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Fuzzy Multiple Attribute Decision Making and Simple Additive Weighting for Supplier Measurement In Furniture Business

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Abstract

This study delves into the complexities of supplier selection in the furniture industry, where Decision Support Systems play a pivotal role in achieving data-driven, sustainable supplier choices. It underscores the Fuzzy Multiple Attribute Decision Making and Simple Additive Weighting approach, particularly emphasizing Price, response time, and delivery fees as critical factors. The overarching objective is to elevate supplier selection in alignment with furniture companies' specific requirements and strategic goals. Additionally, the Supplier Ranking System leverages Fuzzy Multiple Attribute Decision Making and Simple Additive Weighting techniques, ranking the third Supplier as the top Supplier with a high preference score of 0.90 and the fourth Supplier as the lowest-ranked Supplier with a score of 0.50. Notably, User Acceptance Tests affirm the System's outstanding performance and intense user satisfaction.

Keywords: Decision Support System, FMADM, furniture business, Simple Additive Weighting.

1. INTRODUCTION

A furniture company specializes in producing, selling, and distributing various furniture products, including tables, chairs, cabinets, sofas, beds, and other household furnishings [1]. These companies can range from large manufacturers producing furniture in bulk to small furniture stores that cater to customers with customizable or made-to-order products. Furniture companies typically offer a variety of styles and designs to meet the needs and preferences of consumers. As technology and innovation continue to evolve, the furniture industry adapts and innovates to meet the diverse demands of the global market.

Supplier selection is a critical challenge faced by many furniture companies. Choosing suitable suppliers significantly impacts product quality, production costs, and overall business sustainability. Furniture companies must ensure that their suppliers provide high-quality raw materials for furniture production [2].

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Issues can arise when the quality of raw materials does not meet expected standards. Finding suppliers with competitive pricing is essential for preserving profit margins [3]. However, a sole focus on low prices may compromise product quality. Choosing reliable suppliers offering high-quality materials, competitive pricing, and ethical practices supports product quality, cost efficiency, and brand reputation [4]. Consistent and ethical sourcing practices enhance customer loyalty and align with sustainability goals. At the same time, risk mitigation and long-term partnerships contribute to operational stability and adaptability in the dynamic furniture industry, ultimately ensuring the business's long-term sustainability.

Decision Support Systems can play a significant role in solving the supplier selection challenge by providing a structured and data-driven approach to the decision-making process. The decision support system integrates compensatory and non-compensatory decision methods to assess supplier performance across economic, environmental, and social dimensions by facilitating the expression of decision-maker preferences and the identification of the most suitable sustainable suppliers [5]. It enables decision-makers to express their preferences and aids in selecting the most appropriate sustainable suppliers, thus offering a versatile approach to supplier assessment and selection. The outcomes of a supplier selection case demonstrate that the suggested method can effectively choose appropriate suppliers by considering multi-period fuzzy data and collaborative opinion interaction [6]. It achieves this by viewing information spanning multiple periods, incorporating fuzzy data to deal with uncertainty, and promoting interaction among stakeholders' opinions in decision-making. This approach enhances the precision and robustness of supplier selection, ensuring that the chosen suppliers align with the Company's needs and objectives over time. FMADM, which stands for Fuzzy Multiple Attribute Decision Making, is one of the Decision Support System approaches to decision-making that integrates the concepts of fuzzy logic and the analysis of multiple attributes [7]. Numerous researchers employ FMADM to select suppliers. It can be applied to choose Laptop Suppliers [8], better carrier Suppliers [9], and most optimal Suppliers [10].

In the context of furniture manufacturing companies, the FMADM approach is often complemented by the Simple Additive Weighting (SAW) algorithm within Decision Support Systems. A prior study focused on assessing raw material types, pricing of raw materials, auxiliary manufacturing materials, and assembly processes [11]. Another research study investigates three distinct product design solutions [12]. A research study delves into the realm of public indoor seating and public outdoor seating [13]. However, the distinguishing aspect of our research lies in examining the supplier ranking process in fundamental areas, namely, Price, response time, and delivery fees.

The primary aim of this study is to implement FMADM and SAW within a furniture trading company to assist the Company in identifying the most optimal

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suppliers. This endeavor seeks to enhance the supplier selection process by considering multiple attributes and applying fuzzy logic to manage imprecise data effectively. The ultimate goal is to elevate the quality of the Company's supplier base by enabling more informed decisions that align with its specific requirements and strategic objectives.

2. METHODS

2.1 Research Object

PT. Inovasi Guna Sentosa is a company that specializes in selling various furniture and home furnishings, such as sofas, dining tables, living room chairs, wardrobes, and more. The Company has a rich history, established over 15 years ago. Over the years, it has built a strong reputation and a loyal customer base. This customer base includes individual consumers and government organizations purchasing furniture for their office spaces. One notable aspect of the Company's operations is its approach to managing its inventory of furniture in its warehouse. Instead of using automated systems or online ordering platforms, The Company still relies on a manual process. To restock their warehouse with furniture, the Company's staff contacts the suppliers by phone. They do this to inquire about the availability of the desired products supplied by companies that have established business relationships with The Company. In essence, the Company's inventory management process involves traditional, person-to-person communication with suppliers to ensure the consistent availability of furniture products.

2.2 Research Flow

This study will employ Rapid Application Development (RAD). Rapid Application Development (RAD) is preferred for its swift and structured development approach, emphasizing shorter cycles and quicker results, making it time-efficient and effective [14]. As delineated in Figure 1, the RAD methodology encompasses several discrete phases, including Requirement Planning, User Design, Construction, and Cutover [15]. The initial step, Requirement Planning, entails thorough consultations with stakeholders to pinpoint the user requirements for the software application. The process of Requirement Planning incorporates interview methods. The interview is intended to ascertain the challenges The Company faces in its current approach to submitting requests for goods to suppliers. The interview questions will encompass the procedure for ordering goods from the warehouse to suppliers, common obstacles encountered in this process, the typical duration of the ordering process, and the desired System for addressing issues in procuring goods from suppliers. Next, The System uses the Unified Modeling Language during the user design phase. The FMADM and SAW are applied in the prototype in User Design. FMADM can be integrated with the Simple Additive Weighting (SAW) method to create an effective decision support

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system [8]. Afterwards, the System is developed during construction using HTML, PHP programming language, and the MySQL database. Finally, at the cutover phase, the System is tested using User Acceptance Testing (UAT) to validate the System's functionality.

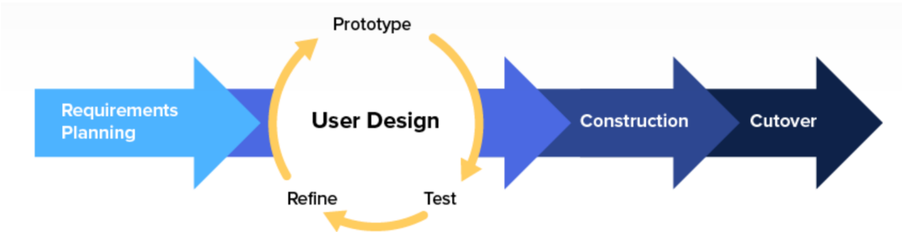

Figure 1. RAD Phases [16]

The prototype steps involved in applying the FMADM and Simple Additive Weighting method are as follows [8]:

1) Make a list of alternatives $A = \{ a_1, a_2, a_3, \dots a_i \}$.
2) Make a list of criteria $C = \{ c_1, c_2, c_3, \dots c_j \}$.
3) For each criteria make a Fuzzy table F= {F_1, F_2, F_3, … F_j}
4) Determine Fuzzy points for each Criterion for each alternative by using appropriate Fuzzy tables.
5) For each Criterion, decide whether it falls under the category of Benefit or Cost. Benefit criteria are those where higher values are considered more beneficial. For these criteria, more significant scores indicate better performance or desirability. While Cost criteria are the opposite, lower values are desirable.
6) For each Criterion, make a list of preference weight $W = \{ w_1, w_2, w_3, \dots w_j \}$.
7) Make a decision matrix D formed by assigning a score for each alternative on each Criterion.

$$D = \begin{bmatrix} d_{11} & d_{12} & \cdots & d_{1j} \\ \vdots & & \ddots & \vdots \\ d_{i1} & d_{i2} & \cdots & d_{ij} \end{bmatrix} \quad (1)$$

8) Normalize the decision matrix using formula 3. The results are placed into a normalization matrix N.

$$N_{ij} = \begin{cases} \dfrac{d_{ij}}{Max\ d_{ij}} \ for\ benefit\ criterions \\ \dfrac{Min\ d_{ij}}{d_{ij}} \ for\ cost\ criterion \end{cases} \quad (2)$$

Where N_{ij} represents the normalized performance rating value, while d_{ij} signifies the attribute values associated with each Criterion, Max d_{ij} refers

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to the highest value for each Criterion, and Min d_{ij} represents the lowest value for each Criterion.

9) Ranking results $R = \{r_1, r_2, r_3, \dots r_i\}$ is performed. A higher r_i value signifies that the alternative a_i is a superior choice obtained by calculating their Preferences using formula 4. The more significant r_i value indicates that alternative a_i is a better alternative.

$$P_{i=} \sum_{j=1}^{n} w_j n_{ij} \quad (3)$$

3. RESULT AND DISCUSSION

3.1 Requirement Planning

The initial step involved interviewing with the Owner. This interview aimed to gain a comprehensive understanding of the current business processes. The Company has not undertaken any evaluation of its suppliers. This lack of supplier evaluation has resulted in various issues, including pricing, delivery fees, and delivery times concerns. Some functionalities required include user-related operations, such as login, registration, and logout, and setting parameter tasks, including maintaining alternatives, criteria, and fuzzy tables. The process of decision-making, involving fuzzy point processing, normalization, and ranking, was also concluded. The validity check for usernames and passwords was effective, and the presentation of decision results proved accurate.

3.2 User Design

The application is not created from scratch as the Company has its current System that handles the operational transactions. As a result, this study only discusses the application for supplier ranking. The System consists of maintaining alternatives, criteria, weight, making decisions, and showing decisions. Admin can access all cases, while users can only access the show decision.

Figure 2 illustrates the Use Case Diagram of the Supplier Ranking System, comprising three primary use cases by User: Login, Setting Parameter, and Process Decision. Within the diagram, the Use Cases for Login, Setting Parameters, and Process Decision all reference the "Check Validity" use case, signifying that these actions involve a verification step. Additionally, within the Process Decision use case, there is an extension to the "Show Decision" use case, indicating that, under specific conditions or situations, the Process Decision use case may be extended to the "Show Decision" process.

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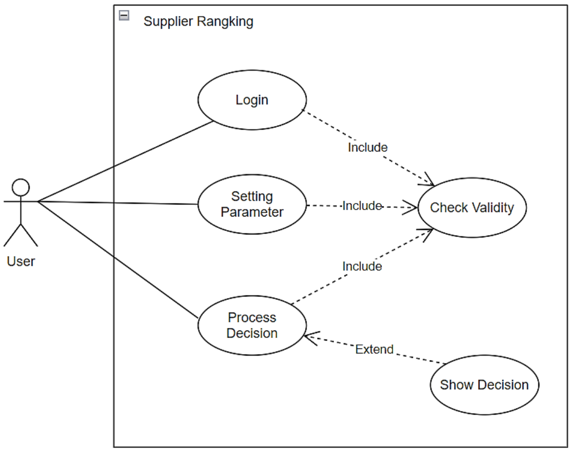

Figure 2. Use Case Diagram of Supplier Ranking System

The activity diagram in Figure 3 commences with the Login activity. Following this, the System proceeds to verify validity. In the event of invalid credentials, the User is prompted to reattempt the login process. If it is valid, the User is presented with the option to either view the results of the decision process or initiate a re-evaluation of the decision. The decision re-evaluation triggers the System to perform the FMADM-SAW processing, followed by the Show Decision activity. Afterward, the User can log out of the System.

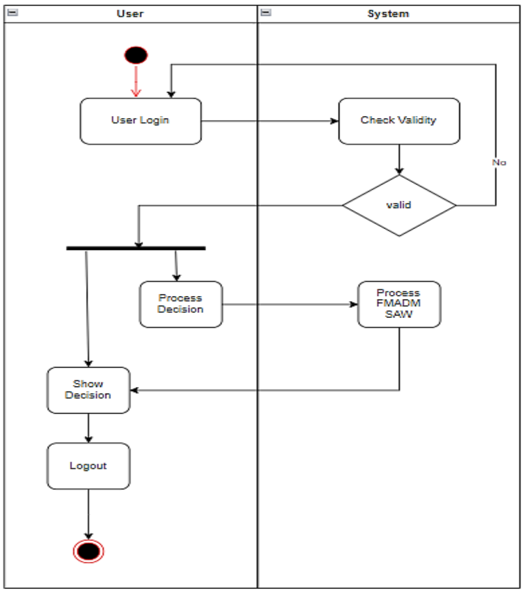

Figure 3. Activity Diagram of Process Decision

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Figure 4 shows the pricing of dining tables for the suppliers and reveals a notable range in cost, spanning from 26,250,000 to 27,640,000 in the Indonesia Rupiah. Suppliers S1, S2, S3, and S8 offer more competitively priced products, while Suppliers S4, S5, S6, S7, and S9 have higher pricing, potentially reflecting premium quality or specialized offerings.

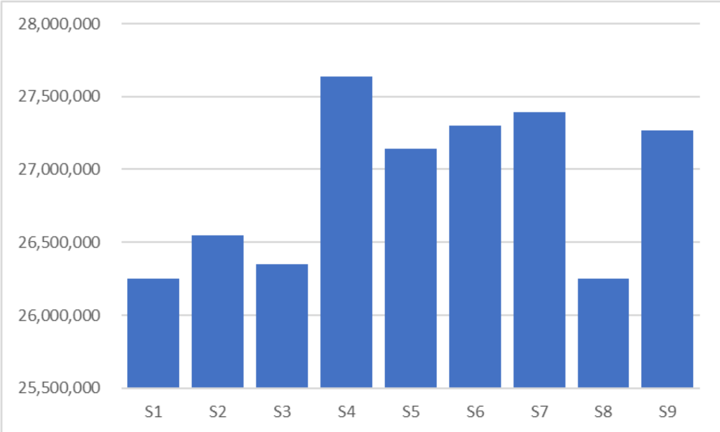

Figure 4. Product Price Among Suppliers

Figure 5 presents the response times of a selection of suppliers quantified in hours. These response times signify the duration each respective Supplier takes to react and respond to various requests or tasks. Suppliers S3 and S6 are notably swift in their responses, demonstrating a 1-hour turnaround time. In contrast, Suppliers S2, S8, and S9 exhibit relatively slower responses, requiring 7 hours to attend to the exact requests.

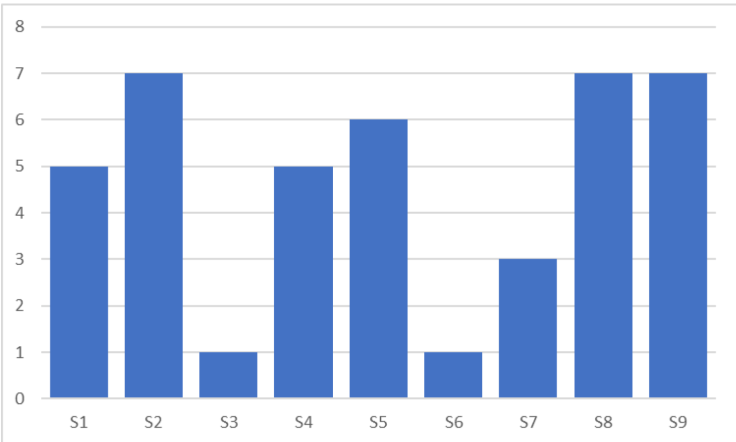

Figure 5. Response Times in Hours

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Figure 6 illustrates the delivery fees levied by various suppliers. Comprehending these delivery fees is paramount in evaluating cost-effectiveness and appropriateness when making procurement decisions. Each Supplier is uniquely identified (S1, S2) and charges varying fees for their delivery services, quantified in a specific currency unit, such as dollars or any other relevant denomination. Among the suppliers listed, Supplier S3 imposes the highest delivery fee at 200,000 units, while Supplier S2 offers the lowest delivery fee, amounting to 104,000 units.

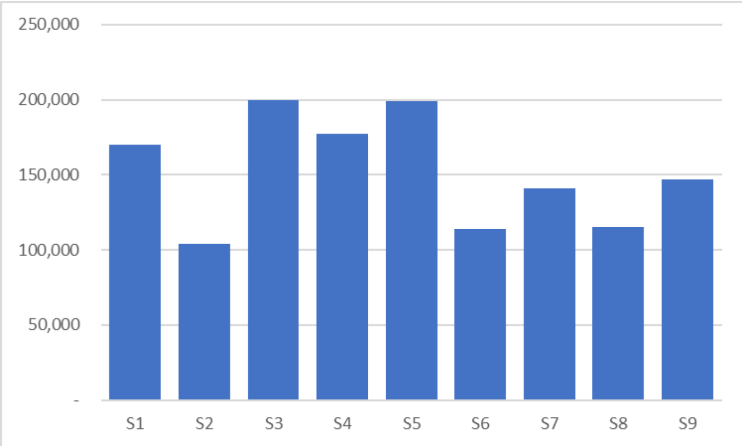

Figure 6. Suppliers' Delivery fee

Table 1 delineates fuzzy points to evaluate suppliers' pricing within distinct price brackets. This table employs a graduated scale ranging from 0.2 to 1 to signify the extent of conformity or suitability of a supplier's pricing within these specified ranges. For instance, if a supplier's pricing falls within the scope of ≤26,000,000, they receive the maximum membership score of 1, indicating a solid alignment. As pricing increases beyond this threshold, the membership score gradually diminishes in increments of 0.2, with a score of 0.8 allocated to prices falling between 26,000,000 and 26,400,000, and so forth.

Table 1. Fuzzy Points of Suppliers' Price

Range	Points
Price≤26,000,000	1
26,000,000<Price≤26,400,000	0.8
26,400,000<Price≤26,800,000	0.6
26,800,000<Price≤27,200,000	0.4
Price>27,200,000	0.2

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Table 2 presents a set of fuzzy points for assessing suppliers' response times. This table utilizes a numeric scale ranging from 1 to 0.33 to express the degree of adequacy or satisfaction with a supplier's response time within specific intervals. If a supplier's response time is within three days or less, they receive the highest membership score of 1, indicating an exemplary level of responsiveness. For response times falling between 3 and 6 days, a reduced score of 0.67 is attributed, denoting a reasonably satisfactory level of responsiveness. In cases where a supplier's response time surpasses six days, the lowest score of 0.33 is assigned, signifying a relatively slower and less favorable response time.

Table 2. Fuzzy Points of Suppliers' Response Time

Range	Points
Rensponse Time<=3	1
3<Rensponse Time≤6	0.67
6<Rensponse Time	0.33

Table 3 presents a set of fuzzy points designed to assess suppliers' delivery fees in Indonesian Rupiah. This table employs a numerical scale ranging from 0.25 to 1 to express the degree of suitability or attractiveness of a supplier's delivery fee within specified price ranges. If a supplier's delivery fee is 100,000 or less, they receive the highest membership score of 1.00, signifying an exceptional level of affordability. For delivery fees exceeding 100,000 but not surpassing 150,000, a reduced score of 0.75 is assigned, indicating a relatively favorable level of affordability. Within the price range of 150,000 to 200,000, a score of 0.50 is allotted, denoting a moderate level of affordability. However, if the delivery fee exceeds 200,000, the lowest score of 0.25 is assigned, signifying higher costs.

Table 3. Fuzzy Points of Suppliers' Delivery Fee

Range	Points
Fee ≤100,000	1.00
100,000<Fee≤150,000	0.75
150,000<Fee≤200,000	0.50
Fee>200,000	0.25

Table 4 show the Types and Weight of the Criteria. It summarizes three criteria - Price, Response Time, and Delivery Fee - all categorized as "Benefits." These criteria are weighted at 0.4, 0.3, and 0.3, respectively, indicating their relative importance in decision-making. Price is the most critical factor, followed by Response Time and Delivery Fee, which have equal, somewhat lower importance. The Price was previously a cost criterion. Because the higher the Price, the worse the value. However, by applying fuzzy logic, Price can be changed as a benefit

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criterion, which means that the higher the fuzzy points assigned to Price, the greater its value. The same principle extends to other criteria like response time and delivery fee.

Table 4. Types and Weight of Criteria

Criteria	Type	Weight
Price	Benefit	0.4
Response Time	Benefit	0.3
Delivery Fee	Benefit	0.3

Table 5 provides a set of fuzzy points for three distinct evaluation criteria (Price, Response Times, and Delivery Fee) for various suppliers, denoted by their respective codes. The values in the table represent the suitability or desirability of each Supplier concerning each Criterion, with scores ranging from 0.20 to 1.00. Supplier S1 receives a score of 0.80 for Price, indicating a relatively strong fit within the price range, a score of 0.67 for Response Times, denoting reasonably good responsiveness, and a score of 0.50 for Delivery Fee, reflecting moderate affordability. Supplier S2, on the other hand, receives a score of 0.60 for Price, signifying a somewhat less favorable price, a score of 0.33 for Response Times, indicating a relatively slower response, and a score of 0.75 for Delivery Fee, highlighting a higher but still reasonable cost.

Table 5. Fuzzy Points of Price, Response Times, and Delivery Fee Criteria

Suppliers' Code	Price	Response Times	Delivery Fee
S1	0.80	0.67	0.50
S2	0.60	0.33	0.75
S3	0.80	1.00	0.50
S4	0.20	0.67	0.50
S5	0.40	0.67	0.50
S6	0.20	1.00	0.75
S7	0.20	1.00	0.75
S8	0.80	0.33	0.75
S9	0.20	0.33	0.75

Table 6 presents a series of normalized fuzzy points used to evaluate suppliers across three specific criteria: Price, Response Times, and Delivery Fee. Each Supplier, identified by their respective codes, is assigned scores ranging from 0.25 to 1.00, which denote the extent of suitability or desirability concerning each Criterion. For instance, Supplier S1 achieves a perfect score of 1.00 for Price, indicating an exceptional alignment within the price range, a score of 0.67 for Response Times, signifying reasonably good responsiveness, and a score of 0.67 for Delivery Fee, suggesting moderate affordability. Conversely, Supplier S2 receives a score of 0.75 for Price, denoting a favorable pricing structure, 0.33 for

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Response Times, indicating a relatively slower response, and a perfect 1.00 for Delivery Fee, highlighting a higher but acceptable cost.

Table 6. Normalized Fuzzy Points

Suppliers' Code	Price	Response Times	Delivery Fee
S1	1.00	0.67	0.67
S2	0.75	0.33	1.00
S3	1.00	1.00	0.67
S4	0.25	0.67	0.67
S5	0.50	0.67	0.67
S6	0.25	1.00	1.00
S7	0.25	1.00	1.00
S8	1.00	0.33	1.00
S9	0.25	0.33	1.00

Table 7 presents data related to suppliers' preference points and their respective ranks. Each Supplier has been assessed based on their preference score, with a higher score signifying a higher degree of preference. Furthermore, the table specifies the rank assigned to each Supplier according to their preference score. Supplier S3 received the highest preference score of 0.90 and was ranked first. Suppliers S1 and S8 received preference scores of 0.80 and are tied for the second rank. Suppliers S2, S6, and S7 received preference scores of 0.70 and shared the third rank. Supplier S9 received a preference score of 0.64 and is ranked fourth. Finally, Suppliers S5 and S4 received preference scores of 0.60 and 0.50, respectively, with S5 ranking fifth and S4 ranking sixth.

Table 7. Suppliers' Preference Points and Rank

Suppliers' Code	Preferences	Rank
S1	0.80	2
S2	0.70	3
S3	0.90	1
S4	0.50	6
S5	0.60	5
S6	0.70	3
S7	0.70	3
S8	0.80	2
S9	0.64	4

3.3 Construction

First and foremost, the User is required to log in, as shown in Figure 7. On the Login page, the User is expected to enter their Username and Password correctly. Subsequently, the User should press the "Login" button. If the User does not yet have access, they may choose to register first. In the event that a user forgets their Username or Password, they can initiate a Password Reset process.

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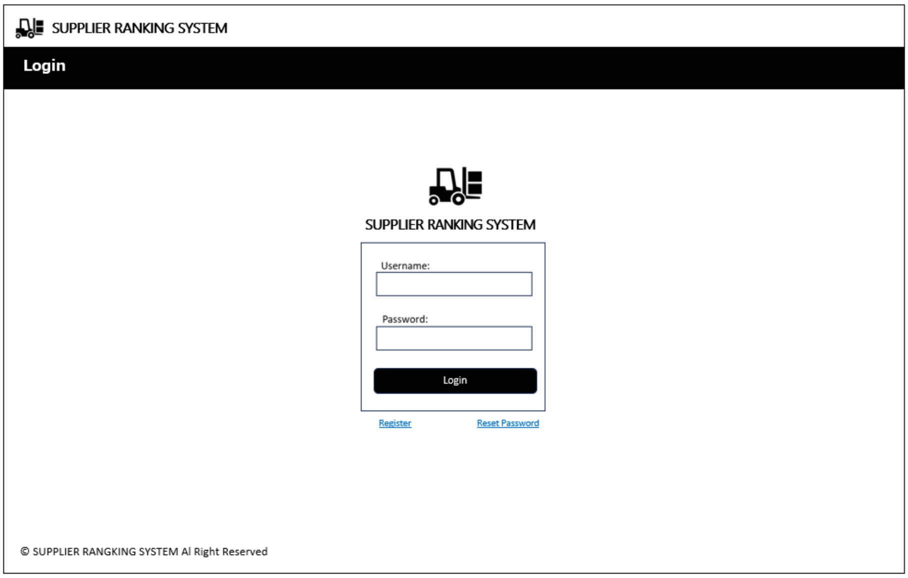

Figure 7. Login Page

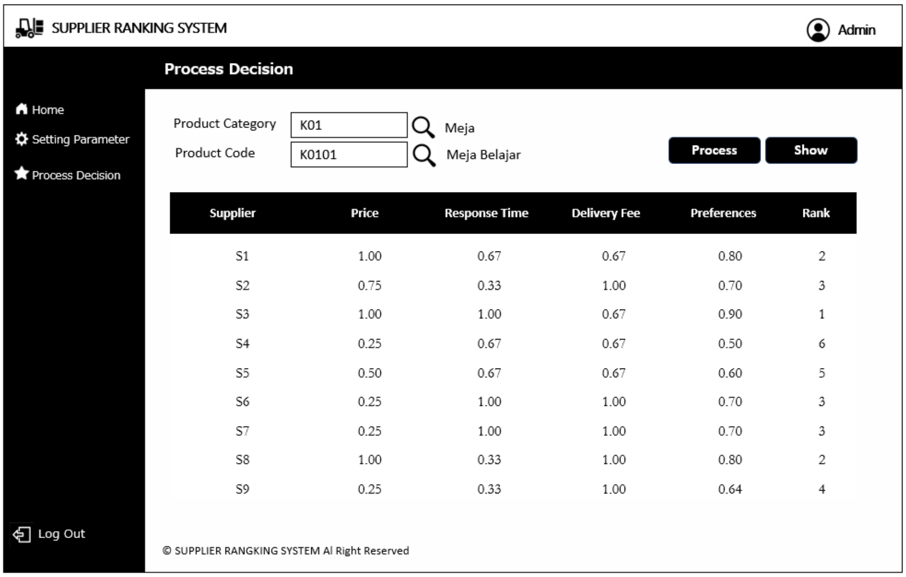

Figure 8. Process Decision Page

On the "Process Decision" page, the User is prompted to select a "Product Category" and a "Product Code." Following this selection, the User can click the "Process" button to initiate the decision support process utilizing the FMADM and SAW algorithms. Subsequently, the system will generate scores for attributes such as Price, Response Times, and Delivery Fee. It will also calculate preferences and rank the suppliers. The "Rank" value determines the order of suppliers, with 1 being the top-ranked or the first-place winner, 2 as the second-ranked Supplier, and so on.

3.4 Cut Over

Within the cutover phase, User Acceptance Testing assumes a pivotal role as it substantiates the new System's congruence with established business requirements and its intended functionality from the perspective of end-users. Executed by end-users or their designated representatives, UAT involves simulating real-world scenarios and workflows to pinpoint and rectify discrepancies or issues meticulously, thus assuring the System's readiness for full-scale implementation.

Table 8, the User Acceptance Test results, assesses various System features based on the expected results, with scores assigned by three Users. The assessment criteria encompass five levels of acceptance, namely: Excellent (5), Very Good (4), Good (3), Bad (2), and Very Bad (1). Each level signifies a specific degree of evaluation, with 'Excellent' representing the highest tier and indicative of exceptionally outstanding quality or performance. 'Very Good' denotes a very high level of achievement with minimal room for improvement, while 'Good' reflects satisfactory performance meeting the required standards. 'Bad' is a negative assessment, indicating subpar quality or performance requiring modification, and 'Very Bad' is the lowest level of review, signifying inferior quality or performance needing immediate attention.

The average score is calculated for each feature, reflecting overall performance. Login, registration, and logout features receive perfect scores, signifying excellent functionality. Maintaining alternatives and criteria also achieved excellent scores, though User 3 rated them slightly lower. The feature "Maintain Fuzzy Tables" garnered a very good rating, while the decision-making process, including fuzzy point processing, normalization, and ranking, performed excellently. The "Check Validity" feature received full marks, specifically checking usernames and passwords. Overall, the System exhibits outstanding performance, particularly in core functionalities, as all features were rated either excellent or very good by users, indicating high user satisfaction.

Table 8. User Acceptance Test

Features	Functionality	User 1	User 2	User 3	Average Score	Status
Login	User Login	5	5	5	5	Excellent
	User Register	5	5	5	5	Excellent
	User Logout	5	5	5	5	Excellent

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Features	Functionality	User 1	User 2	User 3	Average Score	Status
Setting Parameter	Maintain Alternative	5	5	4	4.67	Excellent
	Maintain Criteria	5	5	4	4.67	Excellent
	Maintain Fuzzy Tables	5	4	4	4.33	Very Good
Process Decision	Fuzzy Point Process	5	4	5	4.67	Excellent
	Fuzzy Point Normalization	5	5	4	4.67	Excellent
	Rank Process	5	4	5	4.67	Excellent
Check Validity	Check username and password	5	5	5	5	Excellent
Show Decision	Decision results	5	5	5	5	Excellent

3.5. Discussion

The successful integration of FMADM and SAW methodologies into the furniture trading company's Supplier Ranking System signifies the accomplishment of our primary objective, which is to identify the most optimal suppliers. To determine the winner, we commence by specifying the products and their respective product codes, followed by the selection of candidate suppliers who provide those specific products. Subsequently, the Owner meticulously validates all attribute weights and ensures the precise implementation of fuzzy scaling. Afterward, we conduct User Acceptance Testing (UAT) to validate the system's performance, user-friendliness, and functionality. Following successful UAT, we apply the combined FMADM and SAW methodologies to establish the rankings. The ultimate victor is the Supplier that attains the top-ranking position with a rank value of one.

The combination of FMADM and SAW offers a comprehensive and flexible decision support system that excels in complex decision scenarios [17]. Complex decision scenarios in a supplier ranking system can arise from various factors, including the need to consider multiple attributes and criteria, balance subjective and objective preferences, address conflicting details, manage diverse supplier bases, adapt to changing market conditions, assess risks, reconcile multi-stakeholder requirements, standardizing variable data, ensuring regulatory compliance, and factoring in existing supplier relationships and cost-benefit analyses. To effectively navigate these complexities, a robust decision support system, such as one combining FMADM and SAW, is invaluable. It provides a structured and systematic approach for comprehensive evaluation and ranking [18], enabling informed and rational decisions in the face of multifaceted supplier selection challenges.

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On the other hand, subjectivity in Weighting: SAW allows for subjective attribute weighting [19], and when combined with FMADM, the subjectivity may not always be appropriately managed. If the personal weights are not well-defined or validated, they can introduce bias into the decision process. Furthermore, in the context of a supplier ranking system, the reliance on attribute scaling in the SAW method can be a weakness, especially when evaluating suppliers with diverse attributes that have different measurement scales or units. This challenge arises as the scaling of these various attributes to a common scale is crucial in SAW [20], and the choice of scaling methods can significantly impact the final rankings. If details are not properly scaled, the system can be sensitive to these scaling choices, potentially leading to unintended consequences, biases, unfair comparisons, and inequitable weight distribution among attributes, affecting the accuracy and reliability of supplier rankings. Careful standardization of scaling methods, sensitivity analyses, and data preprocessing are essential to mitigate this weakness and ensure more robust and equitable supplier evaluations.

4. CONCLUSION

We have achieved our primary aim by successfully implementing the FMADM and SAW methodologies within our furniture trading company's Supplier Ranking System. The System features three primary user actions: Login, Setting Parameters, and Process Decisions. Each use case includes a "Check Validity" step for verification. Furthermore, the Process Decision use case extends to "Show Decision. " This accomplishment has led to an enhanced supplier base with improved.

The dining table prices from suppliers range from 26,250,000 to 27,640,000 Indonesian Rupiah. Suppliers S1, S2, and S3 offer more competitive prices, while S4, S5, S6, S7, and S9 have higher prices. Suppliers S3 and S6 are swift, responding within 1 hour, while S2, S8, and S9 are slower, taking 7 hours to respond. Suppliers, like S1 and S2, charge different fees, often in a specific currency unit. S1 charges 170,000 units, while S3 has the highest fee at 200,000 units, and S2 the lowest at 104,000 units. Finally, each Supplier is evaluated based on a preference score, where a higher score signifies greater preference. Supplier S3 boasts the highest score of 0.90, making it the top-ranked and most preferred Supplier. In contrast, Supplier S4 has a lower score of 0.50, indicating less preference, and is ranked sixth. This ranking reflects the Supplier's desirability in the context of the assessment.

From the User Acceptance Test results assessed by three Users, the System excelled in decision-making processes, with all aspects rated excellently. Overall, the System's core functionalities received high ratings, indicating intense user satisfaction.

5. ACKNOWLEDGEMENTS

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