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RESEARCH

Building a Weighted Performance Indicator Concept utilized The Respondent's Opinion Approach

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Abstract

This study discusses building the concept of weighting performance indicators based on respondents' opinions. The opinion of respondents has the power to provide an assessment. So far, the performance appraisal is determined based on the Balanced Scorecard method, AHP, Topics, and others where the dimensions of this method are limited. In companies, performance appraisals are carried out by the HR Department. The specified indicator is sometimes too high, therefore it is considered achieved. The most flexible approach in which the determination of indicators is determined by the respondent who will implement the rule. Weighted performance indicators are constructed by developing an association rule method and ranking method. Performance appraisal structures in the form of multi values and multidimensional can be built using this concept. Items that meet the support value and minimum weight are determined based on the higher frequency. This concept is a new proposal from a mining method developed to produce a performance appraisal model that can be applied to various needs.

Keywords: Respondents Opinion, Weighted Performance Indicator, Association rule, Performance appraisal model

Introduction

Performance assessment is one of the important things in the organization. Performance assessment is not only to measure employee responsibility but also to motivate the employee to increased career. Performance evaluation also becomes a knowledge base organization that able to analyze with a certain technique such as big data analysis [1]

Some methods are familiar utilized to evaluate the performance, for example, balanced scorecard (BSC), AHP [2][3] and 360-degree model [4], ANP based model [5], Topsis method [6] Simple Additive Weighting method [7], etc. Many companies have set up the assessment instrument through management consulting [8] or through evaluation plans implemented by some companies in the country [9].

In the big data era, the source of the respondent's opinion could be from the internet, Twitter, Facebook, company database [10], or on a certain form through a questionnaire.

The respondent's opinion has the power to decided and conclude the indicator needed during the performance assessment conducted. In the development, the respondents opinion could be applied for another purpose, such as presidential electoral [11], determined the key performance indicator (KPI) [12][13]

The study has proposed the concept of setting up the instrument performance assessment base on the respondent's opinion. The respondent opinion concept is collecting data about the kind of indicator required to set up the assessment instrument base on the respondent's opinion. One of the main reasons why it should be done since some of the assessment indicators is taken from the Balance scorecard /AHP / TOPSIS has a limited dimension. Besides that, the setting up of the instrument assessment and goal set by HR, sometimes encumber the employee The data is a process that utilized a certain method and generated a new pattern.

The processing data most utilized is the data mining method. Data mining is consisted of 5 methods and has a different goal. One of the data mining which talking in this study is Association Rule (AR). Nowadays, the implementation of the AR is not on the sales site only but also implemented on marketing, education field, nuclear science, etc.

AR consisted of 4 models, they are 1) Single level Association rule; 2) Multilevel Association rule; 3) Interdimensional Association rule; 4) Hybrid dimensional association rule. The differences between the Multilevel Association rule and the Hybrid dimensional association rule is on the Multidimensional association model is not allowed to repeat the same predicate/ dimension on the one rule, and on the hybrid dimensional association, it was allowed. [14].

Base on some case studies, most AR implementation in the multilevel association and multidimensional association since it has been given the specific information and more focus than a different abstract level [15]. The implementation of AR is to continue to develop following the current problem. Improvisation of the AR model could be given the knowledge contribution in the setting up the simply performance assessment model and applicable for multi-purposed

Association Rule (AR)

Mining of association is a technique to discover an association rule as the result of the item combination. The Association rule has generated the pattern on the data group which appeared together. This method for the first time implemented to process transactions to give a recommendation which things will buy concurrent [16][17][18]. AR is known as Market Basket Analysis (MBA) [19] [20] [21]

AR also collaborates with the other data mining technique for generated the efficient algorithm with a high-frequency pattern [14][22] and so will get the best result.

Numerous studies give expression about the AR application as supporting decision-maker [23], clarification [24][25], prediction [26], clustering [27] from some cases by tracking the correlation data to solve the problem.

AR analysis can become a base of the data mining model development. AR has a step named frequent pattern mining for generated an efficiency algorithm. AR was determined by supporting value which consisted of the item combination percentage in the database, and also the confidence which consisted of correlation between item and association rule. Association rule mention as $\{X\} \rightarrow Y$, $X \cap Y = \emptyset$. If an item eligible to support, priority could be handling big data, however, the main problem is on the setting item-set. To get an eligible item-set should be done a literation repeatedly. The basic methodology of the association analysis defined to be 2 steps, as bellow:

a) Frequent set item analysis

In this step, determine the eligible combination item from the supporting value on the database. The item Supporting value is generated by formula as bellow:

$$support\ (A) = \frac{The\ number\ of\ transactions\ for\ A}{Total\ transaction} \quad (1)$$

Meanwhile, to determined the supporting value from 2 item set, utilized the bellow formula:

$$support\ (A,B) = \frac{\sum The\ number\ of\ transactions\ for\ A,B}{Total\ transaction} \quad (2)$$

b) Determine the Association Rule

Determined the association pattern by calculating the confidence value. The confidence value utilized the formula as below : [28].

$$confidence\ (A \rightarrow B) = \frac{\sum The\ number\ of\ transactions\ for\ A\ and\ B}{\sum Total\ transaction\ \ A} \quad (3)$$

Base on the formula can be explained that the supporting value and confidence value is a divided result from numerous transaction which contained the item A and Item B. The algorithm apriori

using the level-wise search approach, where each K item-set no longer able to be formed. The next step is setting up the association rule by calculated the confidence value from the eligible minimum item-set.

Nowadays, MAR is mostly used to settle the cases to synchronize to the real condition. MAR is also can give specific information and wide application from different abstraction levels [28]. The following is a concept of the Multilevel utilized the shopping database transaction, a sales item relation consists of the transaction number and set of items purchase. The step to building the multilevel AR by concept hierarchy tree, as bellow:

1. Create a concept hierarchy tree from available data;
2. Row the hierarchy tree in the generalized description table;
3. Transformation data to be an encoded truncation table T. Item on generalized description table encoded in accord with the GID value
4. Formed the filtered transaction table T[2] [[28]

The concept hierarchy tree from the transaction :

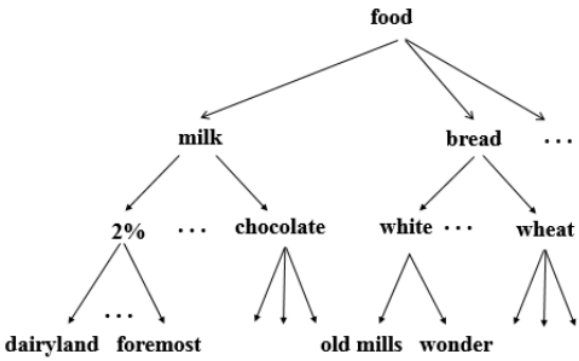

Fig. 1 Concept hierarchy tree

Table 1 Generalized description table

GID	Bar_code_set	category	content	brand
112	{17325,31414,91265}	milk	2%	foremost
...	...	...	...	...

Tabel 2 : Endcoded transaction tabel

TID	Items
T1	{111, 121, 211, 221}
T2	{111, 211, 222, 323}
T3	{112, 122, 221, 411}
T4	{111, 121}
T5	{111, 122, 211, 221, 413}
T6	{211, 323, 524}
T7	{323, 411, 524, 713}

The algorithm utilized to generate the Multilevel Association Rules is Algoritma ML-T2L1[28]**.** The algorithm is consisted of forming an item-set with minimum eligible support and joined the item-set to become a large item set.

Multi dimension AR is the same as AR, the difference is in how many predicates that used. AR used one predicate on the rule that was used repeatedly. And multidimensional association rule used numerous predicate for some rule when the single dimension rule searches a frequent item-set, multidimensional AR or multilevel AR depend on the data storage structure.

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Problem Association Rules

Base on the introduction about AR theory, Multivalue AR, and Multidimention AR that has been explained before, founded some weakness, they are:

1. AR is a method of looking for the correlation between one or more items in the data-set. The mechanism of the AR with algorithm apriori is by determined the minimum support, iterate-, calculating support for each 1-item, if eligible minimum support, 1-item support become a higher frequent pattern. Doing iterate for 2-itemset until K-itemset, till K-itemset no longer eligible minimum support.
   Iterate is one of the weaknesses. The time to scan the database will be longer regarding the more iteration. If data consists of 5 items combination, the iterate could be done maximal 4 times iterate. If some more than 5, the iterate will be done a few times. This condition will encumber the computing process
2. Multivalue and Multi dimension AR theory have advantages and weaknesses as well. Base on the multivalue concept, data consists of some level until the one level where it is categorized specifically. However, the weakness is exactly on the dimension limitation. On the multivalue concept, data has only come from one predicate, and multi-dimension has more than one predicate. The advantage and weaknesses of both concepts become a basis for development. Numerous study has linked both concepts to a settled problem. By integrating data from two different tables will be generated a large item-set and then it could be processed to generate the minimum support eligible item-set

Building A Weighted Performance Indicator Concept

The study is proposed about the building the assessment model concept with determined the important attribute that will be mining from the respondent opinion. This model utilized the hierarchy tree instead of the original data questionnaire form. The tree hierarchy structure has a top position that is named as the top level. The top-level, divided to be several dimension. The dimension has an indicator that has a different characteristic. Each dimension able to breakdown to be several levels with several indicators and correlated items. The tree hierarchy structure is shown in table 2

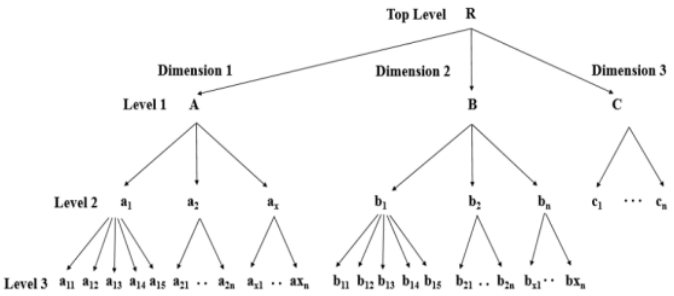

Fig. 2 Structure hierarchy tree for Weighted Performance Indicator

The tree structure simplifies the data classification, if found the new item that unlisted on the tree hierarchy than the additional position will be identified easily. The representative data on the tree hierarchy is made people easy to understand and see what dimension becomes an assessment therewith the indicator and items. To simplify the weight calculation, the tree hierarchy could be represented in the encoded item table form. The encoded item table is shown in table 3.

Table 3. Encoded item table

	Level 1	Level 2	Level 3
Dimension	A	$\{A_1, A_2 .... A_n\}$	$\{a_1, a_2 ... a_n\}$
	B	$\{B_1, B_2 .... B_n\}$	$\{b_1, b_2 ... b_n\}$
	C	$\{C_1, C_2 .... C_n\}$	$\{c_1, c_2 ... c_n\}$

Weighted Performance Indicator is built by adopted several steps on the algorithm apriori, they are data sets in the tree hierarchy form. Encoded item table and determined the minimum value support, and calculated the weight value, base on the calculation ranking method [29]. Base on the questionary structure form, they are multilevel and multidimensional AR forms.

To simplify the understanding of the Weighted Performance Indicator model, thus steps could be explained as below:

1) Collecting data
   The data collected in several ways. The common way is by spreading the questionary form to respondents, and then data is processed by utilizing a certain technique. In this study, the questionary using several open and closed questions or combined both of them. The weight performance indicator model has accommodated the probably additional item from respondents' opinion.
2) Build a tree hierarchical structure
   Data could be grouped base on the dimension and indicator. The grouping data will be composing the tree hierarchy structure and will end on the single data. The tree hierarchy generated will simplify the item table encoding process. Based on collected data, there are has 3 dimensions, 9 indicators, and 27 items.
3) Transformed data into item table encoded
   The item table encoded process is transforming data process from questionary data into the table, with transformed data into numeric data 1 and 0 so that can be accumulated. The value 1 is the mean the data is available, and 0 is the mean unavailable. Value 1 is also showed the respondent's interest in one of the indicators. The more respondents choose the indicator, will become high the frequency. The item transformation results in numeric 1 and 0 are shown in table 4.

Table 4. Encoded item table

	A			B			C		
	a_{11}	a_{12}	a_n	b_{11}	b_{12}	b_{13}	c_{11}	c_{12}	c_n
R_1	0	0	0	0	1	0	0	1	0
R_2	0	1	1	1	0	0	0	0	1
R_3	1	0	0	1	0	0	0	0	1
R_n	1	1	0	0	0	1	0	0	1

4) Count up all of the same items (a_n)
   Base on the item table encoded result, the next step is to count up all of each item.
5) Determine minimum support value (minS)
   In this step, minimum support is a toleration value determined as the minimum limit by the leader. The formula is:

$$minS = minimum\ percentage\ limit * total\ respondent \quad (4)$$

example : $minsS = 40\% \times 30 = 12$

Therefore, the minimum support value is 12. The total item below 12 is mean not eligible and will not process anymore. This step is to simplify the step from setting item-set. The iterating process should not be done, since by determined the min-s value can be eliminated from the non-support item.

6) Combination of minimum eligible item support on the one table
The combination is meant to erase the non-support item, to simplify the counting process from 27 indicators of the process.

Tabel 5. Itemset final

	A					B							C				
	a_{11}	a_{12}	a_{21}	a_{32}	a_{33}	b_{12}	b_{13}	b_{21}	b_{23}	b_{31}	b_{32}	b_{33}	c_{11}	c_{13}	c_{21}	c_{23}	c_{31}
R_1	0	0	0	1	1	1	0	0	1	0	0	1	0	0	0	1	1
R_2	0	1	0	1	0	0	1	1	0	1	0	1	1	0	1	0	1
R_3	1	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0	0
…	1	1	0	0	0	0	1	1	0	1	0	1	0	1	0	0	1
R_{30}	1	0	1	0	1	1	0	1	1	0	1	0	0	1	0	0	1
Sum	19	14	13	14	15	13	18	12	17	15	12	12	13	14	11	13	21

7) Counting weight dimension value (wd_x)
Weighted is the decision-making process to determined the interest level of each indicator.

8) Weighted can be done by statistic and subjective base on certain considerations. In this study, weight is determined base on the higher frequency which counts by utilized the weight formula that synchronizes to the tree hierarchy structure. The weight counting is twice, they are on the 1st level (dimension) and 3rd level (item). The weight formula on 1st level (dimension) as bellow:

$$wd_x = \frac{\sum_n^1 x_n}{\sum_n^1 x_n + \sum_n^1 x2_n + \sum_n^1 x3_n} \quad (5)$$

Note: x is a dimension, n is total data

By utilized the formula, than to counting the wd value for each dimension as bellow:

$$wd_A = \frac{75}{246} = 0.305$$

$$wd_B = \frac{99}{246} = 0.402$$

$$wd_C = \frac{72}{246} = 0.293$$

Distribution of weight values for dimensions based on percentage distribution. If all the values are added up, the result is 1,000

9) Count up the weight item value (wi_x)
After wd value for each item has been known, then the calculation weight value for each item can be done by utilized the formula as below:

$$wi_x = \frac{x_n}{\sum_n^1 x_n} \; x \; wd_x \quad (6)$$

Where :
wi_x is a weight value for item x
x_n is an item value on the n
wd_x is a weight dimension value on the x

For example the counting wi_{a} for dimension A, B, and C

$$wi_{a11} = \frac{19}{(19+14+13+14+15)} * 0{,}305 = \frac{19}{75} * 0{,}305 = 0{,}077$$

$$wi_{a12} = \frac{14}{(19+14+13+14+15)} * 0{,}305 = \frac{14}{75} * 0{,}305 = 0{,}057$$

$$wi_{b11} = \frac{13}{(13+18+12+17+15+12+12)} * 0{,}402 = \frac{13}{99} * 0{,}402 = 0{,}053$$

$$wi_{b12} = \frac{18}{(13+18+12+17+15+12+12)} * 0{,}402 = \frac{18}{99} * 0{,}402 = 0{,}073$$

The calculation could be continued in the same way, until all of the items has a weight value. If all of the weight value is count up, the result value is 1,00

10) Create a weighted assessment table (*weighted score table*)
The weight assessment table is a table that contained the weight value for each statement. The table is needed to support the leader to assess the performance or another assessment. The implementation of the weight assessment table shown in table 6

Tabel 6. Form Weighted score table

Indicator	item	W	Score
A. Education			
1. Teaching	1. Full Daring	0.077	6.179
	2. Blended learning	0.057	.....
2. Book	Handout	0.053	.....
3. Supervisor	1. Diploma Student	0.057	.....
	2. Bachelor Student	0.061	.....
B. Research			
1. Copyright	1. Copyright	0.053	.....
	2. Patent	0.073	.....
2. Research	1. Internal	0.049	.....
	2. External	0.069	.....
3. Publication	1. Reputable	0.061	.....
	2. International	0.049	.....
	3. National	0.049	.....
C. Community Service			
1. Committee	External	0.053	.....
2. Service	Internal	0.057	.....
	External	0.045	.....
3. Publication	International	0.053	.....
	National	0.085	.....
SUM		1.000	.....
Result			achieved

Score point results of the multiple between item point and weight. For example, full daring item point is 80, therefore the score point is 80 * 0,077 = 6,179.
To conclude the calculation result considered creating a decision table which becomes the final result of the assessment. The decision table becomes a reference to take a decision. The decision table could be determined base on the goal of the assessment.

Table 6 is an example of a lecturer performance assessment. Forms of multi-value and multi dimension questions. With the support of respondents' opinions, it will be easier to determine items and weights. The purpose of the assessment is to determine the performance of the lecturer with the assessment that it is well - achieved - not achieved.

CONCLUSION

Association rules are one method of creating new rules. The iteration process until the item-set reaches the minimum support is the weakness of this method. Modification of the algorithm association rules can be done by considering several aspects, namely the objectives, development, and implementation techniques. The association rules use multivalue and multi-model models to assign weighted performance indicators based on respondents' opinions. This concept can produce a variety of new, flexible assessment models by determining the right indicators because these indicators are determined by the respondents who use them. This model also produces conclusions that can be used as decision making.

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Consent for publication
Not applicable

Authors' contributions
The authors hereby confirm that we have all made substantial contributions to the conceptualization of this research. The lead author has contributed to paper writing, model development ideas, and co-authors have contributed to the validation of the experiment and the results of this study. We read and agreed to the final script.

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