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Decision Support System for Selecting Inventory Applications Using the WASPAS and Rank Sum Methods

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Abstract−Inventory applications can help companies monitor, manage, and optimize their inventory. However, the large number of existing inventory applications makes it difficult for companies that want to use inventory applications to choose the right application. This is because to choose an inventory application that suits the company's needs, you have to know each application one by one, so it takes a long time and is difficult to make a choice. This research aims to develop a decision support system for selecting inventory applications by applying the WASPAS (Weighted Aggregated Sum Product Assessment) and Rank Sum approaches. The WASPAS method is used to combine the weights for each criterion and calculate the assessment results based on the product of the criteria values with the appropriate weights. Meanwhile, the Rank Sum weighting technique is used to assign weights or rankings to a number of elements or objects based on their level of importance. Based on the case studies that have been carried out, the results obtained for each alternative include: Zoho Inventory (A4) obtained a value of 0.8531; Onstok (A3) obtained a value of 0.8310; Sortly: Inventory Simplified (A2) obtained a value of 0.7735; BoxHero-Inventory Management (A5) obtained a value of 0.7680; and Shelfit-Inventory Management (A2) obtained a value of 0.6613. In usability testing, we got an average score of 91%, and we can say that the system is suitable for use.

Keywords: Decision Support System; Inventory Applications; Rank Sum; Usability Testing; WASPAS

1. INTRODUCTION

Inventory applications play a crucial role in the modern business world as they help organizations overcome various challenges related to inventory management. Inventory applications are software or computer systems that are used to manage and monitor the inventory of goods or materials in an organization or business [1]. Inventory that is not well managed can be a source of serious problems for the company, such as a lack of stock, which can hinder sales, or excess stock, which causes high storage costs [2]. With the help of inventory applications, companies can efficiently monitor, manage, and optimize inventory [3]. Currently, there are many software developers who have developed inventory applications on the market by offering convenience and features that make inventory management easier for companies. This means that companies that want to use inventory applications must be careful in their choices so they can determine the right one. However, to choose an inventory application that suits your company's needs, you must know each application one by one. This method will take a long time and be difficult for companies that want to choose an inventory application. For this reason, a decision support system is needed that can assist in recommending appropriate inventory applications.

A Decision Support System (DSS) is a computer system designed to assist individuals or groups in complex and important decision-making processes [4]. DSS functions by collecting, processing, and analyzing data from various sources to provide relevant information and solutions that can be used in the decision-making process [5]. There are several methods that can be used in implementing a decision support system. Previous research regarding decision support systems for selecting software or applications for companies or businesses has been carried out by several researchers. The first research regarding the development of a decision support system for selecting business and financial management software uses the SAW (Simple Additive Weighting) approach [6]. This research shows that the SAW approach can determine the best option based on a weighted sum of the performance ratings for all available options. The next research regarding decision support systems for selecting Enterprise Resource Planning (ERP) applications uses the AHP (Analytical Hierarchy Process) approach [7]. The approach used can recommend the best alternative by comparing and assessing the relative value between various decision criteria and alternatives. The next research is a decision support system to determine the best digital bank or e-wallet using the Profile Matching approach [8]. The method used works by comparing the profile or characteristics of an entity with a number of predetermined criteria or profiles.

Based on previous research, it can be seen that the decision support system developed is used to select business and financial management software or applications, Enterprise Resource Learning (ERP) and Digital Banks. So, the difference between this research and previous research is that this research focuses on developing a decision support system for selecting inventory applications. Apart from that, this research uses the WASPAS (Weighted Aggregated Sum Product Assessment) method and determines the weighting using Rank Sum. This is

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used because determining a weighting decision is important because different weights or levels of importance for each criterion can reflect various preferences and priorities. The WASPAS method has flexibility in accommodating various types of criteria and weights [9]. The WASPAS method is a method of multi-criteria decision-making that is used to select the best alternative from a number of available options based on several relevant criteria [10]. The results of this calculation are then used to rank the alternatives, and the one with the best value is chosen as the best solution. Meanwhile, the Rank Sum approach is used to assign weights or rankings to a number of items or elements based on measured or observed data [11]. The Rank Sum technique can identify the most important elements or those that have the best performance based on existing data.

Therefore, the aim of this research is to develop a decision support system for selecting inventory applications to make it easier for users to make appropriate and quick decisions by applying the WASPAS approach and Rank Sum weighting techniques. The decision support system developed is built into a website to make it easier for users to access and use it. The criteria used to select inventory applications in this research are: subscription price, number of superior features, ease of use, system security, and application rating.

2. RESEARCH METHODOLOGY

2.1 Research Stages

Research stages have a very important role in guiding the research process systematically and effectively. The function of the research stages is to provide a structured and organized framework for researchers to carry out research [12]. These stages help researchers better plan, carry out, analyze, and document research [13]. In this research, each stage carried out is visualized in Figure 1.

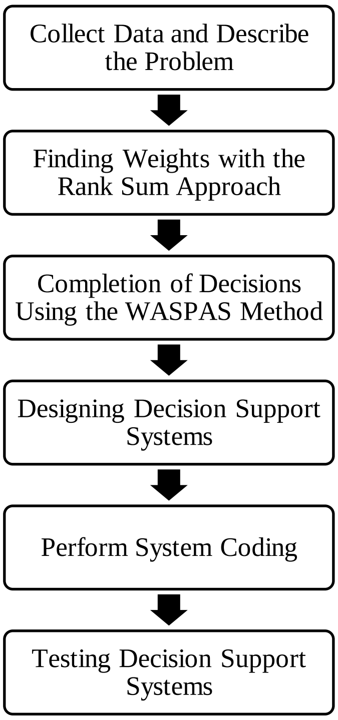

Figure 1. Research Steps

Based on Figure 1, which shows the phases of conducting research, the following is a more detailed description of the research stages carried out:

1) Collect Data and Describe the Problem
   This step involves information gathering, analysis, and a deep understanding of the situation or problem at hand. In this research, problem identification was carried out using interviews and observations to find out the problems experienced by users when selecting inventory applications. After the problem has been identified, the next step is to collect data related to the criteria and alternatives used to solve the problem. The criteria used to select an inventory application are based on experts whose articles are on the MyBest website [14]. The criteria used include: subscription price, number of superior features, ease of use, system security, and application rating.
2) Finding Weights with the Rank Sum Approach
   In this step, a weight value will be determined for each criterion, because each criterion will have a different level of importance, also known as the criteria weight. To produce the best and most appropriate alternative, determining the weight of criteria is an important factor [15]. The Rank Sum approach is used to find weights

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based on the ranking order which must be reflected directly in the weights [16]. Based on the criteria that have been determined, the priority order of each criterion is then searched for by the decision maker. The priority order of criteria in this case study is as follows: Number of Featured Features (C1), Subscription Price (C2), Ease of use (C3), App Ratings (C4), and System Security (C5).

3) Completion of Decisions Using the WASPAS Method
The WASPAS (Weighted Aggregated Sum Product Assessment) approach can be used to determine the best alternative by combining the values of each alternative based on previously determined criteria weights [15]. In this method, each criterion has a weight that reflects the level of importance of the criterion in decision-making. The steps for solving decision problems using the WASPAS method are discussed in subsection 2.3.
4) Designing Decision Support Systems
This stage is related to visualizing the results of the analysis into modeling or design to make it easier to realize the software. System design involves taking concepts and requirements from the analysis stage and turning them into a technical structure that can be implemented.
5) Perform System Coding
This stage relates to the procedure of turning logic, algorithms, and system design into a programming language that computers can understand [16]. Coding involves writing the instructions and commands needed to run an application or system according to predetermined specifications [17]. The final result of this process is software that is ready to be tested and used by users. The decision support system was built based on a website using the JavaScript programming language with a text editor, namely Visual Studio Code and using MySQL for the database.
6) Testing Decision Support Systems
This process involves a series of activities designed to identify errors or defects in the software, ensure that desired functions run correctly, and meet predetermined business or technical requirements [18]. The testing method used in this research is usability testing. Usability testing is an evaluation process designed to measure the extent to which the software can be used effectively, efficiently, and satisfactorily by end users [19]. Usability testing is part of ISO 9126 regarding software quality control. So, the aspects used in testing are taken from ISO 9126 in the usability aspect using four sub-criteria, namely understandability, learnability, operability, and attractiveness.

2.2 Rank Sum Weighting Technique

The ranking method is one of the simplest approaches to determining criteria weights. Determining the weight of criteria is usually based on the order from most important to least important. One approach to determining the weighting of criteria through the ranking concept is the Rank-Sum approach. The Rank Sum approach is a method that assigns weights or rankings to a number of items or elements based on the data being measured [20]. This approach is useful to help identify the most important elements or those that have the best performance based on existing data [11]. The Rank Sum approach has the ability to provide relative ranking values that describe the relative importance or performance of the various elements. To get the weighting value using Rank Sum, it can be obtained through equation (1).

$$w_j = \frac{n-r_j+1}{\sum(n-r_k+1)} \tag{1}$$

where w_j is the criteria weight value for the j parameter, n is the number of parameters being studied, r_j is the ranking position for each parameter, and r_k is the parameter used.

2.3 Weighted Aggregated Sum Product Assessment (WASPAS) Method

The WASPAS (Weighted Aggregated Sum Product Assessment) approach emerged as an improvement on the previous method, where this method is a combination of the Weighted Sum Model (WSM) and the Weighted Product Model (WPM) [21]. The WASPAS method is a multi-criteria decision-making method that combines the values of each alternative based on predetermined criteria weights [15]. Basically, in the WASPAS approach, each criterion has a weight that reflects the level of importance of the criterion in decision-making [22]. The WASPAS method has several advantages, such as the ability to handle multi-criteria comparisons and the ease of determining criteria weights [23]. This method combines the weights for each criterion and calculates the assessment results based on the product of the criteria values with the appropriate weights [24]. The results of this calculation are then used to rank the alternatives, and the one with the best value is chosen as the best solution.

In the WASPAS approach, steps are taken to obtain the best alternative based on a number of criteria. These steps include:

1) Develop an initial decision matrix
This decision matrix is obtained from alternative values against the criteria. For this reason, before the decision matrix is obtained, the criteria, alternatives, and their weights must first be determined. To produce the initial decision matrix, it is obtained through equation (2).

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$$x = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \cdots & \cdots & \cdots & \cdots \\ x_{m1} & x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (2)$$

2) Perform matrix normalization
From the initial decision matrix that has been prepared, normalization is then carried out to obtain a normalized matrix. Before the normalization matrix is formed, the criteria used must first be identified because there are two types of criteria, namely benefit and cost. This benefit criterion is related to the criterion that prioritizes the highest value, whereas the cost criterion is related to the criterion that prioritizes the lowest value. After the type of criteria has been determined, the normalization matrix for the benefit criteria uses equation (3), and the cost criteria uses equation (4).

$$\bar{x}_{ij} = \frac{x_{ij}}{\max_i x_{ij}} \quad (3)$$

$$\bar{x}_{ij} = \frac{\min_i x_{ij}}{x_{ij}} \quad (4)$$

where x_{ij} refers to the performance value of the option for each criterion, $\max_i$ i shows the highest value for all options, while $\min_i$ shows the smallest value for all options.

3) Find the preference value of each alternative (Q_i)
After normalization for each alternative, the next step is to calculate the preference value (Q_i) for each existing alternative. To get the preference value for each alternative, equation (5) is used.

$$Q_i = 0.5 \sum_{j=1}^{n} x_{ij} w + 0.5 \prod_{j=1}^{n} (x_{ij})^{w_j} \quad (5)$$

where Q_i is the preference value for each option, $x_{ij}w$ refers to the multiplication of the value between x_{ij} and w, while $x_{ij}w$ refers to the value of x_{ij} raised to the power of w.

4) Make a ranking of all alternatives
This ranking is obtained by sorting the preference values obtained for each alternative from highest to lowest. The first preference value indicates the best alternative.

3. RESULT AND DISCUSSION

In completing the decision for the inventory application selection case study, the first step is to determine the criteria used to determine the choice. In this research, the criteria used to choose an inventory application are based on experts whose articles are on the MyBest website [14]. The criteria used include: subscription price, number of superior features, ease of use, system security, and application rating. Next, from these criteria, the level of importance of each criterion is determined to find the weight value of each criterion. The weighting technique used is Rank Sum. The Rank Sum approach provides relative ranking values that describe the relative importance or performance of various elements. For this reason, decision makers will determine the ranking or level of importance of each criterion. In this case study, the data in the MyBest article with the web page link https://id.my-best.com/139393 is used to determine the priority order of criteria and alternatives [14]. The level of importance of each criterion is presented in Table 1.

Table 1. Level of Importance for Each Criteria

Criteria	Criteria Code	Order of Priority
Number of Featured Features	C1	1
Subscription Price	C2	2
App Ratings	C3	3
Ease of use	C4	4
System Security	C5	5

Table 1 shows the ranking or level of importance for each criterion. Next, based on the level of importance, the weight is then found using the Rank Sum approach via equation (1). The following is the calculation process to obtain the weight value for each criterion using the Rank Sum approach:

$$w_1 = \frac{5-1+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{5}{15} = 0.3333$$

$$w_2 = \frac{5-2+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{4}{15} = 0.2667$$

$$w_3 = \frac{5-3+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{3}{15} = 0.2000$$

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$$w_4 = \frac{5-4+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{2}{15} = 0.1333$$

$$w_4 = \frac{5-5+1}{(5-1+1)+(5-2+1)+(5-3+1)+(5-4+1)+(5-5+1)} = \frac{1}{15} = 0.0667$$

Based on the values obtained from the weight calculation results for each criterion using Rank Sum, they are entered in Table 2.

Table 2. Results of Weight Values for Each Criterion

Criteria Code	Criteria	Weight
C1	Number of Featured Features	0.3333
C2	Subscription Price	0.2667
C3	Ease of use	0.2000
C4	App Ratings	0.1333
C5	System Security	0.0667

Table 2 shows the weight value of each criterion used to help determine the best choice. This weight is obtained from the results of weighting using Rank Sum which is based on the order of priority or level of importance of the decision-maker. To simplify the calculation process, each criterion value is changed through value conversion. The conversion value for each criterion is presented in Table 3.

Table 3. Value Conversion for Each Criterion

No.	Criterion Code	Criterion Name	Criterion Value	Value Conversion
1	C1	Number of Featured Features	< 2 Features	1
			>= 2 Features and < 4 Features	2
			>= 4 Features and < 6 Features	3
			>= 6 Features	4
2	C2	Subscription Price	> 200.000	1
			>= 200.000 and < 400.000	2
			>= 400.000 and < 600.000	3
			>= 600.000	4
3	C3	Ease of use	Very easy	1
			Easy	2
			Quite easy	3
			Not easy	4
4	C4	App Ratings	> 3.5	1
			>= 3.5 and < 4.0	2
			>= 4.0 and < 4.5	3
			>= 4.5	4
5	C5	System Security	Very Good	1
			Good	2
			Good Enough	3
			Not Good	4

It can be seen in Table 3 that each criterion value will be converted into a value; this is done to simplify the calculation process. Because for each criterion, there are several criteria that use qualitative data, it is necessary to convert them into numbers. The next step is to determine the alternative that is the preferred option for the decision-maker. In this research, five alternative inventory applications were used for the case study, including: Shelfit - Inventory Management (A1), Sortly: Inventory Simplified (A2), Onstok (A3), Zoho Inventory (A4) and BoxHero - Inventory Management (A5). These alternatives will be assessed based on existing criteria. The results of the assessment of each alternative in this case study are presented in Table 4.

Table 4. Values for Each Alternative

Alternative Code	Alternative Name	Criteria				
		C1	C2	C3	C4	C5
A1	Shelfit - Inventory Management	4	445,000	Easy	3.2	Very Good
A2	Sortly: Inventory Simplified	5	450,000	Very Easy	4.2	Good
A3	Onstok	4	235,000	Easy	4.3	Very Good
A4	Zoho Inventory	6	590,000	Easy	4.9	Very Good
A5	BoxHero - Inventory Management	3	320,000	Very Easy	4.4	Good

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Based on the values in Table 4, a value conversion is then carried out to make calculations easier. This value conversion is carried out based on the value conversions in Table 3. The results of the value conversion for each alternative are presented in Table 5.

Table 5. Value Conversion Results for Each Alternative

Alternative Code	Alternative Name	Criteria				
		C1	C2	C3	C4	C5
A1	Shelfit - Inventory Management	3	3	3	1	4
A2	Sortly: Inventory Simplified	3	3	4	3	3
A3	Onstok	3	2	3	3	4
A4	Zoho Inventory	4	3	3	4	4
A5	BoxHero - Inventory Management	2	2	4	3	3

To implement the WASPAS method in this case study, start by compiling an initial decision matrix using equation (1). This initial decision matrix is obtained from the value of each alternative against the criteria in Table 5. The initial decision matrix in this case study can be seen as follows:

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

Based on the initial decision matrix, the normalization value is then searched for. To obtain normalized matrix values, the type of criteria used has already been identified. In this case study, the benefit criteria are criteria C1, C3, C4, and C5. Meanwhile, the cost criteria are in criterion C2. The normalization matrix is then calculated using equation (3) for the benefit criteria and equation (4) for the cost criteria. The following is the calculation process to obtain normalized decision matrix values:

$$\bar{x}_{11} = \frac{3}{max\{3;3;3;4;2\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{21} = \frac{3}{max\{3;3;3;4;2\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{31} = \frac{3}{max\{3;3;3;4;2\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{41} = \frac{4}{max\{3;3;3;4;2\}} = \frac{4}{4} = 1$$
$$\bar{x}_{51} = \frac{2}{max\{3;3;3;4;2\}} = \frac{2}{4} = 0.5$$
$$\bar{x}_{12} = \frac{min\{3;3;2;3;2\}}{3} = \frac{2}{3} = 0.67$$
$$\bar{x}_{22} = \frac{min\{3;3;2;3;2\}}{3} = \frac{2}{3} = 0.67$$
$$\bar{x}_{32} = \frac{min\{3;3;2;3;2\}}{2} = \frac{2}{2} = 1$$
$$\bar{x}_{42} = \frac{min\{3;3;2;3;2\}}{3} = \frac{2}{3} = 0.67$$
$$\bar{x}_{52} = \frac{min\{3;3;2;3;2\}}{2} = \frac{2}{2} = 1$$
$$\bar{x}_{13} = \frac{3}{max\{3;4;3;3;4\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{23} = \frac{4}{max\{3;4;3;3;4\}} = \frac{4}{4} = 1$$
$$\bar{x}_{33} = \frac{3}{max\{3;4;3;3;4\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{43} = \frac{3}{max\{3;4;3;3;4\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{53} = \frac{4}{max\{3;4;3;3;4\}} = \frac{4}{4} = 1$$
$$\bar{x}_{14} = \frac{1}{max\{1;3;3;4;3\}} = \frac{1}{4} = 0.25$$
$$\bar{x}_{24} = \frac{3}{max\{1;3;3;4;3\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{34} = \frac{3}{max\{1;3;3;4;3\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{44} = \frac{4}{max\{1;3;3;4;3\}} = \frac{4}{4} = 1$$
$$\bar{x}_{54} = \frac{3}{max\{1;3;3;4;3\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{15} = \frac{4}{max\{4;3;4;4;3\}} = \frac{4}{4} = 1$$
$$\bar{x}_{25} = \frac{3}{max\{4;3;4;4;3\}} = \frac{3}{4} = 0.75$$
$$\bar{x}_{35} = \frac{4}{max\{4;3;4;4;3\}} = \frac{4}{4} = 1$$
$$\bar{x}_{45} = \frac{4}{max\{4;3;4;4;3\}} = \frac{4}{4} = 1$$
$$\bar{x}_{55} = \frac{3}{max\{4;3;4;4;3\}} = \frac{3}{4} = 0.75$$

After normalization, these values are then entered into a normalized matrix as follows:

$$x = \begin{bmatrix} 0.75 & 0.67 & 0.75 & 0.25 & 1 \\ 0.75 & 0.67 & 1 & 0.75 & 0.75 \\ 0.75 & 1 & 0.75 & 0.75 & 1 \\ 1 & 0.67 & 0.75 & 1 & 1 \\ 0.5 & 1 & 1 & 0.75 & 0.75 \end{bmatrix}$$

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Based on the normalization matrix, calculations are then carried out to find the preference value for each alternative, or Q_i. To get the Q_i value, it can be calculated using equation (5). The weights used are obtained from weighting using the Rank Sum contained in Table 2, namely C1 = 0.3333, C2 = 0.2667, C3 = 0.2000, C4 = 0.1333, and C5 = 0.0667. The following is the calculation process to find the Q_i value:

$$\begin{aligned}Q_1 &= 0.5 \times \big((0.75 \times 0.3333) + (0.67 \times 0.2667) + (0.75 \times 0.2000) + (0.25 \times 0.1333) + (1 \times 0.0667)\big) + \\ &\quad 0.5 \times \big((0.75^{0.333}) \times (0.67^{0.2667}) \times (0.75^{0.2000}) \times (0.25^{0.1333}) \times (1^{0.0667})\big) \\ &= 0.6613\end{aligned}$$

$$\begin{aligned}Q_2 &= 0.5 \times \big((0.75 \times 0.3333) + (0.67 \times 0.2667) + (1 \times 0.2000) + (0.75 \times 0.1333) + (0.75 \times 0.0667)\big) + \\ &\quad 0.5 \times \big((0.75^{0.333}) \times (0.67^{0.2667}) \times (1^{0.2000}) \times (0.75^{0.1333}) \times (0.75^{0.0667})\big) \\ &= 0.7735\end{aligned}$$

$$\begin{aligned}Q_3 &= 0.5 \times \big((0.75 \times 0.3333) + (1 \times 0.2667) + (0.75 \times 0.2000) + (0.75 \times 0.1333) + (1 \times 0.0667)\big) + \\ &\quad 0.5 \times \big((0.75^{0.333}) \times (1^{0.2667}) \times (0.75^{0.2000}) \times (0.75^{0.1333}) \times (1^{0.0667})\big) \\ &= 0.8310\end{aligned}$$

$$\begin{aligned}Q_4 &= 0.5 \times \big((1 \times 0.3333) + (0.67 \times 0.2667) + (0.75 \times 0.2000) + (1 \times 0.1333) + (1 \times 0.0667)\big) + \\ &\quad 0.5 \times \big((1^{0.333}) \times (0.67^{0.2667}) \times (0.75^{0.2000}) \times (1^{0.1333}) \times (1^{0.0667})\big) \\ &= 0.8531\end{aligned}$$

$$\begin{aligned}Q_5 &= 0.5 \times \big((0.5 \times 0.3333) + (1 \times 0.2667) + (1 \times 0.2000) + (0.75 \times 0.1333) + (0.75 \times 0.0667)\big) + \\ &\quad 0.5 \times \big((0.5^{0.333}) \times (1^{0.2667}) \times (1^{0.2000}) \times (0.75^{0.1333}) \times (0.75^{0.0667})\big) \\ &= 0.7680\end{aligned}$$

The results of these calculations become a reference for determining the best alternative, where the highest Q_i value is the best alternative. Next, the preference value for each best alternative is sorted based on the highest-to-lowest value in the form of a ranking. The ranking results for the case study of inventory application selection using Rank Sum weighting and the WASPAS method are presented in Table 6.

Table 6. Preference Value for Each Alternative

Alternative Code	Alternative Name	Q_i Value	Ranking
A4	Zoho Inventory	0.8531	1
A3	Onstok	0.8310	2
A2	Sortly: Inventory Simplified	0.7735	3
A5	BoxHero - Inventory Management	0.7680	4
A1	Shelfit - Inventory Management	0.6613	5

In Table 6, the results of the preference values for each alternative obtained the highest to lowest values, namely Zoho Inventory (A4) obtained a value of 0.8531, Onstok (A3) obtained a value of 0.8310, Sortly: Inventory Simplified (A2) obtained a value of 0.7735, BoxHero - Inventory Management (A5) obtained a value of 0.7680 and Shelfit - Inventory Management (A2) obtained a value of 0.6613.

The results of the analysis and design that have been carried out are then carried out in a coding process to realize the decision support system software. The decision support system was built based on a website using the JavaScript programming language with a text editor, namely Visual Studio Code and using MySQL for the database. This inventory selection decision support system is equipped with a login form to access the system. After the user successfully logs in, the system will display the main menu interface. The main menu will display a dashboard containing the features of the system and a graph of the WASPAS method calculation results. The main menu interface form in the inventory application selection decision support system is presented in Figure 2.

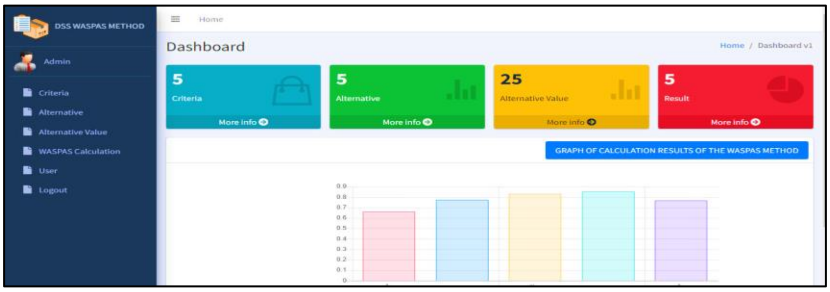

Figure 2. Decision Support System Dashboard Interface for Selecting Inventory Applications

In Figure 2, you can see the system's main menu interface, where in this form the user can select the features of the system. These main features include criteria, alternatives, alternative values, and WASPAS method calculation. To start selecting an inventory application, the user first inputs criteria data via the criteria feature. In this feature, users can add, change, and delete criteria data. Then, the user can carry out alternative blood management in the Alternative feature. In this feature, users can add, change, and delete alternative data. If

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alternative data has been entered, the user can provide an alternative value in the Alternative Value feature. In this feature, users can provide grades based on previously entered criteria. After the alternative value data has been input, the user can see the best alternative results through the WASPAS Calculation feature. This feature will display the steps or calculation process for the WASPAS method. Apart from that, this feature also displays a ranking of alternatives from highest to lowest preference value. The interface for the WASPAS calculation feature is presented in Figure 4.

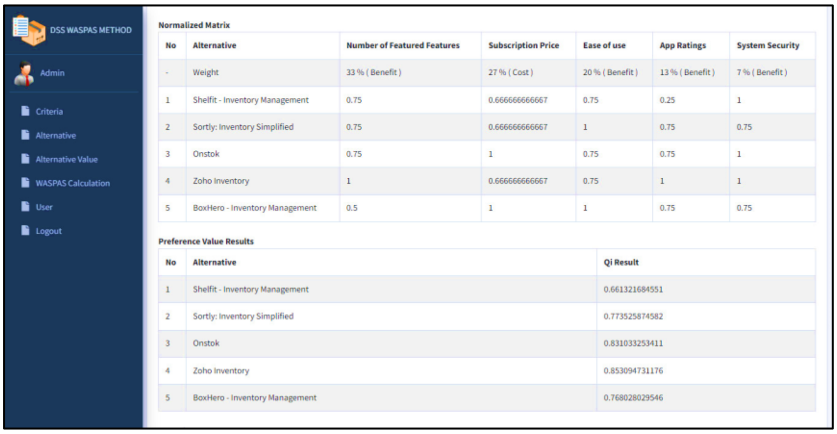

Figure 4. Alternative Selection Results Interface

Figure 4 shows the WASPAS calculation feature, which displays the calculation process steps. The results of calculations by the system for this case study produce the highest to lowest preference values, namely Zoho Inventory (A4) gets a value of 0.8531, Onstok (A3) gets a value of 0.8310, Sortly: Inventory Simplified (A2) gets a value of 0.7735, BoxHero - Inventory Management (A5) obtained a value of 0.7680, and Shelfit - Inventory Management (A2) obtained a value of 0.6613. These results show the same value as manual calculations; therefore, the output from this system is said to be valid because it shows the same results.

After the system has been built, it continues to the testing stage through usability testing so that it can be ensured that this software is suitable for use. Usability testing aims to carry out evaluations designed to measure the extent to which the software can be used effectively, efficiently, and satisfactorily by end users. This testing is carried out by distributing a questionnaire, which will be filled out by users who will select the inventory application. The questionnaire was prepared using the Guttman scale, where there are only two answer choices, namely agree and disagree. This aims to get extreme answers from users. The questionnaire contains 10 questions and will be filled out by 20 respondents. The questionnaire was prepared using the Guttman scale, where there are only two answer choices, namely agree and disagree. This aims to get extreme answers from users. The questionnaire contains 10 questions and will be filled in by 20 respondents. Respondents who filled out the questionnaire consisted of 10 entrepreneurs working in the sales sector and 10 workers in the sales sector. The questions used in this questionnaire include aspects of understandability, learnability, operability and attractiveness. Then, the results of the questionnaire are calculated by calculating the agree and disagree answers and converting them into a percentage. The results of this usability testing are visualized in the form of graphics presented in Figure 5.

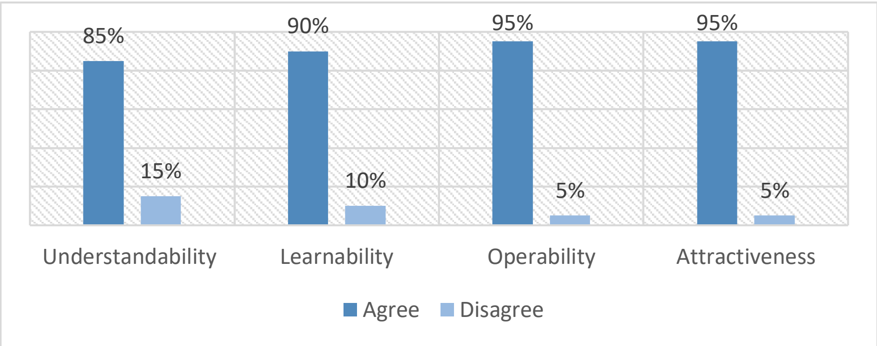

Figure 5. Usability Testing Results

The usability testing results shown in Figure 5 show that respondents agreed to the sub-criteria of understandability of 85%, learnability of 90%, operability of 95%, and attractiveness of 95%. If the average value is calculated, a usability testing value of 91% is obtained. Next, the usability testing results obtained are transformed into an assessment that is guided by the following grouping of values: "Good", the value is between 76% and 100%; “Fair”, the value is between 56% and 75%; “Poor”, the value is between 40% and 55%; and “Not

Good", less than 40% [25]. From this grouping, the usability testing results of the decision support system for selecting the inventory application developed are in the "Good" group. This means that the system is suitable for use because it is considered to have the functionality desired by users.

4. CONCLUSION

This research has developed a decision support system for selecting inventory applications by applying the WASPAS approach and Rank Sum weighting techniques. Based on the case studies that have been carried out, the preference value results obtained for each alternative include: Zoho Inventory (A4) obtained a value of 0.8531, Onstok (A3) obtained a value of 0.8310, Sortly: Inventory Simplified (A2) obtained a value of 0.7735, BoxHero - Inventory Management (A5) obtained a value of 0.7680, and Shelfit - Inventory Management (A2) obtained a value of 0.6613. The output produced by the decision support system for the case study produces the same value, which means that the implementation of WASPAS in the system can be declared valid. Apart from that, the usability testing obtained an average score of 91% and was included in the "good" group. This shows that the system is easy to use and feasible to implement. This means that the system is suitable for use because it is considered to have the functionality desired by users. However, this research requires several improvements for further research, namely that the Rank Sum weighting technique has the weakness of being non-objective in determining rankings, so you can use ranking techniques by changing values in fuzzy form or measuring criteria rankings with statistical data. Apart from that, this research carried out value conversion for qualitative data; this needs to be studied further on how to determine the conversion value in order to get the right value.

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