Application of vikor (vise kriterijumska optimizacija i kompromisno resenje) method for identifying amplifier damage

S.Nurmuslimah 1, N Saidatin 1

1Institut Teknologi Adhi Tama Surabaya, East java, Indonesia

puty71naura@gmail.com

Abstract In this era, many electronics have been marketed in Indonesia. One of which is amplifier that is used to amplify the sound of MP3 player, radio, VCD or television. An amplifier is an electronic appliance that obviously has a certain lifespan or lifetime and afterwards damage will occur. Most people go to an electronics handyman to repair the damaged electronic appliance but not all handymen can analyze the damage easily. To overcome this problem, a system was setup to identify the damage of an amplifier. A damage identification on this system applied Vikor method. Vikor is a ranking method using multiple criteria ranking index based on certain measurement closed to the ideal solution. This application cloud be used as supporting consideration in talking the required steps for repairing an amplifier. The test result and calculation analysis using Vikor method obtained the system accuracy of 81.25%.

1. Introduction
In the era now there are many electronic goods are spread out in Indonesia. One of which is an amplifier OCL. An amplifier is the electronic devices that serves as a loudspeaker to the input in the form of a device mp3 player, cd players, radio and others. A an amplifier sure have a period of time because of age or wear and in time this instrument. To overcome the problems most of a person chooses ran to the electronic service to fix an amplifier than buy a new issue. Maybe that is due to economic reasons. An artisan electronic will serve for analysis before repair goods which will be renovated. It is not a bit an artisan serve electronic experienced difficulty at the time of analyzing or conducts a one-by-one. Component checking to overcome the problems so the government has built a system that could help know damage to an amplifier.

2. Methodology
Retrieval system of decision is a in the manner of someone think about something before take a action. To design systems decision-making obtained from a benefits and therefore measures to be taken will be optimal. The support system of decision is a system that has the ability to solve the problems semi-structured by providing information or advice on a decree certain. Each of the components is regulated by a software which has been available or designed specifically. There are several definition about the support system a decision, between others [1]: defines third party contributions as a population a procedure based on the models to process the data and to help manager in doing decision making. Third party contributions as system based on computer consisting of three components that interacted, namely: a language system (a mechanism that providing a means of communication between user components of the third party contributions). In the decision-making must go through the three phases that is [2]

a. Intelligence: This stage is a process of the search for and detection of scope problems it was and the process of the introduction of a problem. A data input obtained, processed, and tested in order to identify problem.

b. Design: This stage is a process of finding, develop and analyze the act of alternative could be done. This stage covering the process of understand the problem, sent down a solution and test the feasibility solution.

c. Choice: At this stage done the process of selection of a variety of alternative the act of one who may not be executed. The outcome of an election is then implemented in the process of decision making.
Amplifier is a series of electronic components that are used to strengthen power (or power in general). In the audio field, amplifiers will amplify the sound signal that is to strengthen the current signal (I) and voltage (V) electricity from the input into an electric current and a greater voltage (more power) at the output. Power Amplifier OTL model is one of the power amplifier models that are used for small to medium power no more than 100 Watts. Maybe in the past there were still those who used this OTL model power amplifier for sound system devices, but for now it is rarely used. However, today it is still widely used in some electronic devices for producing sound with small power such as televisions, radios, laptops, even cellphones that we use every day all use the type of OTL power amplifier for audio amplifier. One of the characteristics of the OTL type power amplifier model is that the power supply or power supply used is non-symmetrical so it is sufficient to use a battery power supply (at the poles + and -) or an adapter with V (+) and ground (0). [3]

Vikor (Vise Kriterijumska Optimizacija I Kompromisno Resenje) is a method that developed to optimize multicriteria of a system of the complex. This method tend to focus on ranking and chose him by using a number of alternatives based on criteria exist. A method of vikor provides multiindex rank with the measurement of the level of proximity ideal for a solution [4]. It assumed that every alternative has evaluated based on each function criteria so could be codified rank by comparing between the measurement of the level of proximity to an alternative that ideal. The measurement of multicriteria developed from \(L_p\). Metric that has been used as a function of aggregate programming on method[5]. Variety of alternative \((k = 1, ..., n)\) Symbolized by \(a_1, a_2, ..., a_n\). On the alternative \(a_k\), the ratio of the \(j\)th symbolized by \(f_{kj}\). Where \(f_{kj}\) is the value of the function of criteria of the \(j\)th for the alternative \(a_k\); \(m\) is the number of criteria \((j = 1, 2, ..., m)\). Development of the VIKOR method is derived from the shape of \(L_p - \text{metric}:\)

\[
L_{p,k} = \left\{ \sum_{j=1}^{n} \left[ w_j (f_j^* - f_{kj})/\left( f_j^* - f_j^- \right) \right] \right\}^{1/p}, 1 \leq p \leq \infty; k = 1, 2, ..., n \tag{1}
\]

In the VIKOR method, \(L_{1,k}\) and \(L_{\infty,k}\) used for setting measurement ratings. The solution obtained by \(\min S_k\) is the advantage of the majority group (“the majority” of the described as the average distance, \(\text{where } p = 1 \) ) and the solution obtained by \(\min S_k\) is loss individual minimum. The solution \(F\) is the solution that is closest to \(F^*\) ideal where \(\Delta f_j = f_j^* - f_j^2\) dan \(\Delta f_j = f_j^2 - f_j^-\). Refer formula 1.1 Provide a ranking on the alternatives that exist with how to sort or sort the results of the calculation of the index the vikor, starting from the largest value to the smallest value [4]. Then the calculation steps of the VIKOR method will be, the authors describe in detail as follows:

a. Calculate the value of the weight \((w_k)\) on each alternative with how to share between \([\text{the total amount of keriteria of one of the alternatives }]/[\text{the total number of keriteria of all the alternatives }].\)

\[
w_k = \frac{\sum_{j=1}^{n} f_{kj}}{\sum_{k=1}^{n} \sum_{j=1}^{m} f_{kj}} \tag{2}
\]

Here we did not use the symbol \(w_j\) in accordance with the formula reference, or formula (2), because the system that created this is the, a symbol off\(f\)deifying a line and the symbol \(k\) is like a column, in accordance on the tables arrival. So the symbol used is \(w_k\).

b. Set the value \(f_j^*\) and \(f_j^-\)

\(f_j^*\) = The greatest value of all keriteria on each alternative.

\(f_j^-\) = The smallest value of all keriteria on each alternative.

c. Calculate the value of the normalization matrix \(R_{kj}\) by using the following formula:

\[
R_{kj} = \frac{(f_j^* - f_{kj})}{(f_j^* - f_j^-)} \tag{3}
\]

\(f_{kj}\) = The value of the data sample \(k\) criteria \(j\)

Multiply the result of normalization with the weights criteria

\[
Rw_{kj} = R_{kj} \times w_k \tag{4}
\]
d. Calculate the value of $S_j$ and $R_j$

$S_j$ is the value of the sum of all alternatives in each keriteria, contained in the variable $R_{w_kj}$.

$$S_j = \sum_{k=1}^{n} R_{w_kj} \tag{5}$$

$R_j$ is the greatest value of all alternatives in each keriteria, contained in the variable $R_{w_kj}$

$$R_j = \max_k \{R_{w_kj}\} \tag{6}$$

e. Set value $S_j^*$, $S_j^-$, $R_j^*$ and $R_j^-$

$S_j^*$ = The greatest value of the variable $S_j$

$S_j^-$ = The smallest value of the variable $S_j$

$R_j^*$ = The greatest value of the variable $R_j$

$R_j^-$ = The smallest value of the variable $R_j$

f. Calculate the Vikor Index value ($Q_j$)

Please note that the value of $v = 0.5$

$$Q_j = \left(\frac{s_j-S_j^*}{s_j^-} \right) \times v + \left(\frac{R_j-R_j^*}{R_j^-} \right) \times (1 - v) \tag{7}$$

Flowchart of the app Decision-Making System to Identify Damage Amplifier OCL was in Figure 1. The explanation of the flowchart of figure 1 is initiated from the data entry expert and stored in the database. Then inputting the symptoms of the damage so that the calculation can be done in the process of Calculation of Vikor[6] where the data to be calculated is data that refers to the Damage Data and select Amplifier. Then the flowchart of the process of the Calculation of Vikor was shown in Figure 2. At Figure 2 we can see the process after the value of the data experts and the choice of the symptoms the damage has already been entered, then the next process or the process is looking for the value of the weights of each expert[7], then the process of seeking the best value and the worst in each expert. Then go the process of calculating the Normal value Damage. After the value of S and R obtained then carried out the process of searching for the best value and worst each value of S and R. The next step is to calculate the value of the Index the Vikor way as the formula shown in the picture flow. Having obtained the values of the Vikor, then done process sorting index values of the Vikor from the largest value to the smallest value so that the results obtained from the Steps of the Repair Amplifier[8] based on the value of the Vikor, which has sorted the.
Figure 1. Flowchart System

Figure 2. Flowchart of the Calculation of VIKOR
3. Results and discussion

3.1 System Analysis
The system is built can make it easy for a handyman service electronic in recognizing a damage to repair an Amplifier. In other words, this system only as a tool to start the job or the first step that should take precedence, i.e. observe, analyze, check the in sequence in accordance with the highest percentage of estimates which approach the logical symptoms of damage to an Amplifier.

Based on this, we need an application that can help a service electronic to get to know the damage and perform the repair device Amplifier based on the criteria that has been determined by using Vikor method. The Data Criteria that is used is the result of the assessment of some Experts the Electronics against damage data that we have given alternative data in table 2.

To start the construction of the system required some of the data component damage that often occurs on a device Amplifier OCL.

1. Alternative Data (Damage)
   Alternative Data (damage) is the data of some component damage that often occurs on an Amplifier OCL.

2. Data Criteria
   Data Criteria is data that contains the appraisal-appraiser Experts on the damage data which have been determined.

3.2 Calculation of vikor
Before performing the calculation of VIKOR, firstly find out the data that have been obtained from some of the Expert Electronic. In this case, I used the symptoms of the damage to No Noise and 5 Experts to fill in the data of such damage.

a. Find the value of the weights of each Expert
b. Find the value of the maximum and minimum of each Expert.

c. The Calculation Of The Normalization Matrix

Table 1. Weighting of Assessment for Each Expert

| Bobot | Pakar 1 | Pakar 2 | Pakar 3 | Pakar 4 | Pakar 5 |
|-------|---------|---------|---------|---------|---------|
|       | 0.2007  | 0.2007  | 0.2043  | 0.1971  | 0.1971  |

Table 2. The value of the Maximum and Minimum of Each Expert

|       | f_1(.) | f_2(.) | f_3(.) | f_4(.) | f_5(.) |
|-------|--------|--------|--------|--------|--------|
| Max    | 4      | 4      | 4      | 4      | 4      |
| Min    | 1      | 1      | 1      | 1      | 1      |

Table 3. The Value Of The Results Of The Normalization Matrix

|       | A_1(.) | A_2(.) | A_3(.) | A_4(.) | A_5(.) | A_6(.) | A_7(.) | A_8(.) | A_9(.) |
|-------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
|       | 0.6667 | 0.6667 | 0.6667 | 1      | 1      | 0      | 0      | 0      | 0      |
|       | 0.3333 | 0.3333 | 0.3333 | 0.3333 | 0      | 0      | 0      | 0      | 0      |
|       | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
|       | 0.6667 | 0.6667 | 0.6667 | 0.6667 | 0.6667 | 0      | 0      | 0      | 0      |
|       | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      | 0      |
The multiplication of Normalized Matrix with the Weights of the Criteria \((Rw_{kj})\), example of Multiplication of Matrix Normalization with Weights for \(A_1(\cdot)\):

\[
R_{11} = 0.6667 \times 0.2007 = 0.1338 \\
R_{12} = 0.6667 \times 0.2007 = 0.1338 \\
R_{13} = 0.6667 \times 0.2043 = 0.1362 \\
R_{14} = 1 \times 0.1971 = 0.1971 \\
R_{15} = 1 \times 0.1971 = 0.1971
\]

Table 4. Results of the Normalization Matrix Multiplication with Weight

| \(f_1(\cdot)\) | \(f_2(\cdot)\) | \(f_3(\cdot)\) | \(f_4(\cdot)\) | \(f_5(\cdot)\) |
|-----------|-----------|-----------|-----------|-----------|
| \(A_1(\cdot)\) | 0.1338    | 0.1338    | 0.1362    | 0.1971    | 0.1971    |
| \(A_2(\cdot)\) | 0.0669    | 0.0669    | 0.0681    | 0.0657    | 0         |
| \(A_3(\cdot)\) | 0         | 0         | 0         | 0         | 0         |
| \(A_4(\cdot)\) | 0.1338    | 0.1338    | 0.1362    | 0.1314    | 0.1314    |
| \(A_5(\cdot)\) | 0         | 0         | 0         | 0         | 0         |
| \(A_{19}(\cdot)\)| 0         | 0         | 0         | 0         | 0         |

- d. Calculate S and R
  - Calculate S on \(A_1(\cdot)\):
    \[
    S_{A_1(\cdot)} = 0.1338 + 0.1338 + 0.1362 + 0.1971 + 0.1971 = 0,7981
    \]
  - Calculate R:
    \[
    R value is the largest value of the weight of the criteria with normalization data. R value for sample \(A_1(\cdot)\) is \(R_{A_1(\cdot)} = 0,1971\)
    \]
  - e. Calculate the Vikor Index \((Q)\)
    \[
    Q_1 = \frac{(0,7981 - 1)}{0 - 1} \times 0.5 + \frac{(0,1971 - 0,2043)}{0 - 0,2043} \times (1 - 0,5) = 0,1184
    \]
  - d. Rank alternatives available by sorting or sorting results Vikor Index calculation, starting from the largest value to the smallest value.

Table 5. S and R values

| \(f_1(\cdot)\) | \(f_2(\cdot)\) | \(f_3(\cdot)\) | \(f_4(\cdot)\) | \(f_5(\cdot)\) |
|-----------|-----------|-----------|-----------|-----------|
| \(A_1(\cdot)\) | 0.7981    | 0.1971    | 0         | 0         |
| \(A_2(\cdot)\) | 0.2676    | 0.0681    | 0         | 0         |
| \(A_3(\cdot)\) | 0         | 0         | 0         | 0         |
| \(A_4(\cdot)\) | 0         | 0         | 0         | 0         |
| \(A_5(\cdot)\) | 0         | 0         | 0         | 0         |

Table 6. Maximal and Minimum S and R values

|       | S     | R     |
|-------|-------|-------|
| Max   | 1     | 0,2043|
| Min   | 0     | 0     |
Table 7. Ranking S, R, and Q

|   | S         | R         | Q         |
|---|-----------|-----------|-----------|
| A1(.) | 0,7981    | 0,1971    | 0,1185    |
| A2(.) | 0,2676    | 0,0681    | 0,6995    |
| A3(.) | 0         | 0         | 1         |
| A17(.) | 0,6667    | 0,1362    | 0,3333    |
| A18(.) | 0         | 0         | 1         |
| A19(.) | 0         | 0         | 1         |

Table 8. Ranking of S, R, and Q with Big to Small Order based on Q

|   | S       | R       | Q       |
|---|---------|---------|---------|
| A3(.) | 0       | 0       | 1       |
| A5(.) | 0,9319  | 0,2007  | 0,0428  |
| A7(.) | 0,9331  | 0,2043  | 0,0335  |
| A15(.) | 1       | 0,2043  | 0       |

From table 8, we get the data that the possible sequence of damage to Soundless Amplifiers is starting from the possibility of having the largest percentage to the possibility of having the smallest percentage in the following order:

- A3(.): Power Disconnect
- A5(.): Speaker cable is broken
- A10(.): Ceramic resistor (Resistor Fuse) on the amplifier output is damaged
- A11(.): The fuse broke
- A12(.): Speaker out of order
- A14(.): Power button is broken
- A16(.): Transformer is broken
- A18(.): The final amplifier transistor is broken
- A19(.): The voltage stabilizing transistor on the Power Supply is damaged
- A2(.): Diode Bridge on the Power Supply is damaged
- A4(.): The RCA cable in the input channel has broken
- A6(.): The capacitor in the input section is damaged
- A17(.): The transistor in the Driver section is damaged
- A9(.): Potential volume damaged
- A13(.): Lead on the component legs is loose
- A1(.): Diode in the Driver section is damaged
- A8(.): Ground to ground cable broken
- A7(.): The capacitor in the Power Supply section is damaged
- A15(.): Hot Power Supply Transformer

3.3 Expert Data Input Form

The Expert Data Input Form contains a list of the types of damage that are often experienced by Amplifiers and data from electronic experts, namely predetermined assessment range data. Each expert has different assessment criteria, so then the data that has different criteria will be carried out the calculation process using the Vikor method so as to produce an output index Vikor as a decision maker in repairing a damaged amplifier.
3.4 Process Form
This Process Form contains a menu of symptoms that have to be chosen one of them and there is a Process button to do a calculation of error and produce an Output or Report in accordance with the input of damage symptoms that have been selected.

3.5 Calculation Result Form
Calculation Result Form is the final result data from the system calculation that will be made as a reference to repair the Amplifier damage.

3.6 Form Report
Data that has been inputted on the Expert Data Input Form will be displayed again as a preview of the damage data that has been inputted by the expert.
4. Conclusion
From the description in the previous chapters, it can be concluded that the Application of the Vikor Method (Vise Kriterijumska Optimizacija I Kompromisno Resenje) To Identify Amplifier Damage has the following conclusions:

1. Application of the Vikor Method (Vise Kriterijumska Optimizacija I Kompromisno Resenje) to Identify Damage Amplifiers can be a supporting consideration for making decisions on steps to improve the Amplifier.

2. The results of testing for the Vikor Method Application (Vise Kriterijumska Optimizacija I Kompromisno Resenje) To Identify the Damage Amplifier has an accuracy value of 81.25%.

5. References
[1] Turban E dan JEA. *Instructor’s Manual for Decision Suppor System and Intelligent System*. 6 Edition. Upper Saddle River, NJ: Prentice Hall, 2001.
[2] Mintzberg H, Simon HA. The New Science of Management Decision, Revised Edition. *Adm Sci Q* 1977; 22: 342.
[3] Frank, D Petruzella. *Elektronik Industri*. Yogyakarta: Penerbit Andi, 2001.
[4] Opricovic S. *Multicriteria Optimization of Civil Engineering Systems*. 1998.
[5] Zhang N dan GWei. Extension of VIKOR method for decision making problem based on hesitant fuzzy set. ELSEVIER 2012; 37: 4938 – 4947.

[6] Chatterjee P, Chakraborty S. A comparative analysis of VIKOR method and its variants. Decis Sci Lett 2016; 5: 469–486.

[7] 1st International Conference on Green and Sustainable Computing (ICoGeS) 2017. J Phys Conf Ser 2018; 1019: 011001.

[8] Hidayat R. Penerapan Audio Amplifier Stereo Untuk Beban Bersama Dan Bergantian Dengan Menggunakan Saklar Ganda Sebagai Pengatur Beban. J Tek Elektro Unnes 2013; 5: 141163.