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Implementation of Web-Based Loan Application Information System Using Simple Additive Weighting (SAW) at CV. Taruna Jaya Nusantara

William Jeans Tambunan *
PJJ Informatics, Universitas Siber Asia, South Jakarta City, Special Capital Region of Jakarta, Indonesia.
Corresponding Email: william.tambunan14@gmail.com.

Ucuk Darusalam
PJJ Informatics, Universitas Siber Asia, South Jakarta City, Special Capital Region of Jakarta, Indonesia.
Email: ucuk.darusalam@gmail.com.

Catur Nugroho
PJJ Informatics, Universitas Siber Asia, South Jakarta City, Special Capital Region of Jakarta, Indonesia.
Email: caturnugroho@lecturer.unsia.ac.id.

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Abstract: Financial institutions offer cash loans with lighter terms and collateral compared to banks, including motor vehicle ownership as collateral. This study focuses on implementing a web-based Loan Application Information System using the Simple Additive Weighting (SAW) method at CV. Taruna Jaya Nusantara. The research aims to enhance the efficiency of the loan application process and evaluate loan feasibility. The system development method is integrated with web technology, with SAW used to measure relevant criteria. Implementing the Loan Application Information System with SAW significantly simplifies decision-making, reduces potential errors, and improves loan feasibility evaluation. Based on the ranking results, V1 = 1.9; V2 = 1.779; V3 = 2.0625. The selection process uses a tolerance limit for acceptance, where the accepted value threshold is set at > 2. Thus, it can be concluded that A3 with a value of 2.0625 meets the criteria for recommendation.

Keywords: Web-Based Loan Application; Simple Additive Weighting (SAW) Method; Financial Institutions; Loan Feasibility.

1. Introduction

Current technological developments can significantly advance critical needs within a company. With the rapid evolution of technology, businesses benefit immensely from the ability to implement systems that streamline operations and facilitate business growth [1]. When properly developed and applied through information technology, organizing and processing data and information to enhance decision-making can provide substantial advantages. These advantages include improved data processing capabilities that can aid in making informed decisions, particularly in the business sector related to lending funds to customers [2]. CV. Taruna Jaya Nusantara Bekasi, a financial institution, provides cash loan services to its customers, similar to banking institutions, using vehicle BPKB (Vehicle Registration Certificates) as collateral. The loans offered by this institution are relatively large, with conditions and guarantees that are lighter than those required by banks, including using motor vehicle ownership as collateral [3]. However, the current service process for loan applications at CV. Taruna Jaya Nusantara Bekasi is based on an offline system. The existing procedure involves customers manually submitting data, often resulting in backlogs and delays in the borrower data verification process. Consequently, this leads to a significant amount of customer data that decision-makers cannot quickly verify, causing inefficiencies in the loan approval process.

There is a pressing need to implement a more robust system that can handle data management and decision-making more effectively to address these inefficiencies. A decision support-based information system incorporating ranking and weighting methods can significantly improve the service process. Applying the Simple Additive Weighting (SAW) method, a weighted summation method that evaluates the rating of each alternative across all attributes, the feasibility of loan applications can be assessed more accurately. The SAW method is particularly suitable as it systematically evaluates various criteria influencing loan eligibility [4][5]. The primary objective of this research is to develop and implement a web-based Loan Application Information System at CV. Taruna Jaya Nusantara Bekasi using the SAW method. This system aims to enhance the efficiency of the loan application process by providing a more streamlined and automated approach to data processing and decision-making. The SAW method evaluates multiple criteria, such as documentation, collateral, employment status, and dependents, to determine the eligibility of loan applicants. By processing these criteria through the decision support system, the SAW method facilitates accurate and reliable recommendations for loan approvals [6]. In the current offline system, the loan application process involves manual calculations and data verification, which are prone to errors and delays. The proposed web-based system will automate these processes, thereby reducing potential errors and improving the speed and accuracy of loan feasibility evaluations. This system will also be accessible online, allowing for greater flexibility and scalability, especially if new branches are opened. Implementing this system will provide significant operational efficiency and customer satisfaction benefits.

Furthermore, the research involves developing a comprehensive framework for the Loan Application Information System, integrating it with web technology to ensure it meets the security and performance standards required in today's business environment. The use of the SAW method as a decision-making tool is based on the need for an objective and measurable assessment of relevant criteria in the loan application process. The ranking results obtained from the SAW implementation (V1 = 1.9; V2 = 1.779; V3 = 2.0625) will provide a solid basis for selecting customers eligible for loans. The selection process will employ a tolerance limit for acceptance, ensuring that only customers meeting the predefined criteria are recommended for loan approval. Developing and implementing a web-based Loan Application Information System using the SAW method at CV. Taruna Jaya Nusantara Bekasi aims to address current inefficiencies in the loan application process. By enhancing data processing capabilities and automating decision-making, the proposed system will significantly improve operational efficiency and customer service, contributing to the overall competitiveness of the institution in the financial market.

2. Research Method

The development of this science system uses the Prototype method, a form of paradigm in software development in system development that uses a measurable approach to creating a program quickly and gradually so that the user can immediately evaluate it [7]. Gathering system requirements involves customers jointly defining the requirements for making the system software development. After that, the process continues with building a temporary designed prototyping, focusing on demonstrating data to customers. Evaluation of prototyping is carried out to ensure whether the prototyping that has been made meets the needs set by the customer. The data collected during this research process was carefully compiled, providing

the information's accuracy, regularity and quality. The data collection process was carried out through several different methods. First, the observation method is used, where researchers directly observe the loan application process carried out by CV. Taruna Jaya Nusantara at Harapan Indah Housing, West Bekasi. This method provides an in-depth understanding of field practices that occur directly. Second, with the Interview Method, researchers interact directly with various company-related parties. Researchers can gain valuable insight into the loan application system and potential problems by asking relevant questions. Third, through the Literature Study Method, researchers conduct in-depth studies using references from trusted journals, books and internet sources. By exploring information from various sources, researchers can broaden their insights and support the analysis in this research. Combining these three methods, the data collected is complete and high quality, allowing for in-depth analysis and accurate research results. The line research stages also develop the research framework, which is the research activities carried out in a planned, orderly, and systematic manner to achieve goals. The course of this research is divided into four phases, namely: (1) Intelligence, (2) Design, (3) Selection, and (4) Implementation and Solution. It can be seen in Figure 1 [8].

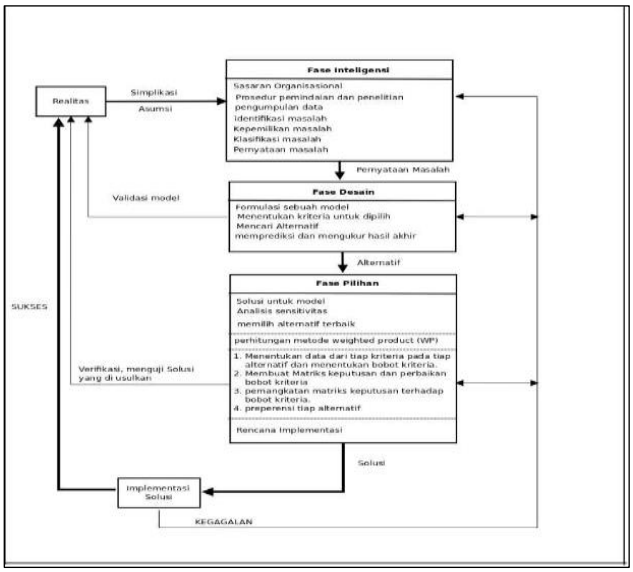

Figure 1. Flowchart of Decision-Making Stages

The explanation of the theoretical analysis starts with false intelligence, the design phase, the choice phase and the implementation of the solution. The intelligent phase is the phase in decision-making. Intelligence includes a variety of activities that emphasize the identification of problem situations or opportunities. In the research, data collection was carried out through (a) observation, interview, and (b) literature study. The design phase includes discovering, developing, and analyzing possible actions to be carried out. In the problem described in the intelligence stage, the need for a system can help users determine appropriate loan proposals in applying for loans that have the highest value quickly, precisely and efficiently with consideration of the criteria that have been chosen, so for the case of selecting the best customer based on multiple attributes. Decision Making (MADM) using the Simple Additive Weighting (SAWl) method. The solution steps are as follows:

1) Determine the criteria used to guide decision making, namely: C1 = Documents, C2 = Collateral, C3 = Employment, C4 = Dependents.
2) the assessment criteria used in the system, as in Table 1.

Table 1. Assessment Criteria

Criteria	Criterion Name	Characteristic
C1	Document	Benefit
C2	Guarantee	Benefit
C3	Work	Benefit
C4	Dependents	Cost

Determine the suitability rating of each alternative for each criterion and the importance and weight of the requirements. Rating the suitability of each alternative based on each criterion using the Likert scale. The choice phase is when an actual decision is made, and a commitment is taken to follow a particular course of

action. Calculating the Simple Additive Weighting (SAW) method is crucial in the Choice Phase. This process involves several stages, including determining the suitability rating of each alternative for each criterion. Next, the decision matrix X is prepared after being converted using fuzzy numbers. The decision maker then assigns weight to each criterion based on its level of importance. The decision matrix X is formed from the prepared match table. The next step is to normalize the decision matrix R based on the matrix X to calculate the value of each criterion using a predetermined equation.

$$r_{ij} = \begin{cases} \dfrac{X_{ij}}{Max\ X_{ij}} & If\ J\ is\ a\ profit\ attribute\ (Benefit) \\ \dfrac{Min_i^{Xij}}{X_{ij}} & If\ J\ is\ the\ cost\ attribute\ (Cost) \end{cases}$$

This normalization process is also presented in Figure 2, which illustrates Decision Matrix Normalization. The final step is the ranking process, where the results of multiplying the normalized matrix R with the weight vector (W * R) are added up. This stage allows for ranking each alternative based on previously established criteria. By carrying out this series of stages systematically, SAW can provide accurate and reliable results in the decision-making process. The Implementation Phase is an essential stage in the system development process. At this stage, the system design prepared in the design phase is implemented, and alternative actions selected in the selection phase are carried out. The success or failure of this System is then assessed based on the results obtained. Implementation involves various aspects, including designing the user interface and preparing the System using the Unified Modeling Language (UML). The system design was realized using the PHP and MySQL programming languages and continued with a testing process to ensure good application performance. After the implementation and testing stages are complete, conclusions related to application design can be drawn. One example of implementation and solution that can be illustrated is using a Flowchart System as a visualization and understanding tool for the workflow of the System being created.

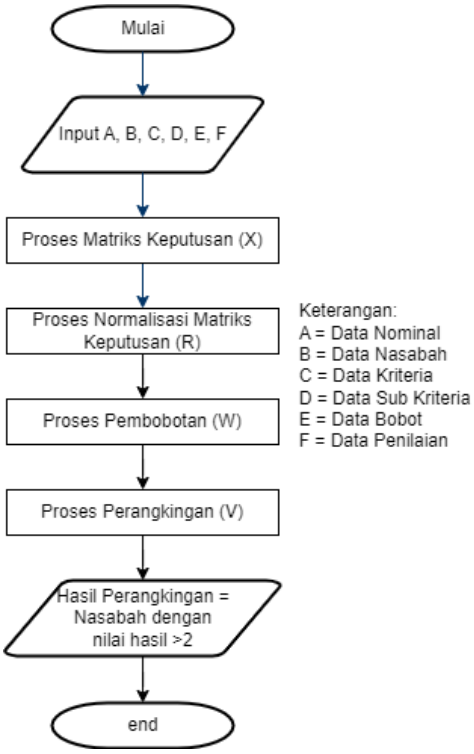

Figure 2. System Flowchart

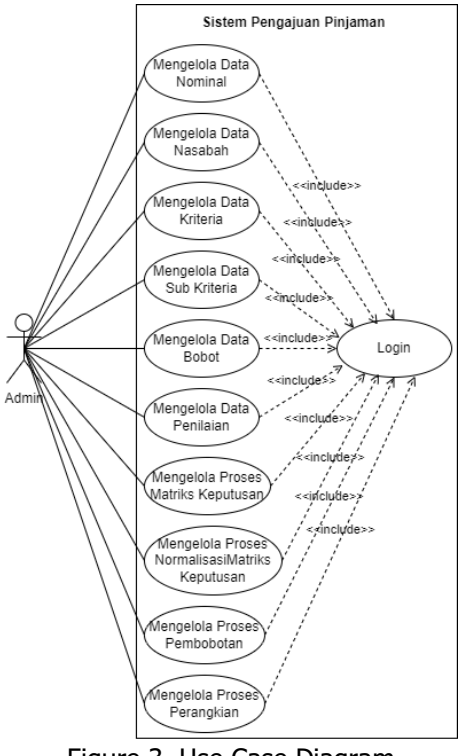

Figure 3. Use Case Diagram

Figure 2 is a system flowchart that is a visual guide to illustrate the process or steps in the system workflow. Figure 3 is a Use Case Diagram that briefly overviews the application user and what the user can do. The user login page is the first page that appears on the system. Each user is required to fill in a username and password to be able to enter the system. Figure 5 shows the implementation of the login page.

3. Result and Discussion

3.1 Results

This research aims to develop an application that allows users to place orders online via Android while enabling the service to confirm customer orders efficiently. This application consists of several main pages, starting with the login page. The user interface for performing assessments can be seen in Figure 4. The login page is the first screen that appears when the system is accessed. Each user must enter their username and password to access the system. Figure 4 illustrates the implementation of the login page.

Figure 4. Login page

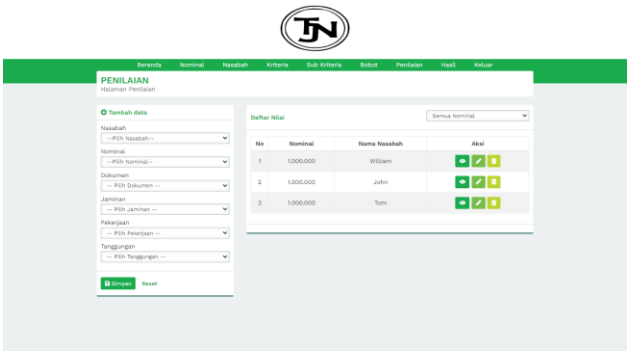

Figure 5. Assessment Page

In this calculation, the author uses the Simple Additive Weighting (SAW) method to evaluate alternative loan applications based on the following criteria:
C1 = Document (Benefit)
C2 = Guarantee (Benefit)
C3 = Work (Benefit)
C4 = Dependents (Cost)

Three customer data will be selected as examples of calculations using the system, as shown in the manual data examples in Table 2.

Table 2. Assessment Data

Alternative	Criteria			
	C1	C2	C3	C4
A1	2	3	4	1
A2	3	5	3	3
A3	5	5	3	2

l For each criterion used, all will be given a weight value. The decision maker assigns weight to each criterion based on CV considerations. Taruna Jaya Nusantara with examples:

$$Weight\ vector\ W\ =\ [0,5 \mid 0,75 \mid 0,75 \mid 0,5]$$

Create a decision matrix X which is arranged based on the assessment table above:

$$X = \begin{bmatrix} 2 & 3 & 4 & 1 \\ 3 & 5 & 3 & 3 \\ 5 & 5 & 3 & 2 \end{bmatrix}$$

From the decision matrix above, a normalization process for the decision matrix XL is carried out with the following calculations:

$$r_{11} = \frac{2}{\max\{2,3,5\}} = \frac{2}{5} = 0{,}4$$

$$r_{12} = \frac{3}{\max\{2,3,5\}} = \frac{3}{5} = 0{,}6$$

$$r_{13} = \frac{5}{\max\{2,3,5\}} = \frac{5}{5} = 1$$

$$r_{21} = \frac{3}{\max\{3,5,3\}} = \frac{3}{5} = 0{,}6$$

$$r_{22} = \frac{5}{\max\{3,5,3\}} = \frac{5}{5} = 1$$

$$r_{23} = \frac{5}{\max\{3,5,3\}} = \frac{5}{5} = 1$$

$$r_{31} = \frac{4}{\max\{4,3,3\}} = \frac{4}{4} = 1$$

$$r_{32} = \frac{3}{\max\{4,3,3\}} = \frac{3}{4} = 0{,}75$$

$$r_{33} = \frac{3}{\max\{4,3,3\}} = \frac{3}{4} = 0{,}75$$

$$r_{41} = \frac{\min\{1,3,2\}}{1} = \frac{1}{1} = 1$$

$$r_{42} = \frac{\min\{1,3,2\}}{3} = \frac{1}{3} = 0{,}333$$

$$r_{43} = \frac{\min\{1,3,2\}}{2} = \frac{1}{2} = 0{,}5$$

Then the normalized matrix lR is obtained, the following are the results:

$$R = \begin{bmatrix} 0{,}4 & 0{,}6 & 1 & 1 \\ 0{,}6 & 1 & 0{,}75 & 0{,}333 \\ 1 & 1 & 0{,}75 & 0{,}5 \end{bmatrix}$$

Next, a calculation process is carried out to find the final value (LV value) which is obtained from the total weight calculation results (lW) multiplied by the normalized matrix (Rl).

A_1 = (0, 5 x 0, 4) + (0, 75 x 0, 6) + (0, 75 x 1) + (0, 5 x 1) = 1, 9
A_2 = (0, 5 x 0, 6) + (0, 75 x 1) + (0, 75 x 0, 75) + (0, 5 x 0,333) = 1,779
A_3 = (0, 5 x 1) + (0, 75 x 1) + (0, 75 x 0, 75) + (0, 5 x 0, 5) = 2, 0625

Based on the ranking results that have been obtained, namely V1 = 1.9; V2 = 1.779; V3 = 2.0625. This is followed by a selection process using a tolerance limit for accepting applications, where the accepted value limit is set at > 2. Thus, it can be concluded that A3 with a value of 2.0625 meets the requirements to be recommended. Next, an example of the system display to see the ranking results can be seen in Figure 6.

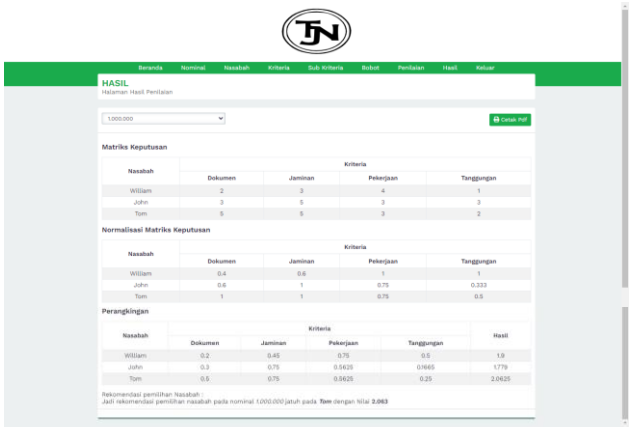

Figure 6. Ranking Results Page

This research successfully demonstrates the development of a web-based loan application information system using the Simple Additive Weighting (SAW) method at CV. Taruna Jaya Nusantara. This system allows users to place loan applications online via Android, and the service can efficiently confirm customer orders. The application comprises several vital pages, starting with the login page, where users enter their credentials to access the system, followed by an assessment page that evaluates loan applications based on predefined criteria. The SAW method evaluates alternative loan applications using criteria such as Document, Guarantee, Work, and Dependents, each assigned a specific weight. The decision matrix is normalized, and the final values are calculated, resulting in a ranked list of applicants. Based on these rankings, the system's decision-making process ensures that only applicants who meet the criteria are recommended for loans, with A3 being the recommended applicant in this study due to its highest score. Implementing this system addresses the inefficiencies of the previous offline, manual process, significantly improving the accuracy and speed of loan feasibility evaluations. The new system streamlines operations and enhances customer service by providing timely and reliable decisions. This research contributes to the broader field of financial technology by showcasing how decision support systems and web-based applications can optimize business processes and improve service delivery. The positive outcomes of this project highlight the potential for similar implementations in other financial institutions seeking to modernize their loan processing systems.

3.2 Discussion

The development and implementation of the web-based Loan Application Information System using the Simple Additive Weighting (SAW) method at CV. Taruna Jaya Nusantara present several critical points of discussion. Firstly, the transition from an offline, manual process to an online, automated system marks a significant improvement in operational efficiency. Previously, the loan application process involved manual data entry and verification, which was time-consuming and prone to errors. The new system eliminates these inefficiencies by automating data processing and decision-making, resulting in faster and more accurate loan assessments. The use of the SAW method for evaluating loan applications is particularly noteworthy. This method allows for a systematic and objective evaluation of multiple criteria, such as Document, Guarantee, Work, and Dependents. By assigning specific weights to each criterion, the SAW method ensures that the evaluation process is transparent and consistent. The normalization and ranking processes further enhance the accuracy of the assessments, as demonstrated by the calculated values (V1 = 1.9; V2 = 1.779; V3 = 2.0625). The system's ability to determine the most eligible applicant based on these rankings, with A3 being the recommended candidate, underscores the effectiveness of the SAW method in making informed decisions.

Another important aspect of this discussion is the user experience. The application is designed with user-friendly interfaces, starting with the login page, which ensures secure access to the system. The assessment page and other subsequent pages are intuitively designed to facilitate ease of use, thereby enhancing user satisfaction. Accessing the system online provides flexibility and convenience for both the customers and the service providers. Moreover, the implementation of this system aligns with the broader trend of digital transformation in the financial sector. By adopting web-based technologies and decision support systems, CV. Taruna Jaya Nusantara improves its internal processes and positions itself competitively in the market. This shift towards digital solutions is essential in today's fast-paced business environment, where the ability to quickly adapt to technological advancements can significantly impact an organization's success. However, transitioning to an online system also brings challenges, such as ensuring data security and managing user acceptance. It is crucial to implement robust security measures to protect sensitive customer

information from potential cyber threats. Additionally, comprehensive training and support must be provided to users to facilitate a smooth transition and to maximize the benefits of the new system. The highlights the transformative impact of implementing a web-based Loan Application Information System using the SAW method at CV. Taruna Jaya Nusantara. The new system not only enhances efficiency and accuracy in loan processing but also aligns with the digital transformation goals of the organization. By addressing potential challenges and continuously improving the system, CV. Taruna Jaya Nusantara can achieve sustainable growth and provide superior service to its customers.

4. Related Work

Developing and implementing systems (DSS) and web-based applications in financial institutions have been widely researched and documented. Various studies have highlighted the advantages of using such systems to enhance decision-making processes and improve operational efficiency. Widyastuti and Kurnianda (2019) discuss designing a web-based loan application system using the Simple Additive Weighting (SAW) method. Their research emphasizes the importance of utilizing SAW for evaluating multiple criteria in loan applications, ensuring a transparent and objective decision-making process [1]. This study provides a foundation for understanding the practical application of SAW in financial institutions and highlights the method's effectiveness in improving loan assessment accuracy. Rahmanto (2021) presents a case study on developing a management information system for cooperatives using web engineering techniques. The study demonstrates how integrating web technologies into traditional systems can streamline operations and facilitate better data management. Rahmanto's research underscores the need for financial institutions to adopt modern technological solutions to remain competitive and efficient [2]. Mare and Yana (2022) focus on the design of a web-based information system for a savings and loan cooperative. Their research outlines the development process and the benefits of using web-based applications to manage loan applications and customer data. The study illustrates the positive impact of such systems on operational efficiency and customer satisfaction, reinforcing previous research findings [3]. Syukron *et al*. (2023) explore the application of the prototype method in designing a web-based information system for cooperatives. Their research highlights the iterative nature of the prototype method, which allows for continuous user feedback and system improvement. This approach ensures that the final system meets user requirements and performs effectively in a real-world setting [4]. Yuswardi *et al*. (2022) investigate using decision support systems in information technology. Their study emphasizes the role of DSS in enhancing decision-making processes in various sectors, including finance. Financial institutions can achieve more accurate and reliable decisions by applying DSS methodologies such as SAW, improving overall business performance [5]. Khoirudin *et al*. (2022) examine implementing a decision support system for motor vehicle loan eligibility using the SAW method. Their research demonstrates how SAW can be applied to assess loan applications based on specific criteria, providing a robust framework for making informed decisions. This study further validates using SAW in financial decision-making and highlights its practical applications [6]. Farina *et al*. (2021) discuss developing an information system for loan applications in a cooperative setting. Their research focuses on the integration of web-based technologies to enhance the efficiency of loan processing and data management.

The findings indicate that web-based systems significantly improve operational workflows and reduce the potential for errors [7]. Maria and Purnomo (2019) present a case study using the SAW method for credit application assessment at Bank BPD DIY. Their research provides insights into the practical application of SAW in banking, demonstrating its effectiveness in evaluating multiple criteria and making objective decisions [8]. Saputri and Eriana (2022) explore implementing the waterfall methodology in designing a web-based Android application for a savings and loan cooperative. Their study emphasizes the structured approach of the waterfall method, ensuring that each development phase is thoroughly completed before moving to the next. This methodology helps create robust and reliable systems that meet user needs [9]. These studies highlight the benefits of integrating decision support systems and web-based applications in financial institutions. The research underscores the effectiveness of methodologies such as SAW in enhancing decision-making processes and improving operational efficiency. By adopting these advanced technological solutions, financial institutions can better manage loan applications, reduce errors, and provide superior customer service.

Integrating decision support systems (DSS) and web-based applications in financial institutions has significantly enhanced operational efficiency and decision-making processes. Utilizing methods like Simple Additive Weighting (SAW) assists in evaluating relevant criteria for loan applications, ensuring transparency and objective assessments. Recent advances in artificial intelligence (AI) have paved the way for developing intelligent financial decision support systems, incorporating technologies such as genetic programming and

wavelet-based indicators for financial forecasting (Jia *et al.*, 2022; Li *et al.*, 2006)[10][11]. These systems are pivotal in optimizing financial management and enhancing decision-making processes within institutions. Furthermore, the relationship between finance and property rights, particularly in transition economies, has demonstrated a substantial correlation, highlighting the role of financial intermediation in bolstering property rights (Hartwell, 2017)[12]. This underscores the interconnectedness between financial systems and broader economic structures, emphasizing the necessity for sophisticated decision-support tools to navigate intricate financial landscapes. Implementing web-based information systems and DSS in financial institutions increases operational efficiency and ensures that decisions taken are more accurate and reliable. By adopting these advanced technology solutions, financial institutions can better manage loan applications, reduce errors and provide better customer service. These improvements also help financial institutions to remain competitive in an ever-evolving market.

5. Conclusion

This research aims to implement a web-based Loan Application Information System using the Simple Additive Weighting (SAW) method at CV. Taruna Jaya Nusantara focuses on increasing the efficiency of the loan application process and evaluating loan eligibility. In a business context, the successful implementation of this system is expected to help CV. Taruna Jaya Nusantara in managing the loan application process more effectively and ensuring more accurate and measurable loan decisions. This research pays attention to the importance of adapting to developments in information technology, which is one of the keys to success in facing increasingly complex business demands. By implementing a web-based information system, CV. Taruna Jaya Nusantara is expected to be able to improve services to customers by speeding up the loan application process and increasing efficiency in making decisions regarding loan eligibility. A system development method integrated with web technology was chosen to ensure that the resulting system meets the security and performance standards required in today's business environment. The use of the SAW method as a decision-making tool is based on the need for an objective and measurable assessment of relevant criteria in the loan application process. The ranking results obtained from the implementation of SAW (V1 = 1.9; V2 = 1.779; V3 = 2.0625) provide a solid basis for selecting customers worthy of getting a loan. The selection process uses tolerance limits for acceptance to ensure that selected customers meet the standards set for loan eligibility. In the context of business benefits, implementing the Loan Application Information System is expected to produce positive results in terms of operational efficiency, improved customer service and more informed decision-making. Apart from that, with this system, CV. Taruna Jaya Nusantara is also expected to be more responsive to changes in the business environment and increase its market competitiveness.

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