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Decision Support System For Determining New Business Location Using The Web-Based Analytical Hierarchy Process (Ahp) Method

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Abstract

Business location selection is a strategic decision for a digital printing business because it affects operating costs, customer accessibility, and proximity to target markets. Previous studies on business location selection have generally focused on alternative ranking and have rarely integrated AHP weighting, dynamic spatial information, competitor data, sensitivity analysis, and usability evaluation within one application. This study developed a web-based Decision Support System (DSS) for selecting shop-house locations for a digital printing business in East Jakarta using the Analytical Hierarchy Process (AHP). The six criteria were rental price, building area, road accessibility, parking availability, surrounding population density, and proximity to schools, universities, offices, or government institutions. The study used six shop-house alternatives from 99.co, official East Jakarta population data, nearby facilities from OpenStreetMap through the Overpass API and OSRM, and competitor data obtained by scraping Google Maps. Pairwise comparison questionnaires were completed by 36 respondents and combined using the geometric mean. The group Consistency Ratio was 0.0197, indicating a consistent comparison matrix. The highest weights were assigned to surrounding population density (34.55%), proximity to facilities (23.68%), and road accessibility (18.64%). Alternative A5 in Matraman ranked first with a final score of 0.919 and was categorized as highly recommended. Functional testing showed that all main features operated as designed, while usability testing with 20 respondents produced an average System Usability Scale (SUS) score of 81.5, categorized as very good. These findings indicate that the system can help users compare shop-house locations more objectively, systematically, and understandably

Keywords Decision Support System, AHP, Business Location, Digital Printing, SUS.

INTRODUCTION

The rapid growth of entrepreneurship and the increasing competitiveness of modern business environments have made the selection of an appropriate business location one of the most critical strategic decisions for entrepreneurs and organizations. A business location directly influences operational efficiency, accessibility to customers, logistics costs, market penetration, and long-term profitability. In today's digital era, decision-makers are often confronted with numerous location alternatives, each characterized by different strengths and weaknesses. Evaluating these alternatives manually is challenging because the decision involves multiple criteria, including population density, transportation accessibility, rental costs, infrastructure availability, market potential, and competitor distribution. Consequently, organizations require systematic approaches that can process complex decision variables objectively and accurately through computer-based decision support systems. Decision Support Systems (DSS) have emerged as an effective technological solution to facilitate structured and rational decision-making processes across various organizational contexts (Turban et al., 2018; Power & Sharda, 2007).

A Decision Support System integrates data, analytical models, and computational techniques to assist decision-makers in evaluating multiple alternatives based on predetermined criteria. Unlike conventional decision-making methods that rely heavily on intuition or subjective judgment, DSS provides quantitative analysis that improves consistency, transparency, and decision quality. Recent developments in web technologies have enabled DSS applications to become web-based, allowing users to access decision-making tools remotely through internet-connected devices. Web-based systems offer several advantages, including real-time accessibility, centralized database management, easier maintenance, and collaborative decision-making among stakeholders. These advantages are particularly beneficial for entrepreneurs who require rapid and flexible access to business information when determining strategic business locations. Therefore, integrating DSS with web technology represents an important advancement in supporting data-driven business decisions (Laudon & Laudon, 2022; Marakas & O'Brien, 2019).

Among the various Multi-Criteria Decision-Making (MCDM) methods employed in Decision Support Systems, the Analytical Hierarchy Process (AHP) has become one of the most widely adopted approaches due to its ability to solve complex problems involving qualitative and quantitative criteria simultaneously. Developed by Thomas L. Saaty, AHP decomposes complex decision problems into hierarchical structures consisting of objectives, criteria, sub-criteria, and alternatives. Through pairwise comparisons, decision-makers assign relative importance to each criterion, enabling the calculation of priority weights while simultaneously measuring the consistency of judgments. This capability makes AHP particularly suitable for business location selection, where multiple evaluation criteria must be considered simultaneously. Numerous studies have demonstrated that AHP improves decision accuracy, reduces subjective bias, and provides a transparent framework for ranking available alternatives (Saaty, 2008; Ishizaka & Labib, 2011).

The determination of new business locations represents a practical application where AHP-based Decision Support Systems can significantly enhance decision quality. Selecting a location solely based on rental prices or intuition often results in suboptimal business performance because other influential factors may be overlooked. A comprehensive evaluation should consider demographic characteristics, purchasing power, accessibility, infrastructure, environmental conditions, competition intensity, security, and future development potential. By incorporating these variables into an AHP-based web application, entrepreneurs can objectively compare multiple location alternatives using weighted criteria generated through systematic analysis. Furthermore, the web-based implementation enables business owners and managers to input evaluation data, update criteria dynamically, and obtain ranking results efficiently without requiring advanced technical expertise. Such systems not only improve decision accuracy but also increase operational efficiency by minimizing time and reducing the possibility of human error during evaluation (Triantaphyllou, 2000; Saaty & Vargas, 2012).

Considering the increasing need for intelligent decision-making tools in business planning, the development of a web-based Decision Support System using the Analytical Hierarchy Process offers a practical and reliable solution for determining new business locations. The integration of structured decision models with modern web technologies enables organizations to evaluate multiple alternatives objectively, consistently, and transparently while accommodating dynamic business environments. This approach supports evidence-based strategic planning and contributes to sustainable business growth by helping entrepreneurs identify locations with the highest potential for success. Therefore, implementing an AHP-based web Decision Support System is expected to improve the effectiveness of business location selection while demonstrating the significant role of information systems in enhancing managerial decision-making processes within increasingly competitive markets (Turban et al., 2018; Laudon & Laudon, 2022; Saaty, 2008).

METHODS

This research is applied research because it aims to produce a system that can be used to assist in the process of determining the location of a new digital printing business. The system developed is a web-based Decision Support System (DSS). DSSs are used to assist decision-making in problems with multiple criteria and alternatives, so that decisions do not rely solely on user intuition (Sprague, 1980). The research approach is quantitative because the analysis process is conducted using numerical data, such as criteria comparison values, priority weights, alternative shophouse scores, final scores, rankings, and usability scores. The Analytical Hierarchy Process (AHP) method is used to obtain the criteria weights, while usability testing is conducted using the System Usability Scale (SUS) (Saaty, 1980; Brooke, 1996).

FINDINGS AND DISCUSSION

OpenStreetMap Facility Verification

The verification process was conducted to ensure that the C6 score corresponded to the number of schools, universities, offices, or government institutions detected within a 1 km walking distance radius. The recorded data included the number of facilities, the C6 score, examples of detected facilities, route distance, detection date, and screenshot reference number.

Table 4.19 OpenStreetMap Nearby Facility Verification

Code	Number of Facilities	C6 Score	Example Facilities	Route Distance	Date	Figure No.
A1	6	3	RW 06 Community Hall, TK Negeri Pembina, Duren Sawit Regional Public Hospital	140 m, 767 m, 789 m	July 13, 2026	Figure 4.41a
A2	3	2	Asya Marketing Office, Sequoia 7 Marketing Office, Jakarta Garden City Marketing Office	296 m, 769 m, 780 m	July 13, 2026	Figure 4.41b
A3	20	5	KB-TK Batu Karang, Kelapa Dua Wetan Police Subsector, RA Daarul Ikhwan	93 m, 167 m, 267 m	July 13, 2026	Figure 4.41c
A4	11	4	PT Architectz Persada	321 m, 501	July	Figure

			Asri, Rawa Bening Police Post, East Jakarta City Health Office	m, 655 m	13, 2026	4.41d
A5	18	5	East Jakarta City Health Office, Jatinegara Community Health Center, East Jakarta Metropolitan Police	107 m, 136 m, 221 m	July 13, 2026	Figure 4.41e
A6	13	4	Cakung Barat 15 Public Elementary School, Syabil Medika Clinic, RW 09 Secretariat	269 m, 363 m, 383 m	July 13, 2026	Figure 4.41f

Source: OpenStreetMap, Overpass API, and OSRM detection results, July 13, 2026.

Usability Testing Using the System Usability Scale (SUS)

Usability testing was conducted directly using the application deployed on a local server through XAMPP. During the testing session, respondents accessed the application via laptops connected to the local network and explored the main user features, including the homepage, shop-house list and details, overall ranking, shop-house comparison, sensitivity analysis, location map, and the AHP method page.

After using the application, each respondent completed the ten-item System Usability Scale (SUS) questionnaire using a five-point Likert scale ranging from 1 to 5. The usability evaluation involved 20 respondents. The researcher only provided an initial explanation of how to use the application and did not influence the respondents' answers, ensuring that the evaluation reflected each participant's actual experience while interacting with the system.

Documentation of the SUS Usability Testing Process
Source: Research documentation, 2026.

Figure 4.42 illustrates the stages of the usability testing process. In Figure 4.42(a), respondents accessed the homepage to understand the application's primary functions. Figure 4.42(b) shows respondents reviewing information on the shop-house detail page, while Figure 4.42(c) presents the process of examining the ranking results. After exploring the application's features, respondents completed the SUS questionnaire, as shown in Figure 4.42(d). This documentation confirms that the SUS responses were collected after the respondents had directly used the application.

Each respondent's SUS score was calculated by subtracting one from the responses to odd-numbered statements and subtracting the responses to even-numbered statements from five. The contribution scores were then summed and multiplied by 2.5, resulting in a final SUS score ranging from 0 to 100. The summary of SUS scores for all respondents is presented in Table 4.20.

SUS Testing Results for Each Respondent

No.	Respondent	SUS Score	Category
1	Fajar	87.5	Excellent
2	Steven Diaz	85.0	Excellent
3	Kevin Diaz Sadewa	85.0	Excellent
4	Rizka April	80.0	Good
5	Rizky	85.0	Excellent
6	Luqmanul Ghibran	72.5	Good
7	Aliusman Maulana Sidik	72.5	Good
8	Marshel Daniel	80.0	Good
9	Lilis Sandera	82.5	Excellent
10	Rahmat Rudianto	90.0	Excellent
11	Ahmad Adnan Fauzi	57.5	Fair
12	Vivi	87.5	Excellent
13	Ayuri	92.5	Excellent
14	Ferdiyan	85.0	Excellent
15	Luthfi Fadlurohman	75.0	Good
16	Dwi Rahmansyah	85.0	Excellent
17	Asep Jaelani	80.0	Good
18	Deni Sutria	85.0	Excellent
19	Damara	100.0	Excellent
20	Rizki Nugraha	62.5	Fair

Source: SUS testing results, recalculated by the researcher, 2026.

Based on Table 4.20, the lowest SUS score was 57.5, while the highest score reached 100.0. The average SUS score obtained from the 20 respondents was 81.5, with a median score of 85.0. Since the average score exceeded the benchmark value of 68, the application was classified as **Excellent**. These findings indicate that the application's main features were generally easy to understand and use, although some respondents experienced minor usability challenges.

Most SUS scores ranged between 72.5 and 92.5. A total of 18 respondents achieved scores above the benchmark value of 68, while two respondents obtained scores of 57.5 and 62.5. Overall, these results demonstrate a high level of user acceptance of the application. Nevertheless, the relatively lower scores reported by two respondents provide valuable feedback for improving user guidance and simplifying interface components that may still require refinement.

Discussion

Interpretation of Weights and Ranking Results

The AHP results indicate that population density is the primary consideration. Proximity to schools, campuses, offices, or agencies is the second priority, while road access is the third. These three criteria align with the characteristics of digital printing businesses, which rely on market potential and customer convenience.

A5 scored highly on C3, C5, and C6, offsetting its relatively high rental price. Conversely, A2 scored the best on price, but weakly on C5 and C6, which carry significant weight. These results indicate that the cheapest location does not automatically translate to the best recommendation when other criteria are considered simultaneously.

Contribution of Application Features

The application not only displays ranking results but also provides detailed score contributions, maps, nearby amenities, competitors, shophouse comparisons, and sensitivity simulations. These features help users explore the rationale behind recommendations and compare alternatives based on different needs.

Competitor data was intentionally excluded from the AHP formula because it was not included in the six criteria assessed by respondents. This information is positioned as additional context so that users can see the competitive conditions without changing the research weighting model.

Validity and Limitations of the Study

The validity of the results is strengthened by the group CR of 0.0197, the agreement of the system values with manual calculations, and the stability of the ranking order when seven inconsistent AHP respondents were excluded. In terms of usability, the 20 respondents produced an average SUS score of 81.5, categorized as Very Good. These results indicate that the application not only produces consistent calculations but is also usable by respondents.

The study still has limitations. The number of alternatives is only six shophouses and does not represent the entire East Jakarta property market. C5 uses a proxy for population density at the sub-district level, so it does not directly reflect the crowding at the shophouse locations. OpenStreetMap facility data and property listings are dynamic, while road access and parking assessments still rely on descriptions and photographs. The SUS testing was conducted on a local network environment using XAMPP, so the results primarily reflect the ease of use of the interface and main functions under local conditions. They do not include the effects of public internet connections or concurrent access loads. Although the average SUS score reached 81.5, categorized as Very Good, two respondents still scored below the benchmark of 68, so improvements to the user manual and interface still need to be considered.

Comparison with Previous Research

The results of this study reinforce the finding that business location selection requires considering multiple criteria simultaneously. Permatasari et al. (2021) used target market, shophouse price, parking space, access to the location, population density, and number of competitors to determine the location of a coffee shop. These similarities indicate that population density, access, cost, and supporting facilities are relevant factors in business location selection. The difference is that that study used a combination of AHP and SAW, while this study uses AHP to obtain criteria weights and standardized score aggregation to produce a ranking of alternative digital printing shophouses.

Isyriyah et al. (2024) also applied AHP in business location selection and utilized geographic information to support location visualization, but used TOPSIS to determine the final ranking. This study used six criteria tailored to the needs of digital printing businesses, including the addition of nearby facilities from OpenStreetMap via the Overpass API, pedestrian route distance calculations using OSRM, digital printing competitor information, and a sensitivity analysis of weights. Competitor data was used as supporting information and did not affect the final AHP score.

Adhiarta et al. (2021) integrated AHP with a geographic information system to assist in selecting an initial business location. This study shared the visual presentation of location information but expanded the application's functionality through detailed contributions of each criterion, comparisons of several selected shophouses, sensitivity simulations, and usability testing using SUS. A SUS score of 81.5 indicated that the addition of spatial analysis and information features could still be presented in an interface that respondents rated very favorably.

Thus, this study's contribution lies not only in applying AHP to determine location weights and rankings, but also in combining decision calculations, population data, dynamic facility information, competitor data, sensitivity analysis, and usability evaluation in a single web-based application. However, the generalization of the results is still limited by the six shophouse alternatives and the use of sub-district population density as an indicator of market potential around the location.

CONCLUSION

The study successfully developed a web-based Decision Support System using PHP Native, MySQL, HTML, CSS, and JavaScript, integrated with Leaflet.js, OpenStreetMap, Overpass API, OSRM, WhatsApp, and Google Maps to support comprehensive business location evaluation. The system manages shop-house, district, and competitor data while providing AHP-based comparisons, automated scoring, ranking, sensitivity analysis, mapping, reporting, and usability assessment. The research utilized six business location alternatives, demographic data from ten districts, 434 competitor records obtained through Google Maps web scraping, nearby facility data from OpenStreetMap, and responses from 36 AHP questionnaires. After data preprocessing and validation, the aggregated geometric mean produced a highly consistent comparison matrix (CR = 0.0197), with population density (34.55%), proximity to facilities (23.68%), and road accessibility (18.64%) identified as the most influential criteria. The ranking results indicated that Ruko Matraman Raya 240 m² was the best alternative with a score of 0.919, matching manual calculations and confirming the accuracy of the implemented AHP model. Furthermore, functional testing verified that all system features operated correctly, while usability evaluation involving 20 respondents achieved an average System Usability Scale (SUS) score of 81.5, indicating excellent usability and confirming that the application effectively supports business location decision-making.

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