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Design of Decision Support System in Determining Maintenance Priority Using *Weighted Product* (WP) Method

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Abstract

Technological developments are very dynamic so that the information produced is fast and accurate, starting from an office to the educational level. Management of facility maintenance data at State Senior High School 2 Sijunjung is still done manually. Determining facility maintenance work based on manual management can cause the determination of facility maintenance work to be irrelevant. To overcome this problem, a decision support system is needed that can improve the process of managing and determining facility maintenance work using the Weighted Product (WP) method. The Weighted Product (WP) method is a multi-criteria decision-making method used to solve the problem of selecting the best option from several available alternatives. Based on the results of the analysis in the process of determining facility maintenance, the researcher made manual calculations using the weighted product method where there are 5 criteria and 15 alternatives. From the results of these calculations, the researcher made a decision by looking at the ranking of the WP calculation where the art room was ranked first with a value of 0.0900. This system is expected to be able to assist schools in managing facility data that affects the determination of facility maintenance work priorities and as a basis for decision-making in determining facility maintenance work.

Keywords : Decision Support System, Weighted Product, Maintenance, Facilities,

1. Introduction

The development of computer technology today has attracted the attention of many groups. This development is very dynamic along with the development of the times so that the information produced is fast and accurate and does not require a long time to search for and find the information needed. Starting from an office to an educational level that uses information systems to solve all existing problems. STATE HIGH SCHOOL 2 Sijunjung is one of the state high schools that has complete facilities for each department. This high school has two departments, namely science and social studies. Every year the number of students entering each department continues to increase, of course with the increasing number of students, the use of facilities also increases. However, the increase in the number of students is not accompanied by an increase in the determination of facility maintenance work, which causes the irregularity of the facility maintenance process at SMA NEGERI 2 Sijunjung.

This can be seen from the absence of information about what applications are used in determining maintenance work. Management of facility maintenance data at SMA NEGERI 2 Sijunjung is still done manually. Determining facility maintenance work based on manual management can result in manipulation of facility data or incorrect recording of facility data which makes determining facility maintenance work irrelevant. The irrelevance of data for determining the work of facility maintenance not only impacts the maintenance of the facility but also impacts the image of the school as well as hindering the school from realizing its vision and mission.

To determine the priority of facility maintenance work properly, valid facility data information is needed because it will affect the determination of the priority of facility maintenance work. Building a decision support system for determining the priority of facility maintenance work is the right media to implement the information system.

To overcome these problems, a system is needed that provides convenience in storing and processing facility maintenance data. The system to be developed can improve the process of managing and determining facility maintenance work and avoid incorrect data recording and data manipulation, because it is done in a computerized manner using decision making with the Weight Product (WP) method.

Decision Support System (DSS) is an interactive computer-based information system, by processing data with various models to solve unstructured problems so that it can provide information that can be used by decision makers in making a decision[1][2][3]. Decision Support System is a system designed to help solve various managerial

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problems or problems related to the company organization. This system aims to improve the effectiveness and productivity of managers in making decisions, by utilizing computer technology. It is important to understand that the Decision Support System does not aim to replace the role of managers, but rather functions as a tool or consideration in determining the final decision [4].

Decision Support Systems use data, provide easy user interfaces and can incorporate decision-making thinking, and describe systems designed to help managers solve specific problems[5][6]. The purpose of DSS is to help managers in decision-making on semi-structured problems. Not only that, other goals can also provide support for manager considerations, not to replace the manager's function, increasing the effectiveness of decisions taken by managers more than improving their efficiency[7][8].

One of the methods in SPK is the Weighted Product method. The Weighted Product (WP) method is a method in determining a decision by means of multiplication to connect between attributes based on the rating of each attribute raised to the power of the weight of the relevant attribute [9][10]. The Weighted Product method is a decision-making method that uses a multiplication approach to connect attribute values. In this method, each attribute value is raised to the power of the relevant attribute weight. Weighted Product is one of the most popular multi-criteria decision analysis (MCDA) methods. MCDA is a method that works by providing a limited set of decision alternatives, which are described based on a number of criteria. Each decision alternative is then compared to other alternatives by multiplying a number of ratios, each for each criterion. The ratios are then raised to the power according to the relative weight of the related criteria [11].

Previous research conducted by Sartin Sartika Dewi et al discussed the criteria used in determining culinary tourism destinations, namely price, service, quality, rating, and distance. Researchers use the Weighted Product (WP) method to produce recommendations for culinary places in Kupang City based on predetermined criteria and available culinary alternatives. Data collection is carried out through two methods, namely observation and literature study (literature review), as the initial step of the research [12].

Previous research conducted by Itin Riatu et al discussed the process of determining the best lecturer must be in accordance with the established criteria. To assist the selection process and determine individuals who are worthy of being the best lecturer, a decision support system is needed. One method that can be used is the Weighted Product (WP) method, which considers the criteria and weights of each. This method was chosen because it is able to determine the best alternative, namely the best lecturer, based on the criteria entered. The process involves calculating the weight of each attribute and continuing with ranking to obtain the best alternative [13].

Another study conducted by Nur Kholiq Aziz and Mufti discussed about In the manufacturing industry, the role of suppliers is very important in ensuring the availability of raw materials for the smooth running of the company's production process. PT Trisinar Indopratama, as one of the largest plasticware manufacturers in Indonesia, must be able to choose suppliers correctly and quickly so that the quality of the products produced is in accordance with the expected standards. However, in practice, errors often occur in the analysis and assessment of suppliers, so that the selected supplier does not match the company's needs. This can cause losses, such as prices that are too high, late delivery, inadequate payment terms, or raw material quality that does not match demand. This study aims to develop a decision support system application that can provide the best supplier recommendations for PT Trisinar Indopratama. This application is designed to help make decisions objectively, quickly and precisely by considering predetermined criteria. This system is able to present supplier information and recommendations, complete with ranking results. This research produces a web-based system developed using Sublime Text. The system can be used by admins to manage lecturer data, criteria, and alternatives. The output of this system is a sequence of alternative lecturers recommended as the best lecturers at Dharmas University of Indonesia [14].

By building a decision support system for determining the priority of facility maintenance work with predetermined criteria and in accordance with needs, it is hoped that it will be able to help schools in managing facility data that influences the determination of the priority of facility maintenance work and as a basis for decision making for determining facility maintenance work .

2. Research methodology

To assist in the preparation of this research, it is necessary to have *a* clear framework of stages . This framework is the steps that will be taken in solving the problems that will be discussed. The research framework used is as seen in Figure 1 below :

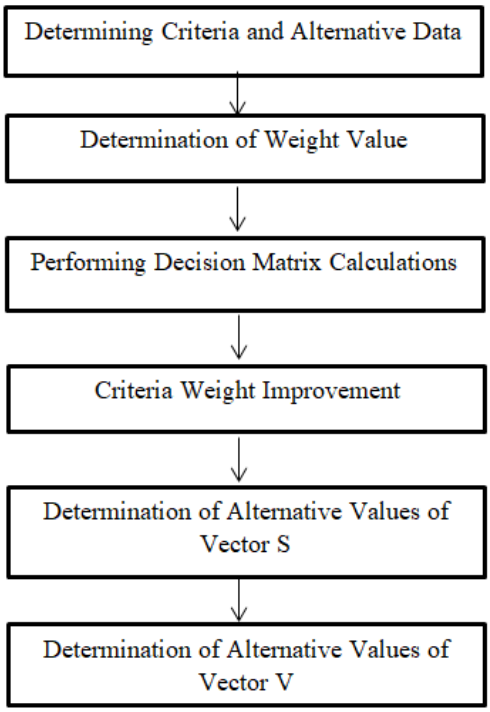


Figure 1. Research Framework

The steps of the Weighted Product method are as follows:

1. Determining the Criteria and Alternative Data used
2. Determining Preference Weight Values
3. Performing decision matrix calculations
4. Performing Weight Correction, weight correction using the following equation

$$Wz = \frac{Wz}{\sum Wz} \qquad (1)$$

In where: W_z is the weight and $\sum W_z$ value is the total overall weight value

5. After the decision matrix and criteria weighting improvements are made, can , then the next step is to find the value of the vector S, using equation 2 as follows :

$$i = \prod_{z}^{n} = 1 \;\; Xiz\, Wz \qquad (2)$$

Where:
S_i is an alternative preference .
X is to state the criteria value.
W is to state the weight of the criteria.
I is stating an alternative.
Z is to state the criteria.
N is the number of criteria.

6. Calculating the vector V or the relative preference of each alternative, for ranking with the following equation 3:

$$Vi = \frac{\prod_{z=1}^{n} Xiz\, Wz}{\prod_{z=1}^{n} (Xwz)wz} \qquad (3)$$

It's as simple as:

$$i = V_i = \frac{S_1}{S_1 + S_2 + S_n} \qquad (4)$$

3. Results and Discussion

Weight Product method is a step taken to find the best alternative calculation through several diverse factors, the steps of the *weight product method* include determining the criteria, which can be seen in Table 1.

Table 1. Criteria Data

No	Criteria	Attribute	Weight Value
1	Processing time	*Cost*	4
2	Cost	*Cost*	4
3	Number of Workers	*Cost*	3
4	Level of Need	*Benefit*	4
5	Difficulty Level	*Benefit*	5

The table shows the criteria and attributes used to assess a project or activity based on a certain value weight. There are five main criteria in this assessment, namely Time of Work, Cost, Quantity, Level of Need, and Level of Difficulty. This table explains how the criteria and attributes are assessed based on priority, with weights reflecting the relative importance of each aspect. Next, we will explain the alternative data used, which can be seen in Table 2.

Table 2. Alternative Data

No	Code	Alternative
1	A_1	Principal's Room
2	A_2	Vice Principal's Room
3	A_3	Teachers' Assembly Room
4	A_4	Administration Room
5	A_5	Guidance Counseling Room
6	A_6	Library
7	A_7	High School Labor
8	A_8	Study Room
9	A_9	Committee Room
10	A_{10}	Al-Kahfi prayer room
11	A_{11}	OSIS Room
12	A_{12}	Uks Room
13	A_{13}	Art Room
14	A_{14}	Sports Room
15	A_{15}	Archive Room

Next, we will describe the scale of importance of each criterion, which can be seen in Table 3.

Table 3 . Scale of Importance of Each Criteria

Level of Interest	Information
1	Very bad
2	Bad
3	Enough
4	Good
5	Very good

This table explains the scale of importance used to assess each criterion in an analysis or decision making. This scale provides a systematic and consistent assessment guide to evaluate the extent to which a criterion meets predetermined expectations or needs.

Table 4. Alternative Values Table

No	Criteria	Data Range	Level
1	Processing Time (days)	0 – 7	1
		8-14	2
		15-21	3
		22-28	4
		29-100	5
2	Cost (Rupiah)	0 - 1,000,000	1
		1,000,000 - 1,999,999	2
		2,000,000 - 3,999,999	3
		4,000,000 - 6,999,999	4
		7,000,000 -100,000,000	5
3	Number of Workers	1-3	1
		4-7	2
		8-10	3
		11-15	4
		16-100	5
4	Level of Need	Very long	1
		Long	2
		Normal	3
		Fast	4
		Very fast	5
5	Difficulty Level	Very easy	1
		Easy	2
		Normal	3
		Difficult	4
		Very difficult	5

Table 5. Decision Matrix

A_1	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}
A_2	X_{21}	X_{22}	X_{23}	X_{24}	X_{25}
A_3	X_{31}	X_{32}	X_{33}	X_{34}	X_{35}
A_4	X_{41}	X_{42}	X_{43}	X_{44}	X_{45}
A_5	X_{51}	X_{52}	X_{53}	X_{54}	X_{55}
A_6	X_{61}	X_{62}	X_{63}	X_{64}	X_{65}
A_7	X_{71}	X_{72}	X_{73}	X_{74}	X_{75}
A_8	X_{81}	X_{82}	X_{83}	X_{84}	X_{85}
A_9	X_{91}	X_{92}	X_{93}	X_{94}	X_{95}
A_{10}	X_{101}	X_{102}	X_{103}	X_{104}	X_{105}
A_{11}	X_{111}	X_{112}	X_{113}	X_{114}	X_{115}
A_{12}	X_{121}	X_{122}	X_{123}	X_{124}	X_{125}
A_{13}	X_{131}	X_{132}	X_{133}	X_{134}	X_{135}
A_{14}	X_{141}	X_{142}	X_{143}	X_{144}	X_{145}
A_{15}	X_{151}	X_{152}	X_{153}	X_{154}	X_{155}

In Table 5 , the calculation of $X_{11} \ldots X_{155}$ states that the performance of alternatives with reference to criteria is the criteria score data for each alternative. Where:

X_{iz} is the performance of the i-th alternative *for* the *z -th criterion* .
A_i (i = 1,2,3 ... m) are the possible alternatives.
X_z (z = 1,2,3 ... m) is the criterion by which the performance of the alternatives is measured.

In this study, the criteria used can be seen in Table 5 , where the existing criteria are the *K values* . Which can be seen as follows:

K_1 = Processing Time .
K2 = Cost .
K_3 = Number of Workers .
K_4 = Level of Needs .
K_5 = Difficulty Level .

Table 6. Decision Matrix Results

	K_1	K_2	K_3	K_4	K_5
A_1	4	5	3	4	4
A_2	1	3	2	3	2
A_3	3	5	4	5	5
A_4	5	1	1	2	1
A_5	1	1	1	2	2
A_6	1	2	2	4	3
A_7	1	1	2	5	2
A_8	1	1	1	1	2
A_9	2	3	2	5	3
A_{10}	2	4	3	5	3
A_{11}	2	5	3	4	4
A_{12}	2	3	2	3	2
A_{13}	1	1	1	3	2
A_{14}	4	5	5	2	1
A_{15}	1	1	1	3	1

Performing Weight Repairs

In the process of completion, after the decision matrix is obtained, the next step is to improve the weight for each criterion. In supporting the results of the facility *maintenance decision* to be used, there are 5 criteria with weights as can be seen in see Table 6 .

In the table 1 the criteria weight value is still in the form of a natural number, the weight value will then be convert to a decimal number by dividing the weight by the number of weights as in Table 7 below:

Table 7. Weight Repair

No	Criteria	Weight Value	Weight Repair
1	Processing time	4	4/20 =0.2
2	Cost	4	4/20=0.2
3	Number of Workers	3	3/20=0.15
4	Level of Need	4	4/20=0.2
5	Difficulty Level	5	5/20=0.25

Vector Value S

Calculation of the Si value can be done look at the following solution:

$S_1 = (4^{-0.2})(5^{-0.2})(3^{-0.15})(4^{0.2})(4^{0.25}) = 0.8693$
$S_2 = (1^{-0.2})(3^{-0.2})(2^{-0.15})(3^{0.2})(2^{0.25}) = 1,0718$

To complete the calculation of the S $_3$ to S $_{15\ values}$, please see Attachment 1.1.

Calculating the Value of Vector V

To get the results of the solution calculation, V_i you can in look at the following calculation:

$$V_1 = \frac{S_1}{S_1 + S_2 + S_3 + S_4 + S_5 + S_6 + S_7 + S_8 + S_9 + S_{10} + S_{11} + S_{12} + S_{13} + S_{14} + S_{15}}$$

$$\frac{0{,}8693}{(0{,}8693+1{,}0718+0{,}9750+0{,}8326+1{,}3660+1{,}3625+1{,}4788+1{,}1892+1{,}1436+1{,}0160+0{,}9985+0{,}9330+1{,}4814+0{,}4956+1{,}2457)} = 0{,}0528$$

$$V_2 = \frac{S_2}{S_1 + S_2 + S_3 + S_4 + S_5 + S_6 + S_7 + S_8 + S_9 + S_{10} + S_{11} + S_{12} + S_{13} + S_{14} + S_{15}}$$

$$\frac{1{,}0718}{(0{,}8693+1{,}0718+0{,}9750+0{,}8326+1{,}3660+1{,}3625+1{,}4788+1{,}1892+1{,}1436+1{,}0160+0{,}9985+0{,}9330+1{,}4814+0{,}4956+1{,}2457)} = 0{,}0651$$

For the completion of the calculation of the values of V $_3$ to V $_{15,}$ please see Appendix 1.2.

Based on the matrix s , the calculation of the matrix V $_i$ value And in find the value of all the data , then the resulting value of $\mathbf{V}_i$ is used for the ranking results can be see Table 8 below :

Table 8. V $_i$ Score Results

Code	Alternative	V_i	Rank
A_1	Principal's Room	0.0528	13
A_2	Vice Principal's Room	0.0651	8
A_3	Teachers' Assembly Room	0.0592	11
A_4	Administration Room	0.0506	14
A_5	Guidance Counseling Room	0.0830	3
A_6	Library	0.0828	4
A_7	Labor High School	0.0898	2
A_8	Study Room	0.0723	6
A_9	Committee Room	0.0695	7
A_{10}	Al-Kahf Mosque	0.0617	9
A_{11}	Oasis Room	0.0607	10
A_{12}	Office space	0.0567	12
A_{13}	Art Room	0.0900	1
A_{14}	Sports Room	0.0301	15
A_{15}	Archive Room	0.0757	5

System Implementation

1. Login Page View

form is used as data validation for each *user*, namely Admin and operator who want to enter the system by inputting username , password . Figure 2 shows the login form in the system.

Figure 2. Login Page View

2. Assessment Process Page View (Weight Product Method)

On this assessment process page is the core of the system to be implemented, In this assessment process the calculation is carried out according to the facility data and criteria data that have been previously inputted on the previous forms. For the calculation process to appear automatically, the data that has been processed is as in Figure 5.24. Based on the results of this calculation, the facility data that will be prioritized in carrying out *maintenance* will be obtained :

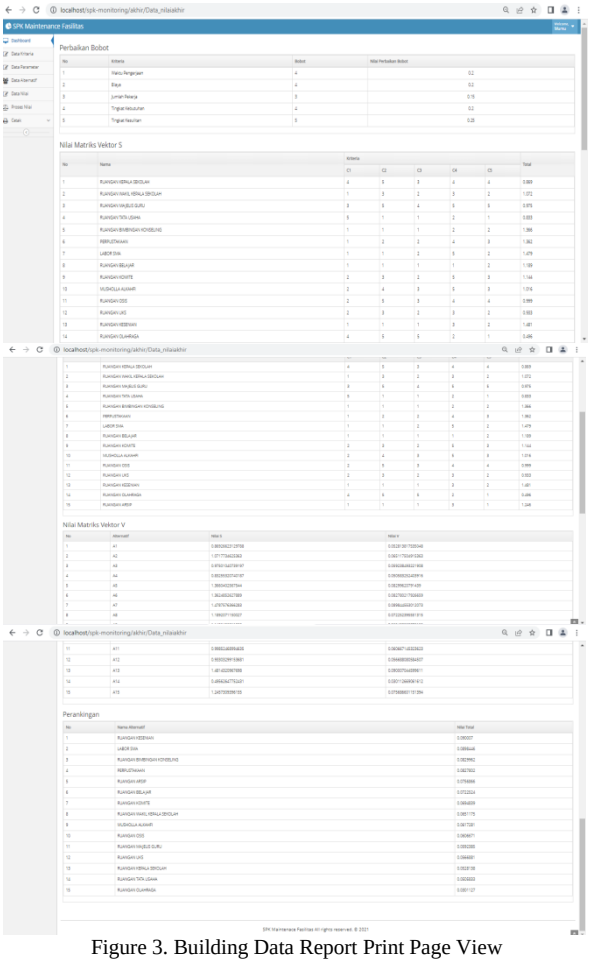
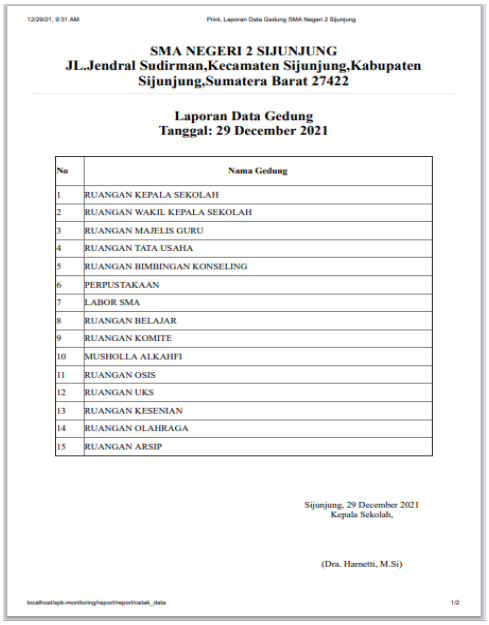


Figure 3. Building Data Report Print Page View

Print building data report containing building data that has been inputted by the operator into the system. The form of the building data report display is as shown in Figure 5 below :



12/29/21, 9:31 AM Print, Laporan Data Gedung SMA Negeri 2 Sijunjung

SMA NEGERI 2 SIJUNJUNG
JL.Jendral Sudirman,Kecamaten Sijunjung,Kabupaten Sijunjung,Sumatera Barat 27422

Laporan Data Gedung
Tanggal: 29 December 2021

No	Nama Gedung
1	RUANGAN KEPALA SEKOLAH
2	RUANGAN WAKIL KEPALA SEKOLAH
3	RUANGAN MAJELIS GURU
4	RUANGAN TATA USAHA
5	RUANGAN BIMBINGAN KONSELING
6	PERPUSTAKAAN
7	LABOR SMA
8	RUANGAN BELAJAR
9	RUANGAN KOMITE
10	MUSHOLLA ALKAHFI
11	RUANGAN OSIS
12	RUANGAN UKS
13	RUANGAN KESENIAN
14	RUANGAN OLAHRAGA
15	RUANGAN ARSIP

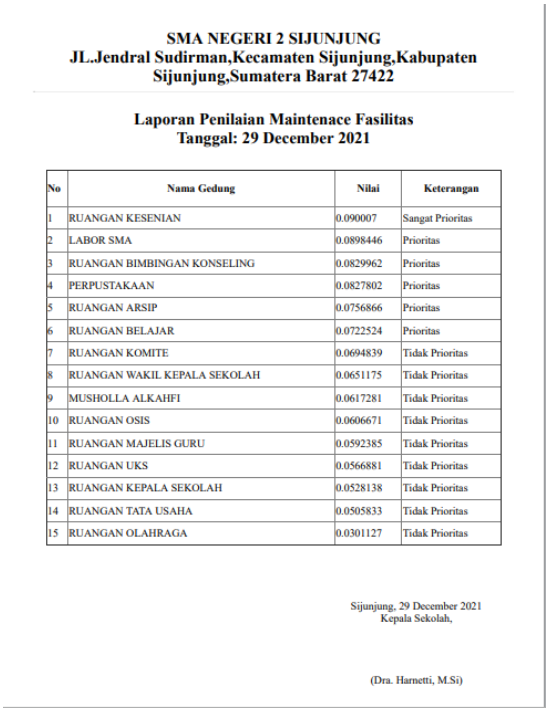
Sijunjung, 29 December 2021
Kepala Sekolah,

(Dra. Harnetti, M.Si)

localhost/spk-monitoring/report/report/cetak_data 1/2

Figure 4. Building Assessment Report Print Page View

Print the building assessment report containing the ranking results data that has been processed by the calculation of the *Weight Product* (WP) method that is inputted by the operator into the system. The form of the building assessment report display is as shown in Figure 6 below :



SMA NEGERI 2 SIJUNJUNG
JL.Jendral Sudirman,Kecamaten Sijunjung,Kabupaten Sijunjung,Sumatera Barat 27422

Laporan Penilaian Maintenace Fasilitas
Tanggal: 29 December 2021

No	Nama Gedung	Nilai	Keterangan
1	RUANGAN KESENIAN	0.090007	Sangat Prioritas
2	LABOR SMA	0.0898446	Prioritas
3	RUANGAN BIMBINGAN KONSELING	0.0829962	Prioritas
4	PERPUSTAKAAN	0.0827802	Prioritas
5	RUANGAN ARSIP	0.0756866	Prioritas
6	RUANGAN BELAJAR	0.0722524	Prioritas
7	RUANGAN KOMITE	0.0694839	Tidak Prioritas
8	RUANGAN WAKIL KEPALA SEKOLAH	0.0651175	Tidak Prioritas
9	MUSHOLLA ALKAHFI	0.0617281	Tidak Prioritas
10	RUANGAN OSIS	0.0606671	Tidak Prioritas
11	RUANGAN MAJELIS GURU	0.0592385	Tidak Prioritas
12	RUANGAN UKS	0.0566881	Tidak Prioritas
13	RUANGAN KEPALA SEKOLAH	0.0528138	Tidak Prioritas
14	RUANGAN TATA USAHA	0.0505833	Tidak Prioritas
15	RUANGAN OLAHRAGA	0.0301127	Tidak Prioritas

Sijunjung, 29 December 2021
Kepala Sekolah,

(Dra. Harnetti, M.Si)

Figure 5. Print View of Building Assessment Report

4. Conclusion

Implementing a decision support system with the weight product (WP) method for determining facility maintenance can provide more accurate results. The use of the PHP programming language and the Mysql database can be used to build a decision support system for the weight product (WP) method in the form of an application that can be implemented at SMA NEGERI 2 Sijunjung to help produce the right decisions in determining the priority of facility maintenance work, and making reports can be done more easily and determining the priority of facility maintenance work can be done quickly.

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