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Improving Decision Accuracy Through LOPCOW Weighting and AROMAN Methods in Retail Store Location Selection

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Abstract

Choosing a strategic store location is an important factor in retail business success, but this decision is often influenced by data uncertainty and scale differences among criteria that can lead to bias in the decision-making process. This study proposes the use of LOPCOW to objectively determine the criterion weights based on data variability among alternatives, and AROMAN to reduce the influence of scale differences among criteria through gradual normalization. With this approach, it is hoped to obtain a more accurate, fair, and consistent ranking of locations. The ranking results in the selection of retail store locations are based on the final value of each alternative location. The location with the code LKM ranks highest with a final value of 0.8212, indicating that this location has the most optimal characteristics compared to other locations. The results of the study show that the combination of these two methods can produce more optimal and reliable decisions in selecting retail store locations, which in turn can enhance competitiveness and operational success in the retail business. The contribution from the ranking results of this retail store location provides significant strategic insights in the decision-making process for business expansion. By leveraging a quantitative approach that generates a final value for each location alternative, this research is able to provide an objective foundation for managers or decision-makers in selecting the best location. The identification of LKM locations as the most superior alternative indicates that the evaluation method used is effective in revealing the competitive advantages of a location based on the established criteria.

1.INTRODUCING

Choosing a retail store location is one of the crucial factors that significantly determines the success of a business[1]–[3]. A strategic location can enhance the store's visibility, attract more potential customers, and facilitate accessibility and shopping convenience. Additionally, the right location can reduce operational costs, such as distribution and logistics, and maximize sales opportunities by reaching the appropriate target market. In contrast, a less suitable location can lead to a low number of visitors, high operational costs, and risks of business losses. Therefore, location selection should be carried out carefully by considering demographic factors, competition levels, and the potential for market growth in the area. The main issue in choosing a retail store location lies in the complexity of considering various interrelated factors that directly impact the operational success of the business. Some of the challenges often faced include the lack of accurate market data, the difficulty in predicting

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consumer behavior in specific areas, high rental or land acquisition costs in strategic locations, and intense competition with other stores nearby. Additionally, changes in consumer trends and uneven infrastructure development can also affect the long-term attractiveness of a location. Errors in analyzing the potential of a location can lead to low customer traffic and a decrease in overall business profitability.

In the selection of retail store locations, the complexity of decisions increases due to the involvement of many criteria that must be considered simultaneously, such as accessibility, demographics, market potential, operational costs, and levels of competition. Additionally, data uncertainty poses its own challenges, especially when information regarding consumer trends, regional growth projections, or local economic stability is incomplete or difficult to predict. The combination of numerous criteria and data uncertainty demands careful and analysis-based decision-making, in order to minimize the risk of errors in location selection and maximize the potential for business success. To address these challenges, business actors need to adopt an analytical and systematic approach in the decision-making process, such as the multi-criteria decision-making (MCDM) method that is capable of evaluating various factors objectively and structurally[4]–[7]. This approach allows for the integration of different types of data and helps manage uncertainty through techniques such as criteria weighting, sensitivity analysis, or the use of historical and predictive data. Consequently, the decisions made become more rational, transparent, and accountable, thereby increasing the chances of success in determining the optimal location for retail stores.

Accurate and objective decision-making methods allow businesses to simulate scenarios, comprehensively compare alternative locations, and identify risks and opportunities of each option. This is crucial, especially in dynamic markets where changes in consumer trends, infrastructure development, and government policies can quickly affect the strategic value of a location. With a structured and data-driven approach, location selection decisions can be more adaptive to environmental changes and can provide sustainable competitive advantages for retail businesses. Furthermore, transparent and documented methods also facilitate evaluation and re-decision-making in the future if market conditions undergo significant shifts. To improve the accuracy in decision-making for retail store location selection, a combination of the logarithmic percentage change-driven objective weighting (LOPCOW) method and the alternative ranking order method accounting for two-step normalization (AROMAN) can be an effective solution. The LOPCOW method is used to determine the objective weights of each criterion based on data variability, thus avoiding the influence of subjectivity in the assessment process. Meanwhile, AROMAN functions to evaluate and rank alternative locations based on normalized values, allowing for a fair comparison between options. The integration of these two methods results in a more systematic and data-driven decision-making process, where criterion weights are objectively calculated and the final results in the form of location rankings are based on comprehensive evaluations. Thus, the decisions made become more accurate, transparent, and can enhance the success of retail business expansion strategies.

The LOPCOW is one of the methods for determining criteria weights objectively in MCDM[8]–[10]. LOPCOW relies on the variation of data among alternatives to determine the importance of a criterion, with the assumption that the greater the variability of a criterion, the more significant its influence in the decision-making process. The LOPCOW method has several advantages that make it superior in determining criterion weights objectively[11]–[13]. One of its main advantages is its ability to eliminate subjectivity in the decision-making process, as the criterion weights are calculated purely based on the variation of data among alternatives. This makes LOPCOW very suitable for use when there is no preference from decision-makers or when absolute objectivity is required. In addition, the logarithmic percentage change-based approach allows this method to be more sensitive to value fluctuations, even for small differences, resulting in weights that more accurately reflect the real contribution of each criterion to the final outcome[14]. In other words, LOPCOW is capable of capturing data dynamics more accurately and stably compared to conventional methods, providing consistent and accountable results in the context of multi-criteria decision-making.

The AROMAN method is one of the approaches in MCDM designed to evaluate and rank alternatives based on criteria that have been normalized through two stages[15]–[17]. This method emphasizes fairness in assessment by reducing the influence of scale and data distribution through a phased

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normalization process. The AROMAN method has several advantages that make it highly effective in multi-criteria decision making. One of its main strengths is its ability to produce more accurate and fair rankings of alternatives, thanks to the use of two normalization stages. This stepwise normalization process helps to equalize the scales across criteria, thereby reducing the potential bias that may arise from differing value distributions among criteria. AROMAN can avoid the dominance of criteria with extreme values, which often disproportionately affects the evaluation results[18]–[20]. In addition, AROMAN also enhances stability and consistency in ranking, providing more balanced and accountable results, making it very suitable for use in situations where alternative data has a large-scale variation. The ease of application and flexibility to be combined with various weighting methods also add to its value.

The aim of this research is to improve the accuracy of decision-making in selecting retail store locations by integrating the LOPCOW and AROMAN methods. This study aims to develop a more objective and systematic approach in determining the weights of criteria and ranking alternative locations, by leveraging the strengths of both methods to reduce subjective bias and manage data uncertainty. Through the application of LOPCOW, this research aims to ensure more accurate criterion weights based on data variability, while AROMAN is used to reduce the influence of scale differences among criteria through a phased normalization process. Thus, this research is expected to make a significant contribution to optimizing the decision-making in store location selection, which in turn can enhance the competitiveness and success of retail businesses.

2.RESEARCH METHOD

Research Stage

The stages of research refer to the systematic steps taken by researchers to achieve research objectives in a structured manner[21]–[23]. Each stage plays an important role in collecting, analyzing, and interpreting data to answer research questions. This stage begins with the identification of problems and research objectives, followed by a literature review to understand the context and theoretical framework, then continues with data collection and processing, as well as the application of relevant methods to achieve valid results. Finally, the research stages include the analysis of results, drawing conclusions, and compiling reports to provide recommendations that can be applied to the research problem. This process helps researchers maintain focus, reduce bias, and ensure that the research findings are accountable. The stages of research conducted are displayed in Figure 1.

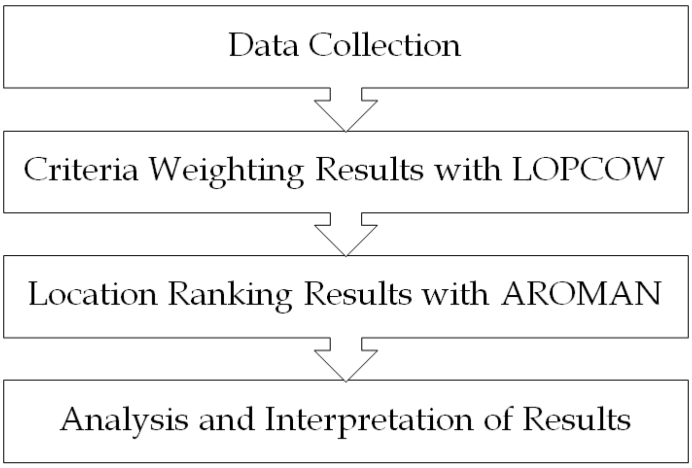

Figure 1. Research Stage

Data collection is an important initial stage in this research, where data related to various alternative retail store locations are gathered. The required data includes both quantitative and qualitative information about the factors influencing location selection, namely rental costs, accessibility, demographics, competition levels, and infrastructure. The sources of data come from field surveys,

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market reports, or secondary data from companies. Next, the Criteria Weighting Results using LOPCOW are carried out to calculate the relative weight of each criterion based on the variability of data among alternatives. The LOPCOW method uses logarithmic percentage changes to measure how important each criterion is in determining the optimal location. This process ensures that the calculated weights are objective, reducing the influence of subjectivity in the decision-making process. After that, the location ranking results using AROMAN are applied to rank alternative locations based on the normalized criterion values. AROMAN uses two stages of normalization to equalize the scale among criteria and ensure that comparisons between alternatives are made fairly and without bias. The final result is the ranking of these locations, indicating the best to the worst alternatives. Finally, in the Analysis and Interpretation of Results, the researcher analyzes the obtained location rankings and interprets the implications of those decisions. This stage is important for drawing conclusions that can provide strategic recommendations in selecting the most optimal location for retail businesses.

Logarithmic Percentage Change-Driven Objective Weighting (LOPCOW) Method

The LOPCOW method is a mult criteria decision-making method used to determine criteria weights based on logarithmic percentage changes between alternatives. This method aims to reduce subjectivity in weight determination by relying on variations in data between alternatives, rather than the preferences of decision-makers. By using logarithmic changes, LOPCOW provides higher sensitivity to small differences between alternatives, creating more representative weights. The end result is objective criteria weights that can be used in the evaluation and ranking process of alternatives more fairly and accurately.

The decision matrix is a tool used in MCDM to organize and analyze alternatives based on relevant criteria. This matrix presents the alternatives as rows, and the criteria used to evaluate those alternatives as columns. Each element in the matrix contains a value that indicates how well the alternative meets the relevant criteria, created using the following equation.

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{2n} \\ x_{12} & x_{22} & x_{2n} \\ x_{m1} & x_{m2} & x_{mn} \end{bmatrix} \quad (1)$$

This normalization is important so that comparisons between alternatives become fairer and are not distorted by differences in scale. The normalization method in LOPCOW is calculated using the following equation.

$$n_{ij} = \frac{x_{ij}}{m+\sum_{i=1}^{m} x_{ij}^2} \quad (2)$$

The next step is to obtain the logarithmic percentage change, the average value of this change is calculated for each criterion. This logarithmic average change illustrates the level of variation in each criterion and provides a measure of the importance of the criterion calculated using the following equation.

$$PV_i = 100 * \left| \frac{\sqrt{\sum_{i=1}^{m} n_{ij}^2}}{\ln \frac{m}{\sigma}} \right| \quad (3)$$

Based on the average logarithmic changes, the weights for each criterion are calculated. These weights reflect the relative contribution of each criterion to the final decision. Criteria with higher data variability will receive a larger weight, as they are considered more important in the decision-making process calculated using the following equation.

$$w_j = \frac{PV_i}{\sum_{j=1}^{n} PV_i} \quad (4)$$

By following these stages, LOPCOW provides an objective approach in determining the weight of criteria based on data variability, reducing the influence of subjectivity, and producing more accurate decisions.

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Alternative Ranking Order Method Accounting for Two-Step Normalization (AROMAN) Method

The AROMAN method is a method in multi-criteria decision-making used to evaluate and rank alternatives based on normalized criteria. This method combines two normalization steps to ensure that all criteria are on a comparable scale, reducing the influence of scale differences among the various criteria.

The decision matrix is a representation of initial data that contains performance values of each alternative against several criteria. Each row represents an alternative, and each column represents a criterion. The values in the cells indicate how well an alternative meets a criterion and are made using equation (1).

Normalization is performed so that all values are on a comparable scale. This is important because the criteria can have different units and ranges of values calculated using the following equation.

$$t_{ij} = \frac{x_{ij} - \min_i x_{ij}}{\max_i x_{ij} - \min_i x_{ij}} \quad (5)$$

$$t_{ij}^{*} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^{2}}} \quad (6)$$

$$t_{ij}^{norm} = \frac{\beta t_{ij} + (1-\beta) t_{ij}^{*}}{2} \quad (7)$$

After the data is normalized, the value in each cell is multiplied by the criterion weights that have been obtained. The weights reflect the relative importance of each criterion to the final decision, calculated using the following equation.

$$\widehat{t_{ij}} = t_{ij}^{norm} * w_j \quad (8)$$

The calculation of the criteria weight results is based on the type of criteria, namely benefit criteria and cost criteria, calculated using the following equation.

$$L_i = \left(\sum_{j=1}^{n} \widehat{t_{ij}}^{(min)}\right)^{\lambda} \quad (9)$$

$$A_i = \left(\sum_{j=1}^{n} \widehat{t_{ij}}^{(max)}\right)^{(1-\lambda)} \quad (10)$$

The final value of an alternative is obtained by summing all the values resulting from the multiplication of the weights and normalization for each alternative. This result is used to rank the alternatives calculated using the following equation.

$$R_i = \exp(L_i - A_i) \quad (11)$$

By using AROMAN, the evaluated alternatives will receive a fairer and more accurate ranking, ensuring that all criteria contribute equally to the final ranking.

3.RESULTS AND DISCUSSION

Retail store location selection is a strategic decision that significantly impacts operational success and long-term profitability. However, this process is not simple as it involves many interacting criteria. This complexity is further increased because the available data is often uncertain or has different scales. Therefore, a multi-criteria decision-making approach is needed that can accommodate diverse information and produce decisions that are objective, fair, and analytically justifiable. The combination of the LOPCOW method and AROMAN becomes a relevant and effective solution. LOPCOW is used to calculate the criteria weights objectively based on the data variation among alternatives, thus eliminating subjectivity in assessing the importance of the criteria. Meanwhile, AROMAN plays a role in the alternative ranking process through two stages of normalization that ensure consistency and fairness in comparing values across criteria. The integration of these two methods not only enhances accuracy in selecting store locations but also provides a more rational and transparent decision-making basis, making it a strategic tool for retail business development.

Setiawansyah: *Corresponding Author

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Data Collection

Data Collection is a very crucial initial stage in the multi-criteria decision-making process, especially in the context of selecting retail store locations. At this stage, information is gathered about various location alternatives and the values of each relevant criterion, which are rental costs (AL1) as a cost, accessibility (AL2) as a benefit, demographics (AL3) as a benefit, competition levels (AL4) as a benefit, and infrastructure (AL5) as a benefit. Data can be obtained through various methods, such as field surveys, interviews, direct observations, and secondary data. The results of the location assessment data are presented in Table 1.

Table 1. Location Assessment Data

Location Name	AL1	AL2	AL3	AL4	AL5
LMG	120	80	70	65	75
LCB	135	90	85	60	80
LBK	110	75	60	70	70
LBD	130	85	75	80	85
LKM	125	70	65	75	60
LCP	140	88	78	68	82
LCD	115	78	72	72	77

The data in table 1 is the result of synthesis based on literature studies, observations of urban retail environments, and realistic scenario simulations that refer to common parameters in store location selection. The values of each criterion are obtained from the results of limited field surveys, secondary data such as retail property market reports, as well as expert assessments who understand the dynamics of accessibility, demographics, infrastructure, and competition in the area.

Criteria Weighting Results with LOPCOW

The LOPCOW method is a technique used to assign weights to criteria in the multi-criteria decision-making process. This method focuses on calculating weights based on the logarithmic percentage change between alternative values for each criterion. The basic concept of LOPCOW is that criteria with greater value variation among alternatives will be considered more important, as they indicate that the criterion has a greater influence on the differences in decision outcomes. In this way, LOPCOW ensures that decisions made are more objective, fair, and aligned with the actual conditions in the field.

The decision matrix is a tool used in MCDM to organize and analyze alternatives based on relevant criteria created using equation (1).

$$X = \begin{bmatrix} x_{11} & x_{12} & x_{13} & x_{14} & x_{15} \\ x_{21} & x_{22} & x_{23} & x_{24} & x_{25} \\ x_{31} & x_{32} & x_{33} & x_{34} & x_{35} \\ x_{41} & x_{42} & x_{43} & x_{44} & x_{45} \\ x_{51} & x_{52} & x_{53} & x_{54} & x_{55} \\ x_{61} & x_{62} & x_{63} & x_{64} & x_{65} \\ x_{71} & x_{72} & x_{73} & x_{74} & x_{75} \end{bmatrix}$$

The general form of the decision matrix from the assessment data is as follows. The result of the decision matrix from the general form based on the values in Table 1 is displayed as follows.

$$X = \begin{bmatrix} 120 & 80 & 70 & 65 & 75 \\ 135 & 90 & 85 & 60 & 80 \\ 110 & 75 & 60 & 70 & 70 \\ 130 & 85 & 75 & 80 & 85 \\ 125 & 70 & 65 & 75 & 60 \\ 140 & 88 & 78 & 68 & 82 \\ 115 & 78 & 72 & 72 & 77 \end{bmatrix}$$

This normalization is important so that the comparison between alternatives becomes fairer and is not distorted by differences in scale calculated using equation (2).

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$$n_{11} = \frac{x_{11}}{7 + \sum_{i=1}^{7} x_{i1}{}^2} = \frac{x_{11}}{7 + ((x_{11}{}^2) + (x_{21}{}^2) + (x_{31}{}^2) + (x_{41}{}^2) + (x_{51}{}^2) + (x_{61}{}^2) + (x_{71}{}^2))}$$

$$n_{11} = \frac{120}{7 + ((120^2) + (135^2) + (110^2) + (130^2) + (125^2) + (140^2) + (115^2))}$$

$$n_{11} = \frac{120}{110082} = 0.00109$$

The overall normalized value of the LOPCOW method based on the calculations from each alternative is presented in Table 2.

Table 2. Normalization Value

Location Name	AL1	AL2	AL3	AL4	AL5
LMG	0.00109	0.00174	0.00190	0.00188	0.00186
LCB	0.00123	0.00195	0.00231	0.00174	0.00198
LBK	0.00100	0.00163	0.00163	0.00203	0.00173
LBD	0.00118	0.00184	0.00204	0.00231	0.00210
LKM	0.00114	0.00152	0.00176	0.00217	0.00148
LCP	0.00127	0.00191	0.00212	0.00197	0.00203
LCD	0.00104	0.00169	0.00195	0.00208	0.00191

The next step is to obtain the logarithmic percentage change, the average value of this change is calculated for each criterion using equation (3).

$$PV_1 = 100 * \left| \frac{\sqrt{\sum_{i=1}^{7} n_{i1}{}^2}}{\ln \frac{m}{\sigma}} \right| = 100 * \left| \frac{0.003013894}{11.25231} \right| = 100 * |0.000267847| = 0.02678$$

The average value of the overall change in the LOPCOW method based on the calculations from each criterion is presented in Table 3.

Table 3. Average Value

	AL1	AL2	AL3	AL4	AL5
PV_i	0.02678	0.04319	0.04997	0.05077	0.04738

Based on the average logarithmic change, the weight for each criterion is calculated. This weight reflects the relative contribution of each criterion to the final decision calculated using equation (3).

$$w_1 = \frac{PV_1}{\sum_{i=1}^{5} PV_i} = \frac{PV_1}{PV_1 + PV_2 + PV_3 + PV_4 + PV_5}$$

$$w_1 = \frac{0.02678}{0.02678 + 0.04319 + 0.04997 + 0.05077 + 0.04738} = \frac{0.02678}{0.21809} = 0.1228$$

The weight for each criterion value of the overall change in the LOPCOW method based on the calculations from each criterion is presented in Table 4.

Table 4. Weight for each Criterion Value

	AL1	AL2	AL3	AL4	AL5
w_j	0.1228	0.1980	0.2291	0.2328	0.2172

By following these stages, LOPCOW provides an objective approach in determining the weight of criteria based on data variability, reducing the influence of subjectivity, and producing more accurate decisions.

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Location Ranking Results with AROMAN

The AROMAN method is an alternative ranking approach in multi-criteria decision-making that uses two stages of normalization to improve the accuracy and stability of evaluation results. In the context of retail store location selection, AROMAN allows for a fair comparison between locations by reducing scale bias among criteria. After the criteria weights are objectively determined through the LOPCOW method, AROMAN integrates these weights into the normalization process and calculates the final value of each alternative based on its proximity to the ideal solution. The final result is a score that reflects the relative performance of each location. The location with the highest score is considered the most optimal to choose.

The decision matrix is a representation of initial data that contains performance values of each alternative against several criteria. Each row represents an alternative, and each column represents a criterion. The values in the cells indicate how well an alternative meets a criterion and are made using equation (1).

Normalization is performed so that all values are on a comparable scale, the first stage of normalization is carried out using equation (4), the results of the first normalization are displayed in table 5.

Table 5. First Normalization Value

Location Name	AL1	AL2	AL3	AL4	AL5
LMG	0.3333	0.5000	0.4000	0.2500	0.6000
LCB	0.8333	1.0000	1.0000	0.0000	0.8000
LBK	0.0000	0.2500	0.0000	0.5000	0.4000
LBD	0.6667	0.7500	0.6000	1.0000	1.0000
LKM	0.5000	0.0000	0.2000	0.7500	0.0000
LCP	1.0000	0.9000	0.7200	0.4000	0.8800
LCD	0.1667	0.4000	0.4800	0.6000	0.6800

Next, calculate the second normalization value using equation (5), the results of the second normalization are displayed in table 6.

Table 6. Second Normalization Value

Location Name	AL1	AL2	AL3	AL4	AL5
LMG	0.3617	0.3727	0.3647	0.3497	0.3731
LCB	0.4069	0.4193	0.4428	0.3228	0.3980
LBK	0.3315	0.3494	0.3126	0.3766	0.3483
LBD	0.3918	0.3960	0.3907	0.4303	0.4229
LKM	0.3768	0.3261	0.3386	0.4034	0.2985
LCP	0.4220	0.4100	0.4064	0.3658	0.4080
LCD	0.3466	0.3634	0.3751	0.3873	0.3831

Finally, calculating the final normalization value that combines the results of the first and second normalization values calculated using equation (6), the final normalization result is shown in table 7.

Table 7. Final Normalization Value

Location Name	AL1	AL2	AL3	AL4	AL5
LMG	0.1738	0.2182	0.1912	0.1499	0.2433
LCB	0.3101	0.3548	0.3607	0.0807	0.2995
LBK	0.0829	0.1498	0.0781	0.2191	0.1871
LBD	0.2646	0.2865	0.2477	0.3576	0.3557
LKM	0.2192	0.0815	0.1347	0.2884	0.0746
LCP	0.3555	0.3275	0.2816	0.1914	0.3220
LCD	0.1283	0.1908	0.2138	0.2468	0.2658

Setiawansyah: *Corresponding Author

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After the data has been normalized, the values in each cell are multiplied by the weights of the criteria that have been obtained. These weights reflect the relative importance of each criterion in relation to the final decision calculated using equation (8).

$$\widehat{t_{ij}} = t_{11}^{norm} * w_1 = 0.1738 * 0.1228 = 0.0213$$

The overall multiplied by the weights of the criteria value of the LOPCOW method based on the calculations from each alternative is presented in Table 8.

Table 8. Multiplied by the Weights of the Criteria Value

Location Name	AL1	AL2	AL3	AL4	AL5
LMG	0.0213	0.0432	0.0438	0.0349	0.0528
LCB	0.0381	0.0703	0.0826	0.0188	0.0651
LBK	0.0102	0.0297	0.0179	0.0510	0.0406
LBD	0.0325	0.0567	0.0567	0.0832	0.0773
LKM	0.0269	0.0161	0.0309	0.0671	0.0162
LCP	0.0437	0.0649	0.0645	0.0446	0.0699
LCD	0.0158	0.0378	0.0490	0.0575	0.0577

The calculation of the criterion weight results is based on the type of criteria, namely benefit criteria and cost criteria, calculated using equations (9) and (10).

$$L_1 = \left(\sum_{j=1}^{5} \widehat{t_{1j}}^{(min)}\right)^{0.5} = (\widehat{t_{11}})^{0.5} = 0.0213^{0.5} = 0.1461$$

$$A_1 = \left(\sum_{j=1}^{5} \widehat{t_{1j}}^{(max)}\right)^{(1-0.5)} = (\widehat{t_{21}} + \widehat{t_{31}} + \widehat{t_{41}} + \widehat{t_{41}})^{0.5} = (0.0432 + 0.0438 + 0.0349 + 0.0528)^{0.5} = 0.4180$$

The overall calculation of the criterion weight results is based on the type of criteria of the LOPCOW method based on the calculations from each alternative is presented in Table 9.

Table 9. Calculation of the Criterion Weight Results is based on the Type of Criteria Value

Location Name	L_i	A_i
LMG	0.1461	0.4180
LCB	0.1951	0.4866
LBK	0.1009	0.3731
LBD	0.1803	0.5235
LKM	0.1641	0.3610
LCP	0.2089	0.4939
LCD	0.1255	0.4494

The final value of an alternative is obtained by adding all the values generated from the multiplication of weights and normalization for each alternative calculated using equation (11).

$$R_i = \exp(L_1 - A_1) = \exp(0.1461 - 0.4180) = \exp(-0.2720) = 0.7619$$

The overall calculation of the final value of an alternative of the LOPCOW method based on the calculations from each alternative is presented in Table 10.

Table 10. Final Value of the Alternative

Location Name	R_i
LMG	0.7619
LCB	0.7472

Setiawansyah: *Corresponding Author

E-ISSN 2988-747X P-ISSN 2988-7461
Volume 3, Nomor 1, Maret 2025, Page 77-88
DOI: https://doi.org/10.58602/jima-ilkom.v4i1.57

LBK	0.7617
LBD	0.7095
LKM	0.8212
LCP	0.7521
LCD	0.7233

The final result of the combination of LOPCOW and AROMAN is a score that reflects the relative performance of each location.

Analysis and Interpretation of Results

Analysis and Interpretation of Results is an important stage in the multi-criteria decision-making process, where data processed through the LOPCOW and AROMAN methods is analyzed to understand the meaning and implications of the obtained results. At this stage, the final values of each alternative location are compared to identify which one best meets the established criteria. This analysis not only focuses on the final ranking but also evaluates how each criterion impacts the position of an alternative. The ranking results of the alternatives are displayed in Figure 2.

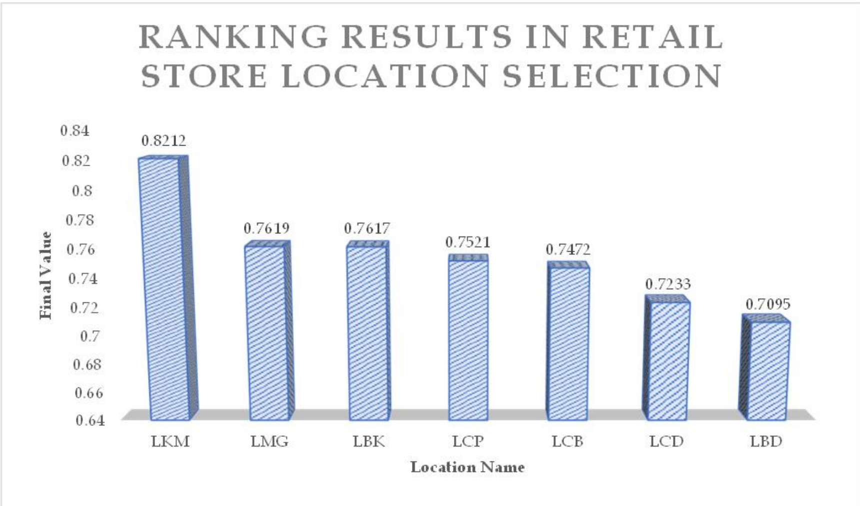

Figure 2. Ranking Results in Retail Store Location Selection

The ranking results in the selection of retail store locations are based on the final score of each location alternative. The location with the code LKM ranks highest with a final score of 0.8212, indicating that this location has the most optimal characteristics compared to others. Next, LMG and LBK are in second and third place with almost the same scores of 0.7619 and 0.7617, respectively. Locations LCP and LCB are positioned in the middle with scores of 0.7521 and 0.7472, respectively. Meanwhile, locations LCD and LBD rank the lowest with scores of 0.7233 and 0.7095, respectively. The differences in scores between locations reflect variations in achieving the evaluation criteria used, making these results an objective basis for strategic decision-making regarding the selection of the most potential retail store locations.

The contribution from the ranking results of this retail store location provides significant strategic insights in the decision-making process for business expansion. By leveraging a quantitative approach that produces an end value for each alternative location, this research is able to provide an objective foundation for managers or policymakers in selecting the best location. The identification of LKM locations as the most superior alternative indicates that the evaluation method used is effective in revealing the competitive advantages of a location based on predetermined criteria. Additionally, the resulting ranking can be used as a reference in investment planning, resource allocation, and the development of marketing strategies in other potential locations. Overall, this study contributes to

Setiawansyah: *Corresponding Author

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enhancing the efficiency and accuracy of retail store location selection through the implementation of a data-driven decision support system and multi-criteria analysis.

4.CONCLUSION

The combination of the LOPCOW weighting method and the AROMAN method effectively increases the accuracy of decision-making in selecting retail store locations. The LOPCOW method provides objective weights based on the level of data change among criteria, while AROMAN is capable of presenting alternative rankings in a more stable and adaptive manner to multi-criteria data dynamics. The final results show that the LKM location received the highest score of 0.8212, indicating that this location is the most optimal choice. The integration of these two methods not only produces consistent rankings but also enhances the reliability and objectivity of the decision support system. This approach can be a strategic solution in data-driven and rational analysis-based retail expansion planning. The contribution from the results of ranking these retail store locations provides significant strategic insights in the decision-making process for business expansion. By utilizing a quantitative approach that yields an end value for each location alternative, this research is able to provide an objective foundation for managers or policymakers in selecting the best location. This study contributes to enhancing the efficiency and accuracy of retail store location selection through the implementation of data-driven decision support systems and multi-criteria analysis.

5.REFERENCES

[1] N. Nursobah and R. Andrea, “Sistem Pendukung Keputusan Penentuan Lokasi Strategis Dalam Membangun Bisnis Usaha Menggunakan Metode Promethee II,” *J. MEDIA Inform. BUDIDARMA*, vol. 6, no. 2, p. 1064, Apr. 2022, doi: 10.30865/mib.v6i2.3997.

[2] Q. Ren and M. H. Dunham, “Using semantic caching to manage location dependent data in mobile computing,” in *Proceedings of the 6th annual international conference on Mobile computing and networking*, 2000, pp. 210–221.

[3] M. Keshavarz-Ghorabaee, “Assessment of distribution center locations using a multi-expert subjective–objective decision-making approach,” *Sci. Rep.*, vol. 11, no. 1, p. 19461, Sep. 2021, doi: 10.1038/s41598-021-98698-y.

[4] J. Wang, D. Darwis, R. D. Gunawan, and F. Ariany, “Optimizing E-Commerce Platform Selection Using Root Assessment Method and MEREC Weighting,” *J. Inform. dan Rekayasa Perangkat Lunak*, vol. 6, no. 1 SE-Articles, pp. 1–12, Mar. 2025, doi: 10.33365/jatika.v6i1.6.

[5] J. Wang, D. Darwis, S. Setiawansyah, and Y. Rahmanto, “Implementation of MABAC Method and Entropy Weighting in Determining the Best E-Commerce Platform for Online Business,” *JiTEKH*, vol. 12, no. 2, pp. 58–68, 2024, doi: 10.35447/jitekh.v12i2.1000.

[6] J. Wang, S. Setiawansyah, and Y. Rahmanto, “Decision Support System for Choosing the Best Shipping Service for E-Commerce Using the SAW and CRITIC Methods,” *J. Ilm. Inform. dan Ilmu Komput.*, vol. 3, no. 2, pp. 101–109, 2024, doi: 10.58602/jima-ilkom.v3i2.32.

[7] R. I. Putra, R. Aryanti, M. F. Prathama, A. Dahroni, and B. Prayitno, *Optimalisasi Multi Attribute Decision Making Dengan Pendekatan CRITIC*. Bandar Lampung: PT. SNN Media, 2025.

[8] S. Biswas, D. Pamucar, S. Dawn, and V. Simic, “Evaluation based on Relative Utility and Nonlinear Standardization (ERUNS) Method for Comparing Firm Performance in Energy Sector,” *Decis. Mak. Adv.*, vol. 2, no. 1 SE-Articles, pp. 1–21, Jan. 2024, doi: 10.31181/dma21202419.

[9] Z. Guo *et al.*, “An integrated MCDM model with enhanced decision support in transport safety using machine learning optimization,” *Knowledge-Based Syst.*, vol. 301, p. 112286, 2024, doi: https://doi.org/10.1016/j.knosys.2024.112286.

[10] D. T. Do, “Assessing the Impact of Criterion Weights on the Ranking of the Top Ten Universities in Vietnam,” *Eng. Technol. Appl. Sci. Res.*, vol. 14, no. 4 SE-, pp. 14899–14903, Aug. 2024, doi: 10.48084/etasr.7607.

[11] S. Korucuk, A. Aytekin, Ö. Görçün, V. Simic, and Ö. Faruk Görçün, “Warehouse site selection for humanitarian relief organizations using an interval-valued fermatean fuzzy LOPCOW-RAFSI model,” *Comput. Ind. Eng.*, vol. 192, p. 110160, Jun. 2024, doi: 10.1016/j.cie.2024.110160.

[12] A. Ulutaş, F. Balo, and A. Topal, “Identifying the Most Efficient Natural Fibre for Common Commercial Building Insulation Materials with an Integrated PSI, MEREC, LOPCOW and MCRAT Model,” *Polymers (Basel).*, vol. 15, no. 6, p. 1500, Mar. 2023, doi: 10.3390/polym15061500.

Setiawansyah: *Corresponding Author

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Volume 3, Nomor 1, Maret 2025, Page 77-88
DOI: https://doi.org/10.58602/jima-ilkom.v4i1.57

[13] F. Ecer, H. Küçükönder, S. Kayapınar Kaya, and Ö. Faruk Görçün, "Sustainability performance analysis of micro-mobility solutions in urban transportation with a novel IVFNN-Delphi-LOPCOW-CoCoSo framework," *Transp. Res. Part A Policy Pract.*, vol. 172, p. 103667, Jun. 2023, doi: 10.1016/j.tra.2023.103667.

[14] S. Setiawansyah, Y. Rahmanto, A. Yudistira, A. D. Putra, and N. Hendrastuty, *Metode Pembobotan Objektif Dalam Multi-Criteria Decision Making*. PT. SNN Media Tech Press, 2025.

[15] K. Kara, G. C. Yalçın, A. Z. Acar, V. Simic, S. Konya, and D. Pamucar, "The MEREC-AROMAN method for determining sustainable competitiveness levels: A case study for Turkey," *Socioecon. Plann. Sci.*, vol. 91, p. 101762, 2024.

[16] S. Bošković, L. Švadlenka, M. Dobrodolac, S. Jovčić, and M. Zanne, "An Extended AROMAN Method for Cargo Bike Delivery Concept Selection," *Decis. Mak. Adv.*, vol. 1, no. 1, pp. 1–9, Jun. 2023, doi: 10.31181/v120231.

[17] S. Bošković, L. Švadlenka, S. Jovčić, M. Dobrodolac, V. Simić, and N. Bacanin, "An Alternative Ranking Order Method Accounting for Two-Step Normalization (AROMAN)—A Case Study of the Electric Vehicle Selection Problem," *IEEE Access*, vol. 11, pp. 39496–39507, 2023, doi: 10.1109/ACCESS.2023.3265818.

[18] I. Nikolić, J. Milutinović, D. Božanić, and M. Dobrodolac, "Using an Interval Type-2 Fuzzy AROMAN Decision-Making Method to Improve the Sustainability of the Postal Network in Rural Areas," *Mathematics*, vol. 11, no. 14. 2023. doi: 10.3390/math11143105.

[19] K. Kara, G. Cihan Yalçın, V. Simic, A. Tuğrul Yıldırım, D. Pamucar, and P. Siarry, "A spherical fuzzy-based DIBR II-AROMAN model for sustainability performance benchmarking of wind energy power plants," *Expert Syst. Appl.*, vol. 253, p. 124300, 2024, doi: https://doi.org/10.1016/j.eswa.2024.124300.

[20] M. B. Bouraima, S. Jovčić, M. Dobrodolac, D. Pamucar, I. Badi, and N. D. Maraka, "Sustainable Healthcare System Devolution Strategy Selection Using the AROMAN MCDM Approach," *Spectr. Decis. Mak. Appl.*, vol. 1, no. 1 SE-Articles, pp. 46–63, Jul. 2024, doi: 10.31181/sdmap1120243.

[21] Y. Rahmanto, J. Wang, S. Setiawansyah, A. Yudhistira, D. Darwis, and R. R. Suryono, "Optimizing Employee Admission Selection Using G2M Weighting and MOORA Method," *Paradig. - J. Komput. dan Inform.*, vol. 27, no. 1 SE-, pp. 1–10, Mar. 2025, doi: 10.31294/p.v27i1.8224.

[22] A. Yudhistira, J. Wang, Y. Rahmanto, and S. Setiawansyah, "Decision Support System for Optimizing Supplier Selection Using TOPSIS and Entropy Weighting Methods," *J. Pendidik. dan Teknol. Indones.*, vol. 4, no. 5 SE-, pp. 175–185, Nov. 2024, doi: 10.52436/1.jpti.456.

[23] S. H. Hadad, I. Chandra, J. Wang, D. A. Megawaty, S. Setiawansyah, and A. Yudhistira, "DYNAMIC WEIGHT ALLOCATION IN MODIFIED MULTI-ATRIBUTIVE IDEAL-REAL COMPARATIVE ANALYSIS WITH SYMMETRY POINT FOR REAL-TIME DECISION SUPPORT ," *J. Tek. Inform.*, vol. 6, no. 1 SE-Articles, pp. 63–74, Feb. 2025, doi: 10.52436/1.jutif.2025.6.1.4170.

Setiawansyah: *Corresponding Author