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Development of a Decision Support System on Employee Performance Assessment Using Weighted Performance Indicators Method

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Abstract: Employee Performance Assessment is a part of the Decision Support System. One of the decision support system methods that are most used in performance assessment is Simple Additive Weighting (SAW). In the SAW method, each criterion has a weight value to show the interest level. The determination of the criteria on the SAW method is subjective and the final result is on the ranked system and creates many problems. The study utilizes the Weighted Performance Indicators (WPI) method to solve the problems in the SAW method. The criterion is determined based on the respondent's opinion so that it will be more realistic to achieve the target. The population of the study is the employee of Indo Global Mandiri University which reach 30 persons. WPI method consists of 9 steps. The research result is shown that 4 employees has a performance below MSV and 36 employee has above MSV. The general value of the employee performance value = is 0.69. It shows that the performance of the employee at Indo Global Mandiri University is good enough. However, it needs to be increased, so that the target could be achieved. WPI method is easy to implement, it is not just limited to the employee performance assessment only, but it could be implemented for the other performance assessment, for example, human resource performance, finance, company, industry, system, etc.

Index Terms: Decision Support System; Employee Performance assessment; Simple Additive Weighting method (SAW); Weighted Performance Indicators Method (WPI); Respondents Opinion.

1. Introduction

The employee performance assessment is important to identify and handle the problem related to employee performance in the institutions. The employee performance assessment is not just for rank promotion only, but it could be used for skill evaluation, the employee ability specifically [1].

The employee performance assessment is a technic that has a positive impact on working performance and employee motivation. The employee could be motivated when the assessment process is based on the employee's

accurate description and up-to-date [2]. Idowu (2017) stated that the positive and significant results when the organization uses the performance assessment as a motivation tool. Using more than one assessment technic able to result in better employee satisfaction, so it could be increasing motivation [3]. Besides that, the performance assessment is also could be the knowledge base organization used by the leaders to plan employee career development [1].

Employee performance assessment aims to achieve the company target and to motivate the employee to increase their performance [4].

An evaluation done with good planning can resulting a good assessment [5]. Subjectively the performance assessment can not avoid, since assigning the performance assessment indicator with human cognition is a subjective analysis [6].

A manager should be knowing the employee's ability limit, however, the fact it is not understood, therefore it most tight in assigning the criterion so the target is not achieved.

Besides that, the performance assessment technic should be in alignment with the current development. Entering the revolution 4.0 era, the Internet of Things (IoT), all activities are connected to the internet. The assessment indicator and performance assessment method should be flexible to follow the changes. Some companies are doing a performance assessment by creating an instrument through Management Consulting [7]. Adjustment with the company needed and the current development become a base in the development of the employee assessment method

Performance assessment method development has become interesting attention for the researcher. Usually, employee performance assessment uses the decision supporting system method (DSS), such as Simple additive weighting (SAW), Analytic Hierarchy Process (AHP), Profile Machine Method, Performance Prism, Multi-Faktor Evaluation Process (MFEP), Metode Graphic Rating Scale method, Balance Scorecard method, Profil Matching method, Weighted Product method, etc.

Generally, these methods utilized the data in the multi-objective or multi-criteria form. It was defined as the number of alternative assessments [8]. The multi-criteria consists of some data composition which showed in the hierarchy form. Utilizing the multi-criteria attribute most known as Multiple Criteria Decision Making (MCDM).

In the MCDM method, the method mostly utilized is SAW [9–11]. SAW is a classic method that is applicable to take the best alternative. However, the SAW method also has a weakness, that is when the data input is incorrect will be occurred a mistake in the weighting process. Besides that, the target determination by the leader is often burdensome, therefore it will be difficult to be achieved. To solve the problem, a new method was developed that can help leaders to set performance assessment criteria based on respondents' opinions.

Besides that, the other weakness of the SAW is rating. The determination of burdensome criteria can create problems in calculating the rankings, just as qualitative selection of criteria can result in an uncertain structure. In 2015, there was a debate at the Conference Society for Industrial and Organizational Psychology, about the performance rating. Some problems which occurred in the performance rating process are intervention from the manager in the determining the criterion, disagreement in the assessment, failure in determining criterion, a weak correlation between performance rating received, etc [12]. They agreed that giving a rating for the results of employee assessments would have a bad impact on employees. Therefore, employee assessment must use the right method in order to have a positive impact on employee competency development and motivation

The new method utilized to solve the problem is the Weighted Performance Indicators Method (WPI) [13,14]. This method uses the opinion of the respondents to determine the criteria. The criteria are usually determined by the leader, but in this method it is determined entirely by the respondent. The respondents referred to in this study are employees are who will use this provision.

WPI method is an employee performance assessment that can use for multi-purpose, one of them is the employee performance assessment.WPI method used a respondent opinion approach to decide the criterion and indicator. This way is more effective to solve the leader's subjective issue and rating problem. WPI has the advantage that it can be applied to multi-criteria and multi-level data.

This method does not use ranking techniques. employee performance assessment results are determined based on the Minimum Standard Value (MSV). If the value of Weighted Performance (WPi) > MSV, it is stated that the employee's performance has reached the target.

WPI method is an employee performance assessment that can use for multi-purpose, one of them is the employee performance assessment. WPI method used a respondent opinion approach to decide the criterion and indicator. Metode ini lebih efektif dalam menyelesaikan masalah subjektif pemimpin dan masalah penilaian, selain itu metode WPI memiliki kelebihan lain, dapat diterapkan pada data multi kriteria dan multi level.

The research aims to develop a performance assessment model for employees of Indo Global Mandiri University (UIGM) with utilized the WPI method based on the respondent's opinions. Currently the role of the respondent has a high validation value to make choices.

Indo Global Mandiri University consists of regular employees and lecturers. Lecturer and regular employee a different job, therefore the criterion and indicator assessment is different as well. A dataset utilized is the employee performance data for even 2021/2022. This performance assessment model is expected to be the best assessment model that can be used by leaders to plan the progress of human resource development at Indo Global Mandiri University.

2. Related Works

2.1 Employee Competency in Revolution 4.0 Era

In the 4.0 revolution era, employees must adapt according to current competency needs. Competency is referred to someone's ability to show their performance at the level expected by the world job. Competence is the ability and skill that a person has to become part of himself to perform certain cognitive and psychomotor behaviors. Someone who has the competency, if given the right skill, could achieve higher performance [15,16]. Based on the literature review, the competency should have by the employee in the revolution 4.0 era is explained in table 1:

Table 1. Employee competence in the 4.0 revolution era

Num	Competence	Reference
1	Ability and willingness to learn new things	[17]
2	Ability to be compromising	[18–20]
3	Ability to transfer knowledge	[18–21]
4	Ability to work in a team	[18,19,21]
5	Ability to work under pressure	[18,19]
6	Analytical skills	[18–20,22]
7	Communication skills	[17,18,20,22,23]
8	Compliance	[18,19,23]
8	Conflict solving	[18]
10	Cooperative	[17–20]
11	Creativity	[17–20,23,24]
12	Decision making	[18–20]
13	Efficiency orientation	[18,22,25]
14	Entrepreneurial thinking	[18–20,22]
15	Flexibility	[17–20,22,23]
16	Language skills	[17,18,23]
17	Leadership skills	[18,24]
18	Problem-solving	[17–20,26]
19	Responsibility	[17,18,20]
20	Technical skills	[18,26]

Based on previous research has shown that the adjustment competency of the employee should in alignment with the current development. People should be able to adapt to the massive changes. The change has affected all aspects, not only in manufacturing but also in all aspects that use IoT, so in the education world, one of them is Higher Education institutions. Higher Education experiences significant changes since all of the academic aspect is done online. A readiness of employees to follow the changes must be supported, so it ready to face changes in academic activities dynamically.

The selection of the right employee performance assessment model can produce an objective assessment.Measurement of employee competence can no longer use the previous assessment model. The selection of the right employee performance assessment model can result in a better assessment. The issues discussed previously can be used as a basis for the development of a more effective performance assessment model.

2.2. Respondents opinions

In the big data era, the data source can be from the internet, twitter, facebook, or a repository [27]. Data can be in the news, video, opinion form, etc. Previously, public opinion considered untested information. The opinion are community's response based on other people's influences, so it was a justification [28].

Nowadays, the opinion could provide a strong influence in making a decision, such as in presidential election [29–32], and become a determinant of the key performance indicator (KPI) [33,34].

Public opinion could be a reference to taking decisions [35]. In the limited environment, the public opinion is called a respondent’s opinion. In a company, the respondent's opinion can be the employee's opinion. The employee's involvement in determining the indicator could result in an assessment system that is more rational in accordance with the employee's ability.

2.3. Weighted Performance Indicator Method (WPI)

The WPI method is a new method that has several advantages over the previous performance assessment method.

WPI method is the Multiple Criteria Decision Making (MCDM). MCDM is a method for taking decisions for determined the best alternative based on some criteria [36]. WPI method is a performance assessment model that uses the criterion as the assessment variable. WPI method has some alternatives from a criterion [8]. WPI method is developed to resolve the criterion with an unlimited level. WPI method is to develop data in the hierarchy tree form. The hierarchy structure has a higher position called the top level. The top Level consisted of some criteria. Criteria consisted of some sub-criteria or indicator. The hierarchy structure tree could achieve n level. Each criteria and sub-criteria has a weight.

The WPI method can calculate weights up to level n using the created formula. The composition of the data is in the form of a tree hierarchy where the weighting formula is used only at the last level and level-1 positions.

The WPI method is based on the shortcomings of the ranking method. The WPI method was developed by analyzing the rule association method, multilevel association rules and a priori algorithm. WPI method is not just only implemented for employee performance assessment, but also able to use for other performance assessment, such as human resources, finance, company, production, system, etc. WPI method consisted of three phases, there are criteria determination, weight calculation, and performance assessment. Each phase consisted of some steps. For detail, explained below [13] :

1. Determined the criteria
2. Designed a hierarchy tree structure
3. Collecting data
4. Data converted to encoded item table
5. Calculating the minimum support value (min_s)
6. Calculating the value of the weight criteria (w_{ai})
7. Calculating the weight item value (w_{aij})
8. Determining the Minimum Standard Value for Assessment (MSV)
9. Calculating the value of Weighted Performance (wp_i)

3. The Proposed Method

The WPI method can be applied to the composition of data in the form of multi-criteria and multi-level. Using a hierarchical tree makes it easier to visualize the criteria and alternatives. Explanation of each research steps below:

3.1. Determine criteria

The first step is to develop the criteria with some alternatives which relevant to the employee performance. Based on the table, each criterion is grouped into 3 dimensions, there is A_1. Leadership, A_2. Cooperative, and A_3. Capability. Dimension A consisted of 6 criteria, dimension b consisted of 5 criteria, and dimension c consisted of 7 criteria. Each of the criteria from each criteria is explained below

A_1. Leadership
- a_{11}. Ability and willingness to learn new things
- a_{12}. analytical skills
- a_{13}. Conflict solving
- a_{14}. Decision making
- a_{15}. Communication skills
- a_{16}. Problem-solving

A_2 Cooperative
- a_{21}. Ability to work in a team
- a_{22}. Ability to be compromising
- a_{23}. Ability to work under pressure
- a_{24}. Language skills
- a_{25}. Flexibility

A_3. Capability
- a_{31}. Ability to transfer knowledge
- a_{32}. Compliance
- a_{33}. Creativity
- a_{34}. Efficiency orientation
- a_{35}. Entrepreneurial thinking
- a_{36}. Responsibility
- a_{37}. Technical skills

3.2. Designed a hierarchy tree structure

The development hierarchy structure tree aims to visualize data into a hierarchy tree to identify the lowest level and number of indicator development. Figure 1 is a Hierarchy Structure Tree of this research.

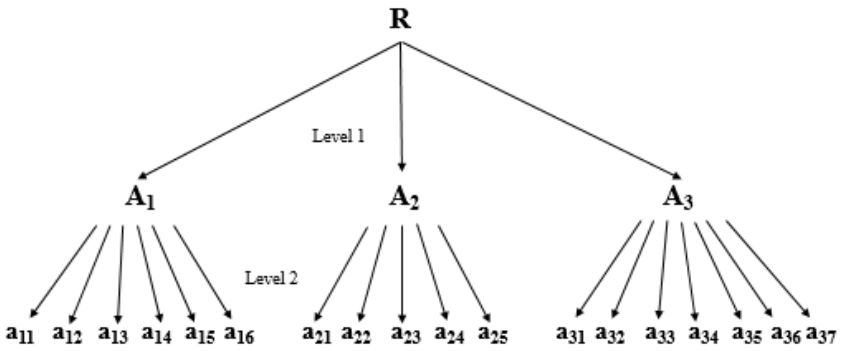

Fig. 1. Hierarchy Structure tree

3.3. Collecting data

Data collection consists of 2 stages. The first stage is to determine the criteria. Experts are involved to provide an assessment of the criteria that can be used as a measuring tool. Points for Yes = 1, Points for No = 0.

The second phase is collecting data on employee performance assessment. The second phase is conducted after all criteria fulfill the minimum support value (min_s). The questionary was given to 30 employees. The employees should choose one answer. Point for done = 1, point for not yet = 0. If the respondent answers yes, it means that the employee has carried out the activity.

3.4. Data converted to encoded item table

An encoded item table is a table result from the transformation respondent's answer to Microsof excel. The respondent answer result from each criterion is accumulated to result in a frequency absolut. Frequency absolut a number that expresses the amount of data in a certain group.

3.5. Calculating the minimum support value (min_s)

Minimum support is a tolerance value determined as the lower limit. Minimum percentage limit (MPL) is the lower limit for eligible criteria, which is 40%. Formula to calculate minimum support using formula (1).

$$\min_s = mpl \times n \tag{1}$$

Where: $\min_s$ are the minimum support; mpl is minimum percentage limit is the lower limit percentage; n is the total number of the respondents, the minimum value of support is

$$\min_s = 40\% \times 30 = 12$$

Determined $\min_s = 12$. If frequency absolute on the sub-criteria $(t_{ij}) < 12$, the sub-criteria is not eligible as an employee performance assessment indicator, and it will be removed from the Encoded item table. Each sub-criteria will be calculated absolute frequency. Absolute frequency is the number of criteria values on certain criteria. Therefore, the formula for calculating the number of sub-criteria is shown in equation (2)

$$t_{ijk} = \sum_{i=1}^{n} a_{ijk} \tag{2}$$

Where : x_{ij} frequency absolute for on the sub-criteria; *n* number of respondents.

The calculation of t_{ij} is :

$T_{a11} = 26$	$T_{a13} = 15$	$T_{a14} = 18$	$T_{a15} = 27$	$T_{a16} = 24$
$T_{a21} = 24$	$T_{a23} = 27$			
$T_{a31} = 26$	$T_{a32} = 20$	$T_{a33} = 19$	$T_{a36} = 25$	$T_{a37} = 26$

Based on the absolute value calculation, there are 7 sub-criteria that do not meet the $\min_s$ requirements, therefore the sub-criteria are deleted in the endcode item table. Table 2 is an encoded item table with frequency absolut which fulfills minimum support ($\min_s$).

Table 2. Encoded item table

R	A_1					A_2			A_3		
	a_{11}	a_{13}	a_{14}	a_{15}	a_{16}	a_{21}	a_{23}	a_{31}	a_{32}	a_{33}	a_{36}
1	1	1	0	1	1	1	1	0	1	0	1
2	1	0	0	1	1	1	0	1	1	1	1
3	1	1	1	1	1	1	1	1	0	1	1
4	1	1	0	1	1	1	1	1	1	1	0
5	1	0	1	0	0	0	1	0	0	0	1
6	1	1	1	1	1	1	1	1	0	1	1
7	0	1	1	1	1	1	1	1	1	0	0
8	1	1	0	1	0	1	1	1	1	1	1
9	1	0	0	1	1	1	1	1	1	1	1
10	0	1	0	1	1	0	1	1	1	1	1
11	1	1	0	1	1	1	1	1	1	1	1
12	1	1	0	1	1	1	1	1	1	1	1
13	0	0	0	1	1	1	1	1	1	1	1
14	1	0	0	1	0	0	0	1	1	1	1
15	1	0	1	1	1	1	1	1	1	1	1
16	1	0	1	0	0	0	1	0	0	0	1
17	1	0	1	1	1	1	1	1	0	0	0
18	1	0	0	1	1	1	1	1	1	1	1
19	1	0	1	1	1	1	1	0	0	0	0
20	1	1	1	1	1	1	1	1	1	1	1
21	0	0	1	0	0	1	0	1	1	0	1
22	1	1	0	1	0	1	1	1	1	1	1
23	1	0	1	1	1	1	1	1	1	1	1
24	1	0	1	1	1	1	1	1	1	0	1
25	1	1	1	1	1	1	1	1	0	1	1
26	1	1	1	1	1	0	1	1	0	0	0
27	1	1	1	1	1	0	1	1	0	0	1
28	1	1	1	1	1	1	1	1	1	1	1
29	1	0	1	1	1	1	1	1	0	1	1
30	1	0	1	1	1	1	1	1	0	0	1

3.6. Calculating the weight value on the criteria ($\boldsymbol{W_{ai}}$)

Weight value shows the importance level of the criteria. The weight calculation has been done twice, there are at level 1 on the criteria and level 2 on the sub-criteria. Based on the table item encoding, all sub-criteria values are accumulated. the more respondents who choose indicates a high level of respondent confidence. Before calculating the weight of the criteria at level 1, first calculate the absolute frequency value at level 1. The absolute frequency formula for criteria at level 1 uses equation (3).

$$T_i = \sum_{k=1}^{ni} t_{ijk} \tag{3}$$

Where: t_{ij} is the value on the sub-criteria; *ni* the number of sub-criteria in one criterion.
The calculation of T_i is

$T_1 = 110$ $T_2 = 51$ $T_3 = 90$

After that calculate the weight value for each criterion (W_{ai}), using the formula (4)

$$w_i = \frac{T_i}{\sum_{i=1}^{r} T_i} \tag{4}$$

Where: T_i is absolute frequency for criteria;
The calculation of W_{ai} is

$$W_{a1} = (110/251) = 0.44$$
$$W_{a2} = (51/251) = 0.20$$
$$W_{a3} = (90/251) = 0.36$$

3.7. Calculating the weight value on the sub-criteria $(\boldsymbol{W_{aij}})$

The calculation of the weight value for each item can do by utilizing the formula (5) below :

$$W_{ijk} = \frac{t_{ijk}}{T_i} W_i \tag{5}$$

Where: $W_{aij}$is a weight for subcriteria x; T_i is absolute frequency for criteria; t_{ij} is frequency absolute on the sub-criteria;

$$W_{a11} = \big(26/(26+15+18+27+24)\big) \times 0.44 = 0.10$$
$$W_{a13} = \big(15/(26+15+18+27+24)\big) \times 0.44 = 0.06$$
$$W_{a14} = \big(18/(26+15+18+27+24)\big) \times 0.44 = 0.07$$
$$W_{a15} = \big(27/(26+15+18+27+24)\big) \times 0.44 = 0.11$$
$$W_{a16} = \big(24/(26+15+18+27+24)\big) \times 0.44 = 0.10$$
$$W_{a21} = \big(24/(24+27)\big) \times 0.2 = 0.10$$
$$W_{a23} = \big(27/(24+27)\big) \times 0.2 = 0.11$$
$$W_{a31} = \big(26/(26+20+19+25)\big) \times 0.36 = 0.10$$
$$W_{a32} = \big(20/(26+20+19+25)\big) \times 0.36 = 0.08$$
$$W_{a33} = \big(19/(26+20+19+25)\big) \times 0.36 = 0.08$$
$$W_{a36} = \big(25/(26+20+19+25)\big) \times 0.36 = 0.10$$

The calculation can be continued with the same calculation formula. The weight score table is a model of employee performance assessment that contained the weight value for each subcriteria. Weight value will be accumulated with other weight values that show the employee performance is done. Table 3 shows the score for each weight below.

Table 3. Employee Performance assessment Score

Indicator	Weight
A_1. Leadership	
a_{11}. Ability and willingness to learn new things	0.10
a_{13}. Conflict solving	0.06
a_{14}. Decision making	0.07
a_{15}. Communication skills	0.11
a_{16}. Problem-solving	0.10
A_2. Cooperative	
a_{21}. Ability to work in a team	0.10
a_{23}. Ability to work under pressure	0.11
A_3. Capability	
a_{31}. Ability to transfer knowledge	0.10
a_{32}. Compliance	0.08
a_{33}. Creativity	0.08
a_{36}. Responsibility	0.10

3.8. Determining the Minimum Standard Value for Assessment (MSV)

A standard minimum value is a value that must be achieved by the employee to fulfill the indicator assessment. Based on the weight score, determined MSV is 0.69.

3.9. Calculate the value of performance indicators (WP)

The performance data is collected from leader assessment to employee. The performance assessment for the odd period 2021/2022 is measured based on the employee activities during the period. The assessment is conducted by the

assessment team for performance has done. If the employee carries out the task on the assessment criteria, then the weight value becomes a performance achievement value. WP value is a performance value and not a ranked value. Therefore, if WP > MSV, then the employee performance is achieved. Table 4 displays the WP value for each respondent.

Table 4. Employee Performance assessment Result

Num	Initial	criteria			WP
		A_1	A_2	A_3	
1	MD	0.71	0.20	0.18	1.09
2	RZ	0.65	0.10	0.33	1.08
3	KK	0.78	0.20	0.25	1.24
4	KM	0.71	0.20	0.24	1.15
5	**RK**	0.18	0.11	0.10	**0.38**
6	TR	0.78	0.20	0.25	1.24
7	TM	0.68	0.20	0.16	1.04
8	RN	0.27	0.20	0.33	0.81
9	CM	0.65	0.20	0.33	1.19
10	EL	0.61	0.11	0.33	1.05
11	IS	0.71	0.20	0.33	1.25
12	DS	0.71	0.20	0.33	1.25
13	VV	0.55	0.20	0.33	1.08
14	**DM**	0.21	0.00	0.33	**0.55**
15	SM	0.72	0.20	0.33	1.26
16	**YP**	0.18	0.11	0.10	**0.38**
17	MI	0.72	0.20	0.08	1.00
18	MA	0.65	0.20	0.33	1.19
19	WD	0.72	0.20	0.00	0.92
20	ND	0.78	0.20	0.33	1.32
21	**VR**	0.07	0.10	0.26	**0.43**
22	PR	0.27	0.20	0.33	0.81
23	AD	0.72	0.20	0.33	1.26
24	SN	0.72	0.20	0.26	1.18
25	TT	0.78	0.20	0.25	1.24
26	YN	0.78	0.11	0.08	0.97
27	AS	0.78	0.11	0.18	1.07
28	DS	0.78	0.20	0.33	1.32
29	JN	0.72	0.20	0.33	1.26
30	ND	0.72	0.20	0.18	1.10

4. Discussion

The employee performance assessment measuring results with 3 criteria and 11 item, resulting in 4 employees being below MSV, there are RK = 0.38, DM = 0.55, YP = 0.38, and VR = 0.43, meanwhile 26 employees are above MSV. Figure 2 shows the Employee performance assessment Result in the line chart form. In Figure MCV value is made on a scale of 10.00.

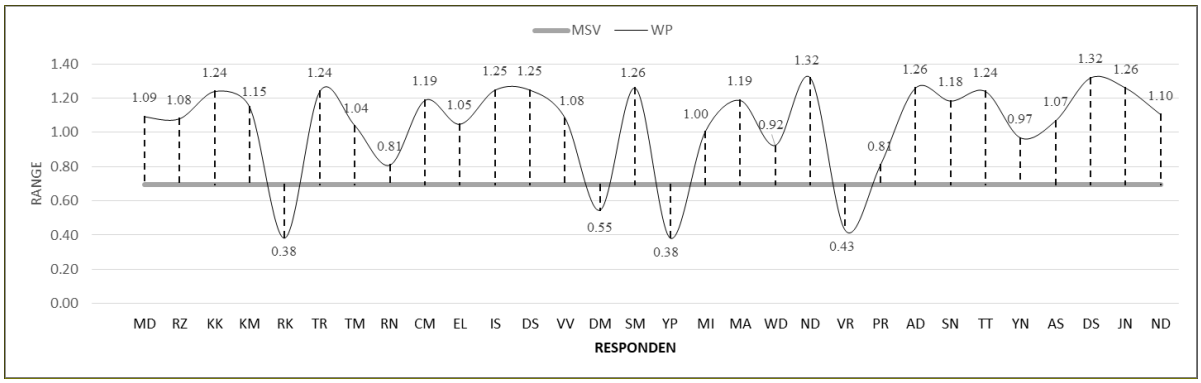

Fig 2. Line chart for Employee Performance assessment result

Figure 2 indicator weighted performance calculation results for UIGM employee performance assessment based on the WP calculation result, then could be concluded that 87% of an employee of UIGM has done their job properly, and just 13% is not doing it properly. The average indicator value that is lowest on indicator a_{13} – Conflict solving, which means the employee to solve the ability of the problem with new ideas and innovation in their job is still low. However, the higher average indicator value on indicator a_{11}- Responsibility means the responsibility of the employee in the settled their job is in alignment with the regulation, also on a_{23}-Ability to work under pressure can be handled well

5. Conclusion

WPI method is able to resolve the weakness of the SAW method. WPI method utilized the respondent's opinion to determine the criteria from some alternatives offered. WPI method is also can resolve the limited level of the SAW method. The target is achieved when the WP value > MSV value. WP average value = 1.03. This condition shows that the employee performance activities are good enough. The result of the WP calculation is also can be used for making decisions for the leader, and for developing employee performance planning in the future.

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