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MEREC-COBRA APPROACH IN E-COMMERCE DEVELOPMENT STRATEGY SELECTION

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Abstract: *The research objective of the paper is to propose a model, based on the Multiple-Criteria Decision-Making (MCDM) methods, that facilitates a selection process of an adequate strategy directed to the development of e-commerce. For that aim, the MEthod based on the Removal Effects of Criteria (MEREC) is applied for defining the criteria weights. The recently proposed COmprehensive Distance Based RAnking (COBRA) method is used for the final assessment and ranking of the considered alternatives. The applicability of the proposed model is tested by using an example borrowed from the literature. Three alternative development strategies are assessed against five evaluation criteria. The final results proved the applicability and reliability of the proposed MCDM model.*

Keywords: *MEREC method, COBRA method, development strategies, e-commerce, selection*

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1. Introduction

An extensive range of online business activities that involve manipulating products and services represents electronic commerce or e-commerce. It can be stated that e-commerce is "*usually associated with buying and selling over the Internet, or conducting any transaction involving the transfer of ownership or rights to use goods or services through a computer-mediated network.*" (Gupta, 2014). The significance of e-commerce was especially revealed during the pandemic COVID-19. Three crucial obstacles that e-commerce faced during the pandemic are: 1) product availability; 2) logistics and transportation disruptions; and 3) consumer protection (Alfonso et al., 2021). In order to maintain proper functioning and retain consumer satisfaction, there is a need for applying adequate strategies for the development and enhancement of e-commerce.

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The selection of the appropriate strategy is influenced by many criteria which exacerbate making a final choice. By introducing adequate mathematical models in the selection process, this problem could be overcome. The Multiple-Criteria Decision-Making (MCDM) methods impose as a suitable approach because they are convenient for application in conditions when existing many mutually conflicting criteria. Until now, many different MCDM approaches have been introduced, to mention some of the newly proposed: Combined Compromise Solution method (CoCoSo) (Yazdani et al., 2018), Full COnsistency Method (FUCOM) (Pamučar et al., 2018), Measurement of Alternatives and Ranking according to COmpromise Solution (MARCOS) (Stević et al., 2020), simple WeIghted Sum Product method (WISP) (Stanujkić et al., 2021). Proposed MCDM methods and models were used for problem solvation in different business fields (Lee & Chang, 2018; Rouyendegh et al., 2019; Stojčić et al., 2019; Štirbanović et al., 2019; Ture et al., 2019; Karabašević et al., 2020; Lin et al., 2020; Chowdhury & Paul, 2020; Tan et al., 2021; Sotoudeh-Anvari, 2022). Researchers and practitioners use the MCDM techniques to facilitate the decision process in the area of e-commerce as well (Alharbi & Naderpour, 2016; Aggarwal & Aakash, 2018; Sohaib et al., 2019; Li & Sun, 2020; Bączkiewicz, 2021a; Bączkiewicz et al., 2021b; Bączkiewicz et al., 2021c; Wang et al., 2021; Ziemba, 2021; Naseem et al., 2021a; Naseem et al., 2021b; Wu et al., 2021; Torre et al., 2022).

A model based on the recently introduced MEthod based on the Removal Effects of Criteria (MEREC) (Keshavarz-Ghorabaee et al., 2021) and the COmprehensive Distance Based RAnking (COBRA) (Krstić et al., 2022) for selection of the appropriate development e-commerce strategy is proposed in this paper. The determination of the criteria weights is based on the MEREC method while the final assessment and ranking are performed by using COBRA method. The numerical example that illustrates the applicability of the proposed model is borrowed from the literature. To present the created model, the paper is organized as follows: Section 2 presents the explanation of the used methods; Section 3 contains numerical example; and in the end, the conclusion is given.

2. Methodology

2.1. The MEREC method

The MEREC method (Keshavarz-Ghorabaee et al., 2021) enables defining of the objective weights of criteria because it uses input data for that matter. Although the MEREC method has been recently proposed, the researchers recognized its potential and used it for resolving various decision-making problems (Keshavarz-Ghorabaee, 2021; Trung & Thinh, 2021; Rani et al., 2022; Ulutaş et al., 2022; Mishra et al., 2022; Ivanović et al., 2022). The computation procedure of the MEREC method involves the following steps.

Step 1. Form a decision matrix:

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1j} & \cdots & x_{1m} \\ x_{21} & x_{22} & \cdots & x_{2j} & \cdots & x_{2m} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{i1} & x_{i2} & \cdots & x_{ij} & \cdots & x_{im} \\ \vdots & \vdots & \ddots & \vdots & \ddots & \vdots \\ x_{n1} & x_{n2} & \cdots & x_{nj} & \cdots & x_{nm} \end{bmatrix}, \quad (1)$$

where x_{ij} is the performance rating of alternative i in relation to criterion j ($x_{ij} > 0$), n are alternatives and m are criteria.

Step 2. Normalize the decision matrix by using following Eq.:

$$n_{ij}^{x}=\begin{cases}\frac{\min_{k} x_{kj}}{x_{ij}} & if \quad j\in B\\ \frac{x_{ij}}{\max_{k} x_{kj}} & if \quad j\in C\end{cases}, \tag{2}$$

where n_{ij}^{x} represents elements of the normalized matrix *N*, *B* is the set of benefit criteria, and *C* is the set of cost criteria.

Step 3. Calculation of the overall performance of the alternatives as is shown:

$$S_i = ln\left(1+\left(\frac{1}{m}\sum_j |ln(n_{ik}^{x})|ij\right)\right), \tag{3}$$

where S_i is the overall performance of the alternatives.

Step 4. Compute the alternatives` performances by removing each criterion in the following manner:

$$S_{ij}' = ln\left(1+\left(\frac{1}{m}\sum_{k,k\neq j} |ln(n_{ik}^{x})|ij\right)\right), \tag{4}$$

where S_{ij}' denotes the overall performance of alternative *i* regarding the removal of criterion *j*.

Step 5. Compute the total of the absolute deviations. The removal effect of the criterion *j* is calculated as follows:

$$E_j = \sum_i |S_{ij}' - S_i|, \tag{5}$$

where E_j represents the effect of removing criterion *j*.

Step 6. Define the overall criteria weights in the following way:

$$w_j = \frac{E_j}{\sum_k E_k}, \tag{6}$$

where w_j represents the weight of the criterion *j*.

2.2. The COBRA method

The COBRA method (Krstić et al., 2022) is recently proposed and because of that, the possibilities of this method are not examined yet. Until now, the COBRA method is mentioned in two papers regarding industry 4.0 and reverse logistics (Balázs et al., 2022; Fauzdar et al., 2022). The computation procedure of the COBRA method could be illustrated by a series of steps.

Step 1. Define a decision matrix in the way presented in the section regarding the MEREC method.

Step 2. Create the normalized decision matrix in the following way:

$$\Delta = [\alpha_{ij}]_{n\times m}, \tag{7}$$

where

$$\alpha_{ij} = \frac{a_{ij}}{\max_i a_{ij}}. \tag{8}$$

Step 3. Create the weighted normalized decision matrix Δ_w by using Eq. (9):

$$\Delta_w = [w_j \times \alpha_j]_{m\times n}, \tag{9}$$

where w_j denotes the relative weight of criterion *j*.

Step 4. Define the positive ideal (PIS_j), negative ideal (NIS_j), and average solution (AS_j) regarding each criterion function as follows:

$$PIS_j = \max_i(w_j \times \alpha_{ij}), \ \ \forall j = 1, \dots, m \ for \ j \in B, \tag{10a}$$

$$PIS_j = \min_i(w_j \times \alpha_{ij}), \ \ \forall j = 1, \dots, m \ for \ j \in C, \tag{10b}$$

$$NIS_j = \min_i(w_j \times \alpha_{ij}), \ \ \forall j = 1, \dots, m \ for \ j \in B, \tag{11a}$$

$$NIS_j = \max_i(w_j \times \alpha_{ij}), \ \ \forall j = 1, \dots, m \ for \ j \in C, \tag{11b}$$

$$AS_j = \frac{\sum_{i=1}^{n}(w_j \times \alpha_{ij})}{n}, \ \ \forall j = 1, \dots, m \ for \ j \in B, C, \tag{12}$$

where B is the set of benefit and C is the set of cost criteria.

Step 5. In this step, the distance from the positive ideal $\left(d(PIS_j)\right)$ and negative ideal $\left(d(NIS_j)\right)$ solutions should be defined. Also, the positive $\left(d(AS_j^+)\right)$ and negative distances $\left(d(AS_j^-)\right)$ from the average solutions should be determined. This procedure is performed in the following way:

$$d(S_j) = dE(S_j) + \sigma \times dE(S_j) \times dT(S_j), \ \forall j = 1, \dots, m, \tag{13}$$

where S_j is any solution $(PIS_j, NIS_j \text{ or } AS_j)$, σ represents the correction coefficient defined by using the following Eq.:

$$\sigma = \max_i dE(S_j)_i - \min_i dE(S_j)_i, \tag{14}$$

where $dE(S_j)_i$ and $dT(S_j)_i$ represents the Euclidian and Taxicab distances, respectively, which are calculated for the positive ideal solution calculated in the following way:

$$dE(PIS_j)_i = \sqrt{\sum_{j=1}^{m}(PIS_j - w_j \times \alpha_{ij})^2}, \ \ \forall_i = 1, \dots, n, \ \ \forall_j = 1, \dots, m, \tag{15}$$

$$dT(PIS_j)_i = \sum_{j=1}^{m}|PIS_j - \ w_j \times \alpha_{ij}|, \ \forall i = 1, \dots, n, \ \ \forall j = 1, \dots, m. \tag{16}$$

For the negative ideal solutions, the Euclidian and Taxicab distances are obtained in the following way:

$$dE(NIS_j)_i = \sqrt{\sum_{j=1}^{m}(NIS_j - w_j \times \alpha_{ij})^2}, \ \forall_i = 1, \dots, n, \ \forall_j = 1, \dots, m, \tag{17}$$

$$dT(NIS_j)_i = \sum_{j=1}^{m}|NIS_j - \ w_j \times \alpha_{ij}|, \ \forall i = 1, \dots, n, \ \ \forall j = 1, \dots, m. \tag{18}$$

For the positive distance from the average solution the Euclidian and Taxicab distances are calculated as follows:

$$dE(AS_j)_i^+ = \sqrt{\sum_{j=1}^{m}\tau^+(AS_j - w_j \times \alpha_{ij})^2}, \ \ \forall_i = 1, \dots, n, \ \ \forall_j = 1, \dots, m, \tag{19}$$

$$dT(AS_j)_i^+ = \sum_{j=1}^{m}\tau^+|AS_j - \ w_j \times \alpha_{ij}|, \ \ \forall i = 1, \dots, n, \ \ \forall j = 1, \dots, m. \tag{20}$$

$$\tau^+ = \begin{cases} 1 \ if \ AS_j < w_j \times \alpha_{ij} \\ 0 \ if \ AS_j > w_j \times \alpha_{ij}. \end{cases} \tag{21}$$

Finally, for the negative distance from the average solution the Euclidian and Taxicab distances are calculated in the following manner:

$$dE(AS_j)_i^- = \sqrt{\sum_{j=1}^{m}\tau^-(AS_j - w_j \times \alpha_{ij})^2}, \ \ \forall_i = 1, \dots, n, \ \ \forall_j = 1, \dots, m, \tag{22}$$

$$dT(AS_j)_i^- = \sum_{j=1}^{m}\tau^-|AS_j - \ w_j \times \alpha_{ij}|, \ \ \forall i = 1, \dots, n, \ \ \forall j = 1, \dots, m. \tag{23}$$

$$\tau^- = \begin{cases} 1 \; if \; AS_j > w_j \times \alpha_{ij} \\ 0 \; if \; AS_j < w_j \times \alpha_{ij} \end{cases}. \tag{24}$$

Step 6. Rank the considered alternatives in ascending order based on the comprehensive distances (dC_i) which is defined by using:

$$dC_i = \frac{d(PIS_j)_i - d(NIS_j)_i - d(AS_j)_i^+ + d(AS_j)_i^-}{4}, \forall i = 1, \ldots, n. \tag{25}$$

3. Numerical Example

In this section, the applicability of the proposed model will be illustrated by using an example regarding the selection of the e-commerce development strategies borrowed from the paper of Stanujkic et al. (2019). Three strategies are submitted under evaluation and they are:

- A_1 – E-customization and personalization
- A_2 – Social e-commerce adoption model
- A_3 – Strong search engine optimization – SEO

The considered strategies are evaluated against the following set of criteria:

- C_1 – The implementation of the strategy feasibility
- C_2 – The speed of implementation
- C_3 – Compliance with the corporate strategy
- C_4 – Compliance of strategy with the mission and vision of the organization and
- C_5 – General acceptance

All criteria involved in the decision process are of benefit type.

Decision-making involved one decision-maker and his ratings are presented in **Table 1.**

Table 1. Decision-makers\` ratings of the alternative strategies

	C_1	C_2	C_3	C_4	C_5
A_1	3	3	3	2	2
A_2	5	4	5	5	5
A_3	3	3	4	5	5

Source: Stanujkic et al. (2019)

Criteria weights are obtained by using the MEREC method and Eqs. (1)-(6) and they are presented in **Table 2.**

Table 2. The criteria weights

	w_j
C_1	0.097
C_2	0.056
C_3	0.153
C_4	0.347
C_5	0.347

Source: Authors\` calculation

As **Table 2** shows, the criteria C_4 – *Compliance of strategy with mission and vision of the organization* and C_5 – *General acceptance have the same highest weight among the considered criteria*.

Now, the COBRA method is applied to achieve the final result and ranking order of the considered alternative strategies. The computation is performed by using Eqs. (7)-(25). The obtained results and ranking order of the e-commerce development strategies are presented in **Table 3**.

Table 3. The results gained by applying the COBRA method

	$d(PIS)$	$d(NIS)$	$d(AS^{+})$	$d(AS^{-})$	dC	*Rank*
A_1	0.35242	0.00000	0.0000	0.2121	0.1411	3
A_2	0.00000	0.35242	0.1087	0.0000	-0.1153	1
A_3	0.05266	0.33619	0.0996	0.0138	-0.0923	2

Source: Authors` calculation

The results show that the optimal strategy for application in the existing conditions is strategy A_2 – *Social e-commerce adoption model* while the least adequate is strategy A_1 – *E-customization and personalization*.

Conclusion

The main goal of this paper was to introduce a new MCDM model suitable for the assessment and selection of e-commerce development strategies. For that purpose, two recently proposed techniques were used. The first one, called MEREC, was used for defining the criteria weights, while the second one, the COBRA method, was applied for the estimating and ranking of the considered alternative strategies. The applicability of the proposed model was verified by the numerical example retrieved from the literature. The obtained results confirmed the usefulness of the proposed approach. Namely, in the paper of Stanujkic et al. (2019), from whom the example is borrowed, in the first place is positioned the alternative A_2 – *Social e-commerce adoption model.* The second-ranked is the alternative A_3 – *Strong search engine optimization – SEO.* Alternative A_1 – *E-customization and personalization* has third, the worst position. The same ranking order is obtained in this case as well, although Stanujkic et al. (2019) give the same significance to all evaluation criteria. This result confirms the applicability and reliability of the proposed approach for application in decision-making in the e-commerce field as well as in other business areas.

The main shortage of paper is the involvement of only one decision-maker in the decision process which possibly leads to a biased result. By engaging more experts, the results and final ranking order would be more representative and real. Besides, the model is applied to the hypothetical example borrowed from the other authors. The potential of the MEREC-COBRA model as well as the potential of each method separately should be further examined and used for resolving real-world problems. Propositions for future research also go in direction of creating and introducing adequate extensions that will further extend the possibilities of these methods.

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