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Application of Electre Method Decision Support System for Laptop Selection

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Abstract

In the contemporary era, laptops have transitioned from being perceived as luxury items to becoming an essential tool for work, education, and various learning activities. The market is saturated with a plethora of laptop manufacturers, providing consumers with a wide array of options to cater to their specific needs and budget constraints. However, a common challenge faced by consumers is the mismatch between their requirements and the specifications of available laptops, often due to a lack of understanding. Addressing this issue requires the implementation of a suitable Decision Support System (DSS). The proposed solution involves employing the Electre method, renowned for its multicriteria approach. This method systematically eliminates unsuitable alternatives, facilitating the identification of laptops that align with the desired criteria. The process involves several key steps, such as defining criteria and alternatives, assigning weights, normalizing the decision matrix, determining concordance and discordance indices, and ultimately establishing an aggregate dominance matrix. By leveraging the Electre method, this Decision Support System can effectively recommend laptops that not only meet the consumer's specified criteria but also align with their budget constraints. This systematic approach aims to enhance the overall decision-making process, ensuring optimal satisfaction for laptop buyers in terms of both performance and financial considerations.

I. INTRODUCTION

Today's laptops are no longer considered a luxury, but rather a basic necessity whose use is increasingly widespread in areas such as work, learning-teaching activities, gaming, and creative content. Therefore, many different brands and types of laptops have emerged, which can ultimately confuse consumers in choosing laptops according to their needs and budget. One of the problems consumers often encounter is the non-compliance of specifications with needs, accompanied by a lack of understanding of laptop specifications making purchases less optimal [1]. To overcome these problems, a decision-support system is needed that can provide an effective solution. One method that can be used is the Electre method, which is a decision-making method with a multi-criterion approach. This method works by eliminating inappropriate alternatives so as to produce alternatives that match the desired criteria [2]. With a decision support system, it will produce outputs that meet the objective of helping consumers choose the laptop that best suits their needs and can facilitate consumers' decision-making processes to produce accurate, effective and efficient information [3]. The Electre method, as a group of multi-criteria methods in decision making, refers to a ranking concept that utilizes pairwise comparisons for each alternative according to specified criteria. The application of the Electre method is not only limited to alternative conditions that do not meet the criteria, but is also able to produce appropriate alternatives. This method can be used effectively in situations where there are many alternatives, but the criteria used are limited [4]. In the context of laptop selection, Electre is implemented using certain predetermined criteria. This criterion includes the condition of the house (building) which involves evaluating the room area, floor type, roof type, wall type, lighting source (electricity), final disposal (WC) condition and drinking water source condition [5]. The Electre method is used as a tool to identify alternatives that do not meet predetermined criteria and eliminate them, while highlighting alternatives that suit consumer desires [6]. Basically, this method provides a systematic and structured framework for dealing with the complexity of decision making, especially in the context of selecting an adequate laptop for the user's needs and budget. By considering many alternatives and criteria, Electre makes a significant

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contribution in producing more accurate and measurable decisions. In addition, this method can be adapted to various decision-making cases to provide optimal and relevant solutions.

II. Related Works/Literature Review (Optional)

Research results [7] using Electre method can solve alternative selection issues well, that is, can determine students who are eligible as recipients of scholarships can be done easily and accurately. Then the results of the research [8] using the decision support system Electre method was able to determine the selection of the best employees. Electre methods can be used by the company PT. MPS Honda Pandeglang in solving problems to provide ease in recommending the location of events. In order to determine whether or not Rutilahu funds are eligible for assistance, a decision-support system is required, namely, the method of Research Results [9], determining the criterion weight. Four approaches for ELECTRE-TRI and 15 approaches to FlowSort are considered. Finally, 19 different approaches are considered to select stocks from large stock groups. The results indicate that the model parameters must be correctly defined to minimize CIS inconsistencies and increase mode strength. ELECTRE is a multi-criterion decision-making model that has proven to be effective in addressing a number of decision making issues. The proposed system takes input from a variety of stakeholders using the 100 point method. The optimized rating is obtained using the ELectRE method.The system developed is validated using a pilot project and proved to be efficient in terms of saving implementation costs and working hours required for implementation. [10] By using the Electre method, we are able to provide alternative recommendations for housing in the city of Medan according to the needs and desires of the community. [11]

III. METHODS

In this study the method used is the ELECTRE method with the following stages:

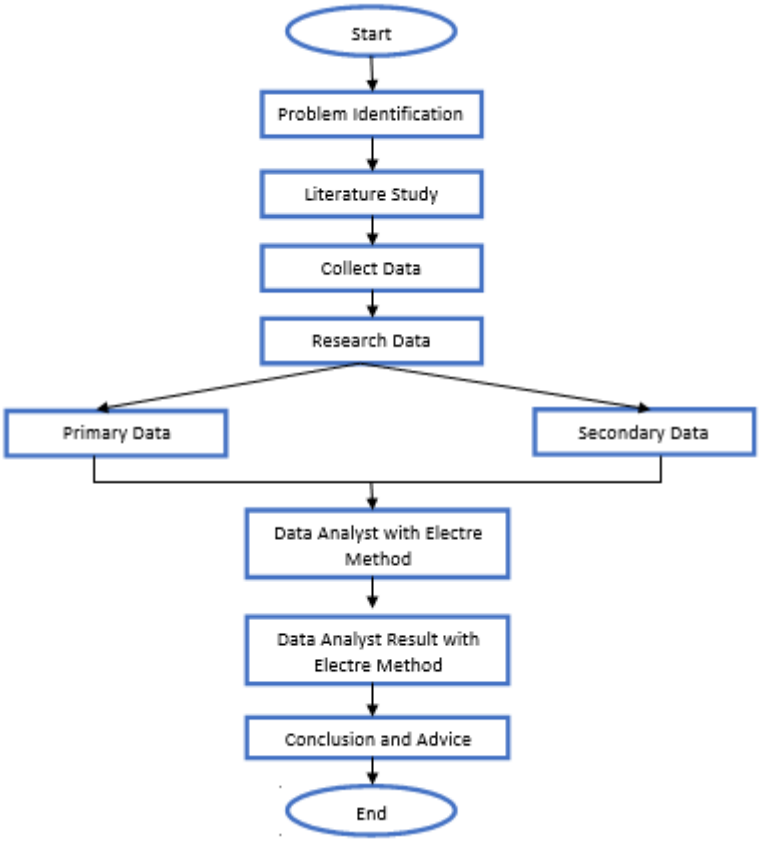

Fig. 1 Research Phase

The steps in the electre method are as follows: [12]

1. Making matrix normalization decision

$$rij = \frac{Xij}{\sqrt{\sum_{i}^{m}=1\ D^2ij}} \quad (1)$$

Note : r = Normalized number
m= Alternative
n = Criteria
i = 1,2,3, ..m,
j = 1,2,3….n

So we obtain the R matrix resulting in normalization

$$R = \begin{bmatrix} r11 & r12 & \dots & r1n \\ r21 & r22 & \dots & r2n \\ \dots & \dots & \dots & \dots \\ rm1 & rm2 & \dots & rmn \end{bmatrix} \quad (2)$$

2. Weighing on a normalized matrix.
Next, the decision maker must give a factor of interest (boot, W) to each criterion that expresses its relative interest. (wj).
W=(w1,w2,…,wn), with the total sum of W values equal to 1, or:

$$\sum_{j=1}^{n} wj = 1 \quad (4)$$

This weight is then multiplied by the matrix of comparison pairs forming the preference matrix (V):

$$v_{ij} = w_j \,.\, x_{ij} \quad (5)$$

3. Determine the set of corcondance and discordance on the index.
The Concordance Matrix (C) contains the calculated elements of the concordance index, and relates to the weight of the attribute, namely:

$$Ckl=\{j|vkj \geq vlj\} \text{ untuk } j=1,2,3\dots n \quad (6)$$

Second, the set of discordance index {dkl} is given as:

$$Dkl=\{j|vkj<vlj\} \text{ untuk } j=1,2,3\dots n \quad (7)$$

4. Calculate the corcondance and discordance matrices
To calculate the values of the elements on the corcondance matrix is by adding the weights on each cor Condance set, i.e.:

$$C_{kl} = \sum_{j \in c_{kl}} wj \quad (8)$$

To determine the discordance matrix, divide the maximum difference between the criteria entered into the discordance set by the highest difference between the values for all the criteria. Likewise, the Discordance Matrix (D) contains elements calculated from the discordance index. This matrix is related to the attribute values. ,that is:

$$D_{kl} = \frac{max\{|V_{kj} - V_{ij}|\} - j \in D_{kl}}{max\{|V_{kj} - V_{ij}|\} V_j} \quad (9)$$

5. Calculate the dominant correlation and discordance matrices
Form a concordance dominance matrix (c) based on the threshold value c obtained from the following equation:

$$C = \frac{\sum_{k=1}^{m} \sum_{l=1}^{m} C_{kl}}{m(m-1)} \quad (10)$$

In the alternative Ak can dominate A1, if the value of the concordance index ckl exceeds the threshold c with the equation form: ckl ≥ c and the elements in the concordance dominance matrix F are obtained from

$$f_{kl} = \begin{cases} 1, Jika\ C_{kl} \geq C \\ 0, Jika\ C_{kl} > C \end{cases} \quad (11)$$

To obtain the discordance dominance matrix G from the threshold value d, which is obtained from the following equation:

$$g_{kl} = \begin{cases} 1, Jika\ d_{kl} \geq d \\ 0, Jika\ Cd_{kl} < d \end{cases} \quad (12)$$

6. Determine the dominant aggregate matrix
Aggregate dominance matrix as matrix E, is obtained from each multiplication between the elements of matrix F and the elements of matrix G, as follows:

$$e_{kl} = f_{kl} \,.\, g_{kl} \quad (13)$$

IV. RESULT

Analysis of selecting the best laptop based on the electre method is as follows:

1. Determine criteria, alternatives and weighting

The criteria that will be used as a reference in making decisions in this method are based on interview results to determine the best laptop most often sought by consumers, namely RAM memory (C1), processor (C2), storage (C3), battery life (C4), laptop size. (C5) and price (C6) while the alternatives are Lenovo (A1), Asus (A2), HP (A3), Acer (A4), Toshiba (A5). Weighting of each criterion, by creating each weight a variable is created which will be converted into a fuzzy number. Below are the fuzzy numbers of the weight of each alternative for each criterion, rated with 1 to 5, namely: 1 = Very bad, 2 = Bad, 3 = Enough, 4 = Good, 5 = Very Good.

TABLE 1
TABLE FUZZY

Range	Fuzzy Numbers	Value
81 -100	Very Good	5
61 - 80	Good	4
41 - 60	Enough	3
21 - 40	Bad	2
1 - 20	Very Bad	1

Then the matching table of the criteria appears as follows:

TABLE 2
CRITERIA MATCHING

Criteria	1	2	3	4	5	6	Assembly
D12	0	1	1	1	1	0	{2,3,4,5}
D13	0	1	0	1	1	0	{2,4,5}
D14	0	1	0	1	1	1	{2,4,5,6}
D15	0	1	1	1	1	1	{2,3,4,5,6}
D21	1	1	0	0	1	1	{1,2,5,6}
D23	1	1	0	1	1	1	{1,2,4,5,6}
D24	1	1	0	0	1	1	{1,2,5,6}
D25	1	1	0	1	1	1	{1,2,4,5,6}
D31	1	0	1	0	0	1	{1,3,6}
D32	1	0	1	0	0	1	{1,3,6}
D34	1	1	1	0	0	1	{1,3,6}
D35	1	1	1	0	1	1	{1,2,3,5,6}
D41	1	0	1	1	1	1	{1,3,4,5,6}
D42	1	0	1	1	1	0	{1,3,4,5}
D43	1	1	1	1	1	0	{1,2,3,4,5}
D45	1	1	1	1	1	1	{1,2,3,4,5,6}
D51	1	0	1	0	0	0	{1,3}
D52	1	0	1	1	0	0	{1,3,4,}
D53	1	0	0	1	0	0	{1,2,4,}
D54	1	0	0	0	0	0	{1}

2. Making Matrix Normalization Decision

TABLE 3
NORMALIZED R MATRIX

Divider	9.434	8.660	8.660	6.481	8.246	8.660
	0.530	0.346	0.462	0.309	0.364	0.462
	0.424	0.346	0.577	0.463	0.364	0.346
R	0.424	0.462	0.346	0.617	0.485	0.346
	0.424	0.462	0.346	0.309	0.364	0.462
	0.424	0.577	0.462	0.463	0.606	0.577

3. Making normalized weighs

TABLE 4
Y-WEIGHTED NORMALIZED MATRIX

Bobot	**4**	**5**	**5**	**4**	**3**	**4**
	2.120	1.732	2.309	1.234	1.091	1.848
	1.696	1.732	2.887	1.852	1.091	1.386
Y	1.696	2.309	1.732	2.469	1.455	1.386
	1.696	2.309	1.732	1.234	1.091	1.848
	1.696	2.887	2.309	1.852	1.819	2.309

4. Determining corcondance and discordance sets on index

TABLE 5
CORCONDANCE ASSEMBLY

Alternative	C1	C2	C 3	C4	C5	C6
A1	5	3	4	2	3	4
A2	4	3	5	3	3	3
A3	4	4	3	4	4	3
A4	4	4	3	2	3	4
A5	4	5	4	4	5	5

TABLE 6
DISCONDANCE ASSEMBLY

Criteria	1	2	3	4	5	6	Assembly
C12	1	1	0	0	1	1	{1,2,5,6}
C13	1	0	1	0	0	1	{1,3,6}
C14	1	0	1	1	1	0	{1,3,4,5}
C15	1	0	0	1	0	0	{1,2}
C21	0	1	1	1	1	0	{2,3,4,5}
C23	1	0	1	0	0	1	{1,3,6}
C24	1	0	1	1	1	0	{1,3,4,5}
C25	1	0	1	1	0	0	{1,3}
C31	0	1	0	1	1	0	{2,4,5}
C32	1	1	0	1	1	1	{1,2,4,5,6}
C34	1	1	1	1	1	0	{1,2,4,5}
C35	1	0	0	1	0	0	{1,2}
C41	0	1	0	1	1	1	{2,3,4,5,6}

C42	1	1	0	0	1	1	{1,2,5,6}
C43	1	1	1	0	0	1	{1,3,6}
C45	1	0	0	0	0	0	{1,3}
C51	0	1	1	1	1	1	{2,3,4,5,6}
C52	1	1	0	1	1	1	{1,2,4,5,6}
C53	1	1	1	0	1	1	{1,2,3,5,6}
C54	1	1	1	1	1	1	{1,2,3,4,5,6}

5. Determining corcondance and discordance matrices

The concordance matrix is obtained by adding the weight contained in the concordant matrix.

$$C = \begin{bmatrix} - & 15 & 12 & 15 & 7 \\ 17 & - & 12 & 15 & 12 \\ 13 & 19 & - & 20 & 12 \\ 16 & 15 & 12 & - & 3 \\ 21 & 19 & 20 & 24 & - \end{bmatrix}$$

The discordance matrix can be determined by the values of the element of the Discordance (D) matrix.

6. Calculating the dominant matrix of concordance and discordance

$$F = \begin{bmatrix} - & 1 & 0 & 1 & 0 \\ 1 & - & 0 & 1 & 0 \\ 0 & 1 & - & 1 & 0 \\ 1 & 1 & 1 & - & 0 \\ 1 & 1 & 1 & 1 & - \end{bmatrix}$$

$$G = \begin{bmatrix} - & 1 & 1 & 1 & 1 \\ 0 & - & 0 & 0 & 1 \\ 0 & 1 & - & 0 & 1 \\ 1 & 1 & 1 & - & 1 \\ 0 & 0 & 0 & 0 & - \end{bmatrix}$$

7. Determining matrix aggregate dominance

$$E = \begin{bmatrix} - & 1 & 0 & 1 & 0 \\ 0 & - & 0 & 0 & 0 \\ 0 & 1 & - & 0 & 0 \\ 1 & 1 & 1 & - & 0 \\ 0 & 0 & 0 & 0 & - \end{bmatrix}$$

8. Eliminates less favourable alternatives

TABLE 7
ELECTRE METHOD RESULT

Alternative	Electre
A1	2
A2	0
A3	1
A4	3
A5	0

So the choice of a laptop based on the electre method is the fourth alternative.

V. CONCLUSIONS

From the results of such data processing, it can be concluded that the decision support system of choice of laptop using the Electre method is very correctly used by the consumer in choosing the laptop according to the needs and the budget that it has. This method succeeds in delivering recommendations that match the established criteria, improving efficiency in decision-making, and addressing the problems of non-compliance with specifications that consumers often encounter. Nevertheless, it should be noted that the Electre method has a limitation, i.e. it can only be used effectively in cases with few criteria. This suggests that although this method is very relevant and accurate in a particular situation, its use needs to be carefully considered especially in contexts involving many criteria. Nevertheless, these shortcomings can be overcome by developing or combining with other methods that can handle a larger number of criteria, thus providing a more holistic and comprehensive solution. With an understanding of the advantages and disadvantages of the Electre method, consumers can use it wisely as a valuable guide in choosing the most suitable laptop. This understanding can help consumers determine whether the method is appropriate to their decision-making needs or whether other approaches are needed that are more appropriate to the complexity of the criteria involved.

REFERENCES

[1] M. A. Noviansyah, I. Cholissodin, and B. Rahayudi, "Penerapan Metode AHP dan TOPSIS sebagai Sistem Pendukung Keputusan untuk Pemilihan Laptop Baru dan Bekas sebagai Media Penunjang Pembelajaran Masa dan Pasca Pandemi COVID-19," vol. 5, no. 12, pp. 5205–5212, 2021, [Online]. Available: http://j-ptiik.ub.ac.id.

[2] R. R. Valentina, "Penerapan Metode ELECTRE Pada Sistem Pendukung Keputusan Pemilihan Asisten Laboratorium," *JATISI (Jurnal Tek. Inform. dan Sist. Informasi)*, vol. 8, no. 2, pp. 880–888, 2021, doi: 10.35957/jatisi.v8i2.757.

[3] H. Hertyana, E. Mufida, and A. Al Kaafi, "Sistem Pendukung Keputusan Pemilihan Laptop Dengan Menggunakan Metode Topsis," *J. Tek. Inform. UNIKA St. Thomas*, vol. 06, pp. 36–44, 2021, doi: 10.54367/jtiust.v6i1.1216.

[4] G. Ginting and R. Rahim, "Implementation of Elimination and Choice Expressing Reality (ELECTRE) Method in Selecting the Best Lecturer (Case Study STMIK BUDI DARMA) Sistem Pakar View project Now Working on Voice Recognition Application and Security View project Mesran Aan STMIK Bud," vol. 6, no. 02, pp. 141–144, 2017, [Online]. Available: https://www.researchgate.net/publication/313316006.

[5] W. Fauzi, "Sistem Pendukung Keputusan Penerima Bantuan Dana Rutilahu dengan Menggunakan Metode Electre," *Semin. Nas. Teknol. Inf. dan Komun. 2016 (SENTIKA 2016)*, vol. 2016, no. Sentika, pp. 1–8, 2016.

[6] L. Y. Rogers, M. G., Bruen, M., & Maystre, *ELECTRE and decision support: methods and applications in engineering and infrastructure investment.* Springer Science & Business Media, 2013.

[7] M. A. Pratama, V. Sihombing, and D. Irmayani, "Penggunaan Metode Elimination Et Choix Traduisant La Realite (ELECTRE) untuk Menentukan Penerima Beasiswa PPA," *JATISI (Jurnal Tek. Inform. dan Sist. Informasi)*, vol. 8, no. 4, pp. 2144–2157, 2021, doi: 10.35957/jatisi.v8i4.971.

[8] T. Andriani, "Sistem Pendukung Keputusan Pemilihan Karyawan Terbaik Dengan Metode Electre (Studi Kasus : Swalayan Maju Bersama)," *J. Multimed. dan Teknol. Inf.*, vol. 1, no. 2, pp. 38–44, 2019, doi: 10.54209/jatilima.v1i2.2.

[9] M. S. M. M. Emamat, C. M. de M. Mota, M. R. Mehregan, M. R. Sadeghi Moghadam, and P. Nemery, *Using ELECTRE-TRI and FlowSort methods in a stock portfolio selection context*, vol. 8, no. 1. Springer Berlin Heidelberg, 2022.

[10] G. S. S. A. Sahaaya Arul Mary, "Multi-Criteria Decision Making Using ELECTRE," *Circuits Syst.*, 2023.

[11] A. P. Silalahi, "Sistem Pendukung Keputusan Pemilihan Perumahan Di Kota Medan Menggunakan Metode Elimination And Choice Translation Reality (ELECTRE)," *Methodika*, vol. 2, no. 2, pp. 204–210, 2016.

[12] M. Mesran, P. Pristiwanto, and D. Sihombing, "Implementasi Metode Electre Dalam Menentukan Rice Cooker Terbaik," *Telematika*, vol. 11, no. 2, p. 43, 2018, doi: 10.35671/telematika.v11i2.699.