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APPLICATION OF THE MULTI-ATTRIBUTIVE BORDER APPROXIMATION AREA COMPARISON (MABAC) AND DECISION MAKING TRIAL AND EVALUATION LABORATORY (DEMATEL) METHODS FOR E-WALLET SELECTION

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Abstract. The rapid growth of digital transactions in Indonesia has increased e-wallet adoption; Bank Indonesia recorded a 34.62% rise in electronic money transaction value to Rp2,503.96 trillion in 2024 (GoodStats, 2025). However, differences among e-wallet services in security, transaction cost, ease of use, promotions, and additional features make e-wallet selection a multi-criteria decision problem that is not always easy for users, so an appropriate decision-making method is needed. This study applies the Multi-Attributive Border Approximation Area Comparison (MABAC) and Decision Making Trial and Evaluation Laboratory (DEMATEL) methods to e-wallet selection, comparing MABAC's capability to rank alternatives against DEMATEL's capability to analyze the relationships and influence levels among selection criteria. Data were collected through questionnaires distributed to e-wallet users, covering seven alternatives (Dana, GoPay, OVO, LinkAja, ShopeePay, Sakuku, and iSaku) evaluated against six criteria (usage rate, security, transaction fees, ease of use, promotions, and additional features). The MABAC results show that GoPay ranked first with a score of 0.679, followed by Dana (0.591) and ShopeePay (0.113), while the DEMATEL results indicate that security, transaction cost, and ease of use are the most influential criteria in e-wallet selection. These findings show that MABAC is effective for ranking alternatives, whereas DEMATEL is effective for analyzing inter-criteria relationships, so combining both methods provides more comprehensive support for e-wallet selection decisions.

Keywords: **E-wallet, Decision Support System, Multi-Attributive Border Approximation Area Comparison (MABAC), Decision Making Trial and Evaluation Laboratory (DEMATEL).**

A. Introduction

Digital financial transactions in Indonesia have grown rapidly, reflecting how the development of information technology has reshaped various sectors, including the financial sector. Bank Indonesia recorded that electronic money transaction value reached Rp2,503.96 trillion in 2024, an increase of 34.62% from the previous year, with top-ups, purchases, and inter-account transfers as the main contributors (GoodStats, 2025). This growth is driven largely by the increasing use of electronic wallets, or e-wallets, which enable users to carry out various digital transactions, such as paying for goods and services, paying bills, purchasing phone credit, and transferring money.

The growing use of mobile devices and internet access has further supported this development of e-wallets. E-wallets are increasingly widely used because they offer convenience and efficiency in carrying out transactions; however, the growing number of e-wallet services creates a problem for users in selecting the alternative that best suits their needs. This difficulty is consistent with prior research on electronic payment platform selection, which shows that users must weigh multiple, often conflicting factors, such as facilitating conditions, security risk, privacy risk, and system quality, so that no single alternative is clearly superior across all criteria (Nguyen, 2023). Each e-wallet application indeed has different characteristics, whether in terms of security, transaction costs, ease of use, application promotions, or additional features. Therefore, e-wallet selection constitutes a decision-making problem that involves multiple criteria. A decision support system (DSS) can be used to assist this process by providing an evaluation of a number of alternatives based on predetermined criteria.

One DSS method that can be used for this purpose is the Multi-Attributive Border Approximation Area Comparison (MABAC), introduced by Pamučar and Ćirović (2015). MABAC is selected for this study because it ranks alternatives based on their distance from a border approximation area, an approach that is computationally simple yet produces stable and consistent rankings even as the number of alternatives or criteria increases. MABAC has also been applied successfully in various multi-criteria selection problems, such as product quality determination (Anriani et al., 2024), best-seller ranking (Hidayat et al., 2023), and employee recruitment selection (Laila & Hasibuan, 2021), supporting its suitability for ranking e-wallet alternatives in this study. The MABAC method is used to evaluate a number of alternatives based on several criteria and produces a final value that can be used to rank the alternatives. In this study, MABAC is used to determine the e-wallet with the best evaluation outcome.

In addition to MABAC, the Decision Making Trial and Evaluation Laboratory (DEMATEL) method can be used to analyze the relationships between criteria. DEMATEL is capable of identifying cause-and-effect relationships among factors and distinguishing between factors that act as causes and factors that act as effects.

The differing characteristics of the two methods form the basis for this research. MABAC is used to identify the best e-wallet alternative, whereas DEMATEL is used to identify the criteria with the strongest relationships and greatest influence. This study therefore applies both methods to e-wallet selection, comparing MABAC's capability to rank alternatives with DEMATEL's capability to analyze the relationships and influence levels among the selection criteria.

Pendahuluan paling sedikit berisi tentang latar belakang masalah penelitian, tujuan penelitian, dan solusi yang ditawarkan untuk mengatasi masalah yang disampaikan. Artikel ditulis dapat ditulis dalam **Bahasa Indonesia** maupun **Bahasa Inggris.** Artikel ini paling banyak terdiri atas 10 halaman.

B. Research Methodology

This research employs a quantitative approach using the survey method. Data were obtained by distributing questionnaires to e-wallet users. This study involves 7 alternatives and 6 criteria; the resulting data were subsequently processed using the MABAC and DEMATEL methods.

1. Research Variables

The variables examined in this study are e-wallets (Dana, GoPay, OVO, LinkAja, ShopeePay, Sakuku, and iSaku).

Table 1 E-wallet Alternative Variables

Alternative	E-wallet Name
A1	Dana
A2	Gopay
A3	OVO
A4	LinkAja
A5	ShopeePay
A6	Sakuku
A7	iSaku

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Table 2. E-wallet Selection Criteria Variables

Variable	Criteria
C1	Widely used application
C2	Security
C3	Transaction Cost
C4	Ease of Use
C5	E-wallet Application Promotion
C6	Other Supporting Features

2. Research Procedure

The research procedure carried out in this study is as follows:

a. Determining the criteria for e-wallet selection, consisting of the following: widely used application, security, transaction cost, ease of use, e-wallet application promotion, and other supporting features.
b. Determining the e-wallet alternatives to be analyzed. The e-wallets analyzed are as follows: Dana, GoPay, OVO, LinkAja, ShopeePay, Sakuku, and iSaku.
c. Distributing questionnaires and conducting interviews with e-wallet users to obtain their assessments of the e-wallet alternatives based on the predetermined criteria.
d. Processing and analyzing the data using both methods, based on the data obtained from the questionnaires and interviews, as follows:
    a) The MABAC method is used to calculate the score and ranking of each alternative based on the given criteria, and to compare the alternatives in order to determine the final ranking.
    b) The DEMATEL method is used to identify the relationships among the criteria used for e-wallet selection, to construct a relationship matrix, and to calculate the weight and influence of each criterion in order to determine criteria priority.
e. Comparing the alternative rankings obtained from both methods and analyzing whether there are significant differences between the results obtained from the MABAC and DEMATEL methods.
f. Selecting the e-wallet that best meets the criteria.
g. Drawing conclusions.

C. Result and Analysis

1. Criteria Determination

In applying the MABAC and DEMATEL methods within the decision-making system for e-wallet selection, sub-criteria are required, each with a predetermined weight. The sub-criteria used are presented in Table 4 as follows:

Table 3 Sub-criteria from the Data Collection Results

	K1	K2	K3	K4	K5	K6
A1	46,4	24,8	39,2	34,94	16,35	36
A2	20	39,2	26,4	25,30	41,51	28
A3	8,8	5,6	10,4	18,67	12,58	6,4
A4	4,8	10,4	6,4	1,8	1,89	2,4
A5	16,8	14,4	12,8	12,65	21,38	15,2
A6	1,6	2,4	3,2	3,61	2,52	6,4
A7	1,6	3,2	1,6	3,01	3,77	5,6

The evaluation scale will be used as the basis for calculation in the DEMATEL method.

Table 4 Evaluation Scale

Value	Description
0	No influence
1	Low influence
2	Medium influence
3	High influence
4	Very high influence

2. Application of the MABAC Method

The Multi-Attributive Border Approximation Area Comparison (MABAC) is one of the methods used in decision support systems to assist decision-making that involves multiple criteria. This method helps analyze and classify options based on the various criteria or attributes involved.

The solution using the MABAC (Multi-Attributive Border Approximation Area Comparison) method is carried out as follows:

a. Constructing the Initial Decision Matrix (X)
   Based on Table 4 above, the alternative data are presented as follows:
b. Normalization of the Initial Decision Matrix (X)

$A1$

$$t_{1,1}=\frac{46,4-1,6}{46,4-1,6}=\frac{44,8}{44,8}=1$$

$$t_{1,2}=\frac{39,2-1,6}{39,2-1,6}=\frac{37,6}{37,6}=1$$

$$t_{1,3}=\frac{24,8-2,4}{39,2-2,4}=\frac{22,4}{36,8}=0,608$$

$$t_{1,4}=\frac{34,94-1,8}{34,94-1,8}=\frac{33,14}{33,14}=1$$

$$t_{1,5}=\frac{16,35-1,89}{41,51-1,89}=\frac{14,46}{39,62}=0,364$$

$$t_{1,6}=\frac{36-2,4}{36-2,4}=\frac{33,6}{33,6}=1$$

$A3$

$$t_{3,1}=\frac{8,8-1,6}{46,6-1,6}=\frac{7,2}{44,8}=0,160$$

$$t_{3,2}=\frac{10,4-1,6}{39,2-1,6}=\frac{8,8}{37,6}=0,234$$

$$t_{3,3}=\frac{5,6-2,4}{39,2-2,4}=\frac{3,2}{36,8}=0,086$$

$$t_{3,4}=\frac{18,67-1,8}{34,94-1,8}=\frac{16,87}{33,14}=0,509$$

$$t_{3,5}=\frac{12,58-1,89}{41,51-1,89}=\frac{10,69}{39,62}=0,269$$

$$t_{3,6}=\frac{6,4-2,4}{36-2,4}=\frac{4}{33,6}=0,119$$

$A2$

$$t_{2,1}=\frac{20-1,6}{46,4-1,6}=\frac{18,4}{44,8}=0,410$$

$$t_{2,2}=\frac{26,4-1,6}{39,2-1,6}=\frac{24,8}{37,6}=0,659$$

$$t_{2,3}=\frac{39,2-2,4}{39,2-1,6}=\frac{36,8}{36,8}=1$$

$$t_{2,4}=\frac{26,30-1,8}{34,94-1,8}=\frac{23,5}{33,14}=0,709$$

$$t_{2,5}=\frac{41,51-1,89}{41,51-1,89}=\frac{39,62}{39,62}=1$$

$$t_{2,6}=\frac{28-2,4}{36-2,4}=\frac{25,6}{33,6}=0,761$$

$A4$

$$t_{4,1}=\frac{4,8-1,6}{46,4-1,6}=\frac{3,2}{44,8}=0,071$$

$$t_{4,2}=\frac{6,4-1,6}{39,2-1,6}=\frac{4,8}{37,6}=0,127$$

$$t_{4,3}=\frac{10,4-2,4}{39,2-2,4}=\frac{8}{36,8}=0,217$$

$$t_{4,4}=\frac{1,8-1,8}{34,94-1,8}=\frac{0}{33,14}=0$$

$$t_{4,5}=\frac{1,89-1,89}{41,51-1,89}=\frac{0}{39,62}=0$$

$$t_{4,6}=\frac{2,4-2,4}{36-2,4}=\frac{0}{33,6}=0$$

$A5$

$$t_{5,1}=\frac{16,8-1,6}{46,4-1,6}=\frac{15,2}{44,8}=0,339$$

$$t_{5,2}=\frac{14,4-2,4}{39,2-2,4}=\frac{12}{36,8}=0,326$$

$$t_{5,3}=\frac{12,8-1,6}{39,2-1,6}=\frac{11,2}{37,6}=0,297$$

$$t_{5,4}=\frac{16,8-2,4}{46,4-2,4}=\frac{14,4}{44}=0,327$$

$$t_{5,5}=\frac{27,2-2,4}{52,8-2,4}=\frac{24,8}{50,4}=0,492$$

$$t_{5,6}=\frac{15,2-2,4}{36-2,4}=\frac{12,8}{33,6}=0,380$$

$A6$

$$t_{6,1}=\frac{1,6-1,6}{46,4-1,6}=\frac{0}{44,8}=0$$

$$t_{6,2}=\frac{3,2-1,6}{39,2-1,6}=\frac{1,6}{37,6}=0,042$$

$$t_{6,3}=\frac{2,4-2,4}{39,2-2,4}=\frac{0}{36,8}=0$$

$$t_{6,4}=\frac{3,61-1,8}{34,94-1,8}=\frac{1,81}{33,14}=0,054$$

$$t_{6,5}=\frac{2,5-1,89}{41,51-1,89}=\frac{0,61}{39,62}=0,015$$

$$t_{6,6}=\frac{6,4-2,4}{36-2,4}=\frac{4}{33,6}=0,119$$

$A7$

$$t_{7,1}=\frac{1,6-1,6}{46,4-1,6}=\frac{0}{44,8}=0$$

$$t_{7,2}=\frac{1,6-1,6}{39,2-1,6}=\frac{0}{37,6}=0$$

$$t_{7,3}=\frac{3,2-2,4}{39,2-2,4}=\frac{0,8}{36,7}=0,021$$

$$t_{7,4}=\frac{3,01-1,8}{34,94-1,8}=\frac{1,21}{33,14}=0,036$$

$$t_{7,5}=\frac{3,77-1,89}{41,51-1,89}=\frac{1,88}{39,62}=0,047$$

$$t_{7,6}=\frac{5,6-2,4}{36-2,4}=\frac{3,2}{33,6}=0,095$$

The normalized matrix X is as follows:

$$N=\begin{bmatrix} 1,000 & 1,000 & 0,608 & 1,000 & 0,364 & 1,000 \\ 0,410 & 0,659 & 1,000 & 0,709 & 1,007 & 0,761 \\ 0,160 & 0,234 & 0,086 & 0,509 & 0,269 & 0,119 \\ 0,071 & 0,127 & 0,217 & 0,000 & 0,000 & 0,000 \\ 0,339 & 0,326 & 0,297 & 0,327 & 0,492 & 0,380 \\ 0,000 & 0,042 & 0,000 & 0,054 & 0,015 & 0,119 \\ 0,000 & 0,000 & 0,021 & 0,036 & 0,047 & 0,095 \end{bmatrix}$$

c. Calculation of the Weighted Matrix Elements (V); the following is the formula for finding the value of the weighted matrix elements:

$$v_{ij} = \left(w_i * t_{ij}\right) + wi$$

$$wi = \left[0,147\ \ 0,200\ \ 0,173\ \ 0,186\ \ 0,153\ \ 0,138\right]$$

$A1$

$V_{1,1} = \left(0,147 * 1,000\right) + 0,147 = 0,294$

$V_{1,2} = \left(0,200 * 1,000\right) + 0,200 = 0,4$

$V_{1,3} = \left(0,173 * 0,608\right) + 0,173 = 0,278$

$V_{1,4} = \left(0,186 * 1,000\right) + 0,186 = 0,373$

$V_{1,5} = \left(0,153 * 0,364\right) + 0,153 = 0,208$

$V_{1,6} = \left(0,138 * 0,138\right) + 0,138 = 0,276$

$A2$

$V_{2,1} = \left(0,147 * 0,410\right) + 0,147 = 0,207$

$V_{2,2} = \left(0,200 * 0,659\right) + 0,200 = 0,331$

$V_{2,3} = \left(0,173 * 1,000\right) + 0,173 = 0,346$

$V_{2,4} = \left(0,186 * 0,709\right) + 0,186 = 0,284$

$V_{2,5} = \left(0,153 * 1,000\right) + 0,153 = 0,306$

$V_{2,6} = \left(0,138 * 0,761\right) + 0,138 = 0,243$

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$A3$

$V_{3,1} = (0,147 * 0,160) + 0,147 = 0,023$

$V_{3,2} = (0,200 * 0,243) + 0,200 = 0,248$

$V_{3,3} = (0,173 * 0,086) + 0,173 = 0,187$

$V_{3,4} = (0,186 * 0,509) + 0,186 = 0,280$

$V_{3,5} = (0,153 * 0,269) + 0,153 = 0,194$

$V_{3,6} = (0,138 * 0,119) + 0,138 = 0,154$

$A4$

$V_{4,1} = (0,147 * 0,071) + 0,147 = 0,157$

$V_{4,2} = (0,200 * 0,127) + 0,200 = 0,225$

$V_{4,3} = (0,173 * 0,217) + 0,173 = 0,210$

$V_{4,4} = (0,186 * 0,000) + 0,186 = 0,186$

$V_{4,5} = (0,153 * 0,000) + 0,153 = 0,153$

$V_{4,6} = (0,138 * 0,000) + 0,138 = 0,138$

$A5$

$V_{5,1} = (0,147 * 0,339) + 0,147 = 0,192$

$V_{5,2} = (0,200 * 0,326) + 0,200 = 0,265$

$V_{5,3} = (0,173 * 0,297) + 0,173 = 0,224$

$V_{5,4} = (0,186 * 0,327) + 0,186 = 0,246$

$V_{5,5} = (0,153 * 0,492) + 0,153 = 0,228$

$V_{5,6} = (0,138 * 0,380) + 0,138 = 0,190$

$A6$

$V_{6,1} = (0,147 * 0,000) + 0,147 = 0,147$

$V_{6,2} = (0,200 * 0,042) + 0,200 = 0,208$

$V_{6,3} = (0,173 * 0,000) + 0,173 = 0,173$

$V_{6,4} = (0,186 * 0,054) + 0,153 = 0,196$

$V_{6,5} = (0,153 * 0,015) + 0,153 = 0,155$

$V_{6,6} = (0,138 * 0,119) + 0,144 = 0,164$

$A7$

$V_{7,1} = (0,147 * 0,000) + 0,147 = 0,147$

$V_{7,2} = (0,200 * 0,000) + 0,200 = 0,200$

$V_{7,3} = (0,173 * 0,021) + 0,173 = 0,176$

$V_{7,4} = (0,186 * 0,036) + 0,186 = 0,192$

$V_{7,5} = (0,153 * 0,047) + 0,153 = 0,160$

$V_{7,6} = (0,138 * 0,095) + 0,138 = 0,151$

d. The following is the weighted normalized matrix X:

$$V=\begin{bmatrix} 0,294 & 0,4 & 0,278 & 0,373 & 0,208 & 0,276 \\ 0,207 & 0,331 & 0,346 & 0,284 & 0,306 & 0,243 \\ 0,023 & 0,248 & 0,187 & 0,280 & 0,194 & 0,154 \\ 0,157 & 0,225 & 0,210 & 0,186 & 0,153 & 0,138 \\ 0,192 & 0,265 & 0,224 & 0,246 & 0,228 & 0,190 \\ 0,147 & 0,208 & 0,173 & 0,196 & 0,155 & 0,154 \\ 0,147 & 0,200 & 0,176 & 0,192 & 0,160 & 0,151 \end{bmatrix}$$

e. Border Approximation Area Matrix (G)

$$GC_1=(0,294\times0,207\times0,023\times0,157\times0,192\times0,147\times0,147)^{1/7}$$
$$GC_1=(0,00000091176)^{1/7}$$
$$GC_1=0,137$$

$$GC_2=(0,4\times0,331\times0,248\times0,225\times0,265\times0,208\times0,200)^{1/7}$$
$$GC_2=(0,000080669)^{1/7}$$
$$GC_2=0,260$$

$$GC_3=(0,278\times0,346\times0,187\times0,210\times0,224\times0,173\times0,176)^{1/7}$$
$$GC_3=(0,000029104)^{1/7}$$
$$GC_3=0,225$$

$$GC_4=(0,373\times0,284\times0,280\times0,186\times0,246\times0,196\times0,192)^{1/7}$$
$$GC_4=(0,000050697)^{1/7}$$
$$GC_4=0,243$$

$$GC_5=(0,208\times0,306\times0,194\times0,153\times0,228\times0,155\times0,160)^{1/7}$$
$$GC_5=(0,000010327)^{1/7}$$
$$GC_5=0,193$$

$$GC_6=(0,276\times0,243\times0,154\times0,138\times0,190\times0,154\times0,151)^{1/7}$$
$$GC_6=(0,0000064556)^{1/7}$$
$$GC_6=0,181$$

f. Calculation of the Matrix Elements for the Distance of Alternatives from the Border Approximation Area (Q)

$A1$

$q_{1,1} = 0,294 - 0,137 = 0,157$

$q_{1,2} = 0,4 - 0,260 = 0,14$

$q_{1,3} = 0,278 - 0,225 = 0,053$

$q_{1,4} = 0,373 - 0,242 = 0,131$

$q_{1,5} = 0,208 - 0,193 = 0,015$

$q_{1,6} = 0,276 - 0,181 = 0,095$

$A2$

$q_{2,1} = 0,207 - 0,137 = 0,07$

$q_{2,2} = 0,331 - 0,260 = 0,071$

$q_{2,3} = 0,346 - 0,225 = 0,121$

$q_{2,4} = 0,284 - 0,242 = 0,242$

$q_{2,5} = 0,306 - 0,193 = 0,113$

$q_{2,6} = 0,243 - 0,181 = 0,062$

$A3$

$q_{3,1} = 0,023 - 0,137 = -0,114$

$q_{3,2} = 0,248 - 0,260 = -0,012$

$q_{3,3} = 0,187 - 0,225 = -0,038$

$q_{3,4} = 0,280 - 0,242 = 0,038$

$q_{3,5} = 0,194 - 0,193 = 0,001$

$q_{3,6} = 0,154 - 0,181 = -0,027$

$A4$

$q_{4,1} = 0,157 - 0,137 = 0,02$

$q_{4,2} = 0,225 - 0,260 = -0,035$

$q_{4,3} = 0,210 - 0,225 = -0,015$

$q_{4,4} = 0,186 - 0,242 = -0,056$

$q_{4,5} = 0,153 - 0,193 = -0,04$

$q_{4,6} = 0,138 - 0,181 = -0,043$

$A5$

$q_{5,1} = 0,192 - 0,137 = 0,061$

$q_{5,2} = 0,265 - 0,260 = 0,005$

$q_{5,3} = 0,224 - 0,225 = -0,001$

$q_{5,4} = 0,246 - 0,242 = 0,004$

$q_{5,5} = 0,228 - 0,193 = 0,035$

$q_{5,6} = 0,190 - 0,181 = 0,009$

$A6$

$q_{6,1} = 0,147 - 0,137 = 0,01$

$q_{6,2} = 0,208 - 0,260 = -0,052$

$q_{6,3} = 0,173 - 0,225 = -0,052$

$q_{6,4} = 0,196 - 0,246 = -0,05$

$q_{6,5} = 0,155 - 0,193 = -0,038$

$q_{6,6} = 0,164 - 0,181 = -0,027$

$A7$

$q_{7,1} = 0,147 - 0,137 = 0,01$

$q_{7,2} = 0,200 - 0,260 = -0,006$

$q_{7,3} = 0,176 - 0,225 = -0,049$

$q_{7,4} = 0,192 - 0,246 = -0,054$

$q_{7,5} = 0,160 - 0,193 = -0,033$

$q_{7,6} = 0,151 - 0,181 = -0,03$

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g. Alternative Ranking (S)

$$S1 = 0,157 + 0,14 + 0,053 + 0,131 + 0,015 + 0,095$$
$$S1 = 0,591$$

$$S2 = 0,07 + 0,071 + 0,121 + 0,242 + 0,113 + 0,062$$
$$S2 = 0,679$$

$$S3 = (-0,114) + (-0,012) + (-0,038) + 0,038 + 0,001 + (-0,027)$$
$$S3 = -0,152$$

$$S4 = 0,02 + (-0,035) + (-0,015) + (-0,056) + (-0,04) + (-0,043)$$
$$S4 = -0,169$$

$$S5 = 0,061 + 0,005 + (-0,001) + 0,004 + 0,035 + 0,009$$
$$S5 = 0,113$$

$$S6 = 0,01 + (-0,053) + (-0,052) + (-0,05) + (-0,038) + (-0,027)$$
$$S6 = -0,156$$

$$S7 = 0,01 + (-0,06) + (-0,049) + (-0,054) + (-0,033) + (-0,03)$$
$$S7 = -0,216$$

The calculation results show that GoPay obtained the highest value and ranked first with a score of 0.679, followed by Dana in second place with a score of 0.591, and ShopeePay in third place with a score of 0.113. Meanwhile, OVO ranked fourth with a score of -0.152, followed by Sakuku in fifth place with a score of -0.156, while LinkAja and iSaku ranked sixth and seventh with scores of -0.169 and -0.216, respectively.

3. Application of the DEMATEL Method

The Decision Making Trial and Evaluation Laboratory (DEMATEL) is a method used to organize and formulate the relationships between criteria into a systematic and easily understandable model. From the questionnaire results above, the sub-criteria weight values can be derived as follows:

a. Determining the relationship between factors (evaluation scale).

Table 5 Evaluation Scale

	C1	C2	C3	C4	C5	C6
C1	0	3	2	3	3	3
C2	3	0	3	3	2	2
C3	2	3	0	2	2	1
C4	3	3	3	0	3	3
C5	2	2	2	3	0	2
C6	2	2	2	3	1	0

b. Constructing the direct-relation matrix

Table 6. Constructing the Direct-Relation Matrix

	C1	C2	C3	C4	C5	C6	Total
C1	0	3	2	3	3	3	11
C2	3	0	3	3	2	2	13
C3	2	3	0	2	2	1	10
C4	3	3	3	0	3	3	15
C5	2	2	2	3	0	2	11
C6	2	2	2	3	1	0	10
Total	12	13	12	14	11	11	

In Table 6, all rows and columns are summed to obtain the maximum value.

Table 7. Direct-Relation Matrix

	C1	C2	C3	C4	C5	C6 `
C1	0	0,2	0,1333	0,2	0,2	0,2
C2	0,2	0	0,2	0,2	0,1333	0,1333
C3	0,1333	0,2	0	0,1333	0,1333	0,0666
C4	0,2	0,2	0,2	0	0,2	0,2
C5	0,1333	0,1333	0,1333	0,2	0	0,1333
C6	0,1333	0,1333	0,1333	0,2	0,0666	0

Table 7 presents the relation matrix obtained from the normalization of Table 8. Each value from C1 to C6 indicates the magnitude of the normalized direct influence between criteria.

c. Normalizing the direct-relation matrix.

Table 8. Normalization of the Direct-Relation Matrix

	C1	C2	C3	C4	C5	C6
C1	1	0	0	0	0	0
C2	0	1	0	0	0	0
C3	0	0	1	0	0	0
C4	0	0	0	1	0	0
C5	0	0	0	0	1	0
C6	0	0	0	0	0	1

Calculating the direct and indirect relation matrix

$$T = X(I - X)^{-1}$$

Table 9. Results of the Subtraction of the Direct-Relation Matrix

	C1	C2	C3	C4	C5	C6
C1	1	−0,2	−0,1333	−0,2	−0,2	−0,2
C2	−0,2	1	−0,2	−0, 2	−0,1333	−0,1333
C3	−0,1333	−0,2	1	−0,1333	−0,1333	−0,0666
C4	−0,2	−0,2	−0,2	1	−0,2	−0,2
C5	−0,1333	−0,1333	−0,1333	−0,2	1	−0,1333
C6	−0,1333	−0,1333	−0,1333	−0,2	−0,0666	1

Next, the total relation matrix is calculated; because of the size of the matrix, the matrix inversion process was carried out using Microsoft Excel.

d. Calculating the D and R Values

After constructing the total relation matrix, the D and R values are then calculated as follows: (D) (R)

$$D_1 = 0,7026+0,9149+0,8203+0,9602+0,8185+0,8183$$
$$= 5,0350$$

$$R_1 = 0,7026+0,8307+0,6496+0,9054+0,6923+0,6516$$
$$= 4,4325$$

Table 10 Results of the D and R Value Calculation

D	R
5,0350	4,4325
4,7501	8,1623
3,7974	7,3316
5,3015	6,6819
4,1129	5,7765
3,8121	5,0841

Table 10 presents the calculation results of D and R. This is followed by calculating the values of (D+R) and (D-R), as shown in Table 11. $(D+R)(D-R)$

Table 11 Calculation Results of (D+R) and (D-R)$(D+R)(D-R)$

$(\boldsymbol{D}+\boldsymbol{R})$	$(\boldsymbol{D}-\boldsymbol{R})$
9,4675	0,6025
12,9125	-3,4122
11,1290	-3,5341
11,9835	-1,3804
9,8895	-1,6635
8,8963	-1,2719

Table 12 Criteria Ranking Results

$(\boldsymbol{D}+\boldsymbol{R})$	$(\boldsymbol{D}-\boldsymbol{R})$	Identification	Rank
9,4675	0,6025	Cause	5
12,9125	-3,4122	Effect	1
11,1290	-3,5341	Effect	2
11,9835	-1,3804	Effect	3
9,8895	-1,6635	Effect	4
8,8963	-1,2719	Effect	6

D. Conclusion

Based on the results of the research on the Multi-Attributive Border Approximation Area Comparison (MABAC) and Decision Making Trial and Evaluation Laboratory (DEMATEL) methods in e-wallet selection, the application of the MABAC method shows that GoPay obtained the highest value and ranked first with a score of 0.679, followed by Dana in second place with a score of 0.591, and ShopeePay in third place with a score of 0.113. Meanwhile, OVO ranked fourth with a score of -0.152, followed by Sakuku in fifth place with a score of -0.156, while LinkAja and iSaku ranked sixth and seventh with scores of -0.169 and -0.216, respectively. Meanwhile, the results of applying the DEMATEL method to the six criteria show which act as causes and which act as effects. The table above shows that the first, second, and third ranks are occupied by the criteria of security, transaction cost, and ease of use of the e-wallet, while the fourth, fifth, and sixth ranks are occupied by the criteria of application promotion, most widely used application, and other supporting features, respectively.

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