Jurnal Mandiri IT ISSN 2301-8984 (Print)
Vol. 12 No. 3, January (2024), pp. 153-160

Decision support system for purchasing light fire extinguisher brands (APAR) on household needs using the weighted product (WP) method

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A R T I C L E I N F O

Article history:

Received Okt 19, 2023
Revised Dec 20, 2023
Accepted Jan 21, 2024

Keywords:

Decision Support System
Fire
Fire Prevention
Light Fire Extinguisher (APAR)
Weighted Product (WP)

ABSTRACT

Fire, as a serious disaster with destructive impacts involving loss of material and human lives, is mainly triggered by electrical short circuits due to massive construction and the use of cables that do not comply with standards. The importance of developing electric power that complies with safety standards to protect people and property cannot be overstated. Electrical integration is aimed at increasing system efficiency, but electrical short circuits remain the main cause of fires, accounting for 45% of cases in Indonesia in 2021. To reduce the risk, preventive measures are needed such as repairing the electrical network, using standard equipment, and educating the public. A light fire extinguisher (APAR) is one of the highly recommended fire prevention media. The appropriate APAR for household needs is the Chemical Powder / Dry Cemical type because it is almost effective for all classes of fires, especially for electrical short circuits. But in purchasing we are faced with the many brands available as well as limited needs, desires and financial capabilities. In this context, a web-based Decision Support System (DSS) was developed using the Weighted Product (WP) method to select the Brand of Light Fire Extinguisher (APAR). The WP method gives weight to the criteria of price, quality and reliability, helping households choose an APAR that suits their needs and budget. The application of this method is expected to minimize errors in selecting the APAR brand, increase accuracy, and make it easier to use for those who want to make a purchase. This SPK makes a positive contribution in helping users make APAR purchasing decisions that suit their needs and preferences.

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1. INTRODUCTION

Fire is a major disaster that has a serious impact on human life and property. Losses caused by fire include building damage, work and production stoppages, casualties, environmental damage, and material losses.(Meliana & Fajriah, 2019). One of the main factors causing fires is electrical short circuit, which is often caused by massive residential development and the use of non-standard

cables. Electric power development is the main focus to improve system efficiency, but electrical safety is also an important priority. Safety standards must be followed to protect people and property from the risk of fire.(Iwan, 2019).

Although electrical integration aims to improve system efficiency, electrical short circuits are still the main cause of fires, contributing up to 45% of fire cases in Indonesia in 2021.(CNN Indonesia, 2022). According to the BPBD of DKI Jakarta in the past year until the end of September 2023, there were more than 1,000 fires that occurred in the capital region. As many as 90% of the fires that occurred were caused by electrical short circuits.(Adevnt, 2023). The importance of preventive measures, such as electrical network improvements, the use of standardized equipment, and public education, is becoming increasingly evident.

Light Fire Extinguishers (APAR) are one of the highly recommended fire prevention solutions, especially the *Dry* Chemical *Powder* type which is effective for electrical short circuits.(Millenia, 2022). However, in choosing fire extinguishers, people are faced with challenges in the form of many brands and financial limitations. Therefore, the development of a web-based Decision Support System (SDM) using the *Weighted Product* (WP) method is proposed. This SPK aims to assist people in choosing a brand of fire extinguisher that suits their needs and budget. The application of the WP method in the SPK is expected to give weight to the criteria of price, quality, and reliability of fire extinguishers, thus minimizing brand selection errors. This SPK is expected to not only improve accuracy in choosing fire extinguishers, but also facilitate the purchasing process for the community.

Previous research using the WP method in purchasing decision support systems has shown success in different contexts, such as in motorcycle purchases. This method was chosen because of its ease of implementation, easy-to-understand results, and support for subjective preferences.(Ramadhani, 2021).

Based on this background, this research aims to develop a web-based SPK using the WP method to help people choose a brand of fire extinguisher that suits their needs and budget. Through this research, it is expected to make a positive contribution in increasing awareness of fire risks, encouraging preventive measures, and making it easier for people to choose the right fire extinguisher.

2. RESEARCH METHOD

In this research, there are 3 research methods used, namely data collection methods, system development methods, decision-making system methods.

1. Data Collection Method

Data collection is done to obtain the information needed in order to achieve the research objectives (M.Sc., 2006). The research methods carried out are:

a. Interview Method
   At this stage what is done is to interview APAR experts to determine what criteria are important and needed to be considered in the selection. Interviews are used for data collection with a systematic question and answer system based on the problem at hand.(Soegijono, 1993).

b. *Literature Study* Method
   Literature study is a series of activities related to the process of collecting library data, reading and writing, and processing research materials.(Kartiningrum, 2015). *Literature study is* carried out to analyze further needs, and collect clarification from previous research. The purpose of the literature study is to get an overview and support existing solutions to the problems being faced.

2. System Development Method

The System Development Method used in this research is the *System Development Life Cycle* (SDLC) *waterfall* model. *The Systems Development Life Cycle* (SDLC) method is a process that describes the steps that must be taken during the time spent creating an information system (Sofyan et al., 2015). SDLC serves to describe the main stages and steps at each stage which are essentially divided into five main activities (Widharma, 2017). This method has several stages, namely

Requirement analysis, System design, Implementation, Testing. *Requirement analysis* is a series of activities to observe and think about everything related to library data collection methods, reading and recording, and processing research materials based on system needs.(Saputra et al., 2012). System design is the Developer makes a framework plan that can assist in determining the equipment and prerequisites of the framework and further assist in characterizing the general framework design. System implementation is System implementation is a system procedure carried out to complete an approved system design such as testing, installing, and starting to use a new or improved system.(Setiadi, 2016). Testing is a system testing stage that is carried out to evaluate the entire system or application, including integration between components, in accordance with the specified specifications.(Suhartono, 2016). The following SDLC flow is as shown in Figure 1.

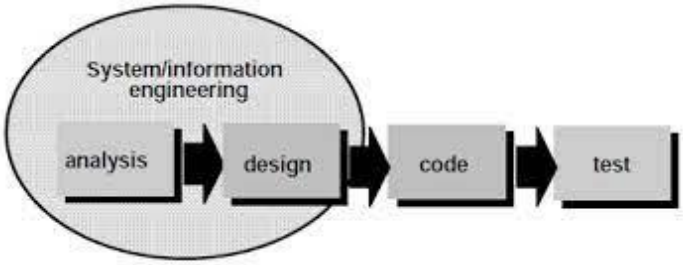

Figure 1. *System Development Life Cycle* (SDLC) flow

3. Decision-Making System Methods

A decision support system (SPK) is a system intended to assist decision making by presenting related information and data analysis to help decision makers evaluate available options. In Tonni Limbong's opinion, according to him, an interactive computer-based system known as a decision support system (SPK) helps decision makers to get solutions to solve unorganized and semi-organized problems by utilizing existing data and models (Limbong, 2020). Meanwhile, according to Man and Watson, SPK (Decision Support System) is a system that can help make decisions through the use of data and decision models to solve semi-structured and unstructured problems. The method used in this decision support system is the *weighted product* (WP) method.(Sianturi et al., 2018)(M.Sc., 2006). The following picture of the decision-making method scheme is in Figure 2.

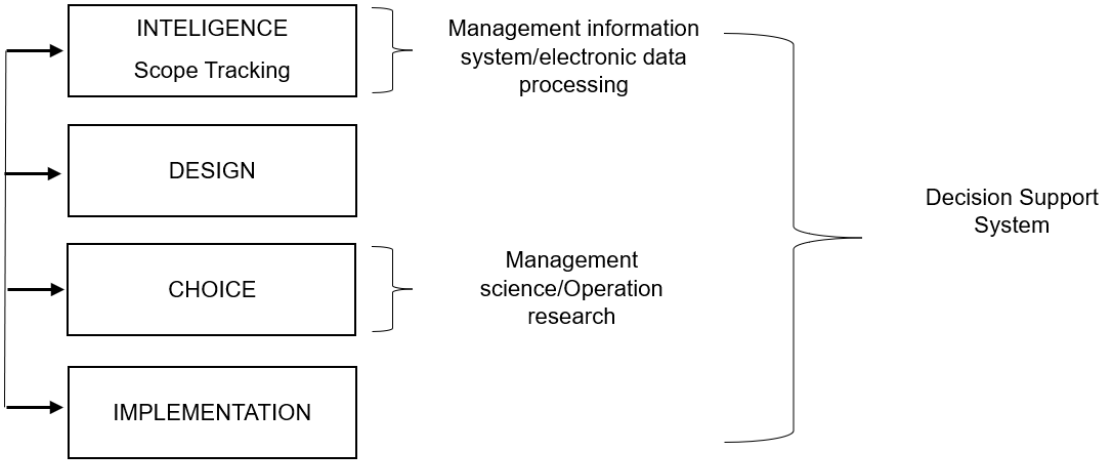

Figure 2. decision-making method scheme

4. Weighted Product (WP) Method

The WP method is a dynamic strategy given that the size of the propensity value is determined based on the value of the variables used, which is increased by the strength of the weights. The greater the presence value of the choice arrangement, the more favorable the choice arrangement is (Supriyono,

2015). The advantages of the Weighted Product method are simple and easy to understand. However, this method also has weaknesses, such as its sensitivity to changes in weights and changes in data order. Therefore, it is necessary to be careful in determining the weights and normalizing the data (Sabandar, 2023). The WP Calculation steps are as follows:

a. Determine criteria
   To be more specific, the measures will be used as a source of perspective or reference in deciding, specifically C and the nature of each criterion.
b. Determining the suitability rating
   That is rating the suitability of each alternative on each existing criterion, and creating a decision matrix.
c. Perform weight normalization
   Normalized weight is the weight of the sum of each existing criterion.
   The value of the sum of the weights must satisfy the equation:

$$W_j = \frac{Wi}{\sum Wj} \quad \text{.....1}$$

d. Determine the value of the vector S

$$Si = \prod_{j=1}^{n} Xij\, Wj \quad \text{.....2}$$

e. Determine the value of vector V

$$Si = \frac{\prod_{j=1}^{n} (Xij)^{wj}}{\prod_{j=1}^{n} (Xi*)^{wj}} \quad \text{.....3}$$

f. Ranking the value vectors V
   Conclusions at the final stage are made at this stage.

3. RESULTS AND DISCUSSIONS

1. Calculating Variables Using the Weighted Product (WP) Method

Identify the criteria factors and their weights and link them to the fire extinguisher brands tested.

a. Calculating Criteria.
   The criteria data for the selection of fire extinguishers for household needs are in table 1:

Table 1. Criteria

Criteria	Weight Value
Price	5
Capacity	3
Features	3
Certification	2

b. Determining the suitability rating
   The next step is to determine the suitability rating of each alternative APAR brand on each existing criteria, and create a decision matrix. The suitability rating can be seen in table 2.

Table 2. Suitability Rating

No.	Brand	Alternative	C1	C2	C3	C4
1	Viking	A1	5	3	4	3
2	Gunnebo	A2	5	3	4	4
3	Fire Stop	A3	5	3	4	1
4	Haka Fireindo	A4	5	3	5	1
5	Servvo	A5	5	3	4	7

c. Calculating Weight Normalization
   W = (5, 3, 3, 2)
   Then the weight of the improvements made:
   W1 = 5/(5+3+3+2) = 5/13 = 0,385

W2 = 3/(5+3+3+2) = 3/13 = 0,231
W3 = 3/(5+3+3+2) = 4/13 = 0,231
W4 = 2/(5+3+3+2) = 2/13 = 0,154
If the values of W1+W2+W3+W4 are summed up, the result will be ≈ 1.
W1 + W2 + W3 + W4 = 0.385 + 0.231 + 0.231 + 0.154 = 1

d. Finding the Vector Value (S)
Find the vector value S by raising all the rules for the option with weights as positive (+) type for the profit measure and weights working as negative (-) type for the cost basis.
$S1 = (350000^{-0.2}) (3^{0.12}) (4^{0.12}) (3^{-0.08}) = 0.096$
$S2 = (1800000^{-0.2}) (3) (4) (4^{0.120.12-0.08}) = 0.068$
$S3 = (315000) (3) (4^{-0.20.120.12}) (1^{-0.08}) = 0.107$
$S4 = (440000) (3^{-0.20.12}) (5^{0.12}) (1^{-0.08}) = 0.103$
$S5 = (1700000) (3) (4^{-0.20.120.12}) (7^{-0.08}) = 0.065$

e. Find Preference Value (V)
The result of calculating the preference value (V) is as follows:
V1 = S1 / S1 + S2 + S3 + S4 + S5
V1 = 0.096/ 0.096 + 0.068+ 0.107+ 0,013 + 0.065
V1 = 0.096 / 0.439
V1 = 0,219

V2 = S2 / S1 + S2 + S3 + S4 + S5
V2 = 0.068/ 0.096 + 0.068+ 0.107+ 0,013 + 0.065
V2 = 0.068/ 0.439
V2 = 0,155

V3 = S3 / S1 + S2 + S3 + S4 + S5
V3 = 0.107/ 0.096 + 0.068+ 0.107+ 0,013 + 0.065
V3 = 0.107/ 0.439
V3 = 0,244

V4 = S4 / S1 + S2 + S3 + S4 + S5
V4 = 0,013 / 0.096 + 0.068+ 0.107+ 0,013 + 0.065
V4 = 0,013 / 0.439
V4 = 0,235

V5 = S5 / S1 + S2 + S3 + S4 + S5
V5 = 0.065 / 0.096 + 0.068+ 0.107+ 0,013 + 0.065
V5 = 0.065 / 0.439
V5 = 0,104

f. Ranking scores
By looking at the previous value, it can be concluded that the value of V3 is greater than the other Vector values. That way it can be concluded that :
Rank 1 -> v3 = 0.244
Rank 2 -> v4 = 0.235
Rank 3 -> v1 = 0.219
Rank 4 -> v2 = 0.155
Rank 5 -> v5 = 0.148

The results of the ranking of alternatives from the preference value (V) are in table 3.

Table 3. Calculation Results

Alternative	Preference (V)	Ranking
A1	0,219	3
A2	0,155	4
A3	0,244	1

A4	0,235	2
A5	0,148	5

2. Implementation

Implementation is an important process in the system development method because at this stage the application of existing concepts and designs into a system that can be used by users.

a. Login Menu

The Login menu is a page used by users to enter the dashboard page of the system. The login menu is shown in Figure 3:

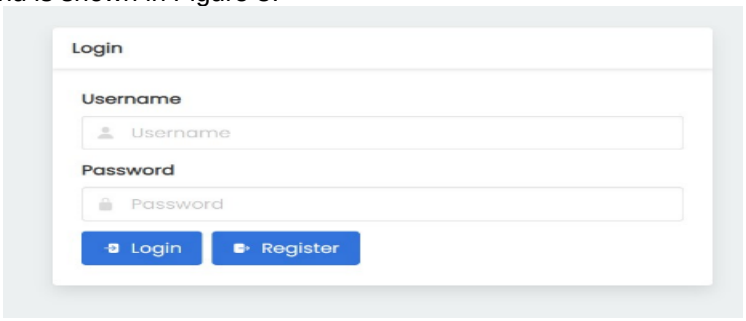

Figure 3. Login menu

b. Alternative Menu

The page used to add alternative APAR brands that you want to add. The Alternative menu is in Figure 4

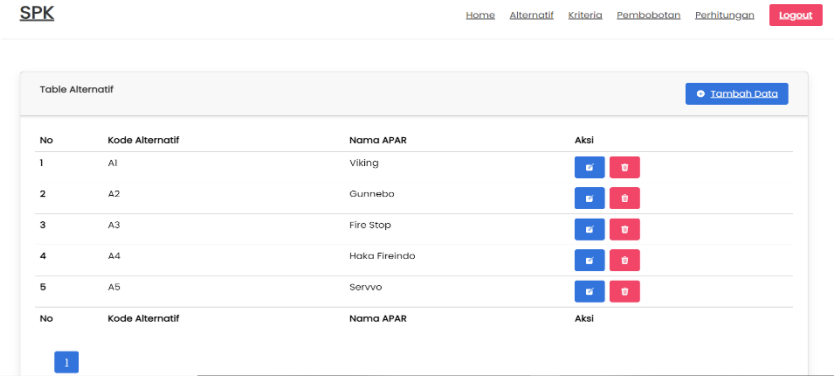

Figure 4. Alternative Menu

c. Criteria Menu

The page used to add the Criteria that you want to add. This menu contains weights and statuses that can be filled in according to the user. The criteria menu is in Figure 5.

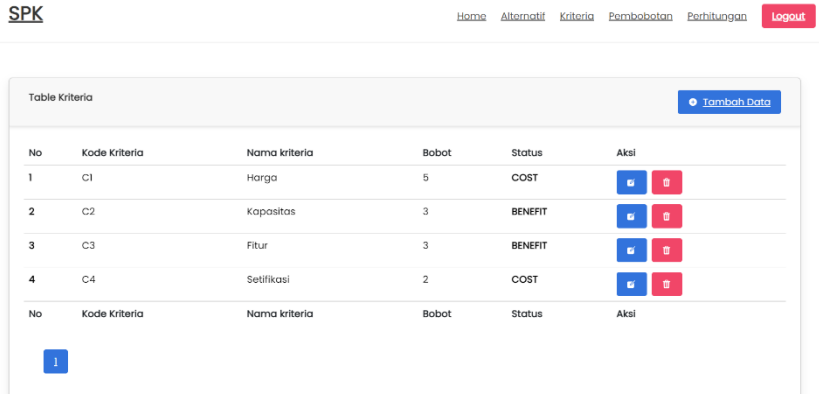

Figure 5. Criteria Menu

d. Weighting Menu
The page is used to combine each alternative and what criteria are selected, after which the user can enter the value in the APAR information. The weighting menu is in Figure 6

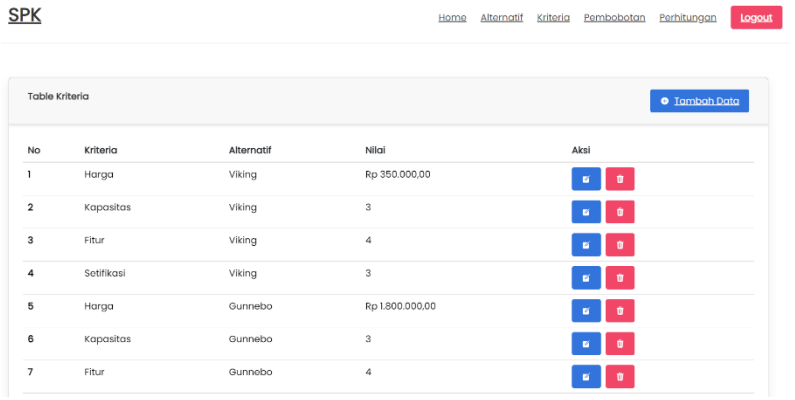

Figure 6. Weighting Menu

e. Result Display
A page that displays the overall results of the weighting, which displays the calculation process and the results of the calculation process. It is also equipped with a graph to make it easier to read the results. The result display is in Figure 7.

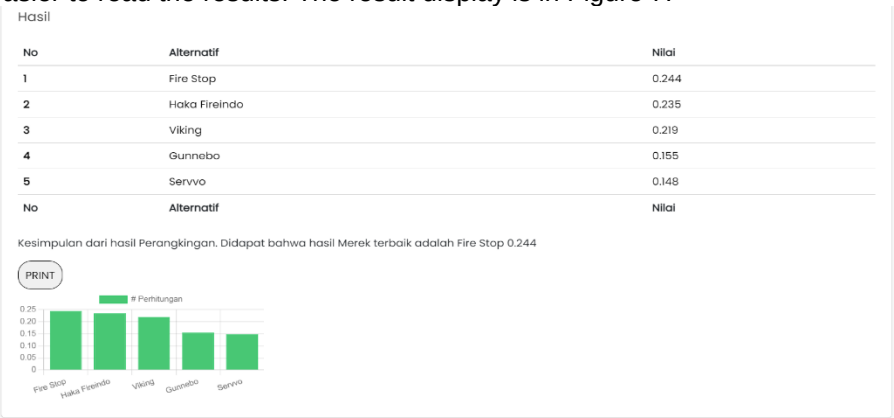

Figure 7. Result Display

4. CONCLUSION

It can be concluded that the fire stop brand is the best compared to other brands based on the weights and priorities that have been analyzed. The application of the Weighted Product (WP) method can significantly reduce the possibility of errors in the selection of fire extinguisher brands. By giving weight to each criterion, the system can provide recommendations based on the highest value resulting from the Weighted Product calculation. This helps users in avoiding selection errors that may arise due to less mature or unbalanced considerations. It is recommended to further explore other methods and even use cross-methods to find additional criteria and even sub-criteria as with more complex calculations and criteria and even implement it in other fields such as IoT. Improving the user interface and experience as well as promoting and partnering with existing brands.

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