MSTS Methods in Science and Technology Studies

futuristech
PT. Teknologi Futuristik Indonesia

Date of publication November 22, 2025, date of current version November 22, 2025.
Digital Object Identifier 10.64539/msts.v1i1.2025.352

Article

A SAW-Based Multi-Criteria Approach for Selecting Strategic Café Branch Locations

Asih Anggina[1], Shary Armonitha Lusinia[1], Devia Kartika[1,*]

[1] Faculty of Computer Science, Universitas Putra Indonesia YPTK Padang, Padang, Indonesia; devia.kartika11@gmail.com
* Correspondence

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Abstract: The rapid development of information technology and artificial intelligence has increased the importance of data-driven decision-making, particularly in competitive industries such as cafés, where branch location significantly affects business success. However, selecting the optimal location remains a challenge due to the variability of local market conditions and the subjectivity of manual assessments, representing a gap in practical, objective evaluation methods. This study aims to determine the most suitable location for Anomali Café's new branch in Padang City using the Simple Additive Weighting (SAW) method, a transparent and effective multi-criteria decision-making approach. The analysis of ten candidate sites reveals that Pantai Air Manis Street achieves the highest overall score, followed closely by Sitebal, Gajah Mada, Raya Lubuk Buaya, and Dr. Sutomo Streets, while the remaining locations are less competitive. These findings provide actionable, data-driven guidance for strategic branch expansion and demonstrate the applicability of SAW in tailoring location decisions to the café industry's specific context.

Keywords: Decision Support System; Strategic Location; SAW; Café Expansion; Site Selection.

1. Introduction

The development of information technology and artificial intelligence has driven the emergence of various decision support systems (DSS) capable of processing data more objectively, quickly, and systematically than manual intuition-based methods [1], [2]. In today's highly competitive business environment, the ability to analyze data and make evidence-based decisions has become an essential requirement for companies seeking to survive and grow [3]. The café industry in Indonesia is one of the rapidly expanding sectors, making the selection of new branch locations a strategic factor that strongly influences the success of culinary businesses.

However, determining the best location for opening a new branch remains a classic dilemma for many business owners, including Anomali Café. Previous studies show that business location decisions are generally influenced by several key factors such as population density, purchasing power, accessibility, environmental conditions, and the level of competition in the surrounding area [4]. A number of earlier studies have employed multi-criteria decision-making methods such as AHP, TOPSIS, and SAW to assess business location feasibility [5]-[8]. Nevertheless, most of these studies are still limited to general retail location contexts or do not incorporate assessment structures tailored to the specific characteristics of the café industry in particular regions.

This issue remains unresolved because branch location selection varies significantly across cities—evaluation variables, priority weights, and local market conditions often cannot be generalized [4]. Moreover, manual assessment processes are prone to subjectivity and bias as they rely heavily on personal managerial judgment [9]. Anomali Café therefore requires a structured method capable of measuring various aspects objectively so that expansion decisions can be more accurate, efficient, and accountable.

In this study, the Simple Additive Weighting (SAW) method is used because it is known to be easy to apply [10], transparent in calculation, and effective for multi-criteria cases with clear rating scales [11], [12]. This approach is offered as the "most logical" (obvious approach) solution because SAW allows Anomali Café's management to assign weights to each criterion based on its importance, perform data normalization, and produce objective rankings of all location alternatives.

The main contributions of this research are:

a) Designing and implementing a SAW-based decision support system tailored to the needs of selecting branch locations for Anomali Café in Padang City;
b) Developing a relevant structure of criteria and sub-criteria for the café industry within the local context;
c) Objectively determining the best location and generating strategic recommendations to support business expansion decisions.

The structure of this paper is organized as follows. The first section discusses the background of the problem and the urgency of location selection using the SAW approach. The second section explains the research methodology and the steps involved in applying SAW. The third section presents the results and discussion related to the location ranking. The final section contains the conclusions drawn from this study.

2. Research Methodology

This study employs the Simple Additive Weighting (SAW) method as a multi-criteria decision-making approach [13] - [15] to determine the most suitable location for a new branch. As illustrated in Figure 1, the research process involves identifying relevant location criteria, assigning values and weights to each criterion, constructing and normalizing the decision matrix, calculating the final scores for all alternatives, and selecting the optimal location based on the SAW results.

Data collection was conducted through interviews, field observations, and questionnaires. Interviews were carried out with individuals knowledgeable about potential commercial areas; field observations were conducted to directly assess the physical and environmental conditions of each location; and questionnaires were used to capture structured assessments for each criterion.

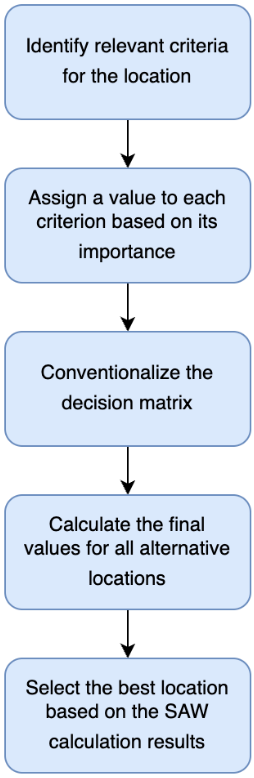

Figure 1. Research flow.

2.1. Determining Criteria and Alternatives

The research begins by identifying the key criteria influencing location selection. For the case of Kafe Anomali, the criteria include rental price, building area, number of competitors, distance to Points of Interest (POI), and environmental cleanliness (see Table 1). These criteria reflect common considerations in evaluating the feasibility of a commercial food and beverage establishment. The alternatives in this study are the candidate locations being considered for the new branch.

The cost–benefit classification determines the direction of preference during normalization [16]. Cost-type are more desirable when the value is lower, whereas benefit-type are preferable when their values are higher [17], [18].

2.2. Assigning Weights to Criteria

Each criterion is assigned a weight based on its perceived importance. These weights were derived from interviews and questionnaire responses, ensuring that the weighting structure reflects the practical priorities used by management when evaluating potential locations. Criteria considered highly influential in determining business success are assigned greater weights.

2.3. Constructing the Decision Matrix

To facilitate quantitative evaluation, each criterion is expressed through sub-criteria rated on a scale of 1 to 5 (see Table 2 - Table 6). These sub-criteria were developed based on standard commercial location assessments, field observation findings, and practical considerations for retail and dining environments.

2.4. Normalizing the Decision Matrix

Once the decision matrix is constructed, the values must be normalized to bring them onto a comparable scale. Normalization is essential because each criterion follows a different preference direction [19], [20].

For benefit criteria, normalization uses [21], [22]:

$$R_{ij} = \frac{x_{ij}}{\max(x_{ij})} \tag{1}$$

For cost criteria, normalization uses [22], [23]:

$$R_{ij} = \frac{\min(x_{ij})}{x_{ij}} \tag{2}$$

Table 1. List of Criteria.

Code	Criterion	Type
C1	Rental price	Cost
C2	Building area	Benefit
C3	Number of competitors	Cost
C4	Distance to POI	Cost
C5	Cleanliness	Benefit

Table 2. Rental price (C1).

Score	Price Range (IDR)
1	1–20 million
2	21–40 million
3	41–60 million
4	61–80 million
5	81–100 million

Note: Although higher prices receive higher raw scores, they are later treated as cost criteria, meaning that lower values are ultimately more desirable.

Table 3. Building area (C2).

Score	Area (m^2)
1	1–50
2	51–100
3	101–150
4	151–200
5	200–250

Note: Larger building area is considered advantageous because it supports greater customer capacity and operational comfort.

Table 4. Number of competitors (C3).

Score	Competitors
1	1–2
2	3–4
3	5–6
4	7–8
5	9–10

Note: As a cost criterion, fewer competitors represent a more favorable condition.

Table 5. Distance to POI (C4).

Score	Type of POI
1	Educational centers
2	Tourist attractions
3	Shopping centers
4	Office districts
5	Residential areas

Note: Locations near residential areas are preferred because they offer a stable flow of potential customers.

Table 6. Cleanliness (C5).

Score	Cleanliness Level
1	Very Dirty
2	Not Clean
3	Moderately Clean
4	Clean
5	Very Clean

Note: Cleanliness scores were derived from direct on-site inspection.

These formulas ensure that all values fall within a 0–1 range, with higher values representing more desirable performance. The resulting normalized matrix then becomes the basis for the final preference calculation.

2.5. Calculating the Preference Values

Each normalized value is multiplied by the corresponding criterion weight, and the products are summed to obtain the final score for each alternative. The SAW formula used is [24], [25]:

$$V_i = \sum_{j=1}^{n} W_j \times R_{ij} \quad (3)$$

The value V_i represents the overall performance of alternative i. The alternative with the highest score is considered the most suitable location.

2.6. Determining the Final Result

The alternative with the highest SAW score is identified as the most strategic location for establishing the new branch. The numerical results are then interpreted alongside field observations—such as population density and purchasing power—to form a comprehensive conclusion regarding the location's economic potential.

3. Results and Discussion

The distribution of SAW scores across the ten evaluated locations is shown in Figure 2, where the top five ranked sites are highlighted in green and the remaining locations in blue. This visual differentiation makes the performance gap between higher-performing and lower-performing alternatives immediately apparent.

From the figure, Pantai Air Manis Street clearly stands out with the highest score, positioned significantly above the other alternatives. Its strong lead suggests a consistently favorable performance across the weighted criteria, making it the most strategic candidate for branch expansion. The next four locations—Sitebal Street, Gajah Mada Street, Raya Lubuk Buaya Street, and Dr. Sutomo Street—also appear in green, indicating that they form a cluster of higher-scoring sites with relatively balanced advantages. Although their scores are lower than the top-ranked location, they remain well above the midrange threshold, showing competitive suitability.

In contrast, the locations shaded in blue display a visible decline in score, with the steepest drop occurring after the fifth position. Limau Manis Unand Street marks the boundary between selected and non-selected zones, positioned at the upper edge of the lower-performing group. The remaining locations, including Pantai Carolina Street and Raya Padang–Solok Street, occupy the lowest positions on the chart. Their placement suggests notable disadvantages in one or more critical criteria, preventing them from competing with the higher-ranked alternatives.

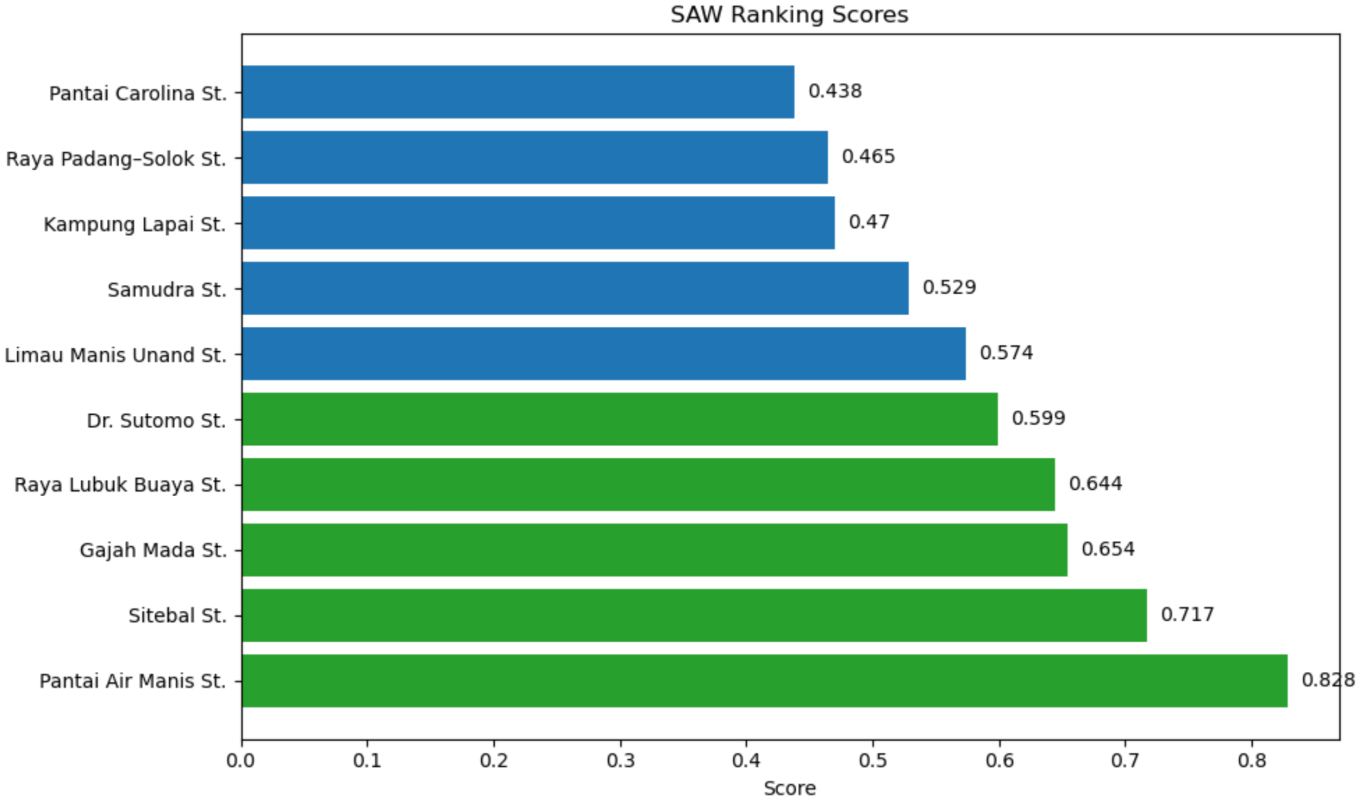

Figure 2. Comparison of the final SAW scores for all evaluated locations.

4. Conclusion

In conclusion, the SAW analysis clearly identifies Pantai Air Manis Street as the most suitable location for branch expansion, outperforming all other alternatives across the weighted criteria. The next four locations—Sitebal, Gajah Mada, Raya Lubuk Buaya, and Dr. Sutomo Streets—also demonstrate strong potential, forming a competitive cluster of high-performing sites. Conversely, the remaining locations show significantly lower scores, indicating limitations that reduce their strategic viability. Overall, this evaluation provides a clear, data-driven ranking to guide optimal site selection decisions.

5. Declarations

5.1. Author Contributions

Asih Anggina: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources; **Shary Armonitha Lusinia:** Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft; **Devia Kartika:** Validation, Formal analysis, Data Curation.

5.2. Institutional Review Board Statement

Not applicable.

5.3. Informed Consent Statement

Not applicable.

5.4. Data Availability Statement

The data presented in this study are available on request from the corresponding author.

5.5. Acknowledgment

Not applicable.

5.6. Conflicts of Interest

The authors declare no conflicts of interest.

6. References

[1] G. Kou, Y. Shi, and S. Wang, "Multiple criteria decision making and decision support systems — Guest editor's introduction," *Decis Support Syst*, vol. 51, no. 2, pp. 247–249, May 2011, https://doi.org/10.1016/j.dss.2010.11.027.

[2] V. Funda and E. Francke, "Artificial intelligence-powered decision support system for operational decision-making in the ICT department of a selected African university," *African Journal of Science, Technology, Innovation and Development*, vol. 16, no. 5, pp. 689–701, Jul. 2024, https://doi.org/10.1080/20421338.2024.2376916.

[3] H. Taherdoost and M. Madanchian, "Multi-Criteria Decision Making (MCDM) Methods and Concepts," *Encyclopedia*, vol. 3, no. 1, pp. 77–87, Jan. 2023, https://doi.org/10.3390/encyclopedia3010006.

[4] S. A. Shaikh, M. Memon, and K.-S. Kim, "A Multi-Criteria Decision-Making Approach for Ideal Business Location Identification," *Applied Sciences*, vol. 11, no. 11, p. 4983, May 2021, https://doi.org/10.3390/app11114983.

[5] A. Saoud, M. Lachgar, M. Hanine, R. El Dhimni, K. El Azizi, and H. Machmoum, "decideXpert: Collaborative system using AHP-TOPSIS and fuzzy techniques for multicriteria group decision-making," *SoftwareX*, vol. 29, p. 102026, Feb. 2025, https://doi.org/10.1016/j.softx.2024.102026.

[6] F. Ciardiello and A. Genovese, "A comparison between TOPSIS and SAW methods," *Ann Oper Res*, vol. 325, no. 2, pp. 967–994, Jun. 2023, https://doi.org/10.1007/s10479-023-05339-w.

[7] M. Şahin, "Location selection by multi-criteria decision-making methods based on objective and subjective weightings," *Knowl Inf Syst*, vol. 63, no. 8, pp. 1991–2021, Aug. 2021, https://doi.org/10.1007/s10115-021-01588-y.

[8] S. A. Shaikh, M. Memon, and K.-S. Kim, "A Multi-Criteria Decision-Making Approach for Ideal Business Location Identification," *Applied Sciences*, vol. 11, no. 11, p. 4983, May 2021, https://doi.org/10.3390/app11114983.

[9] H. Taherdoost, "Analysis of Simple Additive Weighting Method (SAW) as a MultiAttribute Decision-Making Technique: A Step-by-Step Guide," *Journal of Management Science & Engineering Research*, vol. 6, no. 1, pp. 21–24, Feb. 2023, https://doi.org/10.30564/jmser.v6i1.5400.

[10] H. Aulawi, F. Nuraeni, R. Setiawan, W. F. Rianto, A. Surya Pratama, and H. Maulana, "Simple Additive Weighting in the Development of a Decision Support System for the Selection of House Construction Project Teams," in *2023 International Conference on Computer Science, Information Technology and Engineering (ICCoSITE)*, IEEE, Feb. 2023, pp. 517–522. https://doi.org/10.1109/ICCoSITE57641.2023.10127813.

[11] V. Grybaitė and A. Burinskienė, "Assessment of Circular Economy Development in the EU Countries Based on SAW Method," *Sustainability*, vol. 16, no. 21, p. 9582, Nov. 2024, https://doi.org/10.3390/su16219582.

[12] S. Abadi and M. Gumanti, "Simple Additive Weighting: Determination of The Local Government Officials Tanggamus Region," *bit-Tech*, vol. 6, no. 3, pp. 421–430, Apr. 2023, https://doi.org/10.32877/bt.v6i3.1559.

[13] B. Ayan, S. Abacıoğlu, and M. P. Basilio, "A Comprehensive Review of the Novel Weighting Methods for Multi-Criteria Decision-Making," *Information*, vol. 14, no. 5, p. 285, May 2023, https://doi.org/10.3390/info14050285.

[14] Y.-J. Wang, "A fuzzy multi-criteria decision-making model based on simple additive weighting method and relative preference relation," *Appl Soft Comput*, vol. 30, pp. 412–420, May 2015, https://doi.org/10.1016/j.asoc.2015.02.002.

[15] K. Aliyeva, A. Aliyeva, R. Aliyev, and M. Özdeşer, "Application of Fuzzy Simple Additive Weighting Method in Group Decision-Making for Capital Investment," *Axioms*, vol. 12, no. 8, p. 797, Aug. 2023, https://doi.org/10.3390/axioms12080797.

[16] N. Vafaei, R. A. Ribeiro, and L. M. Camarinha-Matos, "Selection of Normalization Technique for Weighted Average Multi-criteria Decision Making," in *Technological Innovation for Resilient Systems*, 2018, pp. 43–52. https://doi.org/10.1007/978-3-319-78574-5_4.

[17] X. Zuo, M. Akhtar, A. Aslam, F. M. Tawfiq, and S. Kanwal, "Multiple-Criteria Decision-Making (MCDM) techniques to study the behavior of dendrimers using topological indices," *PLoS One*, vol. 18, no. 11, p. e0294515, Nov. 2023, https://doi.org/10.1371/journal.pone.0294515.

[18] A. R. Krishnan, M. R. Hamid, G. H. Tanakinjal, M. F. Asli, B. Boniface, and M. F. Ghazali, "An investigation to offer conclusive recommendations on suitable benefit/cost criteria-

based normalization methods for TOPSIS," *MethodsX*, vol. 10, p. 102227, 2023, https://doi.org/10.1016/j.mex.2023.102227.

[19] S. Malefaki, D. Markatos, A. Filippatos, and S. Pantelakis, "A Comparative Analysis of Multi-Criteria Decision-Making Methods and Normalization Techniques in Holistic Sustainability Assessment for Engineering Applications," *Aerospace*, vol. 12, no. 2, p. 100, Jan. 2025, https://doi.org/10.3390/aerospace12020100.

[20] A. R. Krishnan, "Past efforts in determining suitable normalization methods for multi-criteria decision-making: A short survey," *Front Big Data*, vol. 5, Aug. 2022, https://doi.org/10.3389/fdata.2022.990699.

[21] N. Vafaei, R. A. Ribeiro, and L. M. Camarinha-Matos, "Assessing Normalization Techniques for Simple Additive Weighting Method," *Procedia Comput Sci*, vol. 199, pp. 1229–1236, 2022, https://doi.org/10.1016/j.procs.2022.01.156.

[22] D. Kurniawati, F. N. Lenti, and R. W. Nugroho, "Implementation of AHP and SAW Methods for Optimization of Decision Recommendations," *Journal of International Conference Proceedings*, vol. 4, no. 1, pp. 254–265, Jul. 2021, https://doi.org/10.32535/jicp.v4i1.1152.

[23] A. Aytekin, "Comparative Analysis of the Normalization Techniques in the Context of MCDM Problems," *Decision Making: Applications in Management and Engineering*, vol. 4, no. 2, pp. 1–25, Mar. 2021, https://doi.org/10.31181/dmame210402001a.

[24] Adriyendi, "Multi-Attribute Decision Making Using Simple Additive Weighting and Weighted Product in Food Choice," *International Journal of Information Engineering and Electronic Business*, vol. 7, no. 6, pp. 8–14, Nov. 2015, https://doi.org/10.5815/ijieeb.2015.06.02.

[25] M. A. Sanjaya and I. G. A. S. Narendra, "Implementation of the Simple Additive Weighting (SAW) Method on the Determination of Scholarship Recipients," *TIERS Information Technology Journal*, vol. 4, no. 2, pp. 134–143, Dec. 2023, https://doi.org/10.38043/tiers.v4i2.5518.