the successful implementation of CRM.

**(i) Survey Result Analysis:** From the answers of the first round of the survey, it was understood that company has around 80 salespersons and the main problem faced by the company was increase in customer defection rate year by year, company also introduced some free service activities to increase customer retention rate and also implemented two CRM Software previously but were not satisfied because it didn't serve the purpose of implementation and they eventually stopped using that software.

The questionnaire was designed in such a way that it only consisted of one question Based upon the Second-round results indicated that presently the company is not using any CRM software, the leads are being maintained by the person individually in an excel sheet and also quotations are being mailed to the client manually through the mail and there is no centralized system for maintaining all the data.

Mainly the requirements of the CRM were understood from the third round results, it included service escalation matrix, service monitoring, customer retargeting. It was also noted that delay in delivery was also one of the major reasons which affected the customer retention rate. Criteria to evaluate the effective implementation of the software has also been identified.

*C. Client Questionnaire*

After conducting the internal company survey, it was decided to also conduct a Client questionnaire because ultimately clients are the ones who decide why to shift the brand. So accordingly questionnaire was prepared after discussion with the company staff and the same was mailed to their key clients by the company itself.

suggestions given by the company.

**Table 1: Results of the Survey.**

| Answer | Count |
|---|---|
| Delayed Delivery | 54 |
| Cost | 21 |
| Brand Value | 6 |
| Poor Service | 2 |
| **Total** | **83** |

From the results of the survey conducted (as shown in Table 1 and Fig. 3) it is understood that the "Delayed Delivery" is the major reason which contributed for customer defection, in fact this survey was very useful because as the company thought its service support level was the major reason for the customer defection rate, now the survey results will be used in developing algorithm accordingly to decrease the delay in product delivery.

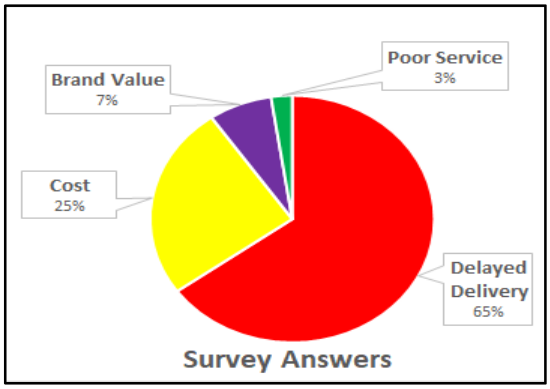


**Fig. 3**. Pie chart of the Survey answers.

*D. Conceptual Model*

Based on the series of surveys conducted within the company and clients it has been found out that increasing Customer Defection Rate was the major problem faced by the company and the major reason which was causing that was Delay in Delivery, so a conceptual model is developed to rank the orders according to the customer value to decrease the delay in delivery, for this FAHP (Fuzzy Analytical Hierarchical Process), TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), vector and linear normalization methods have been used, to check the consistency of different normalization methods some statistical tests like D-test, Correlation test have been used.

**(i) Criteria Selection:** To rank orders using MCDM (Multi-Criteria Decision Making) method some criteria are needed to be selected and weights should be given to them, by using Delphi method following criteria are found to be important, the following criteria have been classified into two types beneficial and non-beneficial, More the value of the beneficial criteria the more importance will be given to the job, whereas for the non-beneficial criteria the lesser the value the more importance it will get, out of five criteria selected there is one non-beneficial criterion and four of the beneficial criteria. For each of the criteria listed below in Table 2, a formula has been defined on how to measure the criteria for each order.

**Table 2: Criteria Description.**

| S. No. | Criteria | Criteria TYPE | Information |
|---|---|---|---|
| C1 | Customer Segment Importance | Beneficial | Dividing a customer base into groups of individuals |
| C2 | Profitability in order | Beneficial | Profitability=(Order cost-Basic cost)/(Basic cost) |
| C3 | Customer Value | Beneficial | Cust Value=(No. of Existing orders)+(No. of predicted orders) |
| C4 | No of Due Days Left | Non-Beneficial | No of days left as per the commitment |
| C5 | Product Manufacturing Time | Beneficial | No. of days required to complete the job |

**(ii) Criteria Weightage:** FAHP (Fuzzy Analytical Hierarchical Process) has been selected to calculate the weightage of each criterion, Analytical Hierarchical Process was first proposed by Saaty (1980), it is used generally with many Multi-Criteria Decision Making (MCDM) Methods to find the weight of the criteria relative to others. It represents the criteria in hierarchical structures and the weights of all the alternatives are calculated by using the answers of the decision-maker given in a pair-wise comparison matrix. The conventional AHP is subjected to many controversies because it takes into account of only fixed value judgments, as they consist of more ambiguity due to the human error, to overcome this ambiguity a fuzzy version of Analytical Hierarchical Process has been introduced to take into account the vagueness in the overall values, this process enables the decision-makers to give their answers in a range which rules out the human errors, there are many kinds of fuzzy numbers out of them Triangular and Trapezoidal function of the Fuzzy numbers are most used.

**Step 1 – Construction of Pairwise comparison matrix:** The first step of FAHP is constructing the pairwise comparison matrix, it is done by filling the relative (comparison of one weightage to the other) weightage of each of the criteria to the other one, on a scale of one to ten. for constructing this matrix filling either side of the diagonal elements is enough, if the upper triangular matrix is filled lower triangular matrix can be found out or vice versa can also be done $V_{ij}$ = Vji, where

$V_{12}$=Relative weightage of $i^{th}$ criteria to $j^{th}$ criteria

$V_{21}$=Relative weightage of $j^{th}$ criteria to $i^{th}$ criteria

Using the rules of constructing the pairwise comparison matrix the below matrix has been constructed (shown in Table 3) with the help of company professionals, the values of the diagonal elements are one because weightage of criterion to itself is one.

**Step 2– Converting to Fuzzy Numbers:** After finding the pairwise comparison matrix using the fixed numbers, they are converted to triangular fuzzy numbers, they typically have three values assigned to each real number, the lower number, middle number and upper number, they indicate the range of possible values for each fixed value number. Using the value from Table 4

the fixed value numbers have been converted to its corresponding triangular fuzzy numbers.

**Table 3: Pairwise comparison matrix.**

| Criteria | C1 | C2 | C3 | C4 | C5 |
|---|---|---|---|---|---|
| C1 | 1 | 7 | 1/2 | 2 | 6 |
| C2 | 1/7 | 1 | 1/8 | 1/4 | 1/2 |
| C3 | 2 | 8 | 1 | 3 | 7 |
| C4 | 1/2 | 4 | 1/3 | 1 | 4 |
| C5 | 1/6 | 2 | 1/7 | 1/4 | 1 |

**Step 3 – Calculating the Fuzzy Geometric Mean:** After finding the Fuzzy Pairwise comparison matrix the fuzzy geometric mean (ri) is calculated for each criteria using the formula also the sum of all the geometric means (R) and Its inverse ($R^{-1}$) is calculated as shown in Table 4

$ri = (x_{i1} * x_{i2} * x_{i3} * x_{i4} * x_{i5})^{1/5}$

where xij= Relative Fuzzy weight of each criterion.

**Step 4 – Calculating the Fuzzy and Defuzzified Weights:** After finding the geometric means fuzzy weights ($\hat{w}_i$) are calculated using the formula mentioned below, after that the fuzzy weights are defuzzified and defuzzified weights ($w_i$) are found by taking the average of three numbers ($l_i$, $m_i$, $u_i$) as shown in Table 5, but $w_i$ found here is not normalized, that means the sum of all defuzzified weights doesn't give an answer one

$\hat{w}_i = (r_i * (r_1 * r_2 * r_3 * r_4 * r_5) -1)$

$w_i = ((l_i + m_i + u_i)/3)$

**Step 5 – Calculating the De-fuzzified Normal Weights:** The defuzzified weights ($w_i$) found in the previous step are normalized by using the formula shown in Table 6.

$w_i = (w_i / (w_1 + w_2 + w_3 + w_4 + w_5))$

**(iii) Criteria Weightage:** To rank the orders according to their criteria values out of all the MCDM methods (ELECTRE, SAW, PROMETHEE, etc.) TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method has been selected because of its analytical simplicity and efficiency in the ranking. TOPSIS is a compensatory method that allows differences between criteria where a less value in one criterion compensates with the more value in other criteria, so it is better than non-compensatory methods.

**Table 4: Geometric mean calculation table.**

| Criteria | Geometric Mean | | |
|---|---|---|---|
| | l | m | u |
| C1 | 1.58 | 2.11 | 2.79 |
| C2 | 0.25 | 0.29 | 0.38 |
| C3 | 2.43 | 3.20 | 3.87 |
| C4 | 0.94 | 1.22 | 1.66 |
| C5 | 0.32 | 0.41 | 0.51 |
| R | 5.53 | 7.24 | 9.20 |
| $R^{-1}$ | 0.11 | 0.14 | 0.18 |

**Table 5: Defuzzified weights calculation matrix.**

| Criteria | Fuzzy Weights (ŵi) | | | DEFUZZIFIED WEIGHTS (wi) |
|---|---|---|---|---|
| | l | m | u | |
| C1 | 0.17 | 0.29 | 0.50 | 0.97 |
| C2 | 0.03 | 0.04 | 0.07 | 0.14 |
| C3 | 0.26 | 0.44 | 0.70 | 1.41 |
| C4 | 0.10 | 0.17 | 0.30 | 0.57 |
| C5 | 0.04 | 0.06 | 0.09 | 0.18 |

**Table 6: Calculation of Defuzzified normal weights.**

| Criteria | Defuzzified Normal Weights (wi) |
|---|---|
| C1 | 0.30 |
| C2 | 0.04 |
| C3 | 0.43 |
| C4 | 0.17 |
| C5 | 0.06 |

It involves normalization methods because it generally involves multi-criteria whose values are incongruous. It compares the set of alternatives by identifying its distance from the positive and the negative ideal solution, the best alternative is ranked in such a way that it has a minimum of the Euclidean distance from the positive ideal solution and maximum of the Euclidean distance from the negative ideal solution, alternative with highest performance score is ranked first. To evaluate the consistency of the vector normalization method it has been compared with four different normalization methods. Following steps are followed for the TOPSIS method.

**Step 1– Creation of Evaluation Matrix:** The Evaluation Matrix is constructed by finding each criteria values using the formulas from Table 2 for all the alternatives.

**Step 2– Normalization of Evaluation Matrix:** After constructing the evaluation matrix and multiplying it with respective weights mentioned for each criterion in Table 6, table values are normalized using the vector normalization method.

In the Vector Normalization method, the performance value is divided by the root of power 2 of the sum of all squares of all the performance values. There are different formulas for the beneficial criteria and the non-beneficial criteria.

For the Beneficial Criteria

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}$$

For Non-Beneficial Criteria

$$r_{ij} = \frac{(1/x_{ij})}{\sqrt{\sum_{i=1}^{m} (1/x_{ij}^2)}}$$

**Step 3– Calculation of Best and Worst Ideal Solution:** After normalizing the evaluation matrix, the best ideal solution ($V_j^+$) and the worst ideal solution ($V_j^-$) are found.

For Beneficial Criteria

$V_j^+ = \text{Max}\ (R_1:R_5)$

$V_j^- = \text{Min}\ (R_1:R_5)$

For Non-Beneficial Criteria

$V_j^+ = \text{Min}\ (R_1:R_5)$

$V_j^- = \text{Max}\ (R_1:R_5)$

**Step 4 – Calculation of Euclidean Distance:** The Euclidean distance of each of the alternative from the best ($S_i^+$) and worst ($S_i^-$) ideal solution is calculated using the formulas mentioned below

$S_i^+ = (\sum (V_{ij} - V_j^+)^2)^{0.5}$

$S_i^- = (\sum (V_{ij} - V_j^-)^2)^{0.5}$

**Step 5 – Calculation of Performance Score:** The performance score ($P_i$) is calculated using the formula mentioned below, the alternatives are ranked according to their performance scores in decreasing order.

$P_i = ((S_i^-) / (S_i^+ + S_i^-))$

*E. Pseudo Code*

The following pseudo code has been developed to understand the implementation of the algorithm

– Construction of pair-wise comparison matrix

– Conversion of pair-wise comparison matrix to fuzzy numbers (l,m,u)

– Calculation of Fuzzy Geometric Mean $r_i$

$r_i = ((l_1*l_2*l_3*l_4*l_5)^{1/5}, (m_1*m_2*m_3*m_4*m_5)^{1/5}, (u_1*u_2*u_3*u_4*u_5)^{1/5})$

– Calculation of fuzzy weights $\hat{w}_i = (r_i * (r_1+r_2+r_3+r_4+r_5)^{-1})$

– Calculation of Defuzzified Weights $w_i$ using Centre of area method. $w_i = ((l_i+m_i+u_i)/3)$

– Normalizing the weights $w_i = (w_i / (w_1+w_2+w_3+w_4+w_5))$

– Calculation of $R_i$ using respective normalization formula

– Calculation of Best ($V_j^+$) and worst ($V_j^-$) ideal value

$V_j^+ = \text{Max}(R_1:R_5)$, $V_j^- = \text{Min}(R_1:R_5)$

– Calculation of euclide an distance from best ($S_i^+$) and worst ($S_i^-$). $S_i^+ = (\sum (V_{ij} - V_j^+)^2)^{0.5}$, $Si- = (\sum (V_{ij} - V_j^-)^2)^{0.5}$

– Calculation of performance score $P_i = ((S_i^-) / (S_i^+ + S_i^-))$

– Rank the orders based upon Performance Score $P_i$

## IV. RESULT

The algorithm has been developed, has been tested thoroughly and then training was given to the company people on how to use the algorithm, as planned the company people started using the algorithm in February – 2020 and also planned production schedule according to the rankings of orders obtained from the algorithm, after implementing the algorithm 37% increase in customer satisfaction was observed in February 2020 compared to the previous month.

*A. Customer Satisfaction Measurement*

The customer satisfaction was measured using the satisfaction survey link which was sent to the client immediately after dispatch of the product through mail and SMS, the survey conducted mainly four Multiple Choice Single Answer Questions and three descriptive questions, the answers of the survey were converted to measurable form with the zero being the least and three being the maximum marks for each question

– Poor

– Satisfactory

– Very Good

– Excellent

Since there were four objective questions the maximum marks possible for the whole survey was twelve and the minimum mark possible was zero, the marks obtained ($C_{sa}$) was then multiplied with Normalized customer value ($C_{vn}$) to obtain individual customer satisfaction

Normalized Customer Value ($C_{vn}$) = ($C_{vi}$)/ Max ($C_v$)

Customer Value ($C_{vi}$) = (Customer Segment Importance + Number of Existing Orders Given + Number of orders expected in future)

Customer Satisfaction ($C_s$) = $\sum (C_{vn} * C_{sa}) / \sum (C_{vn} * 12)$

Using the above-mentioned formula the customer satisfaction of the last five month's data was measured and plotted in a bar graph.

From Fig. 4 it can be understood that after implementing the algorithm there has been a considerable increase in customer satisfaction rate of about 37% compared to the previous month.

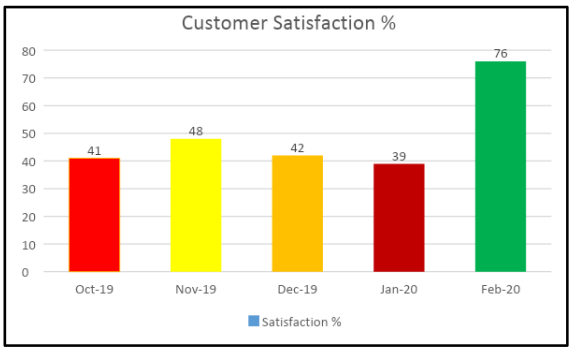


**Fig. 4.** Customer Satisfaction Graph.

The objective function customer defection rate was not measured directly because it would take longer time to measure the results as changes cannot be seen immediately as the time gap between each purchase from the same customer is around 3 months, therefore its substitute function Customer satisfaction % has been measured which will affect the customer defection rate. So the increased customer satisfaction rate ultimately the result will be a decrease in the customer defection rate, which is the main objective of the project.

## V. CONCLUSION

In this work, it was aimed to reduce the increase in the defection rate of customers in a manufacturing company. A study on Customer Relationship Management was done and the effects of customers on a company was studied. Two surveys were conducted, the former being the survey to understand the working of the company's management and the problems faced daily and the latter being the survey to learn the feedback of the clientele. From the data obtained from the conducted surveys, the criteria according to which the performance of the company can be evaluated was derived. FAHP was used to weigh the criteria based on the survey conducted in the company's management and a pair-wise comparison matrix was formed. Normal weights were found after fuzzification. Once the weights were found the priority of each customer was learned based on the data collected a pairwise comparison matrix was formed.

The developed algorithm was used by the company for February 2020. From the data collected, a notable difference in customer satisfaction i.e., from 39% in January to 76%, was noted for February.

## VI. FUTURE SCOPE

In the current study there is a scope for altering the customer weightage factors and also software can be developed using the pseudo-code mentioned for easy user accessibility.

**Conflict of Interest.** The authors don't have any conflicts of interest.

## REFERENCES

[1]. Muthuvel, R., Sharieff, M., & Thenarasu. M. (2019). Productivity Enhancement Through Introducing Lean Principles in Multi-Model Assembly Line. *International Journal of Engineering and Advanced Technology, 8*(5), 2476-2482.

[2]. Neeraj, R. R., Nithin, R. P., Niranjhan, P., Sumesh, A., & Thenarasu, M. (2018). Modelling and simulation of discrete manufacturing industry. Materials Today: Proceedings, *5*(11), 24971-24983.
[3]. Jhony, J., & Thenarasu, M. (2019). Productivity Enhancement In A Pressure Vessel Manufacturing Industry Using Lean Principles. *International Journal of Innovative Technology and Exploring Engineering, 8*(8), 3272-3279.
[4]. Ibrahim, A., Turrahma, A., & Ruskan, E. L. (2019). The Implementation Of Customer Relationship Management (CRM) With Service Oriented Architecture (SOA) to Improve Customers' Loyalty. *In Journal of Physics: Conference Series*, 1-8. IOP Publishing.
[5]. Dewnarain, S., Ramkissoon, H., & Mavondo, F. (2019). Social customer relationship management: An integrated conceptual framework. *Journal of Hospitality Marketing & Management, 28*(2), 172-188.
[6]. Chou, C. M. (2019). Social media characteristics, customer relationship and brand equity. *American Journal of Business, 10*(1), 128-139.
[7]. Çelen, A. (2014). Comparative analysis of normalization procedures in TOPSIS method: with an application to Turkish deposit banking market. *Informatica, 25*(2), 185-208.
[8]. Parsaei, S., Keramati, M., Zorriassatine, F., & Feylizadeh, M. (2012). An order acceptance using FAHP and TOPSIS methods: A case study of Iranian vehicle belt production industry. *International Journal of Industrial Engineering Computations, 3*(2), 2112-224.
[9]. Sun, C. C. (2010). A performance evaluation model by integrating fuzzy AHP and fuzzy TOPSIS methods. *Expert systems with applications, 37*(12), 7745-7754.
[10]. Mohanavelu, T., Krishnaswamy, R., & Marimuthu Prakash, K. (2017). Simulation Modeling and Development of Analytic Hierarchy Process (AHP) based Priority Dispatching Rule (PDR) for a Dynamic Press Shop. *International Journal of Industrial and Systems Engineering, 27*(3), 340-364.
[11]. Thenarasu M., Rameshkumar, K., & Anbuudayasankar, S. P. (2019). Multi-Criteria Decision Making Approach for Minimizing Makespan in a Large Scale Press-Shop. *International Journal of Industrial Engineering: Theory, application and practice, 26*(6), 962-985.
[12]. Sun, C. C., & Lin, G. T. (2009). Using fuzzy TOPSIS method for evaluating the competitive advantages of shopping websites. *Expert Systems with Applications, 36*(9), 11764-11771.
[13]. Chakraborty, S., & Yeh, C. H. (2009). A simulation comparison of normalization procedures for TOPSIS. *In 2009 International Conference on Computers & Industrial Engineering,* 1815-1820. IEEE.
[14]. Amiri, M. P. (2010). Project selection for oil-fields development by using the AHP and fuzzy TOPSIS methods. *Expert systems with applications, 37*(9), 6218-6224.
[15]. Wang, Y. M., & Elhag, T. M. (2006). Fuzzy TOPSIS method based on alpha level sets with an application to bridge risk assessment. *Expert systems with applications, 31*(2), 309-319.
[16]. Torlak, G., Sevkli, M., Sanal, M., & Zaim, S. (2011). Analyzing business competition by using fuzzy TOPSIS method: An example of Turkish domestic airline industry. *Expert Systems with Applications, 38*(4), 3396-3406.
[17]. Ashtiani, B., Haghighirad, F., Makui, A., & Montazer, G. (2009). Extension of fuzzy TOPSIS method based on interval-valued fuzzy sets. *Applied Soft Computing, 9*(2), 457-461.
[18]. Opricovic, S., & Tzeng, G. H. (2004). Compromise solution by MCDM methods: A comparative analysis of VIKOR and TOPSIS. *European journal of operational research, 156(*2), 445-455.

**How to cite this article:** Sidhartha, S. and Thenarasu, M. (2020). Customer-Centric Prioritization using Multi-Criteria Decision Making Method. *International Journal on Emerging Technologies*, *11*(3): 26–32.