Decision Support System Against Customer Management Loyalty in Silvi Using SAW Method

Fifit Alfiah[*1], Dita Setiawan[2], Ade Setiadi[3]
[1,3]Informatics Engineering, Raharja University Faculty of Science and Technology
[2]Applied Computational Engineering, Master of Computer Science, Budi Luhur University
E-mail: [*1]**fifitalfiah@raharja.info**, [2]di_ta_se@yahoo.com, [3]adesetiadi@raharja.info

Abstract

Online financial institutions or currently often referred to as Finance Technology (Fintech) are one of the institutions that are developing in the digital and IoT era with official support from OJK. One of them is PT. Kreigan Sentral Teknologi which has the Silvi application for mobile or android users, the system currently running on the Silvi application still has several problems such as errors in calculating the number of customer transactions carried out by management which are still semi-computerized using Microsoft Excel where management spends considerable time time to calculate customer loyalty data. Therefore, to increase customer loyalty in the Silvi application, this research aims to make customers more comfortable and interested in making transactions using the Silvi application where for each customer transaction, the company will provide loyalty in the form of a Silvi balance reward supported by a design customer loyalty management decision support system using the method SAW (Simple Additive Weighting) to make it faster and more effective in calculating the number of customer transactions so that customers are more interested in making transactions. The results of this study are that the system is able to make decisions in determining customer loyalty carried out by company management in processing customer transaction calculations with a 90% success percentage in determining customer loyalty in the Silvi application.

Keywords *— Decision Support System, Silvi, Customer Loyalty, Simple Additive Weighting*

1. INTRODUCTION

The development of the world of Technology and Information is increasingly very rapid. Of course, with the presence of this growing technology, competitors have their own way of making service strategies on their *respective platforms* or companies, especially in the field of Technology and Information.[1]

Technological developments such as *robotics, artificial intelligence, cloud computing*, and so on that technically support the digital economy include *e-commerce*, *financial technology* (*FinTech)*[2] and so on. *Fintech* itself is the result of combining technology with financial services that changes business models from traditional or conventional to modern, which initially in paying had to be face-to-face and carry a certain amount of cash, now transactions can be done non-cash or *cashless* and can [3] even transact remotely and payments can be made very quickly and provide a choice of more features by using *FinTech*[4].

By looking at this *fintech* technology, the author designed a system that can support all forms of appreciation to the people who use the system, so that users can get comfort when using this system that has been created. To make customers comfortable and interested and make transactions easier to become *virtual*,[5] in this study the author wants to design a decision-making system so that customers who often make transactions in the Silvi application will get a reward with *a voucher* or balance from the Silvi application[6].

2. RESEARCH METHOD

Some of the research methods used to obtain complete and correct data are:

2.1. SAW Method (*Simple Additive Weighting*)

The *Simple Additive Weighting* method is often also known as the weighted summation method. The basic concept of the *simple additive weighting* method is to look for the weighted summation of the performance rating on each alternative on all attributes. The *simple additive weighting* method requires the normalization process of the decision matrix (X) to a scale obtained compared to all existing alternative ratings".

$$R_{ij} = \begin{cases} \dfrac{x_{ij}}{max\, x_{ij}} \text{ Jika j adalah atribut keuntungan(benefit)} \\ \dfrac{min^{xij}}{x^{ij}} \text{ Jika j adalah atribut biaya(cost)} X_{ij} \end{cases}$$

Information:
Rij= Normalized performance rating of alternative Ai on attributes Cj :i=1.2,...,m and j = 1.2, ..., n .
Max Xij= The largest value of each criterion i.
Min Xij= The smallest value of each criterion i.
Xij = The attribute value that each criterion has.
Benefit= If the greatest value is the best
Cost= If the smallest value is best.

Preference formula

$$V_{i=} \sum_{j=1}^{n} W_j R_{ij}$$

Information:
Vi=Ranking for each alternative
Wj=Ranking weight value (of each alternative)
Rij=Normalized performance rating value
A larger Vi value indicates that alternative A imore selected.

2.2. *Literature Review*

1. This research was conducted by Theresia Elisabeth Dameria, Yevita Nursyanti with the title Determining Trucking Service Providers at PT Yicheng Logistics Using the SAW (Simple Additive Weighting) Method. Other proposed improvements submitted are to

provide daily reports as a database of trucking services, and the creation of standard operating procedures in selecting trucking services as supporting documents in the selection of trucking services.[7]

2. This research was conducted by Rizka Ristiana and Yuwan Jumaryadi with the title Decision Support System for Choosing Wedding Organizer Packages Using the SAW (Simple Additive Weighting) Method. To provide recommendations of the desired package there are several criteria. The criteria were calculated using the SAW method. With the results of the ranking, it can be concluded that V6 is an alternative package that is chosen as the best alternative for service users with the weight of each criterion determined by service users.[8]
3. This research was conducted by Fifit Alfiah, Rama Prima and Umriyah with the title Laravel Framework-Based Property Advertence System at PT. New Bloom of Indonesian Property. The author took the initiative to bring together property owners who have difficulty selling their property and prospective home managers through an online platform using the PIECES method in research and Extreme Programing in designing systems based on the Laravel Framework.[9]
4. This research was conducted by Muhammad Rizky Ramadhan, Muhammad Khairul Nizam, Mesran with the title Application of the SAW (Simple Additive Weighting) Method in the Selection of Outstanding Students at Mustafa Private Vocational Schools. a model for determining outstanding students at Mustafa Private Vocational School is needed with a more efficient and effective system. This system is designed using a decision support system through the Simple Additive Weighting (SAW) method. This system can display the results of the ranking of outstanding students based on the results of the SAW method.[10]
5. This research was conducted by Nofri Yudi Arifin, Ghea Paulina Suri, et al with the title Dashboard for Determining Healthy Indonesia Card Recipients (KIS) in Binuang Kampung Dalam Village with the Simple Additive Weighting Method. This study resulted in an application to assist officers in determining KIS recipients by entering data from prospective recipients then the data was processed using the SAW (Simple Additive Weighting) method so as to produce recommendations for a list of KIS recipients with criteria determined for qualified people. [11]

3. RESEARCH RESULTS AND DISCUSSION

Customer Loyalty *Decision Support System Calculation Results*

At this stage, testing will be carried out on a system built using the *Simple Additive Weighting* method which is used for data processing in determining the best *customer loyalty*.

The steps in the SAW method, are as follows:

1. Determining what criteria will be used as a reference in the decision-making process is as follows:

Table I. Assessment Criteria

Criterion	Information
C1	Amount of funds per transaction
C2	Transaction Frequency
C3	Frequency of Use (Viewing Only)
C4	Balance Fill Frequency

2. Determining the *customer* candidates for Silvi App users, is as follows:

Table II. Customer Candidates

Alternative	*Customer* Name
A1	Samsul Arifin
A2	Asep Wahyudi
A3	Fikri Hidayatullah
A4	Beautiful Septiyanti
A5	David Habibi

3. Determining the match rating of the set of criteria, is as follows:

Table III. Criteria Set Match *Rating* Scale

No	Criterion	Set	*Rating Value*	Information
C1				
1	Amount of funds per transaction	The amount of funds per transaction < Rp. 100,000	0 – 54	Less
2	Amount of funds per transaction	The amount of funds per transaction > = Rp. 100,000 and the amount of funds per transaction < Rp. 250,000	55 – 64	Enough
3	Amount of funds per transaction	The amount of funds per transaction > = Rp. 250,000 and the amount of funds per transaction < Rp. 450,000	65 – 79	Good
4	Amount of funds per transaction	The amount of funds per transaction > = Rp. 450.0000	80 – 100	Excellent
C2				
1	Transaction Frequency	Transaction Frequency = 1	0 – 54	Less
2	Transaction Frequency	Transaction Frequency > 2 and Transaction Frequency <= 4	55 – 64	Enough
3	Transaction Frequency	Transaction Frequency > 4 and Transaction Frequency < =6	65 – 79	Good
4	Transaction Frequency	Transaction Frequency > 6	80 – 100	Excellent

No	Criterion	Set	*Rating Value*	Information
C3				
1	Frequency of Use (Viewing Only)	Less Frequency of Use	0 – 54	Less
2	Frequency of Use (Viewing Only)	Sufficient Frequency of Use	55 – 64	Enough
3	Frequency of Use (Viewing Only)	Good Frequency of Use	65 – 79	Good
4	Frequency of Use (Viewing Only)	Excellent Frequency of Use	80 – 100	Excellent
C4				
1	Balance Fill Frequency	Top Up Balance = Rp. 20.000	0 – 54	Less
2	Balance Fill Frequency	Top Up Balance = Rp. 50.000	55 – 64	Enough
3	Balance Fill Frequency	Top Up Balance = Rp. 100.000	65 – 79	Good
4	Balance Fill Frequency	Top Up Balance = Rp. 200.000	80 – 100	Excellent

4. Determining the value of the weight of the criteria will be used as a reference in the decision-making calculation process, as follows:

Table IV. Criterion Weight Value

Criterion	Information	Attribute	Weight
C1	Amount of funds per transaction	*Cost*	30%
C2	Transaction Frequency	*Benefits*	25%
C3	Frequency of Use (Viewing Only)	*Benefits*	10%
C4	Balance Fill Frequency	*Cost*	35%
Total			100%

Based on the several steps of the SAW method above, the next elaboration of the weight of each criterion that has been converted with *fuzzy* numbers, is as follows:

1. Criteria for the Amount of Funds Per Transaction (C1) in the value based on the Amount of Funds Per Transaction

Table V. Criteria for the Amount of Funds Per Transaction

Alternative	*Customer* Name	Value
A1	Samsul Arifin	75
A2	Asep Wahyudi	80
A3	Fikri Hidayatullah	55
A4	Beautiful Septiyanti	60
A5	David Habibi	90

2. Transaction Frequency Criteria (C2) is valued based on Transaction Frequency

Table VI. Transaction Frequency Criteria

Alternative	*Customer* Name	Value
A1	Samsul Arifin	70
A2	Asep Wahyudi	85
A3	Fikri Hidayatullah	90
A4	Beautiful Septiyanti	65
A5	David Habibi	80

3. Usage Frequency Criteria (View Only) (C3) in values based on Frequency of Use (View Only)

Table VII. Frequency of Use Criteria (View Only)

Alternative	*Customer* Name	Value
A1	Samsul Arifin	75
A2	Asep Wahyudi	80
A3	Fikri Hidayatullah	80
A4	Beautiful Septiyanti	95
A5	David Habibi	85

4. Balance Fill Frequency Criteria (C4) in values based on Balance Fill Frequency

Table VIII. Balance Fill Frequency Criteria

Alternative	*Customer* Name	Value
A1	Samsul Arifin	95
A2	Asep Wahyudi	90
A3	Fikri Hidayatullah	85
A4	Beautiful Septiyanti	70
A5	David Habibi	65

Based on the tables above, a match *rating* of each alternative will be formed as shown in the table below:

Table IX. *Match Rating* of Each Alternative

Alternative	Criterion			
	C1 (30%) Min	C2 (25%) Max	C3 (10%) Max	C4 (35%) Min
A1	75	70	75	95
A2	80	85	80	90
A3	55	90	80	85
A4	60	65	95	70
A5	90	80	85	65

In the table above is the *match rating* of each alternative by entering the values of each alternative. Because the value given to each alternative in the criteria is a match value (*Benefit* the largest value is the best, while the *cost* of the smallest value is the best). So, the criteria given are assumed to be criteria for profit (*benefit*) and cost (cost).

The next step is to create a decision matrix X. This matrix is created from each alternative match rating table (Table IX), which is as follows:

$$X = \begin{matrix} 75707595 \\ 8085\ 8090 \\ 55908085 \\ 60659570 \\ 90808565 \end{matrix}$$

Figure 1. Normalization of Matrix Values

The next step is the normalization of the X matrix to calculate each of the criteria, based on the criteria assumed to be the criteria of profit (*benefit*) and cost (*cost*).

The following normalization calculation to find the value of R, is as follows:

$$\text{Formula for Max value: } \frac{\text{CnAn}}{\text{Rmax=Max (C1A1,C1A2,...,C1An}}$$

Figure 2. Max Value Formula

$$\text{Formula for Min values: } \frac{\text{Rmin=Min (C1A1,C1A2,...,C1An}}{\text{CnAn}}$$

Figure 3. Min Value Formula

1. Calculation Criteria (C1)

$$R_{11} = \frac{Min\ (75,80,55,60,90)}{75} = \frac{55}{75} = 0.73$$

$$R_{21} = \frac{Min\ (75,80,55,60,90)}{80} = \frac{55}{80} = 0.69$$

$$R_{31} = \frac{Min\ (75,80,55,60,90)}{55} = \frac{55}{55} = 1$$

$$R_{41} = \frac{Min\ (75,80,55,60,90)}{60} = \frac{55}{60} = 0.92$$

$$R_{51} = \frac{Min\ (75,80,55,60,90)}{90} = \frac{55}{90} = 0.61$$

2. Calculation Criteria (C2)

$$R_{12} = \frac{70}{\text{Max (70,85,90,65,80)}} = \frac{70}{90} = 0.78$$

$$R_{22} = \frac{85}{\text{Max (70,85,90,65,80)}} = \frac{85}{90} = 0.94$$

$$R_{32} = \frac{90}{\text{Max (70,85,90,65,80)}} = \frac{90}{90} = 1$$

$$R_{42} = \frac{65}{\text{Max (70,85,90,65,80)}} = \frac{65}{90} = 0.72$$

$$R_{52} = \frac{80}{\text{Max (70,85,90,65,80)}} = \frac{80}{90} = 0.89$$

3. Calculation Criteria (C3)

$$R_{13} = \frac{75}{\text{Max}\,(75,80,80,95,85)} = \frac{75}{95} = 0.79$$

$$R_{23} = \frac{80}{\text{Max}\,(75,80,80,95,85)} = \frac{80}{95} = 0.84$$

$$R_{33} = \frac{80}{\text{Max}\,(75,80,80,95,85)} = \frac{80}{95} = 0.84$$

$$R_{43} = \frac{95}{\text{Max}\,(75,80,80,95,85)} = \frac{95}{95} = 1$$

$$R_{53} = \frac{85}{\text{Max}\,(75,80,80,95,85)} = \frac{85}{95} = 0.89$$

4. Calculation Criteria (C4)

$$R_{14} = \frac{Min\,(95,90,85,70,65)}{95} = \frac{65}{95} = 0.68$$

$$R_{24} = \frac{Min\,(95,90,85,70,65)}{90} = \frac{65}{90} = 0.72$$

$$R_{34} = \frac{Min\,(95,90,85,70,65)}{85} = \frac{65}{85} = 0.76$$

$$R_{44} = \frac{Min\,(95,90,85,70,65)}{70} = \frac{65}{70} = 0.93$$

$$R_{54} = \frac{Min\,(95,90,85,70,65)}{65} = \frac{65}{65} = 1$$

The result of the normalized calculation (r_{ij}) by forming a normalized matrix (R), is as follows:

$$R = \begin{matrix} 0.73 & 0.78 & 0.79 & 0.68 \\ 0.69 & 0.94 & 0.84 & 0.72 \\ 1 & 1 & 0.84 & 0.76 \\ 0.92 & 0.72 & 1 & 0.93 \\ 0.61 & 0.89 & 0.89 & 1 \end{matrix}$$

Figure 4. Matrix Value Normalization Calculation Results

Furthermore, the ranking process is carried out by multiplying the normalized matrix (R) by the value of the preference weight (W) and determining the preference value for each alternative (V_1) by summing the product between the normalized matrix and the value of the preference weight (W). For the value of the weight preference weight vector (W) by the decision maker for each of the criteria already determined, namely:

$$W = [\,0,\quad 300,\quad 250,\quad 100,\quad 35]$$

Figure 5. Criterion Preference Weight Value (W)

The last step of the ranking process by summing each alternative of the normalized matrix (R) of each row multiplied by the weight (W), is as follows:

By Formula: : $Vn = R11.W + R12.W + Rn.W$

Figure 6. Normalization Matrix Formula (V_n)

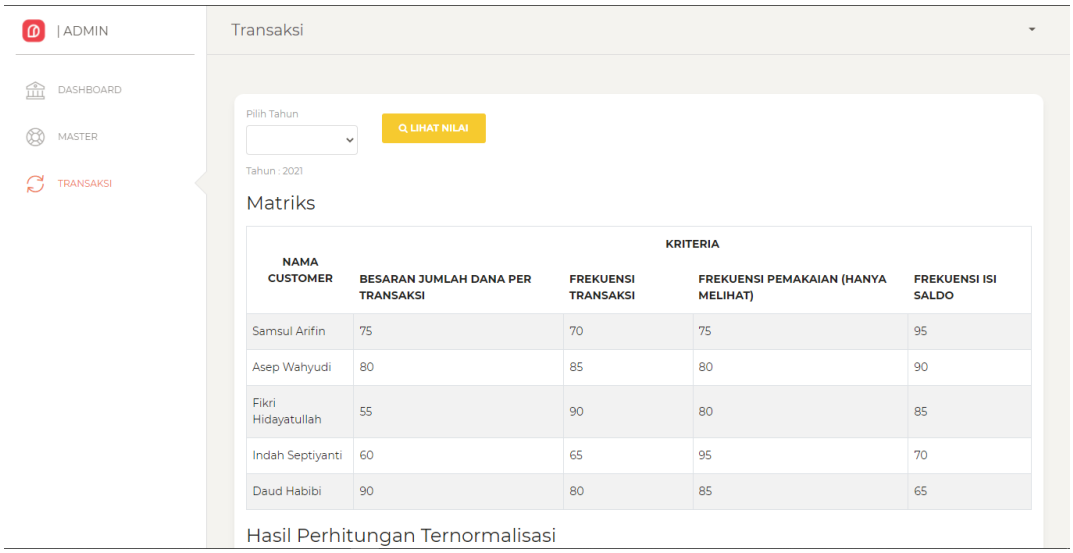
1. Alternative Calculations (A1)
   V_1 = (0.73 x 0.30) + (0.78 x 0.25) + (0.79 x 0.10) + (0.68 x 0.35)
   = (0.21) + (0.19) + (0.07) + (0.23)
   = 0.70
2. Alternative Calculations (A2)
   V_2 = (0.69 x 0.30) + (0.94 x 0.25) + (0.84 x 0.10) + (0.72 x 0.35)
   = (0.20) + (0.23) + (0.08) + (0.25)
   = 0.76
3. Alternative Calculations (A3)
   V_3 = (1 x 0.30) + (1 x 0.25) + (0.84 x 0.10) + (0.76 x 0.35)
   = (0.30) + (0.25) + (0.08) + (0.26)
   = 0.89
4. Alternative Calculations (A4)
   V_4 = (0.92 x 0.30) + (0.72 x 0.25) + (1 x 0.10) + (0.93 x 0.35)
   = (0.27) + (0.18) + (0.10) + (0.32)
   = 0.87
5. Alternative Calculations (A5)
   V_5 = (0.61 x 0.30) + (0.89 x 0.25) + (0.89 x 0.10) + (1 x 0.35)
   = (0.18) + (0.22) + (0.08) + (0.35)
   = 0.83

From the alternative calculations above, the results of the ranking are obtained, as in the following table:

Table X. Ranking Value Results

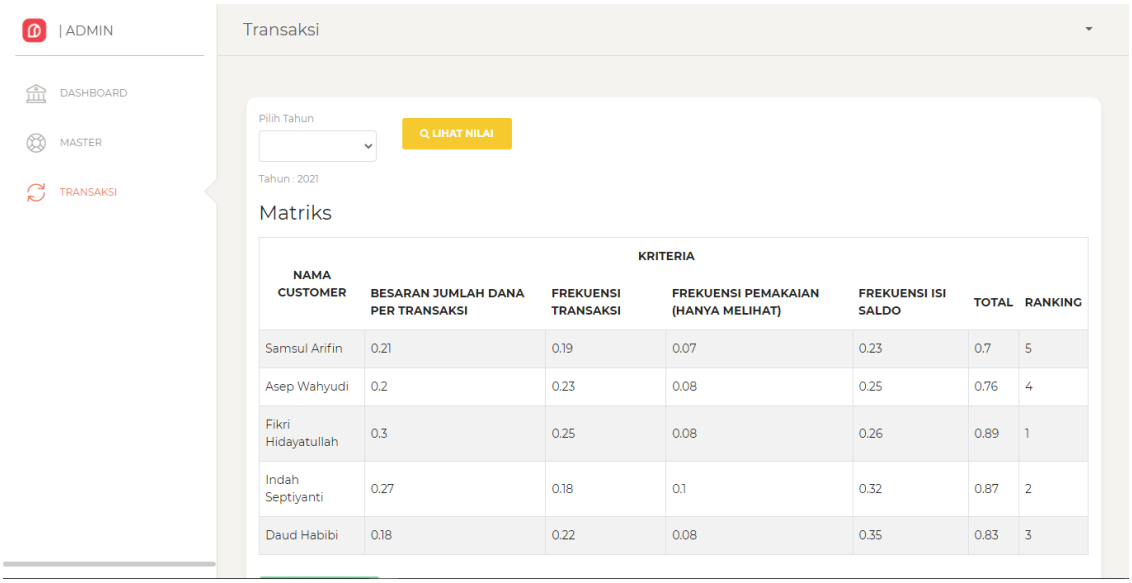
Alternative	Value Result (V_i)
A1	0.70
A2	0.76
A3	0.89
A4	0.87
A5	0.83

Thus, A_3 is ranked first because it has a greater value than other values. So that A_3 and or in this case Fikri Hidayatullah who was chosen as the best alternative can be seen in the following picture:



NAMA CUSTOMER	KRITERIA			
	BESARAN JUMLAH DANA PER TRANSAKSI	FREKUENSI TRANSAKSI	FREKUENSI PEMAKAIAN (HANYA MELIHAT)	FREKUENSI ISI SALDO
Samsul Arifin	75	70	75	95
Asep Wahyudi	80	85	80	90
Fikri Hidayatullah	55	90	80	85
Indah Septiyanti	60	65	95	70
Daud Habibi	90	80	85	65

Figure 7. Customer Rating View



NAMA CUSTOMER	KRITERIA				TOTAL	RANKING
	BESARAN JUMLAH DANA PER TRANSAKSI	FREKUENSI TRANSAKSI	FREKUENSI PEMAKAIAN (HANYA MELIHAT)	FREKUENSI ISI SALDO		
Samsul Arifin	0.21	0.19	0.07	0.23	0.7	5
Asep Wahyudi	0.2	0.23	0.08	0.25	0.76	4
Fikri Hidayatullah	0.3	0.25	0.08	0.26	0.89	1
Indah Septiyanti	0.27	0.18	0.1	0.32	0.87	2
Daud Habibi	0.18	0.22	0.08	0.35	0.83	3

Figure 8. Customer Ranking Display

4. CONCLUSION

Based on the results of research on the best customer loyalty determination system at PT Kreigan Sentral Technology, the following conclusions can be drawn:

1. The current customer loyalty determination system is assessed based on 2 assessment criteria, namely the criteria for the amount of funds per transaction and the frequency criteria per transaction from the public. It is proposed that a decision support system using 4 criteria, namely the criteria for the amount of funds per transaction, the criteria for transaction frequency, the frequency of use criteria (only seeing) and the criteria for the frequency of filling balances to assist the company in determining the best customer loyalty.

2. The current system already uses criteria, namely the criteria for the amount of funds per transaction and the criteria for frequency per transaction from the public. However, the current system is not running well because the data processing still uses Microsoft Excel, it takes a long time to calculate customer loyalty data because one customer needs 5 minutes of calculation time, making calculations long and ineffective.
3. To create a decision support system that can help companies in determining user customer loyalty, the Silvi Application was designed using the SAW (Simple Additive Weighting) method with this study the author used the PHP programming language to create the system and database using MySQL. In this proposed system, there is a feature of inputting data criteria, input customer data or alternatives that will be assessed, customer assessment per criterion to customer ranking and obtaining the best customer loyalty results.

5. SUGGESTED

1. Training is needed for *users* to use this system so that the decision support system for selecting the best *customer loyalty* can run smoothly.
2. It takes the development of this system to be better by adding Android-based features and notification of sending emails to *customers* containing information on selecting the best *customer loyalty*.
3. It is necessary to add *hardware* and *software* infrastructure to support the running of the system that has been created.

6. REFERENCES

[1] E. Walling and C. Vaneeckhaute, "Developing successful environmental decision support systems: Challenges and best practices," Journal of Environmental Management, vol. 264. Academic Press, Jun. 15, 2020.

[2] A. Setya Putra, D. Rahma Aryanti, and I. Hartati, "National Seminar on Technology and Business 2018 IIB DARMAJAYA Bandar Lampung," 2018.

[3] F. Alfiah, F. M. Nur, and D. Gunawan, "Creative Education of Research in Information Technology and Artificial Informatics Application of Computer Laboratory Asset Management System at SMKN2 Tangerang Regency Using the Laravel8 Framework".

[4] K. Zong, Y. Yuan, C. E. Montenegro-Marin, and S. N. Kadry, "Or-based intelligent decision support system for e-commerce," Journal of Theoretical and Applied Electronic Commerce Research, vol. 16, no. 4, pp. 1150–1164, 2021, d

[5] S. M. Dam and T. C. Dam, "Relationships between Service Quality, Brand Image, Customer Satisfaction, and Customer Loyalty," Journal of Asian Finance, Economics and Business, vol. 8, no. 3, pp. 585–593, 2021.

[6] M. I. El-Adly, "Modelling the relationship between hotel perceived value, customer satisfaction, and customer loyalty," Journal of Retailing and Consumer Services, vol. 50, pp. 322–332, Sep. 2019.

[7] T. E. Dameria and Y. Nursyanti, "Determination of Trucking Service Providers at PT Yicheng Logistics Using the SAW (Simple Additive Weighting) Method," APP Jakarta Jl. Timbul No, vol. 1, no. 3, p. 1263, 2022.

[8] R. Ristiana and Y. Jumaryadi, "Decision Support System for Wedding Organizer Package Selection Using SAW (Simple Additive Weighting) Method," Sisfokom Journal (Information and Computer Systems), vol. 10, no. 1, pp. 25–30, Jan. 2021.
[9] F. Alfiah and R. Prima Mufti Al Rasyid, "Laravel Framework-Based Property Adversary System in PT. Mekar Baru Properti Indonesia," vol. 8, no. 1, p. 2022.
[10] M. R. Ramadhan and M. Khairul, "Application of SAW (Simple Additive Weighting) Method in the Selection of Outstanding Students at Mustafa Private Vocational Schools," Applied Informatics Nusantara, vol. 1, no. 9, pp. 459–471, 2021.
[11] Arifin, N. Y., Suri G, et al. Dashboard for Determining Healthy Indonesia Card (Kis) Recipients in Binuang Kampung Dalam Village Using the Simple Additive Weighting Method". JURSIMA Vol.9 No.1 April 2021.