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# The Implementation of the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) in the Decision Support System for Determining Village Development Planning

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**Abstract**: The research was conducted to respond to the existence of personal or group interests in determining village development planning, so to minimize personal and group interests, a decision support system is needed with the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) approaches that have good performance. The purpose of the study was to determine the performance of the method, the quality of the application based on usability. The research was conducted by distributing questionnaires to respondents or participants as expiry users. Where the questionnaire is divided into two parts, namely: the first is a questionnaire to measure the performance of the ANP and SAW methods. The second questionnaire uses the USE qussenere to measure the quality of the application system. The results showed that the performance of the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) methods on the decision support system obtained a Pk% result of 70% which was included in the feasible category. On the quality of the application system based on the usability test value of 75.67%. So that the system is included in the category of decent or good quality.

**Keywords**: Performance, Decision Support System, Analytical Network Process (ANP), Simple Additive Weighting (SAW)

## 1. INTRODUCTION

This research was conducted to respond to the existence of personal and group interests in determining village development planning. Based on the regulation of the Minister of Villages/Kelurahan, Development of underdeveloped areas, and transmigration Number 5 of 2015 concerning the determination of priorities for the use of Village/Urban funds in 2015. Village/Kelurahan Funds are funds sourced from the State Revenue and Expenditure Budget designated for transferred Villages/Kelurahan through the Regency/City Regional Revenue and Expenditure Budget and used to fund governance, development implementation, community development, and community empowerment [1]. Problems that often occur in villages are that the development stage in the village must consider the priority scale and elements of justice, as well as the absence of a Decision Support System for Determining Development Priorities in the village and the system currently being used is not maximally computerized.

Ideally, in determining village development, it starts from the process of planning program activities and making decisions that are free from personal and group interests. However, in reality the planning and decision-making processes do not work as they should. This is because the government's role in implementation is still centralized with top-down planning, so that decision-making is dominated by village elites, and is an annual formal routine. Meanwhile, the results of interviews with the Village Head stated that in the planning process many personal or group interests were involved in proposing village development plans. Therefore, a decision support system (DSS) is needed with an approach that can handle multiple criteria and non-structural problems, thereby minimizing personal and group interests.

The decision support system that produces recommendations for development planning priorities uses the criteria set by the government (Permendagri No. 66, 2007)[2] which can be adjusted based on needs. In addition to these criteria, we need a method that can solve semi-structured and non-structured problems that can minimize the existence of personal and group interests in community proposals. The method used in the DSS for determining village development planning must have good performance. The performance of a method can be measured by using a questionnaire containing the appropriate and accommodative variables. While the quality of a system can be measured through Usability Testing by using a USE Questionnaire that contains several variables, namely usability, easy to use, easy to learn and community satisfaction as consumers regarding perceptions of the quality of an application or product.

Several studies on decision support systems that do not or involve the role of public participation have been carried out. Like the research that has been done by Nababan & Tuti on determining the feasibility of operating a house for poor families using the Weighted Product (WP) method [3] which also still has weaknesses in using this method, namely it does not have costs and benefits for the criteria so that it affects the priority weight level. Meanwhile, Aziz, Febriani, Sopandi, & Gustian's research on the decision support system for determining development priorities using the Analytical Hierrachy Process (AHP) [4] still has weaknesses, because the weighting of the method is still of interest and subjective.

Although there has been research on DSS related to development planning, this research implements the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) methods in the decision support system for determining village building planning. The ANP method is used to determine the priority weight of the criteria, where the method can solve problems with many criteria (multi-criteria) and is able to accommodate the relationship of influence between criteria, so that it will eliminate subjectivity in weighting criteria. Meanwhile, the Simple Additive Weighting (SAW) method is used to get village development planning priorities, because of its ability to make a more precise assessment based on the predetermined cost and benefit criteria.

Based on the description above, the focus of this research is to develop a decision support system for determining village development planning using the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) methods to assist decision makers in determining development planning priorities in accordance with the needs of the village community.

## 1.1 Decision Support System

The concept of a Decision Support System was first introduced in the early 1970s by Michael S. Scott Morton with the term Management Decision System (Sari, 2018). The concept of decision support is characterized by a computer-based interactive system that helps decision makers utilize data and models to solve unstructured problems. Basically DSS is designed to support all stages of decision-making starting from identifying problems, selecting relevant data, determining the approach used in the decision-making process, to evaluating alternative choices [5].

The definition of a Decision Support System (DSS) itself is a flexible, interactive and adaptable computer-based information system developed to support solutions to unstructured specific management problems. Decision Support Systems use data, provide an easy user interface and can incorporate decision-making thinking [6]. Kusrini in his book entitled Concepts and applications of decision support systems defines an information system that provides information, modeling and manipulating data [7]. Meanwhile, Hafiz & Ma'mur define a computer-based information system that provides interactive supporting information between other stakeholders during decision making. So from some definitions Decision Support System can be said as a computer system that helps in managing data into information that can solve problems and provide the right decisions [8].

## 1.2 ANP dan SAW

Decision making, usually more often used a hierarchical method consisting of goals, criteria, and alternatives. The use of a hierarchy is to make it easier for decision makers. However, there are times when decision making does not only pay attention to the hierarchical structure, but also the network or the dependence and feedback between elements in the cluster (inner dependence) and between clusters (outer dependence). According to Rusydiana & Devi, feedback is able to properly capture the influence of interactions, especially when decision makers are faced with risks and uncertainties in a complex business environment [9]. ANP uses a system of pairwise comparisons to measure the weight of structural components, and in turn makes a ranking of the best alternative choices that must be taken.

The Analytic Network Process (ANP) is a multi-criteria assessment method for decision structuring and analysis that has the ability to measure the consistency of assessment and flexibility in choices at the sub-criteria level. Meanwhile, Saaty defines ANP as a relative measurement method used to derive the composite priority ratio from the individual ratio scale that reflects the relative measurement of the influence of interacting elements with respect to control criteria [10]. ANP is able to accommodate linkages between criteria or alternatives, and allows interaction and feedback from elements within the cluster and between clusters.

According to Nofriansyah, the Simple Additive Weighting (SAW) is often also known as the weighted addition method [11]. The basic concept of the SAW method is to find the weighted sum of the performance ratings for each alternative on all criteria [12]. The SAW method requires the process of normalizing the decision matrix (X) to a scale that can be compared with all existing alternative ratings. The SAW method recognizes the existence of 2 (two) attributes, namely the benefit criteria and the cost criteria. The basic difference between these two criteria is in the selection of criteria when making decisions.

## 1.3 Development Planning

Development is a multi-dimensional process involving important changes in a structure, socio-economic system, public attitudes and national institutions and accelerating economic growth, unemployment inequality and eradicating absolute poverty [13]. In addition to the above understanding, experts provide various definitions of development, but in general there is an agreement that development is a process to make changes to the village, both physical and non-physical. Kartasasmita provides a simpler understanding of the development of a process of change for the better through planned efforts [14]. Although the definition of development varies widely, in general, development can be interpreted as a process of change from one national condition to a national condition that is considered better or continuous progress towards the improvement of an established human life.

Village community development is a village change to create an independent and innovative village [15]. Meanwhile, according to Tjokrowinoto, village development can be carried out based on three principles, namely the principle of integral development, the principle of own strength, and the principle of mutual consensus. The principle of integral development is balanced development from all aspects of the village community [16][17]. The principle of self-strength is that each effort must first be based on its own strength (Soekanto, 2013)[18], the principle of mutual agreement is that development must be carried out correctly to become the needs of the village community and the decision to implement the project is not on the priority of superiors but is a joint decision of the members. society [19]. In the end, village development is the development of village independence starting from a good village planning process, followed by good program management.

Effective village development is not solely due to opportunities but is the result of determining activity priority options, not the result of trial and error, but the result of good planning, because development needs are greater than available resources. Through planning, we want to formulate development activities that efficiently and effectively can provide optimal results in utilizing available resources and developing existing potential.

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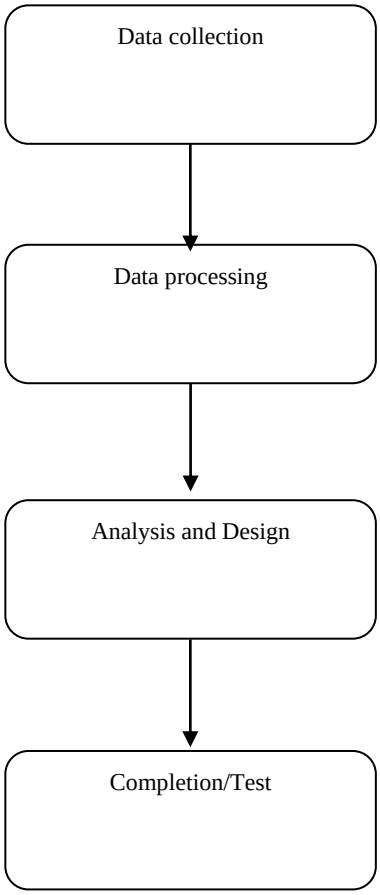
## 2. Meotode Penelitian

Broadly speaking, this research uses a descriptive quantitative approach, with the research stages divided into four stages, namely data collection, data processing, analysis and design and completion/testing which is shown in Figure 1 research flow chart..




Gamabar 1. Diagram alur Penelitian

## 2.1 Data collection

The supporting data in this study is the criteria data that affect the determination of village development planning priorities. These data include urgency (K), public interest (KU), Availability of potential (KP), perceived by many people (DBO), Barriers to income (MP), Cost (B). These data are obtained based on the results of a literature study that can be used for making a decision support system using the ANP method. In addition to the data mentioned in this study, it also requires some supporting data in conducting usability testing, namely, ease of use, ease of use, easy to learn and satisfaction. These data are used to assess the level of quality of the decision support system that has been made and implemented.

## 2.2 Data processing

The data and information that has been obtained will be used in data processing which includes several activities such as the following:

- Criteria analysis and selection

At this stage the aim is to determine what criteria will be used to assess whether the proposed development planning priority program is appropriate or not. The criteria are the results of the author's analysis of journal references, village laws, village planning technical guidelines, books and articles which are then described as a network model.

- Determination of Influence Relationship

Determination of the influence relationship is used to determine whether there is an influence relationship between the criteria/clusters with each other. The results of these determinations are used to build the network structure of the ANP method.

- Criteria priority weighting and ANP calculation

The priority weighting of the criteria is used to determine how big the relationship is between one criterion and another to the criteria that are affected in determining the choice of priority programs. While the calculation with the ANP method by calculating the priority weight of each criterion. Then create a super matrix which includes a weightless super matrix, a weighted super matrix and a limit matrix. The result of this matrix limit calculation is a list of criteria weight values that have been sorted based on the largest calculated value.

- Construction plan weighting and Simple Additive Weighting (SAW) calculations

The weighting is done by providing an assessment of the proposed program based on each of the predetermined criteria. This Simple Additive Weighting (SAW) method requires the decision system to determine the weight for each attribute. The total score for the proposed alternative program is obtained by adding up all the results of the multiplication between the rating and the weight of each criterion, the result of the calculation is a list of alternative weight values that have been sorted based on the largest calculated value.

## 2.3 System Analysis and Design

The purpose of this stage is to analyze the system that will be developed according to the needs of the participants. Furthermore, the specification of user needs will be known and who will use the system (User).

- Database Design and Development

The database is used as a storage medium for input and output data from the decision support system. The database on this system uses MySQL which is an open source database management system.

- System Design and Development

The system developed will be based on a website so that it can be accessed by users from anywhere and anytime. With this system, it is hoped that it can accommodate the process of village community proposals (participants) and decision makers in determining priorities for village development planning programs that are considered the most appropriate using the ANP and SAW methods.

## 2.4 Testing

- Research Instruments

The research instrument used to test the performance of the method and usability test is a series of questionnaires that can process data related to suitability, effectiveness, efficiency, satisfaction with the use of a decision support system. The thing that underlies the use of questionnaires is that questionnaires can provide convenience for respondents to understand and answer the questions asked properly. In addition, the questionnaire makes respondents more comfortable and flexible in answering questions (Munir, 2010). The complete form of the questionnaire package and the Likert measurement scale are shown in Tables 1 and 2..

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**Table 1. Usability and Method Performance Questionnaire**

| Variable | No. | Indicator |
|---|---|---|
| Usefulness | 1 | This system helps me to be more effective |
| | 2 | This system helps me to be more productive |
| | 3 | This system is very useful |
| | 4 | This system saves me time when using it |
| Ease of Use | 5 | This system is easy to use |
| | 6 | This system is practical to use |
| | 7 | This system is User Friendly |
| | 8 | I don't see any inconsistencies while using this system |
| | 9 | Errors that occur in this system are easy to recover quickly and easily |
| Ease of Learning | 10 | I learned to use the system quickly |
| | 11 | I can easily remember how to use this system |
| Satisfication | 12 | I am satisfied with this system |
| | 13 | Using this system is a lot of fun |
| | 14 | This system works exactly what I want |
| | 15 | This system is very comfortable when used |
| Performa Metode | 16 | Is this system in accordance with the priority level of the proposed activity program that you want? |
| | 17 | Has the proposal you put forward through this system been accommodated? |

**Table 2. Criteria for measuring the Likert Scale**

| Score | Answer Criteria |
|---|---|
| 1 | 1=Strongly Disagree(STS) |
| 2 | 2=Disagree (TS) |
| 3 | 3=Sufficiently Agree (CS) |
| 4 | 4=Agree (S) |
| 5 | 5=Strongly Agree (SS) |

➢ System Feasibility Test and Questionnaire

System and questionnaire feasibility tests need to be carried out to ensure that the results of the system and questionnaire data collection are suitable for analysis. A system and questionnaire that will be used in research must have valid and reliable properties so that it is feasible to be used as a research instrument.

The feasibility test of the system was carried out using the validity of the system by comparing the similarity of the results of the ANP and SAW calculations on the system to the results of manual calculations. If the results of the system are the same as the manual, then it is said to be valid, but if it is not the same then it is invalid, and analysis and improvement must be carried out on the system until it is valid.

The questionnaire feasibility test was carried out using two methods, namely validity and reliability tests. Validity test is used to determine the feasibility of the items in a question. The validity test used is Pearson's corellate bivariate (product moment correlation) and the r table is significant with 5%. While the reliability test was conducted to determine the consistency and reliability of the measuring instrument. In this study, the reliability test was carried out using the Cronbach's Alpha measure. To determine the level of reliability of the instrument used the categories shown in table 3.

**Table 3 Reliability Level of Cronbach's Alpha**

| Reliability Interval | Categori |
|---|---|
| $0,80 < r_{11} \leq 1,00$ | Very high reliability |
| $0,60 < r_{11} \leq 0,80$ | High reliability |
| $0,40 < r_{11} \leq 0,60$ | Medium reliability |
| $0,20 < r_{11} \leq 0,40$ | Low reliability |
| $0,00 < r_{11} \leq 0,20$ | Unreliable |

➢ Test Method Performance and Usability

Measurement of performance and usability by calculating the percentage of answers from respondents using the formula stated in (1).

$$PK(\%) = \frac{Sekor\ yang\ diobsevasi}{Sekor\ yang\ diharapkan} x\ 100\ \% \quad (1)$$

The data obtained is then converted based on the table of eligibility categories as shown in table 4.

**Table 4. Eligibility Category**

| Score | Category |
|---|---|
| <21 | Very unworthy |
| 21-40 | not feasible |
| 41-60 | Enough |
| 61-80 | Worthy |
| 81-100 | Very worth it |

➢ Analysis and Processing of Questionnaire Results

Analysis of the results of the questionnaire was carried out after processing the data first. Data processing is carried out after getting the results of the validity and reliability tests in accordance with the provisions. This data processing aims to measure the percentage value of the feasibility of the method performance and the quality of the application system in the USE questionnaire.

# 3. RESULT AND DISCUSSION

## 3.1 System Validity

Decision support system is a product of information systems / information technology that uses a mathematical calculation method approach. As a product with a mathematical approach, validation should be carried out to determine compliance with the calculation rules based on that method. Validation of calculations on the application system is very important to do, this is because it is closely related to the priority weights of criteria and proposals that have an impact on the ranking of criteria and proposals. Validation is done by giving the same input data to the application system and the manual, then the output from the system is compared to the similarity to the manual results. If the system output to the manual has the same value, it is said to be valid, if it is not the same, it is not said to be valid, and an analysis of improvements to the system must be carried out until it is valid. The results of the criteria can be seen in Table 5.

**Table 5. Output criteria on the system and manual**

| Criteria | ANP | |
|---|---|---|
| | system | Manual |
| Inhibiting Income (II) | 7,988 | 7,988 |
| Urgency (U) | 7,101 | 7,101 |
| Felt by Many People FMP) | 3,742 | 3,742 |
| Public Interest (PI) | 5,733 | 5,733 |
| Potential Availability (PA) | 5,352 | 5,352 |
| Cost (C) | 4,400 | 4,400 |

Table 5. Output criteria for the system and manual, showing the criteria with II code in the system calculation using the ANP method has a value of 7.988, U criteria of 7.101, FMP criteria of 3.742, PI of 5.733, PA of 5.352 and criteria C of 4.400. Based on these data, there is no difference in the results found in the results of calculations and system testing against the manual. This shows that the value of the criteria with the ANP method approach on the decision support system is valid.

**Table 6. Alternative Outputs on System and Manual**

| Alaternative | SAW | |
|---|---|---|
| | System | Manual |
| Road repair | 30,852 | 30,852 |
| Water tunnel | 28,705 | 28,705 |
| Entrepreneurship training | 29,821 | 29,821 |

While table 6 alternative outputs on the system and manual, with the proposed road improvement in the calculation of the system with the SAW method has a value of 30,852, the culvert program has a weight of 28,705 and the entrepreneurship training program has a weight of 29,821. Based on these data, the results contained in the calculation of the system to the manual are the same. This shows that the decision support system with the SAW method is valid.

## 3.2 Questionnaire Validity

The validity test of the method performance and usability questionnaire was carried out to find out how much validity the measuring instrument used was with validity analysis using the bivariate correlation product moment method with the help of the SPSS 16 for Windows program. The following are the results of the instrument validity test, application quality and method performance.

**Table 7. Results of the Validity Test of Questionnaire Question Items**

| Indicator | r count | r table | Information |
|---|---|---|---|
| Q1 | 0,502 | 0,344 | Valid |
| Q2 | 0,473 | 0,344 | Valid |
| Q3 | 0,697 | 0,344 | Valid |
| Q4 | 0,439 | 0,344 | Valid |
| Q5 | 0,473 | 0,344 | Valid |
| Q6 | 0,535 | 0,344 | Valid |
| Q7 | 0,479 | 0,344 | Valid |
| Q8 | 0,534 | 0,344 | Valid |
| Q9 | 0,469 | 0,344 | Valid |
| Q10 | 0,405 | 0,344 | Valid |
| Q11 | 0,431 | 0,344 | Valid |
| Q12 | 0,555 | 0,344 | Valid |
| Q13 | 0,489 | 0,344 | Valid |
| Q14 | 0,439 | 0,344 | Valid |
| Q15 | 0,445 | 0,344 | Valid |
| Q16 | 0,867 | 0,344 | Valid |
| Q17 | 0,503 | 0,344 | Valid |

The results of testing the validity of the questionnaire in table 5.12 which consists of 17 questions that have been filled out by 33 respondents indicate that all items are valid. That is, based on the comparison of the calculated r value greater than r table = 0.344 and has a positive value, the question item is declared valid.

## 3.3 Reliability

The reliability test was used to measure the reliability of the usability questionnaire and the performance of the method in research. The reliability test in this study used the Cronbach's Alpha method with the help of SPSS 16 for Windows statistics. The results of the reliability test data can be seen in the following table.

**Table 8. Reliability test results Questionnaire questions**

| Reliability Statistics | |
|---|---|
| Cronbach's Alpha | N of Items |
| .789 | 17 |

According to the data from the reliability test results in table 8, it is known that there are 17 usability and method performance questions with a Cronbach's Alpha value of 0.789. Based on the conversion of Cronbach's Alpha coefficient value to table 3 the level of reliability is in the high category.

## 3.4 Method Performance by Aspect

The performance of the method in this study is the accuracy of the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) methods which are applied to website-based information communication technology in processing community proposals to become the priority level of activity programs in village development planning. In the context of method performance, accuracy can be seen from the suitability of the priority level of the proposal based on the wishes of the participants and the decision maker's accommodation of the participant's (community) activity program. The results of processing the performance questionnaire data on the application of the ANP and SAW methods to the application system on the aspects of suitability and accommodation are shown in Figure 2.

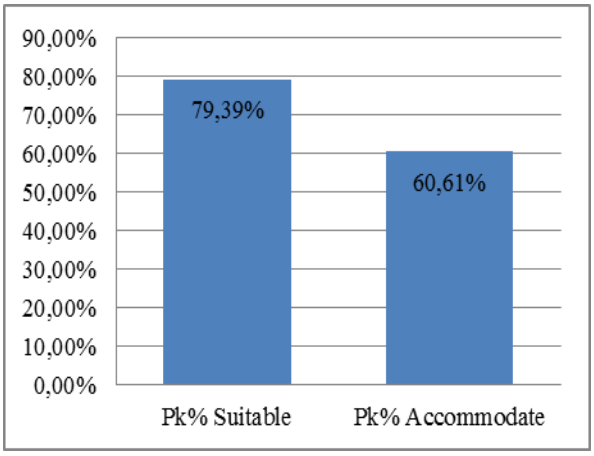


**Figure 2. Graph of Method Performance by Aspect**

Figure 2 is the result of the performance questionnaire on the application of the ANP and SAW methods to the application system in the aspects of suitability and accommodation. Based on table 4, the system feasibility standard on the suitability aspect shows that the Pk% value of 79.39% is included in the feasible category. Meanwhile, in the accommodative aspect, the Pk% value of 60.61% is in a good category.

## 3.5 Usability Berdasarkan Aspek

This study uses the USE Questionnaire as a parameter for measuring usability. The questionnaire consists of usability, ease to use, easy to learn, and satisfaction. It is hoped that it can provide information and empirical evidence that the use of the application system is following the needs and can provide convenience for users or participants of West Waru Village. The results of several aspects used to observe the quality or not of an application system are shown in Figure 3.

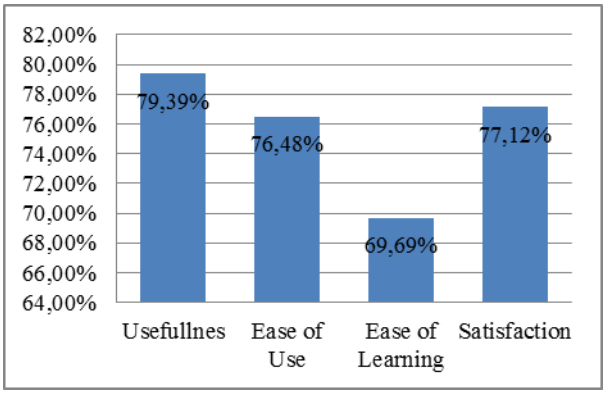


**Figure 3. Usability Graph by Aspect**

Based on Figure 3 on the aspect of usability (usefulness), which includes effective, productive, useful, and efficient, it is necessary to measure the extent to which the product enables users to achieve their goals. Where the level of usability in the usability aspect using the USE Questionnaire on the application system is 79.39%. Meanwhile, the ease of use aspect which includes easy to use, simple, user-friendly, consistent, and easy to recover is needed to measure how far the ease of use for users is, the Pk% value is 76.48%.

In the easy-to-learn aspect, which includes being fast to learn and easy to remember, it is necessary to measure how far the ease of learning for application system users is. Based on Figure 2, the usability level of the ease of learning in the application system is 69.69%. Finally, the aspect of satisfaction (satisfaction) includes satisfied, pleasant, as desired, and comfortable with Pk% of 77.12%.

Based on each of these values, the PK% level on all aspects of usability is included in the feasible category. It can be seen in table 4 of the system's feasibility standards that the value of 61-80 is included in the appropriate category for application system users in proposing program activities according to their needs..

## 3.6 Method Performance and Usability

The performance of the method is needed to measure the accuracy of the ANP and SAW methods in processing the priority level of the proposal in the application system. While usability is used to measure how easy the application system is in carrying out its duties. The results of method performance and usability are shown in Figure 4.

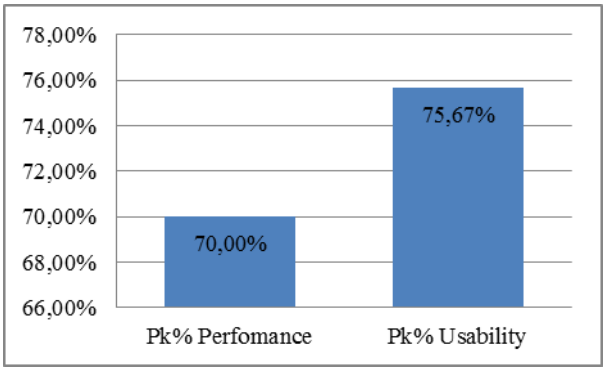


**Figure 4. Performance and Usability Test**

Figure 4 graphs the method performance and usability, the Pk% value of the method performance using the USE Questionnaire on a decision support system is 70%, while the Pk% usability value is 75.67%. Based on table 4, the feasibility standard for the method performance system on the decision support system and usability is in a good category.

# 4. CONCLUSION

Based on the results and analysis that has been done, the following conclusions can be formulated in this study, namely:

In terms of suitability, accommodation and overall performance of the Analytical Network Process (ANP) and Simple Additive Weighting (SAW) methods on the decision support system are in the decent or good category.

The quality of the application system is based on usability tests on the aspects of usability (usefulness), ease of use (ease of use), ease of learning (ease of learning), aspects of satisfaction (satisfaction) and overall in the category of decent or good quality.

# 5. ACKNOWLEDGMENTS

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