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Development of A Decision Support System on Employee Performance Appraisal Using AHP Model

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Abstract— **Many employees' performance appraisal systems lack business standard irrespective of the organization. Performance appraisal system differs depending on the type of work and job description in an organization. Most organizations lack scientific technique for rating their employee's performances. In this case, a decision support system will help organizations to have a standardize way of performance appraisal and make the appraisal process transparent, fair and just. Analytical Hierarchy Process (AHP) was used in this paper to evaluate employees performances based on five criteria: personal skills, initiatives, teaching quality, method of teaching and research in which case each of the criteria was divided into sub-criteria; and by applying the Decision Support software for evaluating employees performance in line with the individual objectives required to meet the overall organizational mission. The result obtained showed that the consistency ratio (CR) of the five criteria is C.R = 0.0976 which showed that there is consistency in all the criteria in appraising the performance of an academic staff in Kampala International University (KIU) except research. Therefore, personal skills, initiatives, teaching quality and method of teaching are consistent and valid factors while research has not been consistent in appraising an academic staff in KIU despite the weight (47%) attached to it.**

Keywords— **Performance appraisal, AHP model, Decision Support System.**

I. INTRODUCTION

The human resource is bestowed with the responsibility of evaluating and appraising an employee's performance within a given organization. The data and information about a given employee includes his or her biological details, educational qualifications, and professional details, field of specialization, job information and experiences gained along the line. An employee is appraised in relation to the aims and objectives of their organizations, base on some established criteria within the working environment (Akinyokun & Uzoka, 2007).

Decision Support System (DSS) is a computerized system that provides assistance for decision makers to make knowledgeable decisions (Power, 2002). According to (Laudon & Laudon, 2003), decision support system help the top management to make decisions which are distinctive, periodically changing and not readily specified in advance. They handle problem in which the procedure and method for reaching a solution to a given problem is not fully defined in advance. They are design and build with a variety of models to scrutinize data, reduced large data into a form in which they can be analyzed by decision makers. A decision support

system is also seen as a highly flexible and interactive IT system that is designed to support decision making when the problem is not structured. The aim of every DSS is to provide effective support and assistance which is a complement to the user's knowledge (Haag, Cummings & McCubbrey, 2002). A good decision support system is developed based on the manager's requirements and needs. The manager analyzes the data gotten from the needs and requirements and documents the findings from which a business model is built from. Areas of flaws are also recognized and necessary actions are taken to eliminate such errors (Sweta, Jitendran & Bhawana, 2012).

Performance appraisal system is a formal interaction that exists between an employee and the supervisor or management conducted periodically to identify the areas of strength and weakness of the said employee. Performance appraisal involved the whole personnel within an organization. It identifies and map out job duties of everyone involved in the appraisal process. The result of the appraisal process is then submitted to the managers for the purpose of decision making (Mohman, Resnick-West & Lawler, 2012). Basically, performance appraisal is a systematic method used in identifying and determining employee's performance within a given organization. Decisions are taken concerning

an employee on weekly, monthly, quarterly or half year bases. Therefore the system is expected to be impartial, transparent, fair and just. Performance appraisal targets are to identify the existing skills' status of work output. A standard employee appraisal system is made up of raw data collection from which information is extracted from and transformed into an authentic value in form of number known as performance rating (Shaout & Yousif, 2014). The appraisal rating of an employee depends on his or her contributions to the success of the organization. It is important that we have a correct and impartial appraisal evaluation system so that employees' input in achieving organization's objectives can be accurately measured. Knowledge in a specialized field of work and skills applied to reach a set target; goal and objective are the most common attributes and characteristics used by the employers to decide and measure the performance level an employee (Shaout & Yousif, 2014).

Performance appraisal has been practiced by many organizations in the time past. It is therefore perceived that performance evaluation or appraisal is part of organization's life (Islam & Rasad, 2006). According to Longenecker & Fink (1999), formal appraisal are carried out in order to justify the several human resource decisions which in one way or the other affect the employee which include promotion, demotion, termination, pay rise and the determination of training needs of an employee. They, Longenecker & Fink (1999), further state that employee performance evaluation is one of the tools deployed by organization for competitive advantage. Nevertheless, precautions should be taken when implementing the evaluation system. Low morale, decreased in production, less passion and support of organization will be the results Of an evaluation system that are wrongly implemented (Sumerick,1999).

1. Research Questions
RQ(i): What are the requirements (criteria) for appraising the academic staff performance in KIU?
RQ(ii): How can the AHP model be used in appraising academic staff performance in KIU?
RQ(iii): how can the AHP model be developed for making reliable decision based on employee performance?
RQ(iv): What is the consistency ratio in the criteria and sub criteria used in performance appraisal in KIU?

2. Methods of Performance Appraisal
There are several methods used in carrying out performance appraisal. They can be formal or informal.

1. Informal Appraisal Method
In this type of method, the evaluation of an employee is done without a formal structure, such assessment depends on factors such as (i) capability to get along with his/her boss, (ii) employee's response under pressure (iii) his/her appearance (iv) degree of organization (v) level of thoughtfulness and curiosity.
2. Formal Appraisal Method
Employees are evaluated based on specific criteria either qualitatively or quantitatively. Examples of formal evaluation techniques include graphic rating scale, behavioral anchored rating scale (BARS),

behavior observation scale (Murphy & Cleveland, 1991) an example is analytical hierarchy process (AHP).

3. Analytical Hierarchy Process (AHP) Model
Analytical hierarchy process is one of the multi-criteria decision making (MCDM) method. AHP is a quantitative technique used for ranking decision alternatives using multiple criteria. The alternative criteria are structured into hierarchy using the AHP to resolve complicated decisions (Russell, Roberta & Taylor, 2003; Fashoto, Uzoka & Okpokpo, 2016). AHP provide the arrangement of factors in a descending order from global goal through criteria and to sub-criteria in those excessive levels (Saaty, 1988). AHP is a model developed by Thomas Saaty in the 1970s as a method for asset and resource assignment and decision making at Wharton school of business and a counsel with the arms and control disarmament agency. The model consists of four major operations which include;

i. Decision problem structure (hierarchy construction)
ii. Making pair-wise comparison and obtaining judgment matrix.
iii. Computing local weight and consistency of the comparisons.
iv. Aggregation of local weight.

The top level of an AHP is the overall objective, the second level is the factors that contribute to the objective and the third level is criteria to be access against the criteria in the second level (Sweta, Jitendran & Bhawana, 2012).

AHP offers the criteria, sub-criteria and the employees to be evaluated as shown in Figure 2.

Employees assume that if they complete their work on time then that is enough. In addition to work completion on time, the employees should also care about proper utilization of resources, helping others, team work, familiarity with organization objectives. The employees are informed about these criteria before the appraisal exercise.

The scale of priorities is composed of the interval from 1 to 9 as shown in Table 1 (Saaty, 2002) that consistency is capacity through a determine number of data is to logically deduce the others. When an element is compared to itself, it is given the value 1 showing that it deals with the same degree of preference (Saaty 1977, 1990). The consistency is expressed by the consistency index (CI) which is the result of the subtraction of the maximum eigen-value (λmas) by the number of elements considered in the matrix (n) and divided by the subtraction of n minus one.
Which is

$$CI = \frac{(\lambda_{max} - n)}{(n-1)} \qquad (1)$$

Consistency ratio (CR) is calculated by dividing the consistency index (CI) for the set of judgments by the index for the corresponding random matrix in equation 1. Saaty suggest that if that ratio exceeds 0.1 the set of judgments may be too inconsistent to be reliable. In practice, CRs of more than 0.1 sometimes have to be accepted. A Consistency Ratio of 0 means that the judgment is perfectly consistent. (Geoff, 2004).

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TABLE I
SAATY SCALE OF PRIORITIES IN AHP

Intensity Dominance	Variable definition
1	equal (importance)
2	weak or slight dominance
3	moderate dominance
4	moderate plus
5	strong dominance
6	strong plus
7	very strong or demonstrated
8	dominance
9	very very strong
	extreme dominance
Comments	
2, 4, 6, 8	For compromise between the above
1.1– 1.9	values
$^1/_2$ – $^1/_9$	for tied activities
	reciprocal of the above

II. RELATED WORKS ON EMPLOYEE PERFORMANCE APPRAISAL

Islam & Rasad,2006 use AHP to determine the performance of 25 employees at Inter System Maintenance Service (ISMS) in Kuala Lumpur, Malaysia the following criteria were used to measure their performance; quality / quantity of work, planning / organizing, initiative / commitment, teamwork / cooperation, communication and external factors. Though there could have been other factors and criteria that could have been considered in the exercise such as age, position, qualifications and experience which were not used.

Luiz and Renata 2012, considered competence as the benchmark of their study. They went further to classify competence in the following other: behavioral skills and technical/scientific skills. In this work, though successful, the issue of scientific skill could have been handled with care since not all the employees possesses this skill due to their background. This make others without such skills feel that the system is been bias which at the end lead to low enthusiasm, low production and low commitment on the part of the employee.

This study considered service, research, teaching and other factor to make decisions on the performances of the academic staff. Though beyond the four criteria used, there are other criteria that could have been added to be able to accommodate other academic staff that is at the lower cadre that may not require research as criteria to measure their performances. With the review of these papers, this research has justify all the point raised in other to make sure that all the academic staff of Kampala International University (KIU) are equally evaluated at their level of assignment.

III. METHODOLOGY

3.1 Data Collection

The primary method of data collection was adopted in getting data from the respondents. The questionnaire method was used to get the data. The use of self-administered questionnaires by the researcher was given to the respondents which give the respondent the opportunity to be anonymous in nature. The respondents were selected from KIU and it was randomly selected across all the colleges. The questionnaire was designed to determine how important a criterion is when comparing it with other criterion in the assessment of an academic staff performance.

The purpose of this research was made known to all the respondents and they were notified that participation is voluntary, the findings are purely for academic purposes and that the issue of their identities will remain private.

3.2 The Existing System

The existing system for performance evaluation appraisal system at KIU has been in existence since the inception of the institution in 2001. The management makes use of five factors as the major criteria for evaluating an employee performance such as personal skill (self-control, efficiency communication, focus, attitude, team working and initiative); initiatives (technical skill, practical experience, handling of tools, technical background in the field, compatibility, and work output); teaching quality; method of teaching and research. The appraisal is done manually and the staffs do not know the outcome of the appraisal. Therefore the five factors (personal skills, initiatives, teaching quality, method of teaching and research) were considered in this study and a computerized approach will be adopted for employee performance appraisal in KIU.

In figure 2 the employees are the alternatives which are the different academic staff to be evaluated in other to be rewarded.

3.3 Analysis of Research Question

Which of the criteria is more important over the other in terms of academic performance? Please rate your response based on the scale in Table 1.

Table 2 showed the pairwise comparison of data captured from the respondents on the five criteria.

IV. DEVELOPMENT TOOLS

The data collected from the respondents was captured, coded, presented and analyzed by the use of the Analytical Hierarchy Process (AHP) model. The model was used because it provides better, precise and concise explanation of the data collected. The AHP compares two or more decisions criteria at once. Java programming language was used for the implementation. The development was based on the use of AHP model.

The first step is to get the column sum which is represented by $\sum C_{ij}$ for each column in the pair-wise comparison table, which is, adding each value in the row   in Table 2 to get produced Table 3.
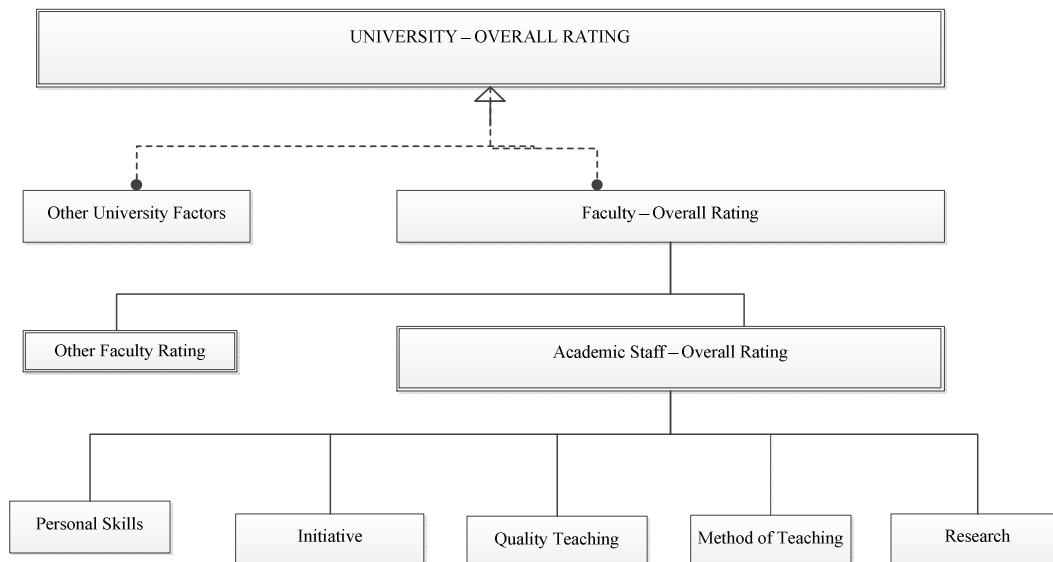
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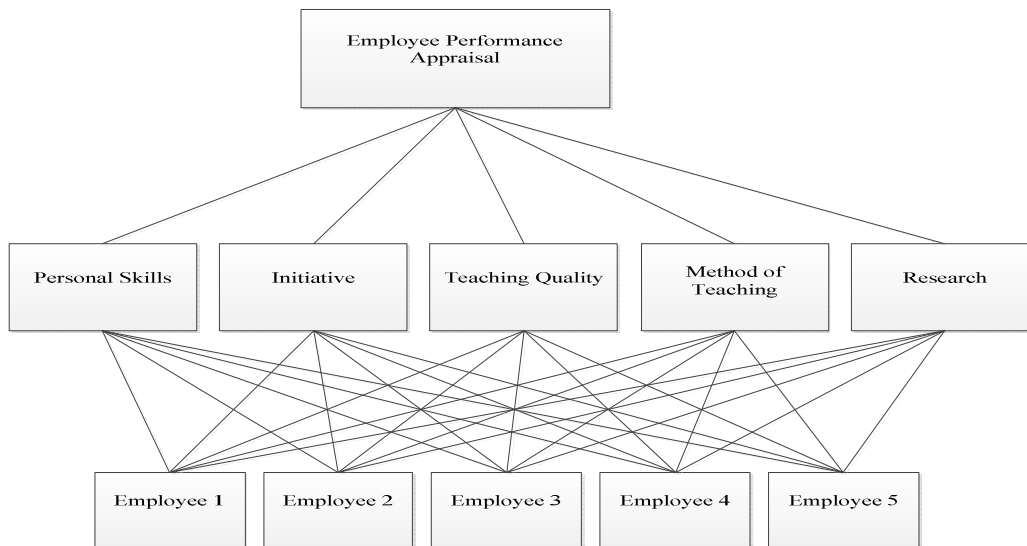Fig 1. Structure for the performance evaluation (PE) of KIU Academic staff.

Fig. 2. Conceptual Frame Work of the Hierarchy

TABLE III

PAIR WISE COMPARISON WITH FRACTION

	Personal Skills	Initiatives	Teaching Quality	Methods Of Teaching	Research
Personal Skills	1	1/3	1/3	1/7	1/7
Initiatives	3	1	1/5	1/7	1/5
Teaching quality	3	5	1	1/3	1/3
Methods of teaching	7	7	3	1	1/3
Research	7	5	3	3	1

TABLE IIIII

CALCULATIONS OF THE COLUM SUM

	Personal Skills	Initiatives	Teaching Quality	Methods Of Teaching	Research
Personal Skills	1.0	0.33333	0.33333	0.14286	0.14286
Initiatives	3.0	1.0	0.2	0.14286	0.2
Teaching quality	3.0	5.0	1.0	0.33333	0.33333
Methods of teaching	7.0	7.0	3.0	1.0	0.33333
Research	7.0	5.0	3.0	3.0	1.0
Sum	21.0	18.33333	7.53333	4.61905	2.00952

Standardize each cell by $X_{ij} = C_{ij}/(\sum C_{ij})$ and get the sum of each row which is represented by $R_i = \sum X_{ij}$ and calculate the weight (W) in Table 4

TABLE IVV
CALCULATIONS OF THE STANDARDIZED MATRIX

	Personal Skills	Initiatives	Teaching Quality	Methods of Teaching	Research
Personal Skills	0.04761904762	0.01818163966	0.44247364711	0.030928437 66	0.0710916 0396
Initiatives	0.14285714285	0.54545464462	0.02654868431	0.030928437 66	0.9952625 5026
Teaching Quality	0.14285714285	0.27272732156	0.13274342156	0.72164189 606	0.1658754 3293
Methods of Teaching	0.33333333333	0.38181825123	0.39823026470 3	0.21649473 376	0.1658754 3293
Research	0.33333333333	0.27272732231	0.39823026470 3	0.64948420 129	0.4976312 7513

The sum of each row which is represented by $R_i = \sum X_{ij}$ is calculated in Table 5

TABLE V
CALCULATIONS OF THE ROW SUM

	Personal Skills	Initiatives	Teaching Quality	Methods Of Teaching	Research	Sum
Personal Skills	0.04761904762	0.0181816 3966	0.44247384711	0.03092843766	0.071091 60396	0.21206809363
Initiatives	0.14285714285	0.5454545 4644	0.02654868431	0.03092843766	0.099526 25502	0.35440598432
Teaching quality	0.14285714285	0.2727272 7322	0.13274342156	0.07216418960	0.165875 43293	0.78636750928
Methods of teaching	0.33333333333	0.3818182 5123	0.39823026470	0.21649473376	0.165875 43293	1.49575201598
Research	0.33333333333	0.2727273 2231	0398230264703	0.64976312751	0.497631 27513	2.15140639677

Calculation of the weights (W) of the standardized matrix is presented in Table 6

TABLE VI
CALCULATIONS OF THE WEIGHT

	Personal Skills	Initiatives	Teaching Quality	Methods Of Teaching	Research	W
Personal Skills	0.047619	0.0181816	0.4424738	0.0309284	0.0710916	0.0424136
Initiatives	0.1428571	0.5454545	0.0265487	0.0309284	0.0995263	0.0708812
Teaching quality	0.1428571	0.2727273	0.1327434	0.0721642	0.1658754	0.5172735
Methods of teaching	0.3333333	0.3818183	0.3982303	0.2164947	0.1658754	0.2991504
Research	0.3333333	0.2727273	3.982E+11	0.6497631	0.4976313	0.4302813

Calculation of the Eigen vector or priority vector by $WI = RI/n$, n= number of criteria is presented in Table 7

TABLE VII
CALCULATIONS OF THE P. VECTOR

	Personal Skills	Initiatives	Teaching Quality	Methods Of Teaching	Research	W	P.Vector
Personal Skills	1	0.333333	0.33333	0.14286	0.14286	0.0424136	0.222671
Initiatives	3	1	0.2	0.14286	0.2	0.0708812	0.3583696
Teaching Quality	3	5	1	0.33333	0.33333	0.1572735	0.8820618
Methods of Teaching	7	7	3	1	0.33333	0.2991504	1.7074603
Research	7	5	3	3	1	0.4302813	2.4508543
Sum	21	18.33333	7.53333	4.61905	2.00952	1	5.6214171

Table 7 shows the calculated priority vector.
Calculate the principle Eigen value by
$V_i = AW_i$ for i = 1, 2, 3, …, n
$\lambda = V_i/W_i$ and calculate λ_{max} by averaging the λ_i's in the Table 8

TABLE VIII
CALCULATIONS OF THE LAMDA AND LAMDA MAX (EIGEN VALUE)

	Personal Skills	Initiatives	Teaching Quality	Methods Of Teaching	Research	Lamda	Lamda Max
Personal Skills	1	0.33333	0.33333	0.14286	0.14286	5.2499891	5.4636
Initiatives	3	1	0.2	0.14286	0.2	5.0559196	
Teaching Quality	3	5	1	0.33333	0.33333	5.6084578	
Methods of Teaching	7	7	3	1	0.33333	5.7076984	
Research	7	5	3	3	1	5.6959353	
SUM	21	18.33333	7.53333	4.61905	2.00952		

Calculate the Consistency Index (CI) and the Consistency Ration (CR)

$$CI = \frac{\lambda max - n}{n - 1} \quad \text{and} \quad CR = \frac{CI}{RI}$$

C.1 = 0.115900010688
C.R = 0.097558931555

V. CONCLUSION

After careful analysis of the questionnaire we draw conclusions from table 6 that research has more weight with 43% when compare with other criteria in appraising the performance of an academic staff in KIU. It is followed by method of teaching (30%), teaching quality (16%), initiatives (7%) and personal skills (4%) in that order. This

showed that research is a major criteria and important factor used in determining the level of performance of an academic staff.

Also with respect to consistency ratio (C.R) of the criteria understudy and the alternatives, we come to conclude that there is consistency in all the criteria in appraising the performance of an academic staff in KIU except research which has not been a major emphasis among the staff. Therefore, it shows that personal skills, initiatives, teaching quality and method of teaching are consistent and valid factors while appraising an academic staff in KIU and it also showed that research is not consistent in appraising an academic staff in KIU despite the weight attached to it.

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