The VIKOR Method to Support the Effectiveness of Decisions in Determining Work Incentive Recipients

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Abstract. Giving Incentives is a way given by the company in increasing the work motivation of its employees. Providing incentives to employees has stages that must be passed by the leadership in producing a better and effective decision. In order for the decisions produced are not objective, the leader needs a process of calculating the performance index of his employees. In this study, the application of VIKOR is needed in managerial decision support systems. It is intended that the decisions produced are no longer of objective value to employees who are given salary incentives.

1. Introduction

Employees are workers owned by a company. Employees also as resources that can advance an organization and provide more benefits to the company where the employee works. As much as any company in an area, it will not be separated from its human resources, namely labor. Although the development of technology today is inseparable from modern production machinery, the company still requires labor (employees). This is in order to achieve an organizational goal set by a company. The achievement of this goal certainly requires more motivation that the company can give to employees, so that employee performance can improve.

There are many ways that the company can improve its employees' performance, including the provision of higher salaries, the provision of allowances, insurance, giving leave in addition to holidays, the closeness of leaders to employees, a comfortable working atmosphere, and the provision of incentives or bonuses for employees. Providing incentives to employees can be the main choice. This is a good choice compared to companies having to raise their salaries, or increase benefits. The provision of incentives can be by choosing employee employees who have good performance, in accordance with
the results of work productivity produced. Providing the right incentives by the company can create a competitive advantage.

In some companies there are several criteria used to determine the incentive for employees, such as productivity, employee attendance, loyalty, work comfort. In providing incentives to employees, can be done in two ways, namely giving materially both, and giving non-material. Non-material provision can be in the form of giving to a work facility, insurance, this can have a positive impact on the achievement of company objectives. Material giving can be like additional salary, incentives, insurance. In order to provide effective incentives to employees, the manager must be truly objective in processing for the determination of employees who will get the incentives.

At this time the use of information systems to help managers grow, including decision support information systems [1], [2]. This system is a system intended for management as decision-makers in a company. In a decision support system, a method of methods is applied that can help in producing a better decision. A variety of multicriteria-based methods can be used in this system, such as using the fuzzy TAHANI, ELECTRE, VIKOR methods [3]–[6]. Simple method methods are also believed to be able to help produce good decisions such as SAW, SMART[7], [8].

In the previous research conducted by Syafrida (2017) concerning the determination of employees who received salary increases, the use of decision support methods was very good in producing more effective decisions[7]. In this study, VIKOR method is used to calculate employee performance index values. It is expected that the VIKOR method can provide more specific results compared to other method methods[6][9].

2. Methodology
One of the developing Multi Criteria Decision Making (MCDM) methods is VIKOR. VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) was first introduced by Serafim Opricovic in 1998 [10][11]. VIKOR aims to complete decision-making on existing alternatives by ranking and choosing sample sets with conflicting criteria.

VIKOR is used as one of the multi-criteria decision making methods based on the best solution obtained from the closest ideal solution. Then the stages of ranking are by comparing the distance to the ideal solution. The VIKOR method applies linear normalization which aims to get the best solution.

Steps for calculating the VIKOR method[6], as follows:

a. Normalize the decision matrix, using equation 1.

\[ r_{ij} = \frac{x_{ij}^+ - x_{ij}}{x_{j}^+ - x_{j}^-} \]

Where \( r_{ij} \) and \( x_{ij} \) (i = 1, 2, 3, ..., m and j = 1, 2, 3, ..., n) are elements of the decision-making matrix (alternative i to criteria j) and \( x_{j}^+ \) is the best element of criterion j, \( x_{j}^- \) is the worst element of criterion j.

b. Calculating the Utility Measure (S_i) values and Regret Measure (R_i) using equations 2 and 3. In obtaining the values of S_i and R_i, we need criteria weighting values. The criteria weight (w_j) aims to represent relative importance.

\[ S_i = \sum_{j=1}^{n} W_j \left( \frac{x_{ij}^+ - x_{ij}}{x_{j}^+ - x_{j}^-} \right) \]

and

\[ R_i = \max_j \left[ w_j \left( \frac{x_{ij}^+ - x_{ij}}{x_{j}^+ - x_{j}^-} \right) \right] \]

Where is the weight of each criterion j.

c. Determine the VIKOR index value using equation 4.

\[ Q_i = \left[ \frac{S_i - S^+}{S^- - S^+} \right] V + \left[ \frac{R_i - R^+}{R^- - R^+} \right] (1-V) \]
Where $S_- = \max S$, $S_+ = \min S$ and $R_- = \max R$, $R_+ = \min R$ and $v = 0.5$.

d. Ranking of Utility Measure ($S_i$), Regret Measure ($R_i$) and VIKOR index ($Q_i$) values.

The ranking of the three values, $S_i$, $R_i$, and $Q_i$ is based on the largest value to the smallest value (ascending order), with the smallest value being the best candidate. So that there will be three lists/ranking versions.

Condition C1: "Acceptance of Profits"
The conditions for fulfilling C1 conditions or profit acceptance are by comparing the difference in the alternative value of the second rank with the alternative in the first rank against the DQ value. Equations (5) and (6) explain how mathematically C1 conditions are met.

$$Q(a'') - Q(a') \geq DQ \quad (5)$$

$$DQ = \frac{1}{m-1} \quad (6)$$

Condition C2: "Acceptance of Stability in Decision Support"
To fulfill C2 conditions, alternatives must also be ranked first in ranking $S_i$ and/or $R_i$ values. If C2 conditions are met, then the stability of the compromise solution is accepted in the decision making process.

The type of stability achieved is in the form of:

- a. Selected by the "majority rule", when $v > 0.5$
- b. Chosen by "consensus", when $v \approx 0.5$
- c. Vetoed, when $v < 0.5$

If one condition is not met, some compromise solutions will be submitted. A compromise solution can consist of:

- Alternatives, if $a''$ and $a'$ only if C2 conditions are not met.
- Alternatives, $a'$, $a''$, ..., $a^m$, if C1 conditions are not met

$$Q(a^m) - Q(a') < DQ \quad (7)$$

3. Result and Discussion
The provision of incentives for employees is done by calculating the performance index of the specified criteria. From each criterion, the weights are determined according to the interests of the existing criteria. In this study, the performance index is calculated with twenty (20) employees in the company. Incentives will be given to 13 employees who have the best performance index values, in this case, have a lower VIKOR Index value ($Q_i < 0.5$).

Table 1 is specified criteria and weight table, while employee data is found in table 2, which is a list of alternatives with values of each criterion.

| Criteria | Description | Weight |
|----------|-------------|--------|
| C_1      | Achievement | 40%    |
| C_2      | Discipline  | 25%    |
| C_3      | Attitude    | 25%    |
| C_4      | Work Period | 10%    |
Table 2. Employee List (Alternatives)

| Employee           | C1  | C2    | C3      | C4  |
|--------------------|-----|-------|---------|-----|
| M. Yusuf (A1)      | Good| Very Good| Very Good| 10 year |
| Susi Santi (A2)    | Good| Good   | Very Good| 15 year |
| Jhoni (A3)         | Good| Good   | Good     | 14 year |
| Erwinsyah (A4)     | Good| Good   | Very Good| 15 year |
| I Made (A5)        | Very Good| Very Good| Good | 12 year |
| Joko W (A6)        | Very Good| Very Good| Enough| 11 year |
| I Saputra (A7)     | Enough| Good  | Good     | 9 year   |
| Ryan Andika (A8)   | Very Good| Very Good| Good | 15 year |
| Soebondo (A9)      | Good| Enough | Very Good| 15 year |
| Hendri K (A10)     | Good| Kurang| Very Good| 14 year |
| FirmanSyah (A11)   | Enough| Very Good| Good | 15 year |
| Andy Syahputra (A12)| Enough| Good  | Good     | 13 year |
| T. Zeuba (A14)     | Very Good| Very Good| Very Good| 9 year |
| Hariyanto (A15)    | Very Good| Very Good| Very Good| 10 year |
| Tiara M (A16)      | Enough| Very Good| Good | 12 year |
| Fatolosa (A17)     | Very Good| Enough| Very Good| 15 year |
| Akhyar (A18)       | Enough| Good  | Good     | 10 year |
| Susi Fitria (A19)  | Good| Very Good| Very Good| 8 year |
| Yenti M (A20)      | Very Good| Good  | Very Good| 13 year |

In table 2 we can see linguistic values, in the form of very good, good, enough or not good. This information will be weighted so that it can get a value that can be calculated as shown in table 3.

Table 3. Weighting alternative values

| Description | Weight |
|-------------|--------|
| Very Good   | 4      |
| Good        | 3      |
| Enough      | 2      |
| Not Good    | 1      |

The results of the weighting in table 3 of table 2 obtained the matching rating data for each employee which can be seen in table 4.

Table 4. List of Alternatives

| Alternatives     | C1 | C2 | C3 | C4 |
|------------------|----|----|----|----|
| M. Yusuf (A1)    | 3  | 4  | 4  | 10 |
| Susi Santi (A2)  | 3  | 3  | 4  | 15 |
| Jhoni (A3)       | 3  | 3  | 3  | 14 |
| Erwinsyah (A4)   | 3  | 3  | 4  | 15 |
| I Made (A5)      | 4  | 4  | 3  | 12 |
| Joko W (A6)      | 4  | 4  | 2  | 11 |
| I Saputra (A7)   | 2  | 3  | 3  | 9  |
| Ryan Andika (A8) | 4  | 3  | 3  | 15 |
| Soebondo (A9)    | 3  | 2  | 4  | 15 |
| Hendri K (A10)   | 3  | 1  | 4  | 14 |
| FirmanSyah (A11) | 2  | 4  | 3  | 15 |
| Andy Syahputra (A12) | 2  | 3  | 3  | 13 |
| Ebenezer (A13)   | 2  | 3  | 2  | 10 |
Alternatives C1 C2 C3 C4
T. Zebua (A14) 4 4 4 9
Hariyanto (A15) 4 4 4 10
Tiara M (A16) 2 4 3 12
Fatolosa (A17) 4 2 4 15
Akhyar (A18) 2 3 3 10
Susi Fitria (A19) 3 4 4 8
Yenti M (A20) 4 3 4 13

After the suitability rating (table 4) is obtained, the completion of VIKOR in the first step is to calculate the normalized matrix. To calculate the normalized matrix using equation (1), here is the matrix resulting from normalization.

| Alternatives | C1 | C2 | C3 | C4 |
|--------------|----|----|----|----|
| A1           | 0,50 | 0,00 | 0,00 | 0,71 |
| A2           | 0,50 | 0,33 | 0,00 | 0,00 |
| A3           | 0,50 | 0,33 | 0,50 | 0,14 |
| A4           | 0,50 | 0,33 | 0,00 | 0,00 |
| A5           | 0,00 | 0,00 | 0,50 | 0,43 |
| A6           | 0,00 | 0,00 | 1,00 | 0,57 |
| A7           | 1,00 | 0,33 | 0,50 | 0,86 |
| A8           | 0,00 | 0,33 | 0,50 | 0,00 |
| A9           | 0,50 | 0,67 | 0,00 | 0,00 |
| A10          | 0,50 | 1,00 | 0,00 | 0,14 |
| A11          | 1,00 | 0,00 | 0,50 | 0,00 |
| A12          | 1,00 | 0,33 | 0,50 | 0,29 |
| A13          | 1,00 | 0,33 | 1,00 | 0,71 |
| A14          | 0,00 | 0,00 | 0,00 | 0,86 |
| A15          | 0,00 | 0,00 | 0,00 | 0,71 |
| A16          | 1,00 | 0,00 | 0,50 | 0,43 |
| A17          | 0,00 | 0,67 | 0,00 | 0,00 |
| A18          | 1,00 | 0,33 | 0,50 | 0,71 |
| A19          | 0,50 | 0,00 | 0,00 | 1,00 |
| A20          | 0,00 | 0,33 | 0,00 | 0,29 |

The solution then uses equation 2 and equation 3 to find the Utility Measure ($S_i$) and Regret Measure ($R_i$) values.

| Alternatives | Utility Measure ($S_i$) | Regret Measure ($R_i$) |
|--------------|-------------------------|------------------------|
| A1           | 0,271                   | 0,200                  |
| A2           | 0,283                   | 0,200                  |
| A3           | 0,423                   | 0,200                  |
| A4           | 0,283                   | 0,200                  |
| A5           | 0,168                   | 0,125                  |
| A6           | 0,307                   | 0,250                  |
| A7           | 0,694                   | 0,400                  |
| A8           | 0,208                   | 0,125                  |
| A9           | 0,367                   | 0,200                  |
From the value of Utility Measure ($S_i$) and Regret Measure ($R_i$), the values of $S^+$ and $S^-$ are determined, the values of $R^+$ and $R^-$ are as follows:

$$ S^+ : 0.071 $$
$$ S^- : 0.805 $$
$$ R^+ : 0.071 $$
$$ R^- : 0.400 $$

Then the VIKOR ($Q_i$) index value is calculated using equation (4). From the above determination, it is obtained the calculation results of the VIKOR index of each employee along with the incentive status.

| Alternatives | $Q_i$ | Rank | Status          |
|--------------|------|------|-----------------|
| A15          | 0    | 1    | Get incentives |
| A14          | 0.031| 2    | Get incentives |
| A20          | 0.046| 3    | Get incentives |
| A5           | 0.147| 4    | Get incentives |
| A8           | 0.175| 5    | Get incentives |
| A17          | 0.21 | 6    | Get incentives |
| A1           | 0.332| 7    | Get incentives |
| A2           | 0.34 | 8    | Get incentives |
| A4           | 0.34 | 9    | Get incentives |
| A19          | 0.351| 10   | Get incentives |
| A9           | 0.397| 11   | Get incentives |
| A6           | 0.432| 12   | Get incentives |
| A3           | 0.435| 13   | Get incentives |
| A10          | 0.54 | 14   | Not given       |
| A11          | 0.809| 15   | Not given       |
| A16          | 0.838| 16   | Not given       |
| A12          | 0.886| 17   | Not given       |
| A18          | 0.915| 18   | Not given       |
| A7           | 0.925| 19   | Not given       |
| A13          | 1    | 20   | Not given       |

Based on the VIKOR index value, it can be determined that alternatives that get incentives are ranked 1 to 13, while from 14 to 20 do not get incentives. From table 6 the VIKOR index graph is created so that the distribution of each value is clearly seen in each employee.
In Figure 1 evenly distributed VIKOR index value, employees who get incentives are those that have a VIKOR index value below 0.5.

4. Conclusion
Based on research conducted using the VIKOR method, for criteria with linguistic values (achievement, discipline, attitude) must first be weighted. The results given by VIKOR are very different when compared to other methods, in VIKOR the smaller the index value (Qi), the alternative becomes the best. This can help decision-makers to provide more effective results.

References
[1] Tzeng G-H and Huang J-J, 2011 Multiple Attribute Decision Making Method And Applications CRC Press.
[2] Ginting G Fadlina Mesran Siahaan A P U and Rahim R, 2017 Technical Approach of TOPSIS in Decision Making Int. J. Recent Trends Eng. Res. 3, 8 p. 58–64.
[3] Sahir S H Rosmawati R and Rahim R, 2018 Fuzzy model tahani as a decision support system for selection computer tablet Int. J. Eng. Technol. 7, 2.9 p. 61–65.
[4] Mesran M Ginting G Suginam S and Rahim R, 2017 Implementation of Elimination and Choice Expressing Reality ( ELECTRE ) Method in Selecting the Best Lecturer ( Case Study STMIK BUDI DARMA ) Int. J. Eng. Res. Technol. 6, 02, February-2017 p. 141–144.
[5] Yanie A et al., 2018 Web Based Application for Decision Support System with ELECTRE Method J. Phys. Conf. Ser. 1028, 1.
[6] Siregar D et al., Jun. 2018 Multi-Attribute Decision Making with VIKOR Method for Any Purpose Decision J. Phys. Conf. Ser. 1019 p. 012034.
[7] Sahir S H Rosmawati R and Minan K, 2017 Simple Additive Weighting Method to Determining Employee Salary Increase Rate Int. J. Sci. Res. Sci. Technol. 3, 8 p. 42–48.
[8] Risawandi R and Rahim R, 2016 Study of the Simple Multi-Attribute Rating Technique For Decision Support Int. J. Sci. Res. Sci. Technol. 2, 6 p. 491–494.
[9] Mardani A Zavadskas E Govindan K Amat Senin A and Jusoh A, Jan. 2016 VIKOR Technique: A Systematic Review of the State of the Art Literature on Methodologies and Applications Sustainability 8, 1 p. 37.
[10] El-santawy M F, 2012 A VIKOR Method for Solving Personnel Training Int. J. Comput. Sci. 1, 2 p. 9–12.
[11] Huang J-J Tzeng G-H and Liu H-H, 2009, A Revised VIKOR Model for Multiple Criteria Decision Making - The Perspective of Regret Theory, in Communications in Computer and Information Science, 35, p. 761–768.