Universitas Ahmad Dahlan

IJIO

(*International Journal of Industrial Optimization*)

ISSN 2723-3022 (online) | 2714-6006 (printed)

Vol 5, No. 1, 16-30

https://doi.org/10.12928/ijio.v5i1.9061

Decision support system in determining the location of new supermarket branches using the copras method

Siti Lathifah Tsaqila [a,*], Sri Winiarti [a], Ida Widaningrum [b]

[a] Informatics Department, Universitas Ahmad Dahlan, Indonesia
[b] Informatics Department, Universitas Muhammadiyah Ponorogo, Indonesia
* Corresponding Author: siti1900018084@webmail.uad.ac.id

ARTICLE INFO

Article history
Received: September 19, 2023
Revised: November 29, 2023
Accepted: January 13, 2024

Keywords
Retail business;
New supermarket branch;
Complex Proportional Assessment (COPRAS);
Determining location;
Decision support system.

ABSTRACT

Supermarkets are one of the ideal and profitable retail business sectors to try because they are located in various urban and rural areas. This causes many people to be interested in setting up a supermarket. However, determining a strategic location is not easy and requires many strategic location considerations. The research objective is to develop a Decision Support System (DSS) to determine the location of new supermarket branches using the Complex Proportional Assessment (COPRAS) method, which is expected to be helpful for management and supermarket partners as a business strategy. The COPRAS method excels in calculating alternative utilities and selecting the best alternative. There are nine criteria (land rental price, distance to competitors, security, distance to education, warehouse distance, cleanliness, land area, building price, crowd) and five alternative locations (Juanda, Hos Cokroaminoto, Bayangkara, Batoro Katong, Sumoroto) are considered. This research created a web-based DSS that selects the best location for supermarket, with Juanda (A1) ranked first and scored 100, followed by Somoroto (location A5) with a score of 99.861, Bayangkara (A3) with a score of 97.099, Batoro Katong (A4) with a score of 91.293, and HOS Cokroaminoto (A2) with a score of 88.877. From the results of the COPRAS calculation, it can be concluded that Juanda is the best location to build a new supermarket branch location. This result provides a valuable tool for management and supermarket partners seeking to make informed decisions about branch expansion strategies.

This is an open-access article under the CC–BY-SA license.

1. Introduction

Supermarkets, strategically located in proximity to residential areas, are pivotal in meeting the majority of daily necessities. Their presence in various localities is essential due to their comprehensive provision of goods required for daily living. The impact of the Supermarket business is one of the business prospects that has the potential to get a significant profit [1]–[4]. Retail businesses sell goods and services that serve their interests and households [5]–[8]. Supermarkets are one of the ideal and profitable retail business sectors to try because they can be found in various urban and rural areas [9]–[11]. This has caused many people to be interested in setting up supermarkets [12]–[15]. However, to establish a supermarket retail business, it is also necessary to consider factors such as location to well [16]–[19]. The selection of the right location is decisive in supporting the development of the retail business, so the location selection must be accompanied by consideration of positive and negative impacts [20]. The correct and strategic location can be one of the attractions for consumers who pass by around the location of the supermarket [21],[22]. Choosing the right and strategic location can create the potential for loyal consumers who always buy at the supermarket and attract consumers to that location [23]. Of course, with more and more residential houses in the community, places of education and crowds in the location will be a distinct advantage for choosing that location. The choice of location can affect income, expenses, and even the legality of the business establishment [24]–[26]. Therefore, location is also one of the key success factors of a business. Determining a strategic business location is challenging because it involves many considerations that affect costs and profits [27]–[30]. In determining the location of a business, a selection process is required based on several stages to assess each location's potential. Supermarket location selection is done by considering predetermined criteria based on the results of interviews with Supermarket management and references from previous journals [31]–[36]. This research focuses on a case study at Surya Mart Supermarket in Ponorogo City.

Surya Mart is one of the fastest-growing Supermarkets and is a Muhammadiyah-owned enterprise (BUMM). Until now, Surya Mart has had 1600 outlets spread across Ponorogo, Madiun, Magetan, Pacitan, and various other areas. It is a great opportunity and an excellent strategy to open new branches by cooperating between Surya Mart and people interested in opening a Supermarket business or partners [37]. But when partners face several location options, it is essential to consider the best, most appropriate, and strategic location to determine the location of new branches to achieve successful development. Meanwhile, Surya Mart does not yet have a system that helps partners to choose the best location. Therefore, this research helps determine the correct and strategic location for new Surya Mart branches using a Decision Support System (DSS) with the Complex Proportional Assessment (COPRAS) method.

The COPRAS method was chosen. After all, it is a method that is superior to other methods because it calculates the degree of utility of each alternative and indicates the extent to which the alternative is good to take [38]–[41]. Unlike other Multi-Attribute Group Decision Making (MADM) methods, the COPRAS method uses stepwise ranking and degrees of significance and utility to make rational selections. Compared to the SAW method, the SAW method will add up the results by multiplying the weights with the criteria values for each alternative. So, the calculation is simpler and more direct [42].

In comparison, the COPRAS method is more complex because it calculates the level of usefulness and relative weight of the criteria. The maximum and minimum criteria index values are calculated separately [43],[44]. From there, the value of the valuable criteria matrix is obtained minus the value of the cost criteria matrix. Compared to the TOPSIS method, the TOPSIS method focuses more on selecting alternatives based on the closest distance to the ideal solution and the farthest distance from the non-ideal solution. Whereas when compared to the PROMETHEE method, the PROMETHEE method performs pairwise comparisons between alternatives based on a preference function [42]. A comparative study conducted by Chatterjee et al. [45] revealed that the COPRAS-based technique requires less estimation time, is very simple, and has a higher possibility of graphical explanation than other methods [46].

Some previous studies have reviewed DSS to find the best location. Sztubecka et al. [47] found that using the innovative DGIS system DGIS system empowers local decision-makers, enabling targeted actions to address climate change and safeguard the environment to determine the energy efficiency potential in urban areas. This innovative approach aligns with new data strategies, shaping optimal energy scenarios within urban landscapes. Apriyani et al. [48] developed DSS to determine where to put the center for souvenir development using the PROMETHEE method. One of the research conducted by Moradi et al. [49] developed multi-criteria DSS for wind farm site selection and sensitivity analysis with a case study located in Alborz Province, Iran analysis indicates that results were generally reliable. Hamada et al. [50] observed a DSS using the k-means clustering algorithm method for detecting the optimal store location based on social network events using Instagram data extracted via Octoparse. Through Minimax and K-means algorithms, cleaned data were visualized on a map, pinpointing optimal locations for store placement. Furthermore, Golovnin et al. [51] proposed a DSS leveraging GIS and optimization methods to position convenience stores within walking range, considering the interplay between supply and demand locations on pedestrian

 10.12928/ijio.v5i1.9061

flow and goods demand. Through experiments in two areas, the DSS's efficiency was evaluated using program execution time as a benchmark, affirming its effectiveness in optimizing store placement.

The research identified a critical gap in the field of supermarket location selection. While the importance of choosing a strategic location for supermarkets is well-established, a systematic DSS cannot assist in this process. This gap is particularly evident in the case of Surya Mart Supermarket, a rapidly growing chain with expansion opportunities. The absence of a location selection system for partners interested in opening new branches has highlighted the need for a DSS tailored to the specific needs of the supermarket industry. Existing studies in decision support systems for location selection have primarily focused on various methods and technologies but haven't addressed the unique requirements of supermarket chains like Surya Mart.

Therefore, the research objective is to develop a DSS to determine the location of new supermarket branches using the COPRAS method. The research contribution directly impacts Surya Mart's growth strategy, revenue generation, and marketing efforts. With the COPRAS method, the DSS helps identify optimal locations and streamlines decision-making for potential partners interested in opening new branches. This research has contributed valuable resources to the supermarket industry, demonstrating the effectiveness of the COPRAS-based technique for location selection. The study has practical implications for Surya Mart and other supermarket chains looking to expand, ultimately enhancing their profitability and competitive positioning in the market.

2. Method

2.1. Problem description

Established on March 5, 1999, PT. Daya Surya Sejahtera, also known as Surya Mart, represents a Muhammadiyah-owned business enterprise that provides daily essentials through its supermarket chain, SURYA. Their slogan is "Affordable, Islamic-Friendly" [37]. The criteria for establishing a Surya Mart branch are multifaceted: legal recognition, securing a suitable property (owned or leased), adequate financial resources tailored to the outlet's requirements, a workforce of 5 to 9 individuals, and a leadership team with substantial knowledge. Additionally, strategic environmental considerations, such as locations near markets, residential areas, and offices, are essential.

The selection of a site for a new Surya Mart branch is a critical decision guided by a strategic feasibility study, which necessitates the site to be in a populous area, surrounded by numerous offices, educational institutions, and residential complexes while being distanced from rapid public transportation routes. The site should range from 90 to 120 square meters to display a wide range of products, be situated along a main road with high pedestrian traffic and easy access, and maintain a minimum distance of 200 meters from other branches.

Surya Mart supermarkets are categorized into three types based on their retail space and facilities. Type A encompasses a 216 square meter area, providing parking for ten cars and 20 motorcycles, along with rental space for food and beverage vendors. This type includes six refrigerators, six display cases, and space for four to five cashier tables, with a minimum electrical requirement of 13,200 amps and a 100-square-meter storage space. Type B, slightly smaller, offers a 150 square meter retail area, parking for seven cars and 15 motorcycles, and includes two freezers, three display cases, and space for two cashier stations, requiring at least 10,600 volts of power and a 75 square meter warehouse. The smallest, Type C, spans 100 square meters, accommodates parking for five cars and ten motorcycles, and is equipped with two freezers, two display cases, and space for 1-2 cashier stations, with a minimum electrical requirement of 7,500 watts and a 60 square meter storage area.

2.2. Proposed Method

The COPRAS method was first introduced by Zavadskas, Kaklauskas, and Sarka in 1994. Based on individually taken into account assessment outcomes, this method is utilized to evaluate the maximization of attribute indices [52]. The COPRAS approach distinguishes positive (benefit) and negative (cost) criteria, and each type of criterion is individually assessed during the computation process [53]. This technique compares the distinctiveness of one alternative to another and positions it as a viable choice to be made after weighing the various criteria. The COPRAS approach differs from other methods in that it evaluates several criteria to maximize and reduce the value of each one. This approach examines the individual effects of maximizing and minimization criteria on evaluation outcomes. The COPRAS method stages and ranks options according to their applicability and level of usefulness [54]. The advantage of the COPRAS method in determining alternative utility levels reveals how extensively alternatives are used for comparison. In contrast to previous methods, alternative ranking results using the COPRAS method are more accurate in assessing and validating calculation findings [1], [41], [53]–[56], [57].

The COPRAS method is put into place in the following steps:

a. Determine the initial matrix X.

$$x = [x_{ij}]_{mxn} = [\, x_{11}\ x_{12}\ \dots\ x_{1n}\ \ x_{21}\ x_{22}\ \dots\ x_{2n}\ \ \dots\ x_{m1}\ \ \dots\ x_{m2}\ \ \dots\ \dots\ \ \dots\ x_{mn}\ ] \quad (1)$$

x_{ij} = The evaluation of the *i-th* alternative in relation to the *j-th* criterion.
m = The quantity of alternatives
n = The quantity of criteria

b. Matrix normalization.

$$R = [r_{ij}]_{mxn} = \frac{x_{ij}}{\sum_{i=1}^{m} x_{ij}} \quad (2)$$

r_{ij} = Normalized value of the *i-th* alternative on the *j-th* criteria.

c. Determine the weighted matrix.

$$D = [y_{ij}]_{mxn} = r_{ij}.w_j\,, i = 1 \dots, m, j = 1, \dots, n \quad (3)$$

y_{ij} = Relative weight for criterion *j*.

w_j = Weight of the *j-th* criteria.

d. Calculate the maximum and minimum criteria values.

$$S_{+I} = \sum_{j=1}^{n} y_{+ij}\,, S_{-I} = \sum_{j=1}^{n} y_{-ij} \quad (4)$$

S_{+I} = Maximum value of index criteria.

S_{-I} = Minimum value of index criteria.

y_{+ij} = Weighted normalization for favorable criteria.

y_{-ij} = Weighted normalized value for unfavorable criteria.

e. Determine relative significance.

$$Q_i = S_{+i} + \frac{S_{-min} \sum_{i=1}^{m} S_{-i}}{S_{-i} \sum_{i=1}^{m} (\frac{S_{-min}}{S_{-i}})}, i = 1, \dots, m \quad (5)$$

S_{-min} = Minimum value of S_{-i}

f. Calculate quantitative utility.

$$U_i = \frac{Q_i}{Q_{max}} \times 100\% \quad (6)$$

Q_{max} = Maximum relative significance value.

10.12928/ijio.v5i1.9061

Alternative candidates have utility values ranging from 0 to 100, with greater Ui values denoting more importance. These utility values are used to rank the alternatives, with the choice with the highest value being the most practical option.

2.3. Criteria, Alternatives, and Weights

The criteria identified are not the result of mere assumptions but based on in-depth research from previous scientific journals referenced in this research. After collecting potential criteria from journals, the author conducted discussions or interviews with Surya Mart to determine the most relevant criteria for their needs. Surya Mart itself determines whether each criterion is considered a cost or benefit.

Table 1 presents nine distinct criteria, each subdivided into three category ranges, each comprising three different values. Furthermore, an analysis of Table 2 reveals that every individual criterion is assigned nine varying weights. Complementing this, Table 3 lists five potential locations associated with each criterion, explicitly focusing on different street names.

Table 1. Criteria, range, and value

Code	Criteria	Cost/ Benefit	Range	Value
C1	Land rental price	Cost	> 10 B	100
			>6 – <=10 B	75
			3 - <=6 B	50
C2	Distance to competitors	Cost	0	100
			1-2	75
			>=3	50
C3	Security	Benefit	There have been no cases of theft. It's close to the police station; no naughty kids are making trouble, and there's no place to get drunk.	100
			Far from the police station, there have been cases of theft, no drunk places, and no naughty children causing trouble.	75
			Far from the police station, there is a drinking place for teenagers, and there have been cases of theft.	50
C4	Distance to place of education, office, or housing	Benefit	0 - <=500 m	100
			>500 m - <=1 km	75
			>1 km	50
C5	Distance to warehouse	Cost	>1km	100
			>100 - <=1 km	75
			The same location.	50
C6	Cleanliness	Benefit	Waste management is organized and not adjacent to waste disposal sites, and it can cooperate with the environment and authorities.	100
			Garbage management is planned out and distant from garbage disposal sites, making it unable to cooperate with the environment and agencies.	75
			Garbage management is disorganized and close to garbage disposal locations, making cooperating with the environment and authorities difficult.	50
C7	Land area	Benefit	>300 - <=500 m2	100
			>200 - <=300 m2	75
			>50 - <= 200 m2	50
C8	Building price	Cost	Type A: >1 - <=1.4 B	100
			Type B: >800 Jt - <=1 B	75
			Type C: >500 - <=800 M	50
C9	Crowd	Benefit	City street.	100
			District road.	75
			Village Road.	50

Next, the range or sub-criteria were detailed based on Surya Mart's internal standards in choosing store locations, and some were taken from Surya Mart's textbook. These sub-criteria are rated on a scale that reaches a maximum of 100. To ensure a more accurate evaluation, the value of sub-criterion one should be the highest and not the same as the other sub-criteria.

Meanwhile, the value of sub-criterion 2 should be less than sub-criterion one but more significant than sub-criterion 3, and also should not be the same as other sub-criteria. Finally, sub-criterion 3 must have the smallest value compared to sub-criteria 1 and 2, and the value must not be the same as other sub-criteria. This approach can create an evaluation method that is not only research-based but also tailored to the needs and standards of Surya Mart so that it is expected to provide more precise and effective results. The default weight is obtained from expert opinion or experts who refer to Surya Mart management. Alternatives are obtained from several street names of established Surya Mart in Ponorogo that have been established so that they can be used as examples or references later in determining the location of new Surya Mart branches.

Table 2. Weight

Weight	Code
23	W1
13	W2
18	W3
11	W4
6	W5
5	W6
9	W7
11	W8
4	W9

Table 3. Alternative

Alternative	Code
Juanda	A1
HOS Cokroaminoto	A2
Bayangkara	A3
Batoro Katong	A4
Sumoroto	A5

2.4. Research Flows

Fig. 1 illustrates a methodical process flow for algorithm calculations. There are:

a. Literature review

The sources of literature study can be journals, books, websites, and so on, both from within the country and abroad. In the context of this research, the literature study focuses on studies relevant to research on developing a DSS to determine the location of new branches. In addition, it also includes journals that discuss the method to be used, namely the COPRAS method.

b. Determine the object and subject of research

The subject of this research is Surya Mart Supermarket in Ponorogo, which is looking for a location to open a new branch. While the object of this research is the shop owners interested in establishing a new branch of the Surya Mart Supermarket.

c. Data collection

Data collection in this study was done in three ways: literature study, interviews, and observations. Data collection through interviews was carried out with the Surya Mart Supermarket, namely the founder of Surya Mart, Mr. Imam Kurdi, one of the employees who became a representative, namely Mr. Parno and the owner of each Surya Mart Supermarket which became an alternative to be processed into a system. Data on the system's criteria, alternatives, and weights were

10.12928/ijio.v5i1.9061

obtained from the interview. In addition, observation techniques are also carried out to collect data from several criteria that require direct observation at the location where the supermarket is established. The data needed for direct observation to the location is the data on the criteria for the number of competitors in the location taken from a distance of one kilometer.

d. Algorithm determination

The process of determining or selecting the right algorithm to solve a problem. The problem here is determining the best location to build a new supermarket branch. The algorithm in this study is the COPRAS method algorithm. The COPRAS method was chosen because it is a method that is superior to other methods because it is used to calculate the utility level of each alternative and shows the extent to which the alternative is good to take [30].

e. Algorithm calculation

After determining the algorithm, the next step is to perform the algorithm calculation. This involves performing the steps specified by the COPRAS method algorithm on a set of input data to produce the desired output.

f. Expert judgement

Expert judgment is conducted to evaluate the effectiveness of the web-based DSS system to determine the best location for a new Supermarket branch using the COPRAS method that has been created and involves structured evaluations from various experts. Each group of experts will most likely provide a unique perspective based on their respective expertise. Expert judgment was conducted by five selected experts, namely 2 entrepreneurs, 2 lecturers, and 1 supermarket manager.

g. Conclusion

The conclusion is that the best location for the new branch of Surya Mart Supermarket is in Surya Mart. The conclusion will be generated after completing all stages of the research.

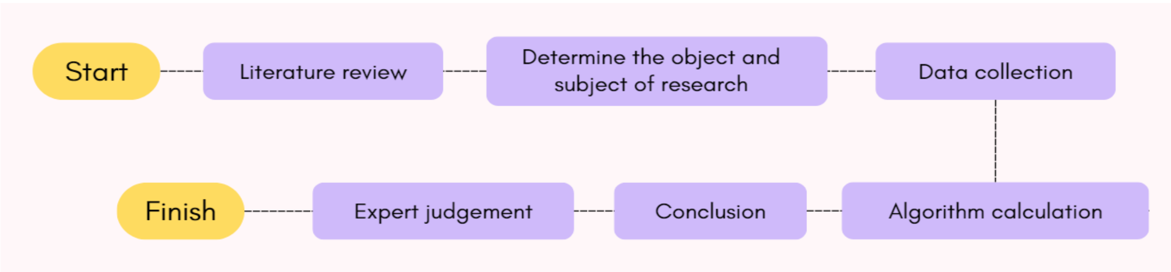

Fig. 1. The process flows

2.5. Algorithm Calculation Flow

The flow of algorithm calculation is shown in Fig. 2. The COPRAS method calculation stage is the COPRAS method's calculation stage based on the gathered data. The COPRAS method is used to process these data, and the results show which areas are the ideal for constructing supermarket branches.

a. Establish the starting matrix X.

The COPRAS method calculation starts by creating the starting matrix X. Data from the obtained criteria and options are included in the matrix. Matrices can be set up using tables to make it simpler to store, search for, process, and analyze data.

b. Normalizing the matrix.

In order to reduce scale disparities between criteria, matrix data must be normalized. This process is used to make sure that each criterion contributes fairly to the final calculation.

c. Weighted matrix normalization.

Weighted matrix normalization is achieved by combining weights with already normalized matrix data from each alternative. The weights will now be multiplied by the normalized matrix.

d. Determine the highest and lowest values for the criteria.

At this point, the COPRAS method's equation formula calculates and groups the sum of the weighted normalized values for each favorable and unfavorable criterion. Each solution's relative suitability or preference level is demonstrated at this crucial step.

e. Evaluating relative significance.

Using a complicated mathematical formula by the COPRAS approach, this stage determines the relative importance value for each choice.

f. Quantitative utility calculation.

The goal of this stage is to arrive at a final number that is more stable and that can be compared relative to all other options. The final scores are listed in order from highest to lowest. The best option is the one with the highest value.

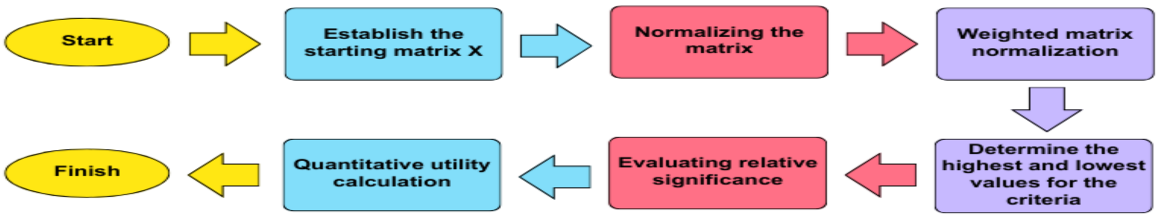

Fig. 2. Algorithm Calculation Flow

3. Results and Discussion

3.1. Determine the Initial Matrix

To enhance visibility, Table 4 presents matrix alternatives, criteria, and weight.

Table 4. Matrix alternative, criteria, and weight

Alternative	Criteria								
	Benefit					Cost			
	C3	C4	C6	C7	C9	C1	C2	C5	C8
Juanda	100	100	100	100	100	75	50	100	100
HOS Cokroaminoto	100	100	100	50	100	75	75	100	100
Bayangkara	100	75	100	50	100	50	75	100	75
Batoro Katong	75	100	100	50	100	75	50	100	75
Sumoroto	100	100	100	50	100	50	75	100	75
Total	475	475	500	300	500	325	325	500	425

3.2. Normalized matrix

The matrix can be normalized using the formula for matrix normalization, as shown in Table 5.

Table 5. Normalized matrix

Alternative	Criteria								
	Benefit					Cost			
	C3	C4	C6	C7	C9	C1	C2	C5	C8
Juanda	0.211	0.211	0.2	0.3333	0.2	0.23	0.154	0.2	0.235

Alternative	Criteria								
	Benefit					Cost			
	C3	C4	C6	C7	C9	C1	C2	C5	C8
HOS Cokroaminoto	0.211	0.211	0.2	0.1667	0.2	0.23	0.231	0.2	0.235
Bayangkara	0.211	0.158	0.2	0.1667	0.2	0.15	0.231	0.2	0.176
Batoro Katong	0.158	0.211	0.2	0.1667	0.2	0.23	0.154	0.2	0.176
Sumoroto	0.211	0.211	0.2	0.1667	0.2	0.15	0.231	0.2	0.176

3.3. Determine the weighted matrix

The matrix can be normalized using the weighted matrix formula. Table 6 shows weighted matrix normalization.

Table 6. Weighted Matrix Normalization

Alternative	Criteria								
	Benefit					Cost			
	C3	C4	C6	C7	C9	C1	C2	C5	C8
Juanda	3.789	2.316	1	3	0.8	5.31	2	1.2	2.588
HOS Cokroaminoto	3.789	2.316	1	1.5	0.8	5.31	3	1.2	2.588
Bayangkara	3.789	1.737	1	1.5	0.8	3.54	3	1.2	1.941
Batoro Katong	2.842	2.316	1	1.5	0.8	5.31	2	1.2	1.941
Sumoroto	3.789	2.316	1	1.5	0.8	3.54	3	1.2	1.941

3.4. Calculate the maximum and minimum criteria values

The maximum and minimum index criteria values can be determined by applying the formula for calculating these values. Table 7 shows weighted matrix normalization.

Table 7. Weighted Matrix Normalization

Alternative	S_{+I}	S_{-I}
Juanda	10.905	11.096
HOS Cokroaminoto	9.4053	12.096
Bayangkara	8.8263	9.6796
Batoro Katong	8.4579	10.449
Sumoroto	9.4053	9.6796
Total		53

Based on the provided calculation table, it can be observed that S-min is determined to be 9.6796, representing the minimum value of S_{-I}.

3.5. Determine relative significance

Calculate the relative significance by employing the relative significance formula. Table 8 presents the results of relative significant calculations. The maximum value of Q, denoted as Qmax, is determined to be 20.959 based on the provided data.

3.6. Calculate quantitative utility

The calculation of utility, often known as U_i, is determined through the use of a quantitative utility formula. Fig. 3 presents the results of relative significant calculations. The optimal choice for the establishment of a new branch of a supermarket, which has been assigned the top rank, is A1 (Juanda), with a value of 100, followed by A5 Somoroto (location 5) with a score of 99.861, A3 Bayangkara (location 3) with a score of 97.099, A4 Batoro Katong (location 4) with a score of 91.293, and A2 HOS Cokroaminoto (location 2) with a value of 88.877. It indicates that A1 is the best location to choose according to the COPRAS technique. The data suggests that based on the COPRAS technique, A1 emerges as the optimal choice of location.

Table 8. Relative Significant Calculations

Alternative	$\frac{S_{-min}}{S_{-I}}$	$S_{-i}\sum_{i=1}^{m}(\frac{S_{-min}}{S_{-i}})$	$\frac{S_{-min}\sum_{i=1}^{m}S_{-i}}{S_{-i}\sum_{i=1}^{m}(\frac{S_{-min}}{S_{-i}})}$	Q_i
Juanda	0.872	51.03	10.053	20.959
HOS Cokroaminoto	0.8	55.629	9.2222	18.627
Bayangkara	1	44.516	11.524	20.351
Batoro Katong	0.926	48.054	10.676	19.134
Sumoroto	1	44.516	11.524	20.93
Total	4.599			

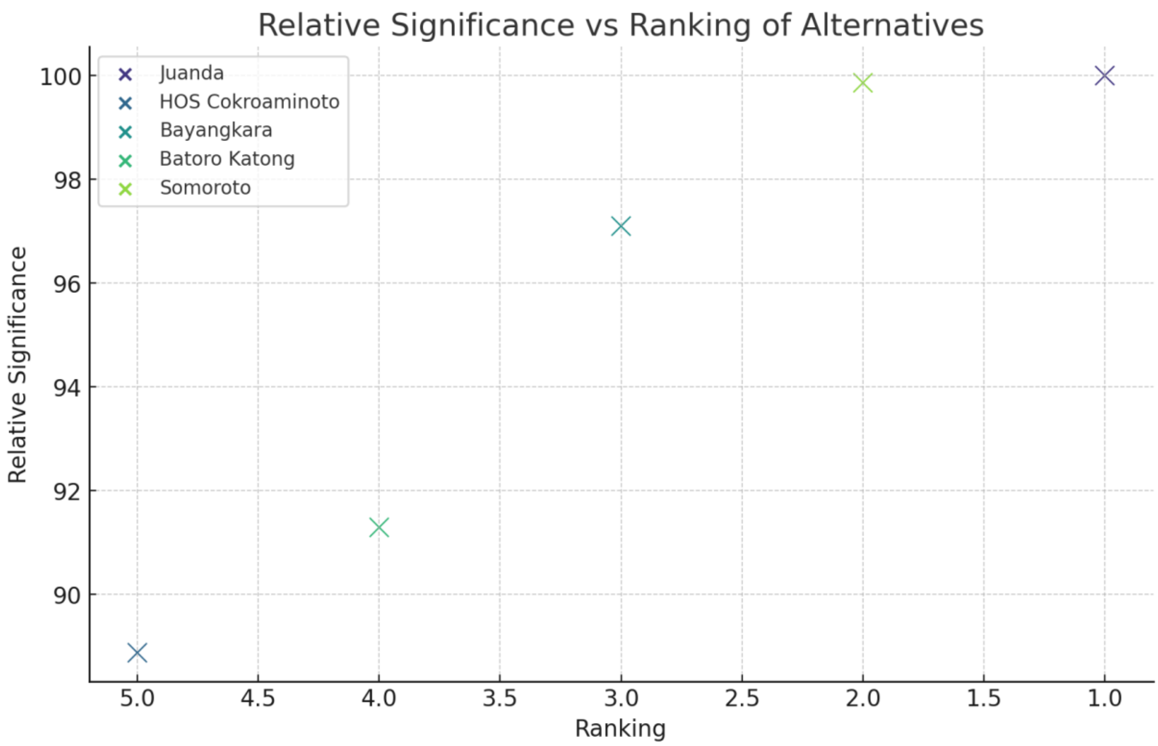

Fig. 3. Relative Significant Calculations

Fig. 4 serves as a graphical portrayal of a DSS that operates through web-based means, facilitating users in the process of assessing and choosing the most optimal site for establishing a supermarket. The presented ranking of optimal locations is derived from suggestions generated by a DSS algorithm that uses the COPRAS approach. The top-ranked location in the ranking is highly suggested as the optimal choice for establishing a new supermarket.

The decision-making process is guided by a comprehensive evaluation of multiple criteria, including land rental price, proximity to competitors, security, accessibility to education facilities, offices, or housing, warehouse distance, cleanliness, land area, building price, and customer density. This approach is somewhat aligned with contemporary research trends in location selection for retail establishments, as evident in Karna et al. [58]. They proposed different decision-making

 10.12928/ijio.v5i1.9061

methodologies, which employed AHP, conducted in Big Mart in Bakhundol, Nepal, for understanding convenient location selection in a specific context. The integration of various criteria, including demographic factors, competition, economic considerations, and precise location features, is consistent with the trends in current research. While AHP is also a well-regarded method for handling complex decision-making processes, the COPRAS method's application in this study highlights its utility in providing a direct and quantifiable assessment of multiple location factors, which could offer more insights for specific retail contexts like Surya Mart.

Moreover, utilizing a web-based Decision Support System (DSS) for visualizing and processing these criteria is an innovative approach that aligns with the increasing digitalization of decision-making processes in contemporary business environments. This integration of technology could enhance the decision-making process's efficiency and accuracy. It contributes to the field by offering a practical, comprehensive, and technologically integrated approach to location selection, which is essential for retail businesses like Surya Mart to optimize their revenue and market strategies.


HASIL PERHITUNGAN

Halaman ini berfungsi untuk menampilkan data lokasi, kriteria, bobot, hasil, dan rangking yang telah anda lakukan. Anda juga dapat mengunduh hasil rekomendasi lokasi terbaik untuk disimpan pada perangkat anda. Lokasi terbaik yang di tampilkan merupakan rekomendasi lokasi terbaik berdasarkan algoritma sistem pendukung keputusan menggunakan metode AHP dan COPRAS pada website ini. Tentu saja rangking 1 merupakan lokasi yang paling di rekomendasikan untuk dipilih untuk dijadikan lokasi supermarket.

No	alternatif	Bobot	Hasil	Rangking	Tanggal
1	Juanda	Default	100	1	2023-08-09 23:33:30
2	Somoroto	Default	99.8615	2	2023-08-09 23:33:30
3	Bayangkara	Default	97.0991	3	2023-08-09 23:33:30
4	Batoro Katong	Default	91.2933	4	2023-08-09 23:33:30
5	HOS Cokroaminoto	Default	88.8774	5	2023-08-09 23:33:30

Fig. 4. Result web-based

4. Conclusion

This research proposes a web-based Decision Support System (DSS), demonstrating its effectiveness in helping users to identify the most suitable site for new supermarket branches. Utilizing the COPRAS methodology, it ranks potential sites by systematically evaluating them against nine key criteria. This approach has proven to be beneficial in pinpointing the prime locations for Surya Mart outlets and offering actionable insights for implementation but also contributes to Surya Mart's business growth through increased revenue and effective marketing strategies. This system is also valuable for stakeholders in the supermarket sector who seek to enhance their profitability through strategic site selection. Future studies might explore alternative methods to COPRAS, such as Fuzzy Logic, Multi-Objective Decision Making (MODM), or the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS). Additionally, integrating more comprehensive criteria like demographic trends, market dynamics, potential for population growth, transportation accessibility, and specific environmental factors could refine the accuracy in determining locations for new branches.

References

[1] S. J. Arnold and M. Narang Luthra, "Market entry effects of large format retailers: a stakeholder analysis," *International Journal of Retail & Distribution Management*, vol. 28, no. 4/5, pp. 139–154, 2000, doi: 10.1108/09590550010319896.

[2] Q. Zhou *et al.*, "Neighborhood supermarket access and childhood obesity: a systematic review," *Obesity reviews*, vol. 22, p. e12937, 2021, doi: 10.1111/obr.12937.

[3] D. Sim, *Soft city: building density for everyday life*. Island Press, 2019.

[4] I. Van Liempt and S. Miellet, "Being far away from what you need: the impact of dispersal on resettled refugees' homemaking and place attachment in small to medium-sized towns in the Netherlands," *Journal of Ethnic and Migration Studies*, vol. 47, no. 11, pp. 2377–2395, 2021, doi: 10.1080/1369183X.2020.1845130.

[5] M. G. Dekimpe, "Retailing and retailing research in the age of big data analytics," *International Journal of Research in Marketing*, vol. 37, no. 1, pp. 3–14, 2020, doi: 10.1016/j.ijresmar.2019.09.001.

[6] Y. Hole, M. S. Pawar, and E. B. Khedkar, "Omni channel retailing: An opportunity and challenges in the Indian market," in *Journal of Physics: Conference Series*, IOP Publishing, 2019, p. 12121. doi: 10.1088/1742-6596/1362/1/012121.

[7] D. Novita and D. P. Rini, "A Literature Review Knowledge Management for Traditional Retail Business Strategies," in *2022 International Conference on Informatics, Multimedia, Cyber and Information System (ICIMCIS)*, IEEE, 2022, pp. 88–93. doi: 10.1109/ICIMCIS56303.2022.10017714.

[8] A. Sundari and A. Y. Syaikhudin, *Manajemen Ritel (Teori dan Strategi dalam Bisnis Ritel)*. 2021.

[9] B. L. Debela, K. M. Demmler, S. Klasen, and M. Qaim, "Supermarket food purchases and child nutrition in Kenya," *Global Food Security*, vol. 25, p. 100341, 2020, doi: 10.1016/j.gfs.2019.100341.

[10] M. Saber and A. Weber, "How do supermarkets and discounters communicate about sustainability? A comparative analysis of sustainability reports and in-store communication," *International Journal of Retail & Distribution Management*, vol. 47, no. 11, pp. 1181–1202, 2019, doi: 10.1108/IJRDM-08-2018-0156.

[11] L. Dries, T. Reardon, and J. F. M. Swinnen, "The rapid rise of supermarkets in Central and Eastern Europe: Implications for the agrifood sector and rural development," *Development policy review*, vol. 22, no. 5, pp. 525–556, 2004, doi: 10.1111/j.1467-7679.2004.00264.x.

[12] Z. Ton, *The good jobs strategy: How the smartest companies invest in employees to lower costs and boost profits*. Houghton Mifflin Harcourt, 2014.

[13] C. S. R. Nuthalapati, R. Sutradhar, T. Reardon, and M. Qaim, "Supermarket procurement and farmgate prices in India," *World Dev*, vol. 134, p. 105034, 2020, doi: 10.1016/j.worlddev.2020.105034.

[14] C. Data, "Indonesia pertumbuhan penjualan ritel." Accessed: Aug. 03, 2023. [Online]. Available: https://www.ceicdata.com/

[15] "Indonesia Pertumbuhan Penjualan Ritel," CEIC DATA.

[16] A. Bonfrer, P. Chintagunta, and S. Dhar, "Retail store formats, competition and shopper behavior: A Systematic review," *Journal of Retailing*, vol. 98, no. 1, pp. 71–91, 2022, doi: 10.1016/j.jretai.2022.02.006.

[17] S. Van de Sanden, K. Willems, and M. Brengman, "In-store location-based marketing with beacons: from inflated expectations to smart use in retailing," in *The Role of Smart Technologies in Decision Making*, 1st Edition, Routledge, 2022, pp. 148–175, doi: 10.4324/9781003307105-7

[18] N. H. Tien, P. T. Diem, P. Van On, V. T. Anh, N. Van Dat, N. T. Hung, and B.Q. Tam, "The formation and development of CRM system at Thien Hoa electronics supermarket in Vietnam," *International Journal of Research and Growth Evaluation*, vol. 2, no. 4, pp. 752–760, 2021, Available: https://www.researchgate.net/

[19] I. Ahmad, "Faktor-Faktor yang Mempengaruhi Pemilihan Lokasi Usaha Pedagang di Pasar Tradisional Sapeken." Universitas Pendidikan Ganesha, 2022.

 10.12928/ijio.v5i1.9061

[20] M. J. Sirait, W. Handayani, and L. T. Sianturi, “Sistem Pendukung Keputusan Penentuan Lokasi Outlet Cv. Boga Amanda Menggunakan Metode the Extended Promethee Ii (Exprom Ii),” *KOMIK (Konferensi Nasional Teknologi Informasi dan Komputer)*, vol. 1, no. 1, 2017, doi: 10.30865/komik.v1i1.482.

[21] Y. K. A.-A. Migdadi and E. H. A. Abdel-Rahman, "The impact of grocery retail superstores location on the customer's perceived quality of servicescape in Jordan," *Quality Management Journal*, vol. 27, no. 2, pp. 120–132, 2020, doi: 10.1080/10686967.2020.1722045.

[22] A. Baviera-Puig, J. Buitrago-Vera, and C. Escriba-Perez, "Geomarketing models in supermarket location strategies," *Journal of Business Economics and Management*, vol. 17, no. 6, pp. 1205–1221, 2016, doi: 10.3846/16111699.2015.1113198.

[23] A. Sundari and A. Y. Syaikhudin, *Manajemen ritel (Teori dan strategi dalam bisnis ritel)*. Academia Publication, 2021.

[24] S. Hirsch, D. Lanter, and R. Finger, "Profitability and profit persistence in EU food retailing: Differences between top competitors and fringe firms," *Agribusiness*, vol. 37, no. 2, pp. 235–263, 2021, doi: 10.1002/agr.21654.

[25] R. Mohd Roslin and H. Rosnan, "Location as a strategic retail decision: the case of the retail cooperative," *International Journal of Commerce and management*, vol. 22, no. 2, pp. 152–158, 2012, doi: 10.1108/10569211211239458.

[26] S. Fitriyani, T. Murni, and S. Warsono, "Pemilihan Lokasi Usaha dan Pengaruhnya Terhadap Keberhasilan Usaha Jasa Berskala Mikro dan Kecil," *Managament Insight: Jurnal Ilmiah Manajemen*, vol. 13, no. 1, pp. 47–58, 2019, doi: 10.33369/insight.13.1.47-58.

[27] R. Ferreira, R. Pereira, I. S. Bianchi, and M. M. da Silva, "Decision factors for remote work adoption: advantages, disadvantages, driving forces and challenges," *Journal of Open Innovation: Technology, Market, and Complexity*, vol. 7, no. 1, p. 70, 2021, doi: 10.3390/joitmc7010070.

[28] T. H. A. Bijmolt *et al.*, "Challenges at the marketing–operations interface in omni-channel retail environments," *Journal of Business Research*, vol. 122, pp. 864–874, 2021, doi: 10.1016/j.jbusres.2019.11.034

[29] M. Kabeyi, "Organizational strategic planning, implementation and evaluation with analysis of challenges and benefits," *International Journal of Applied Research and Studies*, vol. 5, no. 6, pp. 27–32, 2019, doi: 10.22271/allresearch.2019.v5.i6a.5870.

[30] E. F. Wati, “Penerapan Metode SAW Dalam Menentukan Lokasi Usaha (Embun Fajar Wati)| 241 Universitas Bina Sarana Informatika Jl,” *Jurnal Sains Komputer & Informatika (J-SAKTI*, vol. 5, no. 1, 2021, doi: 10.30645/j-sakti.v5i1.316.

[31] M. Shao, Z. Han, J. Sun, C. Xiao, S. Zhang, and Y. Zhao, "A review of multi-criteria decision making applications for renewable energy site selection," *Renewable Energy*, vol. 157, pp. 377–403, 2020, doi: 10.1016/j.renene.2020.04.137.

[32] M. S. Margolang, “Sistem Pendukung Keputusan Pemilihan Lahan Pembangunan Minimarket Dengan Menggunakan Metode Preference Selection Index,” *Seminar Nasional Teknologi Komputer & Sains (SAINTEKS)*, 2019, [Online]. Available: https://seminar-id.com/

[33] W. Pertiwi, N. Nurahman, and A. Aziz, “Decision Support System untuk Menentukan Lokasi Cabang Baru Muhri Fashion Menggunakan Penggabungan TOPSIS dan SAW,” *Jurnal Sistem Komputer dan Informatika (JSON)*, vol. 3, no. 3, p. 241, Mar. 2022, doi: 10.30865/json.v3i3.3874.

[34] L. Meidarwati Laia, B. Andika, E. Fahmi Ginting, and U., “Sistem Pendukung Keputusan Dalam Menentukan Lokasi Strategis Cabang Baru di UD. Ario Nias Selatan Menggunakan Metode WASPAS (Weighted Aggregated Sum Product Assesment),” *Jurnal CyberTech*, vol. 1, no. 4, pp. 218–227, 2021, [Online]. Available: https://ojs.trigunadharma.ac.id/

[35] R. Andri Agus, M. Ardiansyah Sembiring, M. Istaufa Arif Sinaga, and S. Royal, “Penerapan Metode Smart dalam Menentukan Lokasi Toko Roti,” *Journal of Science and Social Research*, 5(2), 2022, doi: 10.54314/jssr.v5i2.973

[36] G. Ginting, S. Alvita, A. Karim, M. Syahrizal, and N. Khairani Daulay, “Penerapan Complex Proportional Assessment (COPRAS) Dalam Penentuan Kepolisian Sektor Terbaik,” *J-SAKTI (Jurnal Sains Komputer & Informatika)*, 4(2), 2020, Available: https://tunasbangsa.ac.id/

[37] I. Kurdi *et al.*, *Pendirian Surya Mart Badan Usaha Milik Muhammadiyah*. 2022.
[38] P. Rani *et al.*, "Hesitant fuzzy SWARA-complex proportional assessment approach for sustainable supplier selection (HF-SWARA-COPRAS). Symmetry 12: 1152." 2020. doi: 10.3390/sym12071152.
[39] L. Kraujalienė, "Comparative analysis of multi-criteria decision-making methods evaluating the efficiency of technology transfer," *Business, Management and Education*, vol. 17, no. 1, pp. 72–93, 2019, doi: 10.3846/bme.2019.11014.
[40] S. Narayanamoorthy, L. Ramya, S. Kalaiselvan, J. V. Kureethara, and D. Kang, "Use of DEMATEL and COPRAS method to select best alternative fuel for control of impact of greenhouse gas emissions," *Socio-Economic Planning Sciences*, vol. 76, p. 100996, 2021, doi: 10.1016/j.seps.2020.100996.
[41] P. Thakur *et al.*, "A new entropy measurement for the analysis of uncertain data in mcda problems using intuitionistic fuzzy sets and copras method," *Axioms*, vol. 10, no. 4, p. 335, 2021, doi: 10.3390/axioms10040335.
[42] V. S. Gadakh, "Application of complex proportional assessment method for vendor selection," *International Journal of Logistics Research and Applications*, vol. 17, no. 1, pp. 23–34, 2014, doi: 10.1080/13675567.2013.836159.
[43] M. H. Utomo and W. M. Minza, "Perilaku menolong relawan spontan bencana alam," *Gadjah Mada Journal of Psychology (GamaJoP)*, vol. 2, no. 1, pp. 48–59, 2016, doi: 10.22146/gamajop.31871
[44] G. Ginting, S. Alvita, M. Mesran, A. Karim, M. Syahrizal, and N. K. Daulay, "Penerapan Complex Proportional Assessment (COPRAS) Dalam Penentuan Kepolisian Sektor Terbaik," *J-SAKTI (Jurnal Sains Komputer dan Informatika)*, vol. 4, no. 2, pp. 616–631, 2020, Available: https://tunasbangsa.ac.id/
[45] P. Chatterjee, V. M. Athawale, and S. Chakraborty, "Materials selection using complex proportional assessment and evaluation of mixed data methods," *Mater Des*, vol. 32, no. 2, pp. 851–860, 2011, doi: 10.1016/j.matdes.2010.07.010.
[46] A. P. Darko and D. Liang, "An extended COPRAS method for multiattribute group decision making based on dual hesitant fuzzy Maclaurin symmetric mean," *International Journal of Intelligent Systems*, vol. 35, no. 6, pp. 1021–1068, 2020, doi: 10.1002/int.22234.
[47] M. Sztubecka, M. Skiba, M. Mrówczyńska, and A. Bazan-Krzywoszańska, "An innovative decision support system to improve the energy efficiency of buildings in urban Areas," *Remote Sens (Basel)*, vol. 12, no. 2, p. 259, 2020, doi: 10.3390/rs12020259
[48] M. E. Apriyani, I. D. Wijaya, and K. A. Wahyu, "Decision Support System Location of Development Center Using Promethee Method," *Nusantara Science and Technology Proceedings*, pp. 24–31, 2022, doi: 10.11594/nstp.2022.2905.
[49] S. Moradi, H. Yousefi, Y. Noorollahi, and D. Rosso, "Multi-criteria decision support system for wind farm site selection and sensitivity analysis: Case study of Alborz Province, Iran," *Energy Strategy Reviews*, vol. 29, p. 100478, 2020, doi: 10.1016/j.esr.2020.100478.
[50] M. A. Hamada and L. Naizabayeva, "Decision support system with k-means clustering algorithm for detecting the optimal store location based on social network events," in *2020 IEEE European Technology and Engineering Management Summit (E-TEMS)*, IEEE, 2020, pp. 1–4, doi: 10.1109/E-TEMS46250.2020.9111758
[51] O. K. Golovnin and A. A. Igonina, "Decision support system for location selection of convenience stores and retail facilities using optimization techniques and GIS," in *Journal of Physics: Conference Series*, IOP Publishing, 2021, p. 012015, doi: 10.1088/1742-6596/2134/1/012015
[52] A. Alinezhad and J. Khalili, *New methods and applications in multiple attribute decision making (MADM)*, vol. 277. Springer, 2019. doi: 10.1007/978-3-030-15009-9.
[53] S. Sahir, K. Minan, M. Mesran, and S. Suginam, "Determination of Cooperative Loan Funds Recipients Using Complex Proportional Assessment (COPRAS) Method," in *Proceedings of the Third Workshop on Multidisciplinary and Its Applications, WMA-3 2019, 11-14 December 2019, Medan, Indonesia*, 2020. doi: 10.4108/eai.11-12-2019.2290845.
[54] Y. Kustiyahningsih and I. Q. Aini, "Integration of FAHP and COPRAS method for new student admission decision making," in *2020 Third International Conference on Vocational*

Education and Electrical Engineering (ICVEE), IEEE, 2020, pp. 1–6. doi: 10.1109/ICVEE50212.2020.9243260.

[55] A. Organ and E. Yalçın, "Performance evaluation of research assistants by COPRAS method," *European Scientific Journal*, vol. 12, no. 10, pp. 102–109, 2016, doi: 10.19044/ESJ.2016.V12N10P.

[56] E. K. Zavadskas, A. Kaklauskas, F. Peldschus, and Z. Turskis, "Multi-attribute assessment of road design solutions by using the COPRAS method," *The Baltic journal of Road and Bridge engineering*, vol. 2, no. 4, pp. 195–203, 2007, Available: https://bjrbe-journals.rtu.lv/

[57] S. J. Arnold and M. N. Luthra "Market entry effects of large format retailers: a stakeholder analysis," *International Journal of Retail & Distribution Management*, 28(4/5), 139-154, 2000, doi: 10.1108/09590550010319896

[58] M. Karna, A. Rai, B. Karki, L. Karna, M. Rai, and S. Adhikari, "A Study on Selection of Location by Retail Chain: Big Mart," *International Journal of Research-Granthaalayah*, vol. 7, no. 1, pp. 383–395, 2019, doi: 10.5281/zenodo.2561093.