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E-Commerce Promotional Products Selection Using SWARA and TOPSIS

Nabilla Farah Raissa Maharani[1]
Department of Industrial Engineering
Universitas Indonesia
Depok, Indonesia

Novandra Rhezza Pratama[2] and M. Dachyar[3]
Department of Industrial Engineering
Universitas Indonesia
Depok, Indonesia

Abstract:- This research aims to select products that will be used for promotion on e-commerce platforms. The increasing use of e-commerce has led to a high level of competition in the e-commerce field. The company strives to maintain the quality of its services to increase customer satisfaction, one of which is by providing regular promotions. The process of selecting promotional products is a routine activity carried out every week. However, the current promotional product selection process is not effective enough, and there are no criteria to use as a reference for selection. This research was conducted on two e-commerce companies actively operating in Indonesia. The research began with a literature study and expert survey to select important criteria in selecting promotional products. Weighting of important criteria is carried out using the Stepwise Weight Assessment Ratio Analysis (SWARA) method. Finally, the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method is used to rank the best products to promote. The results showed that products from Soundcore, Lenovo, and Xiaomi were the best products with preference values of 0.83, 0.65, and 0.60 respectively.

Keywords:- *Product Promotion, Product Selection, E-Commerce, SWARA, TOPSIS.*

I. INTRODUCTION

Digital developments have become the basis of corporate transformation. Companies are competing to improve their quality by upgrading all aspects of the company toward digital. In other side, many new start-up companies that are directly adapting digital concepts, one of which is e-commerce companies. Marketplace or e-commerce is a platform that gathers sellers and buyers in one integrated application, so that the buying and selling process can be done online. Marketplace or e-commerce provides a new experience in the form of easy access for both sellers offering their products and buyers getting the products they want, without having to move directly. Online shopping makes it easier for consumers to get goods without having to leave the house [1]. This provides benefits for sellers, where sellers can increase their target market because sales are not limited by region. As for buyers, the potential for finding the desired product is getting bigger and easier. The most interesting thing, e-commerce provides more competitive product prices compared to direct purchases in stores. Since its release in Indonesia, e-commerce has provided many attractive offers which have made shopping on e-commerce a trend. The large number of discounts and promotions also makes the e-commerce trend even stronger. Companies in the e-commerce sector are currently experiencing enormous development [2].

The COVID-19 pandemic era has become the peak of increasing sales in e-commerce. The existence of government policies in the form of limited access in and out of the house makes it difficult for people to interact directly. Government policies regarding limited access to outside the home during the COVID-19 pandemic have caused a shift in consumer spending patterns [1]. However, people need to continue to fulfil their daily needs, and the alternative option is to make transactions using e-commerce. After the Covid-19 pandemic, most people shop online to meet their requirements [1]. There is a shift in customer priorities which means shops are no longer the main place for people to buy goods [3]. This was the beginning of the change in the function of e-commerce from just a trend to a necessity. Until now, many people have used e-commerce to fulfil their monthly needs. This is because besides considering competitive prices, people also find it easy to get what they need without having to look for it directly. As it improves, competition between e-commerce companies is increasing. People will be more interested in e-commerce that provides a good shopping experience [4]. Each company strives to provide the best service to customers, such as improving features, maintaining price competitiveness, and conducting regular monthly promotions. Some e-commerce companies usually have their own regular periodical campaigns. This campaign is a strategy for e-commerce to provide attractive promotions with the aim of increasing customer satisfaction. The process of selecting products to promote is a routine e-commerce activity that must be carried out selectively to achieve campaign goals.

Activities for selecting products to be promoted are carried out before the campaign begins. There is a short time difference between campaigns, making product selection time tends to be narrow. E-commerce companies must select products quickly so that the products can be broadcast on time on the specified campaign date. However, there are still several obstacles related to efficiency that hinder product selection. Currently the product selection system still uses a manual system with a filtering method which is carried out one by one based on the desired criteria. This makes product

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selection less effective and can take longer. Moreover, there are no certain standard criteria between each product selector, thus increasing the possibility that the selected product is not quite right. This can have an impact on promotion achievement, which can influence customer satisfaction with e-commerce services themselves. As competition between e-commerce companies increases over time, of course this is a serious problem that must be addressed immediately. The efficiency of selecting promotional products will influence the effectiveness of campaigns and promotions.

Previous research was carried out to select products that would be recommended to buyers [2] [5]. The research aims to create a framework that will help e-commerce develop customer decision support system features. Another research provides alternative products from various e-commerce to be recommended to buyers [6]. This research selects products from several e-commerce companies in Indonesia. Other research provides alternative development strategies for e-commerce [7] [8] . These alternative suggestions can be input for e-commerce in choosing development priorities. Another research was conducted to select the best third-party logistics (3PL) service provider [9] [10]. The hybrid MCDM method is used to determine the best 3PL recommendation. From previous research related to product selection and e-commerce companies, there is still no research conducted to help e-commerce companies in choosing products to promote. This shows that there is still a research gap regarding the selection of recommended products to be promoted by e-commerce companies.

- RQ1: What are the important criteria to choose product promotions?
- RQ2: How to determine criteria weight to choose the important criteria for selecting product promotion?
- RQ3: How to choose alternative product to be promoted on e-commerce company?

This research was conducted with the main aim of finding alternative products as recommendations for e-commerce companies in choosing products to promote. The research begins by looking for important criteria that must be considered when selecting promotional products. After the important criteria are obtained, the criteria are weighted to determine the most important criteria to pay attention to. The final stage is ranking the product, where the top ranking indicates the product is the best to promote.

II. LITERATURE REVIEW

➢ *Product Selection*

Research related to product selection has been carried out previously to create a recommendation system framework that buyers can use to select products to purchase [2], [5]. The first research used a comparison of the TOPSIS, VIKOR, PROMITHEE II, and COMET methods in selecting headphone products in an e-commerce site to recommend to buyers [2]. The first rank is occupied by the A1 product according to the TOPSIS, VIKOR, and COMET methods, where using PROMITHEE II is in third place. Similar research was also carried out to find recommended products for buyers [5], by comparing the results of four MCDM methods, namely COMET, SPOTIS, VIKOR, and TOPSIS. Some criteria include price and product specifications. Other research was carried out to create a Decision Support System (DSS) which is also intended as a recommendation system for buyers [11]. The TOPSIS-COMET, COCOSO, EDAS, MAIRCA, and MABAC methods are used, with criteria including product weight, product specifications, and price. There is also other research conducted to help buyers choose the best products from three e-commerce applications [6]. This research uses SMARTER for criteria weighting, and VIKOR for product selection. The criteria include product price, quantity sold, seller rating, buyer reviews, and distance. And there is also research related to selecting the best e-commerce for cross border programs using the DANP and TOPSIS methods [12].

➢ *Stepwise Weight Assessment Ratio Analysis (SWARA)*

Weighting of important criteria for selecting promotional products is carried out using one of the Stepwise Weight Assessment Ratio Analysis (SWARA) methods. Previously, the SWARA method had succeeded in resolving criteria weighting problems in several fields. Previous research used SWARA to weight criteria for selecting locations for geothermal power plant construction [13], where nine important criteria were obtained. The results showed that the three most important criteria include the number of refineries entering the province, the distance of the refinery from the distribution center, and the distance of the geothermal location from the distribution site with weights of 0.218, 0.177, and 0.140. The weighting of the criteria for selecting wind turbines for home scale was also carried out using SWARA [14], with fourteen assessment criteria where the results showed that the most important criteria included wind penetration, total production, and capital costs with weights of 0.106, 0.095, and 0.091 respectively. Other research related to the application of IoT in the manufacturing industry also uses SWARA to weight potential implementation barriers [15]. The results showed that sensor technology, fog networking, and system interface were the most important criteria with weights of 0.0533, 0.0517, and 0.0505 respectively. Research related to artificial intelligence models for detecting forest fires uses SWARA to weight eleven fire predictors consisting of 58 classes [16]. The results showed an increase in accuracy of 18% compared to the previous model. Other research uses SWARA in weighting seventeen criteria for selecting renewable materials, where the selection is carried out using the Best-Worst Method (BWM) method [17]. The use of SWARA for weighting criteria is also used to weight factors for increasing the survivability of the Sustainable Supply Chain (SSC) during the COVID-19 pandemic and after [18]. The results obtained were the weights of the criteria and sub-criteria, with the criteria weights including SC performance under uncertainty (0.079921), supply chain configuration (0.027501), SC governance (0.046891), SC network continuity (0.45455), collaborative SC (0.24428), and digital data-based SC (0.14256).

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➢ *Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS)*

In selecting promotional products, the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method is used to select products. The TOPSIS method has been widely used successfully in selecting alternative solutions with multi-criteria constraints. Previous research used the TOPSIS method to select the best e-commerce site for business to customers (B2C) services [19]. The results showed that Site-5 was the best e-commerce in terms of design criteria, information, service quality, security and privacy, and customer service support. Other research uses DEMATEL-TOPSIS to select the best suppliers to improve Supply Chain Resilience (SCR) [20]. In this study, the results of the TOPSIS method were also validated with other MCDM methods such as MABAC, VIKOR, MAIRCA, and OCRA. Research related to the selection of logistics service providers in electronic trading companies uses the TOPSIS method which is integrated with the three-parameter interval gray number (T-PIGN) [21]. The selection is based on four criteria and twenty sub-criteria, with the result being delivery service 4 as the best delivery service. Another research was conducted to assess which e-commerce has the best key performance matrix (KPM) [3]. There are 35 assessment criteria with seven e-commerce being assessed, and AMAZON is the best e-commerce. Research related to location selection uses AHP-TOPSIS to select the best location for fire station placement [22]. Nine criteria were used to select the best location, and Alternative 1 was produced as the best location with a closeness value of 0.65. In other research, TOPSIS is used for stock portfolio selection, where these constraints are considered as multi-criteria constraints [23]. This research modifies the PIS and NIS values to be absolute to control stock trades.

III. METHODOLOGY

➢ *Selecting Improtant Criteria*

The initial stage of this research is to search for important criteria in selecting promotional products. Important criteria were obtained from previous research and expert discussions. To find important criteria from literature studies, previous research was searched for product selection in e-commerce companies that involved important criteria. Where we will look for criteria that are still related to the selection of important criteria. This is because there is still no research that discusses the search for important criteria in choosing promotional products in e-commerce companies. The criteria obtained from further research will become material for discussion with experts.

In the expert discussion, 7 experts were selected who had more than five years of experience in the digital commercial field. Apart from that, the experts selected are also those who currently have work that is directly related to the selection of promotional products. Discussions are held online to increase the flexibility of the conversation. Experts are asked to provide opinions related to the criteria obtained from literature studies. Experts are also allowed to add criteria that they consider important to pay attention to when selecting promotional products.

After all the criteria from literature studies and expert discussions were obtained, experts were asked to assess the criteria on a Likert scale of 1 to 6. Scale 6 indicated that the criteria were the most important to pay attention to, whereas scale 1 indicated that the criteria were the least important to pay attention to. This criteria assessment was carried out using an online form with 7 experts, the same as the expert discussion stage.

➢ *Validity and Reliability Test*

After the expert assessment is obtained, validity and reliability tests are carried out to find out the suitability of the data for use at the next stage. Validity and reliability tests were carried out with Microsoft Excel. In the validity test, the r value will be calculated, where if the calculated r is greater than the r table, it indicates the data is valid [24]. An r table was used with a significance of 0.05. In the reliability test, Cronbach's Alpha value will be calculated. If the Cronbach's Alpha value is > = 0.7, it indicates that the data is reliable [25].

➢ *Stepwise Weight Assessment Ratio Analysis (SWARA)*

The Stepwise Weight Assessment Ratio Analysis (SWARA) method was first used in 2010 [26], where it was used to find the significance of attributes by weighting assessment criteria to help with multi-criteria decision making (MCDM). In this research, the SWARA method was used to weigh important criteria in searching for promotional products. The following are the steps of the SWARA method according to [27].

- Step 1: First calculate the relative initial average value by dividing the sum of the values for each criterion by the number of respondents following Eq. (1).

$$P_j = \frac{\sum_{k=1}^{l} p_k^j}{l}, \text{j} = 1, 2, \ldots, \text{n} \quad (1)$$

- Step 2: Each criterion is ranked based on its initial relative mean value.

- Step 3: Calculate the criterion coefficient value using Eq. (2).

$$c_j = s_j + 1, \text{j} = 1, 2, \ldots, \text{n} \quad (2)$$

- Step 4: Calculate the comparative value of the criteria based on their initial ranking with Eq. (3).

$$s'_j = \frac{s'_{j-1}}{c_j} \quad (3)$$

- Step 5: The final stage is weighting the criteria following Eq. (4)

$$w_j = \frac{s'_j}{\sum_{j=1}^{n} s'_j}, \text{j} = 1, 2, \ldots, \text{n} \quad (4)$$

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The highest weight indicates the most important criteria to pay attention to when selecting promotional products, whereas the lowest weight indicates the least important criteria to pay attention to.

- *Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) Method*

Promotional product selection is carried out using the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method. The data used are 10 product data samples taken from one of the active e-commerce sites in Indonesia. The following are the steps in selecting alternative solutions using TOPSIS following [12].

- Step 1: Create a decision matrix from sample product data following Eq. (5), where n is the alternatives and m is the criteria.

$$D = \begin{bmatrix} x_{11} & x_{1j} & x_{1m} \\ x_{i1} & x_{ij} & x_{im} \\ x_{n1} & x_{nj} & x_{mn} \end{bmatrix} \quad (5)$$

- Step 2: Create a normalized matrix from the decision matrix using Eq. (6)

$$g_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{n} x_{ij}^2}}, \text{(i = 1, 2, …, n) , (j = 1, 2, …, m)} \quad (6)$$

- Step 3: Create a weighted normalized matrix from the normalized matrix with Eq. (7).

$$q_{ij} = w_j g_{ij}, \text{(i = 1, 2, …, n) , (j = 1, 2, …, m)} \quad (7)$$

- Step 4: Calculate the positive ideal solution (A+) and negative ideal solution (A-) using Eq. (8) and Eq. (9) respectively.

$$A^+ = max q_{i1}, q_{i2}, \dots, q_{im}, \text{ i = 1, 2, …, n} \quad (8)$$

$$A^- = min q_{i1}, q_{i2}, \dots, q_{im}, \text{ i = 1, 2, …, n} \quad (9)$$

- Step 5: Next, the weighted distance between the optimal solution and the negative and positive ideal solutions is calculated using Eq. (10) and Eq. (11), respectively.

$$D_i^+ = \sqrt{\sum_{j=1}^{m} (q_{ij} - q_j^+)^2}, \text{ i = 1, 2, …, n} \quad (10)$$

$$D_i^- = \sqrt{\sum_{j=1}^{m} (q_{ij} - q_j^-)^2}, \text{ i = 1, 2, …, n} \quad (11)$$

- Step 6: Calculate the relative approximation value using Eq. (12)

$$C_i = \frac{D_i^-}{D_i^+ + D_i^-} \quad (12)$$

Where the largest relative value means the best solution

IV. RESULT AND DISCUSSION

This research begins with identifying important criteria in selecting promotional products. These important criteria were obtained from literature studies sourced from previous research, as well as from discussions with experienced experts in the field of digital commerce. From the literature study, 6 important criteria were found that are still related to the selection of promotional products. Table 1. displays important criteria and sources of previous research related to digital trade.

Table 1 Important Criteria from Previous Research

Research	Criteria
[2]	Price
[5]	Price
[6]	Price, Shop Rating, Product Rating, Quantity Sold
[12]	Price, Number of Variant, Product Specification
[11]	Price, Product Specification

Furthermore, these six criteria, which include price, store rating, product rating, quantity sold, number of variations, and product listing, become topics of discussion with experts. There were 7 experts who had at least 5 years of experience in the field of digital commerce and are currently in direct contact with promotional product selection activities in their companies. These experts come from two e-commerce companies that are actively operating in Indonesia. The identity of each expert is attached in Table 2.

Table 2 Experts Identity

Experts	Role	Company
R1	Project Manager	P1
R2	Merchandiser	P1
R3	Account Manager	P2
R4	Account Manager	P1
R5	Account Manager	P2

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R6	Account Manager	P1
R7	Account Manager	P1

From discussions with experts, 9 important criteria were obtained including stock, shop voucher, shipping service, product review, product description, active promotion, seller type, free shipping label, and number of products with discount. Thus, a total of 15 important criteria were obtained in selecting promotional products which are including price, store rating, product rating, quantity sold, number of variations, product listing, stock, shop voucher, shipping service, product review, product description, active promotion, seller type, free shipping label, and number of products with discount.

After obtaining all the important criteria, the expert assessment was carried out using a Likert scale of 1 to 6. Table 3 displays the results of the expert's assessment regarding the important criteria for selecting promotional products.

Table 3 Criteria Score from Expert

Criteria	**Variable**	**Expert Score**						
		R1	**R2**	**R3**	**R4**	**R5**	**R6**	**R7**
Price	C1	5	5	6	6	5	6	6
Shop Rating	C2	2	4	6	6	4	5	5
Product Rating	C3	4	5	6	6	4	5	5
Quantity Sold	C4	4	4	6	4	4	4	4
Number of Variations	C5	2	4	6	4	3	3	4
Product Listing	C6	5	4	6	6	4	6	6
Stock	C7	5	2	6	5	3	6	4
Shop Voucher	C8	2	2	6	6	5	4	4
Shipping Service	C9	2	2	4	4	5	4	5
Product Review	C10	2	6	6	6	5	5	5
Product Description	C11	2	5	6	6	4	5	5
Active Promotion	C12	4	5	6	6	5	4	5
Seller Type	C13	3	3	4	4	3	4	4
Free Shipping Label	C14	4	4	6	6	5	6	4
Number of Product with Discount	C15	2	2	6	3	2	6	5

Validity and reliability tests were carried out before continuing the research to the criteria weighting stage. Table 4 shows the results of the validity test, where the r value obtained is greater than r (0.05), which is 0.514. This shows that the survey data is valid.

Table 4 Validity Test

Criteria	R1	R2	R3	R4	R5	R6	R7	r
C1	5	5	6	6	5	6	6	0.885
C2	2	4	6	6	4	5	5	0.958
C3	4	5	6	6	4	5	5	0.858
C4	4	4	6	4	4	4	4	0.616
C5	2	4	6	4	3	3	4	0.787
C6	5	4	6	6	4	6	6	0.731
C7	5	2	6	5	3	6	4	0.555
C8	2	2	6	6	5	4	4	0.846
C9	2	2	4	4	5	4	5	0.583
C10	2	6	6	6	5	5	5	0.693
C11	2	5	6	6	4	5	5	0.871
C12	4	5	6	6	5	4	5	0.671
C13	3	3	4	4	3	4	4	0.885
C14	4	4	6	6	5	6	4	0.777
C15	2	2	6	3	2	6	5	0.771

Next, the Cronbach Alpha calculation was carried out, which was found to be 0.933. This value is greater than the reference value, namely 0.7, which shows the data is reliable.

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The next stage is weighing the criteria using the SWARA method, and the calculations are carried out using Microsoft Excel. The results obtained were the weight of important criteria with the 3 most important criteria including price, product listing and rating. The results of the criteria weighting are displayed in Table 5 below.

Table 5 Criteria Weight

Criteria	Variable	Wj (Criteria Weight)	Rank
Price	C1	0.24904	1
Product Listing	C6	0.21939	2
Product Rating	C3	0.17271	3
Product Review	C10	0.12289	4
Active Promotion	C12	0.08744	5
Free Shipping Label	C14	0.06222	6
Product Description	C11	0.04427	7
Shop Rating	C2	0.02275	8
Stock	C7	0.01093	9
Quantity Sold	C4	0.00493	10
Shop Voucher	C8	0.0021	11
Number of Variations	C5	0.00084	12
Shipping Service	C9	0.00032	13
Number of Product with Discount	C15	0.00012	14
Seller Type	C13	0.00005	15

The results from criteria weighted then become reference variables in selecting promotional products. In selecting promotional products, a sample data set in the form of product and store data is used. Sample data is used in the form of True Wireless Stereo (TWS) product data sold at Company 1. The selected data comes from different stores, with different TWS brands. Table 6 displays the brands and stores of the sample products taken.

Table 6 Sample Product

Brand	Store	Product Variable
Baseus	Baseus Official Shop	A1
Lenovo	ZNP Official Store	A2
Xiaomi	Xiaomi Official Store	A3
Soundcore	Soundcore Official Shop	A4
Huawei	Huawei Official Store	A5
Edifier	Edifier Official Shop	A6
Nokia	Nokia Audio Official Shop	A7
JBL	Desound Official Shop	A8
Robot	MAVICPC Official Shop	A9
MINISO	MINISO INDONESIA	A10

Selection of promotional products is carried out using the TOPSIS method. Product selection data processing was carried out using Microsoft Excel. From here the ranking of the ten products is obtained which is attached in Table 7, where the three best products to be promoted were obtained, namely products from the Soundcore, Lenovo and Xiaomi brands, respectively.

Table 7 Ranking Product

Product	Preference Value	Rank
A4	0.8274	1
A2	0.6504	2
A3	0.6001	3
A7	0.5981	4
A1	0.5977	5
A10	0.5459	6
A9	0.5272	7
A6	0.5172	8

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A5	0.4312	9
A8	0.3009	10

V. CONCLUSION

This research has been carried out with the main aim of looking for recommended products to be promoted by e-commerce companies. The first stage was the search for important criteria taken from previous research, where 6 important criteria were obtained. Next, an expert discussion was held to discuss whether these important criteria were relevant and whether the experts had other additional criteria. From discussions with experts, 9 important criteria were obtained, so that a total of 15 important criteria were obtained when looking for promotional products. The next stage is the validity and reliability test, where it is proven that the survey data is valid and reliable. Then the criteria were weighted using the Stepwise Weight Assessment Ratio Analysis (SWARA) method, with the results of the most important criteria being price, product listing and product rating with weights of 0.249, 0.219 and 0.173 respectively. The final stage is selecting important criteria using the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) method. As input, a sample of 10 true wireless stereo (TWS) earphone product data from one e-commerce in Indonesia was used. From here, the results for the top three products, namely the Soundcore, Lenovo and Xiaomi brands, were obtained with values of 0.8274, 0.6504 and 0.6001.

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