Decision Support System in Scholarship Acceptance Selection Using The Vikor Method

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\textbf{Article history:}
Submission November 2021
Revised November 2021
Accepted November 2021

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\textbf{ABSTRACT}

This study aims to apply the vikor method in the selection of scholarship receipts at Bengkulu Dehasen University. Designing the process by describing how the VIKOR (Visekriterijumsko Kompromisno Rangeranje) method should be used based on criteria (indications, achievements, credits and living expenses) fulfilled by prospective scholarship recipients in accordance with the provisions of Dehasen Bengkulu University in selecting scholarship acceptance. Based on the results obtained it can be proven that the condition of Acceptable stability in decision making is fulfilled (Namely a smaller value than 1) and Intan P Can be proposed to be a compromise solution which is the best ranking of scholarship recipients ranking by this VIKOR (Visekriterijumsko Kompromisno Rangeranje) method.

\textit{Keywords: Decision Support System, Vikor, Scholarship}

\section*{Introduction}

Educational institutions ranging from elementary schools to universities become a benchmark in building the nation’s future generations. Scholarship is defined as a form of appreciation given to individuals in order to continue their education to a higher level (Andri, 2008). Dehasen University (UNIVED) Bengkulu is one of the tertiary institutions in Indonesia that provides scholarship programs for outstanding students and has financial limitations.

The Faculty of Computer Science is one of the departments at UNIVED. The Faculty of Computer Science has 5 majors namely Informatics, Computer Systems Engineering, Information Systems, Information Management and Computer Engineering. Based on observations, the selection process at the Faculty of Computer Science consists of two stages, namely the completeness of the file and the selection stage of the scholarship recipient (Bernadth, 2009). The selection stage for scholarship recipients is still using the manual method. Manual selection is a ranking process that is carried out still by sorting out the existing files in accordance with due regard to the criteria. This manual selection has a weakness in the ordering of data and ranking so that it can cause errors, then ranking manually requires a longer time (Departemen Pendidikan dan Kebudayaan, 2012).

Decision Support System is an interactive information system that provides information, modeling, and data manipulation. Where in this issue SPK is expected to help resolve existing
problems using predetermined criteria (Erny, 2009).

The Visekriterijumsko Kompromisno Rangiranje (VIKOR) method is one of the MADM methods that sees the closest solution / alternative as an approach to the ideal solution in ranking (Badudu & Sutam, 2010). In this study, the VIKOR method will be used as a method for determining scholarship recipients. The VIKOR method was chosen because of its ability to rank and can compromise alternatives.

From the description above, the title is taken on "Decision Support System in Scholarship Acceptance Selection at Bengkulu Dehasen University Using the Vikor Method."

**Material and Method**

VIKOR (Visekriterijumsko Kompromisno Rangiranje) method provides ranking to the nearest solution, even though there are conflicting criteria, so that the decision maker in this case the maker can choose the right ranking in accordance with the available alternatives.

The basic equations of the VIKOR method and the steps for completion can be seen below:

a) Develop criteria and alternatives in the form of a decision matrix (F):

\[
F = \begin{bmatrix}
C_1 & C_2 & C_3 & \cdots & C_n \\
A_1 & x_{11} & x_{12} & \cdots & x_{1n} \\
A_2 & x_{21} & x_{22} & \cdots & x_{2n} \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
A_n & x_{n1} & x_{n2} & \cdots & x_{nn}
\end{bmatrix}
\]

Where \( A_i \) alternative i, i = 1, 2, ..., n; \( C_j \) is the criterion-j and \( x_{ij} \) is an element of the matrix that shows the level of performance of alternative-\( i \).

b) Next determine the criteria weight (W) as follows, with a fixed value: \( W = [0.45, 0.20, 0.05, 0.30] \), and perform a positive value calculation

\[
f_j^+ = \{ \min f_j | j = 1, 2, \ldots, c \}
\]

\[
f_j^+ = \{ f_1^+, f_2^+, \ldots, f_j^+, \ldots, f_j^+ \}
\]

\[
f_j^- = \{ \max f_j | j = 1, 2, \ldots, c \}
\]

\[
f_j^- = \{ f_1^-, f_2^-, \ldots, f_j^-, \ldots, f_j^- \}
\]

c) Make a normalization matrix by first calculating the positive and negative values of each criterion. In determining positive and negative values, it is necessary to consider each type of criteria (max / min) to determine the best value for these criteria. After the positive and negative values are obtained, then calculate the normalization of the decision matrix (N).

\[
N_{ij} = \frac{f_{ij}^+ - X^-}{f_{ij}^+ - f_{ij}^-}
\]

d) Normalized decision matrix (N) is then multiplied by the criteria weight (W).

\[
F^*_i = N_{ij} \times BK_i
\]

Calculating the utility measures of each alternative, there are two utility measures that are calculated S and R.

e) Calculating the VIKOR index value (Q) before calculating Calculating the VIKOR index value (Q) of each alternative, it is necessary to first calculate the values of S +, S −, R +, and R −.

\[
Q_i = \left[ v \left( \frac{S_i - S^*}{S^* - S^*} \right) + \left( 1 - v \right) \left( \frac{R_i - R^*}{R^* - R^*} \right) \right]
\]

f) Rank alternatives by sorting starting from the smallest Q value.

g) The final step is to propose a compromise solution. A compromise solution can be proposed by proving two conditions, the value of V (the value of the weighting strategy of the maximum group utility) are V = 0.4 (with veto), V = 0.5 (by consensus), and V = 0.6 (voting by majority rule).

a. Proof 1

Proving the condition of acceptable advantage with the equation.

\[
DQ = \frac{1}{(J - 1)} Q(A^{(2)}) - Q(A^{(1)})
\]

b. Proof 2

Proving the acceptable stability condition in decision making.
Result and Discussion

To understand this Vikori Method, the following stages of completion are presented in ranking the selection of scholarship receipts at Bengkulu Dehasen University. The following data are known:

**Table 1. Preliminary Data**

<table>
<thead>
<tr>
<th>Kode</th>
<th>Name</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>Shinta S.</td>
<td>2.77</td>
<td>7</td>
<td>130</td>
<td>1700000</td>
</tr>
<tr>
<td>A2</td>
<td>Intan</td>
<td>3.57</td>
<td>3</td>
<td>130</td>
<td>1500000</td>
</tr>
<tr>
<td>A3</td>
<td>P. Yuna</td>
<td>3.41</td>
<td>7</td>
<td>75</td>
<td>1500000</td>
</tr>
<tr>
<td>A4</td>
<td>Hilmi D.</td>
<td>3.68</td>
<td>7</td>
<td>50</td>
<td>1800000</td>
</tr>
<tr>
<td>A5</td>
<td>Mirza</td>
<td>3.27</td>
<td>3</td>
<td>45</td>
<td>2200000</td>
</tr>
<tr>
<td>A6</td>
<td>James</td>
<td>3.33</td>
<td>7</td>
<td>90</td>
<td>2500000</td>
</tr>
<tr>
<td>A7</td>
<td>M. Usman</td>
<td>3.13</td>
<td>7</td>
<td>90</td>
<td>3200000</td>
</tr>
<tr>
<td>A8</td>
<td>Firza</td>
<td>2.50</td>
<td>7</td>
<td>90</td>
<td>2700000</td>
</tr>
<tr>
<td>A9</td>
<td>L. Alfian</td>
<td>3.68</td>
<td>2</td>
<td>90</td>
<td>1250000</td>
</tr>
<tr>
<td>A10</td>
<td>Kevin</td>
<td>2.78</td>
<td>2</td>
<td>90</td>
<td>2200000</td>
</tr>
<tr>
<td>A11</td>
<td>Dewi T.</td>
<td>3.94</td>
<td>3</td>
<td>90</td>
<td>1750000</td>
</tr>
<tr>
<td>A12</td>
<td>S. Gatot</td>
<td>2.55</td>
<td>4</td>
<td>62</td>
<td>3200000</td>
</tr>
<tr>
<td>A13</td>
<td>Zaki</td>
<td>3.57</td>
<td>6</td>
<td>450</td>
<td>2000000</td>
</tr>
</tbody>
</table>

Remarks Table 1.

C1: Achievement Index (IP)
C2: Achievements (Number of Achievements prospective scholarship recipients have)
C3: SKS that have been taken
C4: Parental Income (Life Expense (Rp))

The criteria considered for scholarship recipients are as follows:

a) Performance Index (IP) - the higher the better; weight: 45% high IP shows the academic ability of students. So that the IP criteria become the highest assessment weight in determining this outstanding scholarship.

b) Achievement - the higher the better; weight: 5%, Achievement shows the ability of prospective scholarship recipients.

c) SKS that have been taken - the lower the better; weight: 25%. The low level of SKS is considered by the leadership to be able to stimulate the enthusiasm of young students to score achievements so that the semester criteria are taken into consideration in determining this outstanding scholarship.

d) Economic Burden (Parental Income) (Rp)) - the lower the better; weight: 25% Criteria Income parents included as one of the assessment criteria because the income of parents can see income from the family of the prospective scholarship recipient.

Step 1:

Arrange alternatives and criteria in the form of a decision matrix (F) as follows:

Step 2:

Determine the criteria weights (W) as follows: 

\[ W = [0.45, 0.20, 0.05, 0.30] \]

Calculate the positive \((f^+)\) negative \((f^-)\) of each criterion with the equation:

\[ f^+ = \max\{f_{1,1}; f_{2,1}; f_{3,1};...; f_{13,1}\} \]
\[ f^- = \max\{3,25; 3,24; 2,74;...; 2,75\} \]

After that proceed to calculate the normalization of decision matrix N, namely N1,1 to
N13; N1,2 to N13,2; N1,3 to N13,3; N1,4 to
N13,4 in the following way:
N1,1 = (3.91 - 2.77) / 3.91 - 2.74
0.040) = 0.325
R1 = max{ F1,1*; F1,2*; F1,3*; F1,4*} = max{0.325 ; 0.250 ; 0.048 ; 0.040} = 0.325
R2 = max{ F2,1*; F2,2*; F2,3*; F2,4*} = max{0.102 ; 0.050 ; 0.48 ; 0.223} = 0.223
R3 = max{ F3,1*; F3,2*; F3,3*; F3,4*} = max{0.424 ; 0.424 ; 0.048 ; 0.048} = 0.424
R4 = max{ F4,1*; F4,2*; F4,3*; F4,4*} = max{0.472 ; 0.424 ; 0.048 ; 0.048} = 0.472
Step 3:
Forming a Normalization Matrix:
The Normalization Matrix (N) is multiplied
by the weight of the criteria, with the following
equation:
F* = N1,1 x W1
F* = N13,1 x W1
And so on obtained as follows:
F1,1* = 0.253;
F2,1* = 0.257;
F3,1* = 0.450;
F4,1* = 0.223;
F5,1* = 0.430;
F* = 0.134;
F* = 0.373;
F* = 0.050;
F* = 0.073;
F* = 0.015.
Step 4:
The calculation of VIKOR index value (Q) Before calculating the VIKOR index value (Q) of each alternative, it is necessary to first calculate the S+, S-, R+ and R- values as follows:
S+ = max{S1 ; S2 ; S3 ; ... ; S17} = max{0.663 ; 0.424 ; 0.640 ; ... ; 0.674} = 0.703
S- = min{S1 ; S2 ; S3 ; ... ; S17} = min{0.663; 0.424 ; 0.640 ; ... ; 0.674} = 0.211
R+ = max{R1 ; R2 ; R3 ; ... ; R17} = max{0.325 ; 0.223 ; 0.250 ; ... ; 0.313} = 0.400
R- = min{R1 ; R2 ; R3 ; ... ; R17} = min{0.325 ; 0.223 ; 0.250 ; ... ; 0.313} = 0.113
Step 5:
Menghitung nilai utility measure dari setiap alternatif S dan R dengan rumus :
S1=F1,1+F1,2+F1,3+F1,4=0.325+0.250+0.048+0.040=0.663
S1=F1,1*+F1,2*+F1,3*+F1,4*=0.325+0.250+0.048+0.040=0.663
S2=F2,1+F2,2+F2,3+F2,4=0.102+0.050+0.48+0.223=0.775
S2=F2,1*+F2,2*+F2,3*+F2,4*=0.102+0.050+0.48+0.223=0.775
... and so on until
R17=max{ F17,1 ; F17,2 ; F17,3 ; F17,4} = max{0.313 ; 0.250 ; 0.025 ; 0.085} = 0.313
Step 6:
Alternate ranking by sorting from the smallest Q value. The full ranking results are as follows:

<table>
<thead>
<tr>
<th>Alternatif</th>
<th>Nilai Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>A9 L. Alfian</td>
<td>Q9</td>
</tr>
<tr>
<td>A11 Dewi T.</td>
<td>Q11</td>
</tr>
<tr>
<td>A5 Mirza</td>
<td>Q5</td>
</tr>
</tbody>
</table>
Step 8:
The final step is to propose a compromise solution. A compromise solution can be proposed by proving both conditions. In proving this compromise solution the values of \( v \) (the weighting value of the strategy of the maximum group utility) are \( v = 0.4 \) (with veto), \( v = 0.5 \) (by consensus), and \( v = 0.6 \) (voting by majority rule).

Proof 1:
Proof of conditions for Acceptable advantage
The resulting value of difference is greater than the value of \( D_Q \), so that the condition of Acceptable advantage is fulfilled (That is a smaller value than 1).

Based on the results obtained, it can be proven that the condition of Acceptable stability in decision making is fulfilled.

Table 3. Ranking of Vikor Method Ranking

<table>
<thead>
<tr>
<th>Rangking</th>
<th>Alternatif</th>
<th>Nilai Q</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>kode</td>
<td>Nama</td>
</tr>
<tr>
<td>4</td>
<td>A13</td>
<td>Zaki</td>
</tr>
<tr>
<td>5</td>
<td>A2</td>
<td>Intan</td>
</tr>
<tr>
<td>6</td>
<td>A4</td>
<td>Hilmi D.</td>
</tr>
<tr>
<td>7</td>
<td>A6</td>
<td>James</td>
</tr>
<tr>
<td>8</td>
<td>A3</td>
<td>P. Yuna</td>
</tr>
<tr>
<td>9</td>
<td>A10</td>
<td>Kevin</td>
</tr>
<tr>
<td>11</td>
<td>A7</td>
<td>Usman</td>
</tr>
<tr>
<td>12</td>
<td>A1</td>
<td>Shinta S.</td>
</tr>
<tr>
<td>13</td>
<td>A12</td>
<td>S. Gatot</td>
</tr>
<tr>
<td>14</td>
<td>A8</td>
<td>Firza</td>
</tr>
</tbody>
</table>

Based on the results of proving both conditions can be seen that both conditions are met. Diamond P can be proposed to be a compromise solution and is the best ranking of scholarship recipient ranking with the VIKOR method.

Conclusion
Vikor method is very well used in ranking to be used as a reference in supporting decision making. Specifically for scholarship recipients at the Faculty of Computer Science, Department of Informatics, Dehasen University.
Bengkulu. The main candidates for scholarship recipients are students who have or rank the lowest ranking in the SPK-Vikor application. Based on the results of proving the two conditions above can be seen that both conditions are met. So students named Intan P can be proposed to be a compromise solution and are the best ranking of scholarship recipient ranking by the VIKOR method. But the VIKOR method still requires quite a long and complicated calculation time so that the development of a computerized application system is needed that can help calculations to be faster, precise, easy and efficient.

Acknowledgement

Thank you to the Dehasen University Bengkulu, especially the Faculty of Computer Science who has helped both morally and materially so that this research can be completed well. Thank you to Mrs. Dra. Asnawati, M. Kom, Yupianti, M.Kom, Siti Sundari, M.Pd.I, Shinta Wiji Rahayu, SE, Msi, who have helped to complete this research, both energy and thought that are very influential.

References