International Journal of Computer, Network Security and Information System (IJCONSIST)
Vol. 5 No. 2, Maret 2024

Enhanced Decision Making Using Multi Factor Evaluation Process for Innovative Product Selection

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***Abstract*—The process of selecting innovative products can be complex and challenging due to the multiple factors involved. This study explores an enhanced decision-making approach using the Multi-Factor Evaluation Process (MFEP) to assist in selecting the most suitable product among alternatives. The MFEP methodology evaluates products based on various criteria and assigns weightings to each factor according to its significance. In this research, three innovative products—SkyWalker, HORNET, and BPP-4D—are evaluated. The evaluation considers critical performance indicators and calculates a final score for each product. The results indicate that SkyWalker has the highest evaluation score, followed by HORNET and BPP-4D, providing insights into their relative suitability for recommendation. This paper demonstrates the effectiveness of the MFEP in facilitating objective decision-making in the selection of innovative products.**

Keywords—Decision-making; Evaluation criteria; Innovative product selection; Multi-Factor Evaluation Process (MFEP); Product recommendation; Weight assessment; Web-based application

I. INTRODUCTION

In the highly competitive retail industry, determining the most in-demand products is essential for maximizing profitability and maintaining customer satisfaction. To address this challenge, Marvel Aircraft Store has decided to implement a Decision Support System (DSS) using the Multi-Factor Evaluation Process (MFEP) method. A DSS is a computer-based system that assists in decision-making by analyzing large datasets and providing actionable insights [1]. By integrating both qualitative and quantitative factors, a DSS ensures more informed and accurate decision-making processes, particularly in complex scenarios such as product selection.

The MFEP is a structured method for decision-making that evaluates multiple alternatives based on weighted criteria [2]. This method is particularly effective for scenarios that require integrating diverse factors, as it assigns weights to each criterion and calculates scores for alternatives based on their performance in these criteria. In this study, the MFEP method is employed to consider five key factors: price, quality, brand reputation, purchasing power, and customer interest. The primary goal of this DSS is to recommend the most suitable product for inclusion in the Marvel Aircraft Store's inventory. By leveraging this system, the store aims to enhance efficiency in decision-making, optimize inventory management, and ultimately strengthen its market position. Moreover, the DSS will enable the store to identify customer preferences and adjust its marketing strategies accordingly, ensuring higher satisfaction and profitability. This study aims to develop a DSS using the MFEP method to recommend optimal products for inclusion in Marvel Aircraft Store’s inventory. The system is expected to improve decision-making efficiency, prevent inventory imbalances, and enhance customer satisfaction and store profitability.

The research is guided by the following questions: What factors should be considered to determine the most in-demand products at Marvel Aircraft Store? How can a DSS integrate qualitative and quantitative factors for effective decision-making? How can the DSS optimize inventory management and prevent overstock or understock situations? In what ways can the DSS enhance the store’s efficiency and competitiveness in the market? The objectives of this study include the development of a DSS using the MFEP method to assist Marvel Aircraft Store in selecting products, improving decision-making efficiency, optimizing inventory management, and strengthening its market position. The study also explores how a DSS can provide strategic insights to boost profitability and customer satisfaction. The implementation of a DSS using MFEP offers several benefits. It streamlines the decision-making process, simplifies the evaluation of multiple criteria, and ensures that the chosen products align with customer preferences. Furthermore, it helps prevent inventory imbalances, reduces operational inefficiencies, and enhances the store's ability to compete in a dynamic retail environment. By employing the MFEP method, this study contributes to the growing body of research on DSS applications in the retail industry. The findings aim to provide valuable insights for retailers seeking to leverage data-driven approaches to improve their operations and customer satisfaction [3].

The Multi-Factor Evaluation Process (MFEP) method was used in the study conducted by Tambunan, Sovia, and Safitri to evaluate aluminum metal quality based on various criteria, with the results identifying Blue Sky Aluminum as the best option with a preference value of 100 [4]. This study applies the Multi-Factor Evaluation Process (MFEP) method to evaluate suppliers based on multiple criteria such as price, quality, and delivery time, with Cirebon Mega Bangunan (CMB) achieving the highest evaluation score of 0.86 [5]. The Multi-Factor

Evaluation Process (MFEP) method was chosen for its ability to streamline the decision-making process and enhance data validation, ensuring consistency between leasing companies and dealers [6]The study conducted by Purnama used the Multi-Factor Evaluation Process (MFEP) method to assist in determining eligible students for the Poor Student Assistance (BSM) program, considering factors such as KIP, student values, parental income, and other criteria [1].The study by Suryani et al. utilized the Multi-Factor Evaluation Process (MFEP) method to efficiently elect the Student Executive Board President, considering criteria such as communication skills, leadership attitude, and organizational experience, with candidate A7 ranking highest with a score of 4.35 [7].

[8] discussed the use of the Multi-Factor Evaluation Process (MFEP) method in employee performance appraisal, emphasizing its importance in selecting high-performing employees through pairwise comparison to achieve optimal decision-making in organizational management. With the continuous advancement of business intelligence technology, Decision Support Systems (DSSs) have become integral in marketing decision-making. In China, research in this area is still developing, with marketing decision support systems facing challenges such as data integration and analysis. This article discusses the application of data mining, OLAP, and data warehouse technology in DSSs for marketing. A marketing decision support system using BP neural networks for forecasting was designed, with sales time, product price, and customer purchasing power as inputs, and sales volume as the output. The test results showed a prediction accuracy of 84.87% with an average absolute percentage error of 15.13%. This system helps enhance marketing decision-making by providing scientifically informed analyses, offering new insights to decision-makers, and contributing to system improvement [3].

Decision Support Systems (DSS) can significantly aid farmers in making informed decisions for effective weed management. These systems can recommend the appropriate herbicides and suggest optimal dosage rates for herbicide applications, leading to eco-friendly and profitable weed control strategies. By reducing herbicide use, DSSs contribute to more sustainable farming systems. However, farmers' varying expectations and practices make it challenging to encourage DSS adoption. Accurate weed assessments are essential for DSSs, but capturing the necessary data can be difficult. Future DSS developments should focus on enhancing weed management strategies that are less dependent on herbicides and consider weed seedbank dynamics for long-term management across different seasons. Further research is needed to optimize DSSs for various crops, soil, and climatic conditions [2]

[9]developed an expert system using the Naive Bayes method to help users select skincare products based on their skin type. The system, tested with 30 customer data points, achieved a 100% accuracy rate in matching skincare products to users' needs. [10] developed a web-based expert system using the Forward Chaining method to facilitate early diagnosis and treatment of anxiety disorders in people with disabilities. Tested with 15 patients, the system achieved 100% accuracy, proving effective in areas with limited access to mental health services. [11] developed NomophobiCare, a web-based expert system using the Certainty Factor method to address the negative impact of smartphone addiction. The system was tested with 10 student respondents, achieving accuracy consistent with manual calculations and expert knowledge representation. User Acceptance Testing (UAT) showed an average acceptance rate of 96.4%, reflecting high user satisfaction. This system helps identify early signs of nomophobia and provides preventive measures to manage smartphone dependency.

The quality of human resources plays a crucial role in an organization's progress. Rumah Zakat, a major non-profit in Indonesia, has been transforming its work culture since 2017. However, there was no system to support real-time 360 Degree Feedback assessments of work culture. To address this, a web-based Decision Support System (DSS) was developed using the Multifactor Evaluation Process (MFEP) method, enabling objective evaluations based on defined criteria for each employee rank. In the first semester of 2019, 68.4% of respondents exceeded the standard, while 22% met it [1].

In selecting the best employees, performance metrics such as craft, discipline, and achievements are considered. This study uses a dataset from IBM Analytics, consisting of 29 features and 22,005 samples, to build a system for predicting employee attribution. Various machine learning algorithms, including KNN, Naïve Bayes, Decision Tree, Random Forest, and ensemble techniques like stacking and bagging, were tested. The Random Forest classifier produced the best results, achieving an accuracy of 0.88, comparable to stacking and bagging methods [12].

Previous studies have demonstrated the effectiveness of MFEP in various contexts, including supplier selection, scholarship eligibility, leadership evaluation, and employee performance assessment . This study contributes to the growing body of knowledge on DSS applications in the retail sector by demonstrating how MFEP can support product selection decisions. Through this approach, Marvel Aircraft Store aims to align its inventory with market demands and customer preferences, resulting in improved satisfaction and profitability.

II. METHOD

A. Data

The data used in this study consists of product specifications and evaluation results aimed at selecting the best new product to be introduced at the Marvel Aircraft Store. Five evaluation criteria were selected—price, quality, brand reputation, purchasing power, and customer interest—based on their relevance to both customer preferences and the store's strategic goals in offering competitive and desirable products.

Data collection was carried out using a mixed-method approach, combining both primary and secondary sources. Primary data was gathered through structured interviews and questionnaires distributed to Marvel Aircraft Store staff, including sales managers and procurement officers. These respondents provided insights on sales trends, customer preferences, and assessments of existing product brands. Secondary data was obtained from reliable sources such as official manufacturer websites, product brochures, and ecommerce platforms, which provided detailed technical specifications and pricing information for each product.

The three product alternatives analyzed in this study are the T-Motor BPP-4D, Hobbywing SkyWalker, and HtiRC HORNET. These products were selected based on market availability, relevance to store needs, and potential customer demand.

Each product was evaluated using the Multi-Factor Evaluation Process (MFEP), a structured decision-making method that assigns weights to each criterion and scores each product accordingly. The weights and scores were derived from expert judgment and respondent feedback to ensure an objective, data-driven evaluation process.

The dataset includes three product alternatives and five decision-making criteria. Detailed information on the evaluation scores and assigned weights is presented in Table 1 and Table 2. This structured approach supports a transparent and systematic product selection process by considering multiple relevant factors to identify the most suitable product.

TABLE I. Alternatives

Code	Alternatives Name
A1	T-Motor BPP-4D
A2	Hobbywing Skywalker
A3	HtiRC Hornet

TABLE II. Criteria Dataset

Code	Criteria	Weight
C1	Price	0.35
C2	Quality	0.2
C3	Brand Reputation	0.1
C4	Purchasing Power	0.2
C5	Customer Interest	0.15
Total		1

The selection of these five criteria is based on their direct relevance to both consumer behavior and strategic business considerations in the retail drone component industry. Price (C1) holds the highest weight (0.35) due to its critical role in influencing purchasing decisions, especially in a competitive market where customers often seek the best value for money. Quality (C2) is equally essential as it determines product performance, durability, and overall customer satisfaction, which in turn affects repeat purchases and brand loyalty.

Brand Reputation (C3), although weighted lower, contributes to perceived product reliability and trustworthiness. Well-known brands often benefit from established consumer confidence, which can influence decision-making even in the presence of similar specifications. Purchasing Power (C4) reflects the store's ability to procure and maintain inventory based on budget constraints and expected return on investment, making it vital for operational sustainability.

Lastly, Customer Interest (C5) represents market demand and preference trends. It is included to ensure that the product selected aligns with what customers are actively seeking, thereby increasing the likelihood of successful sales. Together, these criteria offer a comprehensive basis for evaluation that balances financial, operational, and market-driven factors.

From Table 1 and Table 2, it can be inferred that the dataset includes a combination of categorical (nominal) and numerical data. The categorical data represents qualitative aspects, such as the names of product alternatives and criteria like brand reputation and customer interest. The numerical data comprises quantitative evaluations including price, quality scores, and weight assignments used in the decision-making process.

In the following step, the data will undergo preprocessing to ensure it is ready for analysis using the Multi-Factor Evaluation Process (MFEP). This step involves normalizing and standardizing the scores to make them comparable across all criteria. Additionally, the criteria weights will be properly aligned to reflect their relative importance in the decision-making process. This preprocessing phase is critical for ensuring that the evaluation is both consistent and reliable, leading to an objective and data-driven selection of the best alternative.

The Multi-Factor Evaluation Process (MFEP) method is a decision-making framework that systematically evaluates alternatives based on multiple factors. The first step in applying the MFEP method involves identifying the factors essential for the decision-making process, which are then assigned weights. These weights must sum to 1 (Σ weights = 1), reflecting the relative importance of each factor. Once the factors and their respective weights are determined, each alternative is assessed according to the predefined evaluation factors. The evaluation values, ranging between 0 and 1, represent how well each alternative performs in relation to each factor. To calculate the weight evaluation (Nbe) for each alternative, the factor weight (Nbf) is multiplied by the evaluation factor value (Nef). This gives a weighted score for each factor. The total evaluation (Tbe) is then calculated by summing the individual weight evaluations (Nbe) for each factor, resulting in the final score for each alternative. This method ensures that decisions are made based on objective assessments of the alternatives, with the final choice reflecting the highest cumulative evaluation. Formula for Weight Evaluation (Nbe) as shown in (1).

$$Nbe = Nbf \times Nef \qquad (1)$$

Where:

- *Nbe: Weight Evaluation*
- *Nbf: Factor Weight*
- *Nef: Evaluation Factor Value*

The total evaluation for each alternative is obtained by summing the individual weight evaluations (Nbe). This provides the final score for each alternative. Formula for Total Evaluation (Tbe) as shown in (2):

$$Tbe = Nbe1 + Nbe2 + Nbe3,..+ Nbe(n) \qquad (2)$$

Where:

- Tbe: Total Evaluation
- Nbe: Weight Evaluation for each factor

B. Flowchart

Fig. 1 illustrates a systematic process for evaluating and selecting the best product based on specific criteria. The process begins with the user inputting data related to the sample products under consideration. Next, the relevant variables or criteria for evaluation are provided as input. Following this, the system calculates the weighted evaluation (Nbe) for each product based on the specified criteria. Subsequently, a total evaluation score (Tbe) is computed, enabling the identification of the best product with the highest evaluation score. Finally, the process concludes, having determined the optimal choice among the products. This structured approach ensures a logical and objective evaluation, making it suitable for decision-making in various research or practical applications.

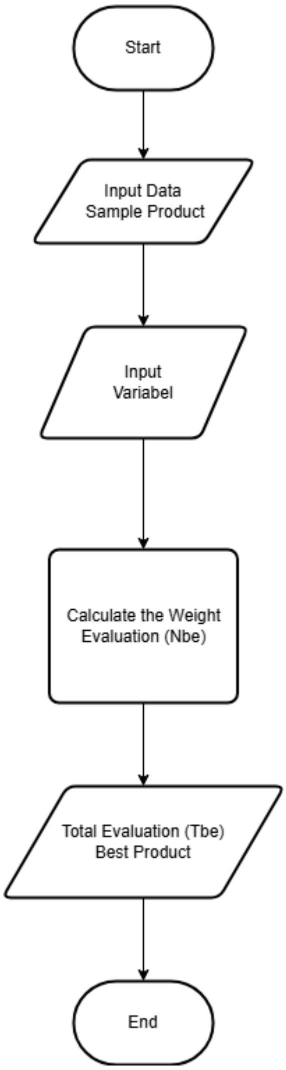


Fig. 1. System Flowchart

Fig. 2 represents a step-by-step process for calculating a total evaluation score based on given data samples, weights, and ratings.The process begins with the initialization of input data, including data samples, variables, weights, and ratings. A counter variable iii is initialized to zero. The process then enters a loop to evaluate each factor. At each iteration, the system checks whether iii has reached the total number of factors. If not, it calculates the current total by adding the product of the weight and rating for the iii-th factor to the overall total. The counter iii is then incremented, and the loop continues. Once all factors have been processed, the system exits the loop and displays the final total evaluation score. The process concludes after presenting the result.

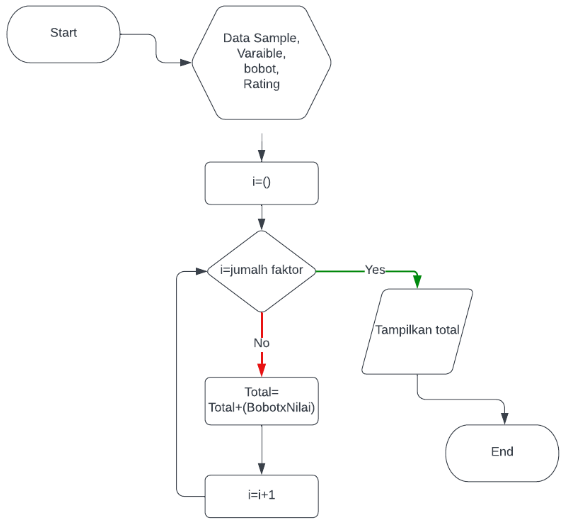


Fig. 2. MFEP Flowchart

III. Result and Discussion

In this section, the results obtained from the calculation process are presented and analyzed to determine their implications and relevance to the objectives of the study.

TABLE III. NEF

NEF					
	C1	C2	C3	C4	C5
A1	2	5	5	2	4
A2	4	4	5	3	3
A3	3	4	4	4	1

The Table 3 presented represents the evaluation values (Nef) for three alternatives (A1, A2, and A3) based on five criteria (C1, C2, C3, C4, and C5). These values were provided by stakeholders and reflect how well each alternative meets the criteria on a scale, where higher values indicate better performance. For instance, in criterion C1, Alternative A2 scored the highest with a value of 4, while Alternative A1 scored the lowest at 2. Similarly, for criterion C2, Alternative A1 outperformed the others with a value of 5. Criterion C3 shows that both A1 and A2 achieved a perfect score of 5, while A3 scored 4. For criterion C4, the values are more varied, with A2 scoring 3, while A1 and A3 both received lower scores of 2 and 4, respectively. Finally, in criterion C5, A1 scored the highest with a value of 4, while A3 received the lowest score of 1. These evaluations from stakeholders will later be used in the MFEP method to calculate the overall performance of each alternative.

TABLE IV. NBF

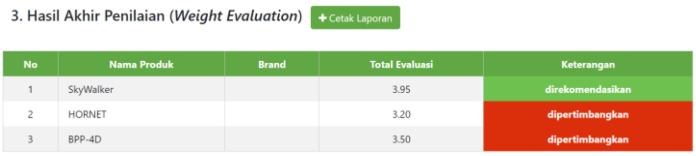
NBF	0,35	0,2	0,1	0,2	0,15

The Table 4, now provides the factor weights (Nbf) for each of the five criteria (C1, C2, C3, C4, C5). These weights represent the relative importance of each criterion in the decision-making process, and the sum of these weights equals 1 (Σ Nbf = 1). According to the table, criterion C1 has the highest weight of 0.35, indicating that it is the most important factor in evaluating the alternatives. Criterion C2 follows with a weight of 0.20, suggesting it holds significant importance as well, while criteria C4 and C5 both have a weight of 0.20 and 0.15, respectively. Criterion C3 has the lowest weight of 0.10, implying that it is the least influential factor in the decision-making process. These factor weights will be used in combination with the evaluation values (Nef) from the stakeholders to calculate the final decision-making results.

TABLE V. NBE

NBE						TBE
A1	0,7	1	0,5	0,4	0,6	3,2
A2	1,4	0,8	0,5	0,6	0,45	3,95
A3	1,05	0,8	0,4	0,8	0,15	3,50

The Table 5 the weight evaluations (Nbe) and the total evaluations (Tbe) for three alternatives (A1, A2, A3) based on the factors C1, C2, C3, C4, and C5. The Nbe values represent the weighted score for each alternative under each criterion, calculated by multiplying the factor weight (Nbf) with the evaluation factor value (Nef). Based on the total evaluation scores (Tbe), alternative A2 has the highest score of 3.95, making it the most recommended choice among the three alternatives, followed by A3 with a score of 3.50, and A1 with a score of 3.2. This evaluation process helps in identifying the best alternative based on the given criteria and their respective weights.


3. Hasil Akhir Penilaian (*Weight Evaluation*) + Cetak Laporan

No	Nama Produk	Brand	Total Evaluasi	Keterangan
1	SkyWalker		3.95	direkomendasikan
2	HORNET		3.20	dipertimbangkan
3	BPP-4D		3.50	dipertimbangkan

Fig. 3. Result on Application

Fig. 3 displays the final results of the weight evaluation for three different products: SkyWalker, HORNET, and BPP-4D. The statistical results from the Multi-Factor Evaluation Process (MFEP) clearly demonstrate the effectiveness of using weighted criteria for product selection. The final scores show SkyWalker (A2) as the top product with a score of 3.95, followed by HtiRC HORNET (A3) with 3.50, and T-Motor BPP-4D (A1) with 3.20. These scores reflect the products' performance across five criteria: price, quality, brand reputation, purchasing power, and customer interest. The "Keterangan" column provides additional remarks for each product, indicating whether they are recommended or should be reconsidered based on their scores. SkyWalker is marked as "direkomendasikan" (recommended), while both HORNET and BPP-4D are labeled as "dipertimbangkan" (to be reconsidered). These results align with the manual calculations performed earlier, confirming the accuracy of the web application's implementation.

The use of the Multi-Factor Evaluation Process (MFEP) in this study highlights its effectiveness in making data-driven decisions by considering both quantitative (price and quality) and qualitative (brand reputation and customer interest) criteria. This balanced approach ensures that product selection is based on comprehensive, objective analysis, reducing bias and promoting transparency.

For organizations like Marvel Aircraft Store, MFEP helps align product selection with strategic priorities. By adjusting the weights of each criterion, the store can tailor its decision-making to its goals, whether that's cost efficiency or brand differentiation. In this study, the highest-scoring product, SkyWalker, demonstrates a strong alignment with the store's business objectives and customer preferences, suggesting it is the optimal choice for maximizing customer satisfaction and sales.

Additionally, the web-based implementation of MFEP makes the evaluation process accessible and efficient, allowing stakeholders from various departments to contribute and collaborate. This improves decision-making speed and communication across teams.

Overall, MFEP offers significant value beyond individual product selection. It fosters systematic, data-driven decision-making, promoting smarter, more transparent choices. Over time, it can help organizations refine their evaluation processes, adapt to market changes, and gain a competitive edge in selecting the best products.

IV. Conclusion

The application of the Multi-Factor Evaluation Process (MFEP) for selecting innovative products has proven to be an effective method for objective and data-driven decision-making. The final evaluation results indicate that SkyWalker, with a score of 3.95, is the most recommended product, demonstrating its overall superiority based on the established criteria. Meanwhile, HORNET and BPP-4D, with scores of 3.20 and 3.10 respectively, are categorized as products that should be reconsidered.These results not only validate the reliability of the scoring system but also confirm the accuracy of the evaluation process when implemented through a web-based application. The MFEP method thus provides a consistent and structured approach for organizations aiming to select the most suitable innovative products. Furthermore, the findings underscore the importance of using a systematic evaluation framework that considers multiple relevant factors. This approach enhances transparency, reduces bias, and supports more rational and strategic decisions. By adopting MFEP, organizations can significantly improve the quality of their product selection processes, leading to better outcomes and long-term success. In conclusion, MFEP stands out as a valuable tool for organizations seeking to enhance their decision-making capabilities. Its structured methodology ensures that product evaluations are comprehensive, fair, and aligned with organizational goals ultimately contributing to more effective innovation and competitive advantage.

ACKNOWLEDGMENT

The authors would like to thank all contributors who supported the development of this research, especially those involved in data collection and system implementation at Marvel Aircraft Store. Special thanks are also extended to the academic supervisors and technical advisors whose guidance was invaluable throughout the study. This work would not have been possible without their continuous support and constructive feedback.

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