

Design a Decision Support System to Evaluate the Performance of Indonesian Lecturers by Developing a Simple Additive Weighting Method

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Abstract:

Simple Additive Weighting (SAW) method is one of the methods in the Decision supporting system (DSS) to discover the best option from some option with certain criteria. The determination of option by determining grade on the data group which as the result of weight multiple with an interests value. The determination of the weight will be tough when using more than two grade criteria because the weight should be calculated repeatedly until the sub-criteria at the last grade.

The research is aim to develop the Simple Additive Weighting (SAW) in order to simplify the weight calculation. SAW method able to calculate the sub-criteria until more than four grade, so that determination of the key performance indicator and multi-criteria could be done unlimited. The case study in this research is about a lecturer performance assessment in Indonesia. The assessment will be referred to the three pillars of the higher education activities, which consisted an education and teaching, research and the society service. Base on that reason, the determining of the key performance indicators is referred to the translation of the three pillars. Therefore, necessary simplification of the weight calculation so that make it easier to calculate the value of the preverensi for each alternative

Keywords: *Decesion Support System, Simple additive weighting method , Key Performance Indicators*

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I. INTRODUCTION

The decision supporting system (DSS) is a system which provide a problem-solving option of the unstructured problem. The decision supporting system is a system which supports the leader job to decide solved the semi-structure problem, to obtain a decision [1][2][3] by utilizing computer applications [4][5][6]

The development of the DSS method not only by combined some methods but by developing the existing method as well, so that the problem settlement become simple. Every method in the DSS has a strength and weakness [7]. Therefore we can not determine which the method most accurate to resulting a decision. Before determining a DSS method, should be analyzed

first the indicators will be use. Some research utilizing DSS method are additive weighting method (SAW) [4][7]; Flood risk area mapping in Semarang City [8]. The research has a multi-criteria indicator on the first level, therefore the SAW method able to implemented the directly devoid developing process

This research is studying a developing SAW method to evaluate lecturer performance in Indonesia. The SAW method is an easier implemented method. SAW method is a Multiple-attribute Decision Making (MADM) [7][9] could be utilize to solve a complex problem [10][11][12] MADM also known as a balanced linear combination, assessment method, or number weighted [13].

The lecturer has an important role to increase the academic activities. The low quality of the lecturer could be influence the institution quality as well [14]. To measure an achievement the lecturer performance should be done an evaluation. The performance evaluation is aiming to increase the lecturer quality in doing the academic activities

This paper is starting by the first question how to build a lecturer performance calculation model in Indonesia which has a sub-multicriteria? The second question is how to simplify a weight calculation so that simple to implement?

KPI is a tool to measure target achievement [3][2][4]. To determine KPI with multi indicators is needed an accurate value distribution composition. Therefore, the determining success factor is on the performance determine an indicator which relevant with utility and situation. KPI comes from derivative of the three pillars of higher education, but determining the lecturer assessment weight is base on the university rule. KPI is translated in to some indicators which represented the specific activities. The final result of the assessment is a lecturer performance ranking [5].

This research starts with the determination of KPIs. The KPIs determination is a SAW. The criteria in this research are base on the lecturer working load assessment. The criteria contain the tiered multivalue. To counting the KPIs value, it needs to develop the SAW method.

II. METHODOLOGY

SAW method is one of the methods for a decision support system which simple to implement. The role of the chairman is necessary to set up an assessment indicator and target. The SAW calculation method consisted of 7 steps, they are 1) Determine the alternative (A_i); 2) Determine the criteria of each alternative (C_i); 3) Determine the coherences rating value for each criteria; 4) designed a decision matrix; 5) Do a normalization; 6) Calculate the preference value (V_i) 7) Updating. The final result of the SAW Calculation provides data which has a level value for each criteria.

The lecturer performance review utilizes the SAW method, however it necessary to develop, since the criteria have a derivative to some level. This is the weakness of the SAW method, where the calculation cannot utilized to calculate the weight on the sub-criteria, even though in the implementation, thus case study easy to find. Therefore, the SAW method necessary to develop in order to conform the requirement of the observing system.

A. SAW Method Development

The SAW method which utilizes in this study is only until the third step. The next step is developing a new calculation by calculating the weight value multi-level for each sub-criteria. The development method explainable as below:

1) *Determine an alternative*: Numerous of the lecturer at IGM University in 2019 is 130 lecturers. However, the number of sample in this study only 10 data. The data which utilizes is the data which represented the determined

criteria. The chairman has set up the target should be achieved is 8.36 point

2) *Determined the Criteria:* The three principles of higher education are three basic lecturer activities that must be carried out as an act of professionalism of the lecturers in carrying out their duties and responsibilities. Based on the references and discussions that have been carried out, the assessment criteria consisted of : Education and Teaching (C_1), Research and Development (C_2), Society service (C_3) dan other supporting activities (C_4). All of them to be the key performance indicator on the lecturer performance evaluation. Definition of the criteria and sub-criteria as below:

TABLE I
DETERMINATION CRITERIA AND SUB-CRITERIA ON THE LECTURER PERFORMANCE ASSESSMENT.

Criteria	Sub criteria
Education and Teaching	Formal Education, Informal Education, Field Work, Counseling, Examiner, coaching to student and lecturer, person in charge, teaching
Research and Development	Book, Research, publication, seminar, produce a copyright
Society Service	Occupying positions in the Community, providing training / counseling to scheduled and unscheduled community / servants
Other supporting activities	ccupying positions in the Community, providing training / counseling to scheduled and unscheduled community / servants

Each of the criteria has a sub-criteria, and sub-criteria could be has a derivative. Weight calculation techniques for each criterion can be done after all the criteria and sub-criteria are set.

3) *Determine the weight for each of the criteria:* Weight value is a value determined based on importance. For the first step, in determining the weight value needs to be discussed in advance with the leader. The contribution value is influenced by the target that must be achieved by

the lecturer in a certain period. Setting targets will always change according to the needs of the university. In this case, the weight values for each criterion are as follows determined for each criterion, namely education and teaching (W_1) = 30, research and services (W_2) = 40, community services (W_3) = 20 and activities prison (W_4) = 10. The highest weight value is on the research and service criteria (W_2). It was provided that the criteria are the priority assessment should be done.

4) *Determine a coherence rating value each of the criteria:* The coherence rating value is an interests value for each of the criteria. In this step, developing of the SAW method has done. However, in this case, study, the coherence rating value determined to all of the criteria and sub-criteria which put on the second and the third level.

5) *Graded weight for each of the sub-criteria:* Before calculated the weight value, should be determined the value of the interests for each of the criteria. The calculation of weight value utilizing the formula as below:

$$W_{ij} = \frac{W_i}{\sum_{i=1}^n I_{ij}} \times I_{ij}, \quad i=1..n; j=1..n \quad (1)$$

Definite that W_{ij} is a weight for sub-criteria. W_i is weight for criteria, I_{ij} is interests level for sub-criteria. The calculation will be done with recursive on all of the level and their derivative as well. Base on the calculation result, the weight value for each of the criteria as below:

TABLE III

CALCULATION OF WEIGHT FOR EACH OF THE SUB-CRITERIA

C_{ij}	I_{ij}	W_{ij}	C_{ijk}	I_{ijk}	W_{ijk}	C_{ijkl}	I_{ijkl}	W_{ijklm}	
Education (C_{11})	6	8.57	Formal (Doctorate Degree)	2	5.71	1-2 Days 3-6 Days 2 Week ≥ 1bln	1	0.29	
			Non Formal	1	2.86		2	0.57	
Counselor (C_{12})	3	4.29	Field Work /PKL	1	0.43		3	0.86	
			Final Assignment / Essay	2	0.86		4	1.71	
			Thesis / Dissertation	4	1.71		3	1.29	
			Academic Lecturer	3	1.29		1	0.95	
Examiner (C_{13})	2	2.86	Final Assignment / Essay	2	1.90		2	1.90	
Development (C_{14})	1	1.43	Thesis / Dissertation	2	1.90		Student Activities	1	1.43
			Chancellor	6	1.63			5	1.36
Occupation (C_{15})	4	5.71	Vice of Chancellor	5	1.36			Diploma / Bachelor Degree	1
			Departement Head	4	1.09	> 12 sks		2	0.79
			Dean	3	0.82	≤ 12 sks		1	0.79
			Head Of Study Programe	1	0.27	> 12 sks	2	1.59	
Teaching (C_{16})	5	7.14	Head of Bereau	2	0.54	> 12 sks	1	1.19	
			Diploma / Bachelor Degree	1	1.19	≤ 12 sks	2	2.38	
			Master Degree	2	2.38	> 12 sks	1	1.19	
			Doctorate Degree	3	3.57	≤ 12 sks	2	2.38	

C_{ij}	I_{ij}	W_{ij}	C_{ijk}	I_{ijk}	W_{ijk}	C_{ijkl}	I_{ijkl}	W_{ijklm}
Book (C_{21})	1	2.67	Reference	7	0.67		2	5.93
			Hand Book	5	0.48		1	2.96
			Monograph	6	0.57		2	2.96
			Translation	4	0.38		1	1.48
			Senior High School / Junior High School / Primarv School /Equivalent	3	0.29		2	2.37
			1	0.10	1		1.19	
Research (C_{22})	5	13.33	Funded by Government	2	8.89	Leader	2	2.96
			Funded by University	1	4.44	Member	1	1.48
			Reputable International	5	3.56	Leader	2	2.37
			International	3	2.13	Member	1	1.19
Publication (C_{23})	4	10.67	Accredited National	4	2.84	Leader	2	1.42
			National	2	1.42	Member	1	0.71
			Local	1	0.71	Leader	2	1.90
			International	3	2.67	Member	1	0.95
			National	2	1.78	Leader	2	0.95
Seminar (C_{24})	2	5.33	Regional	1	0.89	Leader	2	0.47
			International	3	2.67	Member	1	0.24
			National	2	1.78	Leader	2	1.78
			Local	1	0.71	Member	1	0.89
Masterpiece (C_{25})	3	8.00	Copyright	2	5.33	Leader	2	1.19
			HAKI	1	2.67	Member	1	0.59

C_{ij}	I_{ij}	W_{ij}	C_{ijk}	I_{ijk}	W_{ijk}
Hold a position at Society (C_{31})	3	10.00	National	2	6.67
			Local	1	3.33
Provide a Training for Society (Schedule) (C_{32})	2	6.67	International	3	3.33
			National	2	2.22
			Local	1	1.11
Provide a Training for Society (unschedule) (C_{33})	1	3.33	International	3	1.67
			National	2	1.11
			Local	1	0.56

C_{ij}	I_{ij}	W_{ij}	C_{ijk}	I_{ijk}	W_{ijk}	C_{ijkl}	I_{ijkl}	W_{ijklm}
Participant in the activities at University (C_{41})	2	1.33	Leader	2	0.89			
			Member	1	0.44			
Participant in the activities out side of University (C_{42})	3	2.00	International	3	1.00	Leader	2	0.67
			National	2	0.67	Member	1	0.33
			Regional	1	0.33	Leader	2	0.44
Member of Lecturer Profession Organization (C_{43})	1	0.67	International	2	0.44	Member	1	0.22
			National	1	0.22	Leader	2	0.15
Receiving a Honor (C_{44})	4	2.67	Medal Of Honor satya lancana karya satya	2	1.78	30 years	3	0.89
			Other Honors	1	0.89	20 years	2	0.59
Assesor (C_{45})	5	3.33	International	3	1.67	10 years	1	0.30
			National	2	1.11	International	4	0.36
			Campus	1	0.56	National	3	0.27
						Local /Regent	2	0.18
						Campus	1	0.09

6) *Setting the Target Table:* Target table designed base on the weight value on the last level. The target value is a compilation of some weight value on the sub-criteria which has been determined by the chairman as a performance obligation. A successful of the lecturer to do their obligation measured by the target achievement. The target which determined by the chairman base on 4 subject assessment, provides on table 3

TABLE III
SETTING THE TARGET

Criteria	Sub-Criteria	Point
Teaching (C_{16})	Diploma / Bachelor Degree (6 ≤ SKS ≤ 12)	0.79
Research (C_{22})	Funded by University (Leader)	2.96
Publication (C_{23})	International (Leader)	1.42
Seminar (C_{24})	National (Leader)	1.19
Provide a Training for Society (Schedule) (C_{32})	Local	1.11
Participant in the activities at University (C_{41})	Leader	0.89
Sum		8.36

7) *Designing a calculation matrix of the lecturer performance assessment:* The matrix of the lecturer performance assessment designed base on the lecturer performance achievement for one

semester (6 months). The final criteria value (rA_n) is a compilation of some weight value base on achievement performance. The calculation matrix of the lecturer performance as below:

TABLE IV
MATRIX OF THE LECTURER
PERFORMANCE ASSESSMENT

X	rA_1	rA_2	rA_3	rA_4	Sum	Result
X1	4.17	11.02	1.11	0.63	16.94	Achieve
X2	6.26	7.11	5.56	1.15	20.07	Achieve
X3	3.49	12.45	0.56	0.63	17.12	Achieve
X4	6.71	10.73	5.00	1.79	24.22	Achieve
X5	2.10	3.14	0.56	0.52	6.31	Failed
X6	2.21	3.91	0.56	0.52	7.19	Failed
X7	5.76	12.62	1.67	1.74	21.80	Achieve
X8	2.78	0.24	0.56	0.52	4.09	Failed
X9	9.69	11.02	0.56	1.52	22.79	Achieve
X10	6.59	8.06	1.11	0.63	16.39	Achieve

Base on the calculation results on table 4, summarized that 7 lecturers have a KPI over of the target and 3 lecturers failed to achieve the target. It does mean the lecturers have done their obligation properly, and vice-versa. The highest KPI value at 24,22, and the lowest value at 3,72. The calculation result could be used by the chairman as an input to give a reward or punishment.

III. CONCLUSIONS

1. In Indonesia, the performance evaluation of the lecturers based on The three principles of higher education has 57 KPIs with the percentage of weights namely education and teaching = 30, research, and development = 40 %, community service = 20% and other supporting activities = 10
2. Performance appraisal models using weighting calculation formulas can be used to calculate KPIs that have multiple sub-variables.
3. The performance appraisal model is very flexible to adjust target changes and weight percentages for each variable. So that this model can also be used to measure KPIs for other case studies

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