SMART and TOPSIS Method For Determining The Priority Of Screen Printing

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Abstract— The number of micro, small and medium enterprises (MSMEs) in the field of screen printing and convection that use websites in marketing is one of them CV. Ini Sablon. but in the production process there are obstacles in working on orders that come to be done first in accordance with predetermined criteria, namely deadlines, number of orders, design, profit, and availability of goods. The use of Decision Support System (DSS) aims to provide recommendations to owners of screen printing companies. This study uses the SMART method to weight the criteria and the TOPSIS method for product selection. This system is built using the PHP programming language and MySQL database. The results of the study were a screen printing production priority website with the best final value of 0.62 and the worst final value of 0.35 with the level of accuracy between manual and system calculations reaching 100%. In this study the criteria cannot be updated, it is expected that further research criteria can be updated and use a combination of methods that have not been done.

Keywords—DSS; SMART Method; TOPSIS Method; Screen Printing

I. INTRODUCTION

Progress in the field of technology and information is developing very fast. That is what drives people to make a computer system that can replace their work. Many micro, small and medium enterprises (MSMEs) in the field of screen printing and convection that use websites in marketing one of them cv.ini screen printing. According to survey data from the Central Statistics Agency (BPS), mentioning the positive trend of the increasing number of micro-convection businesses and screen printing in Jabodetabek. This number is increasing from year to year. The highest increase occurred in 2016, namely as many as 250 business units.

However, in this pre-order system there are several obstacles, one of which is the difficulty in determining which shirts will be produced first. Some things that affect the determination of the production

of pre-order goods are deadlines, number of orders, design, profit, and availability of goods. Therefore, a system that is needed to solve the problem is needed.

A decision-making system is a system of producing specific information aimed at solving a particular problem that must be solved by managers at various levels. In building a decision support system there are several methods used, among others, such as AHP, TOPSIS, SAW, SMART, WP, MAUT and so on (Subakti, 2002).

SMART method is a multi-criteria decision making method that can solve complex problems. TOPSIS method is a method of decision making not only based on profit factors but also influenced by adverse factors in decision making. And many are implemented for practical decision-making problems. Because this method includes easy and efficient.

Combining the SMART method with TOPSIS is because the TOPSIS method inputs weights in the form of preference values that do not have comparisons between criteria in a calculation, therefore the TOPSIS method should be combined with other methods (Rahman, Furqon, & Santoso, 2018). The use of the SMART method as a combination of TOPSIS because this method in search of weights between criteria is done by finding a comparison matrix of each alternative consisting of a number of criteria that have values and each criterion has a weight describing the importance of weighting compared to other criteria.

In this study DSS will be built with the SMART and TOPSIS Combined Method in determining the priority of screen printing production with 5 criteria different with these previous literatures (Ichwan, 2016; Utama, 2014; Novianti, Asturi, & Khairina, 2016; Sembiring, Sembiring, & Siregar, 2018; Al Azis, Cholissodin, & Furqon, 2017) where the SMART method is used to calculate the weighting and the TOPSIS method is used to calculate the ranking. In this study using input 5 criteria by showing in detail the calculation process.

II. LITERATURE REVIEW

2.1. Decision Support Systems

Decision Support System (DSS) is a computer-based information system that approaches to produce various alternative decisions to assist certain parties in handling problems using data and models. An DSS only provides alternative decisions, while the final decision taken is still determined by the decision maker. Decision support systems integrate intellectual resources from individuals with computer capabilities to improve the quality of decision formulations.

2.2. SMART Method

The multi-criteria decision-making method developed by Edward in 1977 was based on the theory that each alternative consists of a number of criteria that have values and each criterion has a weight that illustrates how important weighting is compared to other criteria. This is used to assess each alternative to get the best alternative (Sutanto, 2016; Sanjaya, Khairina, & Maharani, 2015; Suryanto, & Safrizal, 2015).

The order in using the SMART method is as follows :
1. Determine the number of criteria.
2. The system by default provides a scale of 0-100 based on the priority that has been entered and then normalized.

$$normalized. = \frac{W_j}{\sum W_j}$$

Information :
W_j: weights a criterion
$\sum W_j$: total weight of all criteria
3. Give criteria values for each alternative.
4. Calculate the utility value for each of the criteria.

$$U_i(a_i) = 100 \frac{(C_{out\ i} - C_{min})}{(C_{max} - C_{min})}\%$$

Information :
$U_i(a_i)$ = 1st criterion utility value for i-criteria
C_{max} = maximum criteria value
C_{min} = minimum criteria value
$C_{out\ i}$ = value of the i-criteria
5. Calculate the final value of each

$$U_i(a_i) = \sum_{j=1}^{m} W_j\ U_i(a_i)$$

1.1 TOPSIS Method

The TOPSIS method is a multi-criteria decision making method that was first introduced by Yoon and Hwang (1981). TOPSIS uses the principle that the chosen alternative must have the closest distance from the positive ideal solution and the farthest distance from the negative ideal solution from a geometric point of view by using the distance between two points to determine the relative closeness of an alternative with the optimal solution. (Abdillah, 2017; Muzakkir, 2017; Mahmudi, & Tahwin, 2016; Larasati, Setyaningrum, & Wardhani, 2016; Herawatie, & Wuryanto, 2017; Wahyuni, Khairunnisa, Abriyani, Muchlis, & Ulfa, 2017; Gustriansyah, 2016; Al Azis, Cholissodin, & Furqon, 2017; Kurniawan, Mustafidah, & Shofiyani, 2015;

The order in using the TOPSIS method is as follows:
1. Make a decision matrix according to the problem to be solved, then do the normalization of the matrix with the equation.

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

Information :
r_{ij} is a normalized matrix from the basic matrix of the problem, with i = 1,2,3, ... m, and j = 1,2,3 ... n.
X_{ij} is the basic matrix that will be normalized. For each i shows the row of the matrix, and for each j shows the column of each matrix.
2. Perform normalization matrix using the following

equation

$$y_{ij} = w_i . r_{ij}$$

Information:

y_{ij} is a weighted rating matrix,

w_i is the rating weight to i

r_{ij} is the matrix resulting from the normalization of the matrix dasar

3. Determine the positive ideal solution (A +) and the ideal negative solution (A-) based on the weighted rating matrix value in step 2. The following equation is used to find the value of a positive ideal solution and the value of a negative ideal solution.

$$A^+ = (y_1^+, y_2^+ ..., y_n^+)$$
$$A^- = (y_1^-, y_2^- ..., y_n^-)$$

4. Determine the distance between the weighted value of each alternative to the positive ideal solution and the negative ideal solution with the following equation.

$$D_i^+ = \sqrt{\sum_{i=1}^n (y_1^+ - y_{ij})^2}$$

$$D_i^- = \sqrt{\sum_{i=1}^n (y_1^- - y_{ij})^2}$$

5. The last step is to calculate the preference value for each alternative which will be used as a ranking with the following equation.

$$V_i = \frac{D_i^-}{D_i^- + D_i^+}$$

III. PROPOSED METHOD

3.1. Data Collection Techniques

Data collection techniques are useful when carrying out analyzes related to the research being conducted. The following techniques are used:
1. Literature study
2. Observation
3. Interview

3.2. System development methods

This study the author uses RAD (Rapid Application Development). Some stages of the RAD development cycle are as follows:
1. Stage of Planning Terms

2. Design Phase
3. Implementation Phase

IV. RESULT AND DISCUSSION

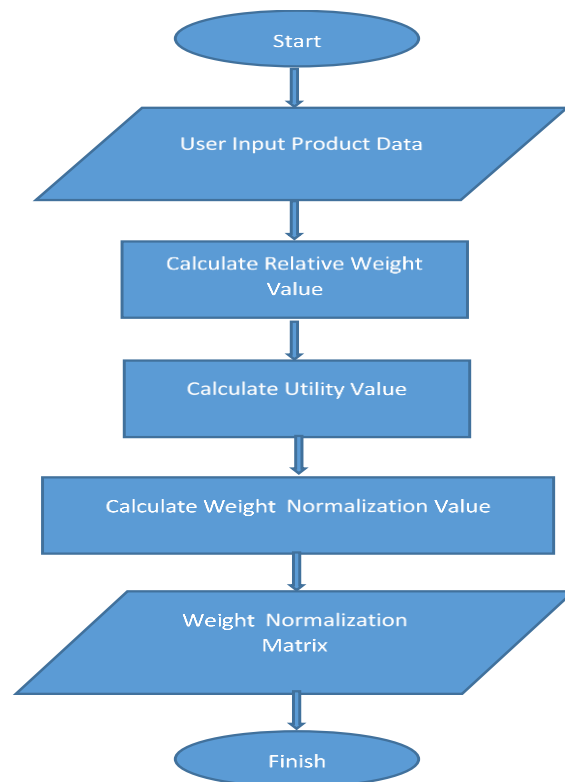### 3.1 SMART Calculations

Fig. 1. SMART Calculation Flow

The following is an example of the order data being tested displayed as the table I below.

TABLE I.   ORDER LIST

ID (name)	Dead line	Order	Design	Profit (Rp)	Material Stock
A1 (Order 1)	5	9	Easy	12000	Adequate
A2 (Order 2)	10	20	Middle	6000	Adequate
A3 (Order 3)	3	10	Difficult	15000	Adequate
A4 (Order 4)	11	40	Easy	8000	Less
A5 (Order 5)	7	54	Easy	7000	Less

The weight for each criterion is explained as follows at Table II :

TABLE II.   CRITERIA WEIGHT LIST

No	Criteria	Sub-criteria	Value
1	Deadline	11-14	1
		8-10	2
		4-7	3
		1-3	4
2	Order	1-12	1
		13-24	2
		25-50	3
		50>	4
3	Design	Difficult	1
		Middle	2
		easy	3
4	Profit	1000-5000	1
		6000-10000	2
		11000-15000	3
		16000 – 20000	4
5	Stock	No	1
		Less	2
		Adequate	3

1. Provide a scale of 0-100 on each criteria weight based on prior predetermined priorities then normalization.

TABLE III. RELATIVE WEIGHT CALCULATION LIST

Criteria	Weight	Normalization	Relative Weight
Deadline	75	75/350	0,21
Order	50	50/350	0,14
Design	50	50/350	0,14
Profit	100	100/350	0,29
Stock	75	75/350	0,21
Total	350		1

2. Calculate utility values for each criterion.

TABLE IV. MATRIX UTILITY VALUE

	K1 (Deadline)	K2 (Order)	K3 (Design)	K4 (Profit)	K5 (Material)
A1	66,67	0	66,67	66,67	66,67
A2	33,33	33,33	33,33	33,33	66,67
A3	100	0	0	66,67	66,67
A4	0	66,67	66,67	33,33	33,33
A5	66,67	100	66,67	33,33	33,33

3. Calculating the Value of Weighting Results (Utility Value x Normalization Weight)

TABLE V. MATRIX WEIGHT RESULT

	K1	K2	K3	K4	K5
A1	14	0	10	18,6	14
A2	7	5	5	9,3	14
A3	21	0	0	18,6	14
A4	0	10	10	9,3	7
A5	14	15	10	9,3	7

After getting the weighting matrix with the SMART method, proceed with the selection of the best products using the TOPSIS method.
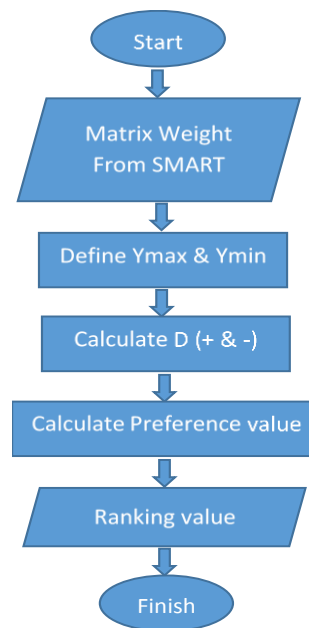
3.2 TOPSIS Calculations

Fig. 2. TOPSIS Calculation Flow

1. After getting the SMART matrix, then proceed by calculating the value of Ymax and Ymin from the matrix SMART weight at Table V below.

TABLE VI. MATRIX SMART WEIGHT

Y1	Y2	Y3	Y4	Y5
14	0	10	18,6	14
7	5	5	9,3	14
21	0	0	18,6	14
0	10	10	9,3	7
14	15	10	9,3	7

TABLE VII. YMAX & YMIN

		Ymax	Ymin
Y1	{14 ,7 ,21 ,0 ,14 }	21	0
Y2	{0 ,5 ,0 ,10 ,15}	15	0
Y3	{10 ,5 ,0 ,10 ,10 }	10	0
Y4	{18.6 ,9.3 ,18.6 ,9.3 ,9.3 }	18.6	9.3
Y5	{14 ,14 ,14 ,7 ,7 }	14	7

2. Calculate positive and negative ideal solutions.

TABLE VIII. POSITIVE IDEAL SOLUTIONS

	FORMULA	DI +
D1	$\sqrt{(21-14)^2+(15-0)^2+(10-10)^2+(18.6-8.6)^2+(14-14)^2}$	16.55
D2	$\sqrt{(21-7)^2+(15-5)^2+(10-5)^2+(18.6-9.3)^2+(14-14)^2}$	20.18
D3	$\sqrt{(21-21)^2+(15-0)^2+(10-0)^2+(18.6-18.6)^2+(14-14)^2}$	18.02
D4	$\sqrt{(21-0)^2+(15-10)^2+(10-10)^2+(18.6-9.3)^2+(14-7)^2}$	24.52
D5	$\sqrt{(21-14)^2+(15-15)^2+(10-10)^2+(18.6-9.3)^2+(14-7)^2}$	13.58

TABLE IX. NEGATIVE IDEAL SOLUTIONS

	FORMULA	DI -
D1	$\sqrt{(0-14)^2+(0-0)^2+(0-10)^2+(9.3-18.6)^2+(7-14)^2}$	20.77
D2	$\sqrt{(0-7)^2+(0-5)^2+(0-5)^2+(9.3-9.3)^2+(7-14)^2}$	12.16
D3	$\sqrt{(0-21)^2+(0-0)^2+(0-0)^2+(9.3-18.6)^2+(7-14)^2}$	24.01
D4	$\sqrt{(0-0)^2+(0-10)^2+(0-10)^2+(9.3-9.3)^2+(7-7)^2}$	14.14
D5	$\sqrt{(0-14)^2+(0-15)^2+(0-10)^2+(9.3-9.3)^2+(7-7)^2}$	22.82

Calculating preference values for each alternative, the results will be used for ranking.

TABLE X. RANKING RESULT

	FORMULA (D)	RESULT	RANKING
Order 1	20,77 /(20.77+16,55)	0.57	3
Order 2	12,16/(12,16 +20,18)	0.38	4
Order 3	24,01/(24,01+18,02)	0.59	2
Order 4	14,14/(14.14+24,52)	0.35	5
Order 5	22,82/(22,82+13,58)	0.62	1

Following is the final result of the calculation in the system that has been made :
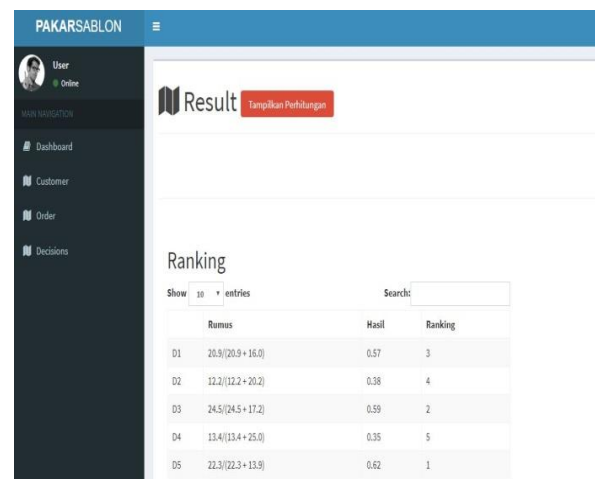

Fig. 3. System Ranking Result

3.3 System Testing
1. Black Box Testing
2. System Accuracy Testing

TABLE XI. RANKING RESULT

Order Name	Manual Calculation	System Calculation	Result
Order 1	0,57	0,57	Appropriate
Order 2	0,38	0,38	Appropriate
Order 3	0,59	0,59	Appropriate
Order 4	0,35	0,35	Appropriate
Order 5	0,62	0,62	Appropriate

From this system accuracy test it is known that, 5 system test data in accordance with 5 manual test data. Therefore the results of the system accuracy test are:

$$Accuracy\ (\%) = \frac{5}{5}x\ 100\% = 100\%$$

So the level of accuracy of the system against the accuracy of the manual test is 100%.

3.4 Discussion of results

The results of the system calculation using the SMART and TOPSIS methods, using the preference weight values on the criteria obtained from the interview. The preference weighting is on a scale of 0 -100, 75 deadlines, 50 orders, 50 designs, 100 profits, 75 availability of items. In the system, the authors compare 5 orders. From the results of these calculations, the best order has a final value of 0.62 and the worst order has a final value of 0.35, where the best results are close to the value. From this result, the weighting of a criterion influences the final result. weight of 100.

V. CONCLUSION AND RECOMMENDATIONS

Based on the analysis that has been done, it can be concluded several things as follows:

Calculation of DSS by comparing 5 orders using criteria from the owner of this screen printing, namely deadlines, number of orders, design, profit and availability of goods. Then the order of order will be produced with the best final value 0.62 and the worst final value 0.35, where the best value approaches the value of 1. From the results, the weighting of a criterion affects the final result, here the weight of the most influential criteria is the weight of 100 is followed by the deadline criteria of 75. In this study 2 tests were carried out, namely the blackbox test and system accuracy. From the results of testing the blackbox, it is known that the system can work properly.

For further research it is recommended that you can use other methods that have never been integrated or incorporated into a system and the criteria can be updated (added or reduced) and developed on other platforms besides the website, such as Android, iOS and Windows Phone

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