Faculty Performance Evaluation using Analytic Hierarchy Process

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Abstract

In the long run, an organization will only perform excellently when it succeeds in balancing the all needs of its stakeholders. Long term success requires customer satisfaction and loyalty, which, in turn, is based on fulfilling the needs of the employees. By implementing a regular self-assessment module, an organization can establish a permanent learning cycle. Therefore, there is an ardent need to evaluate the performance of the faculty members of an educational institution, which will systematically determine the strengths and areas for improvement, deduce and prioritize definite measures, and build up continuous development and improvement strategies. In this paper, analytic hierarchy process (AHP) technique is employed to evaluate the performance of the faculty members of an engineering department in an Indian university of high repute. Different criteria affecting the performance evaluation of the faculty members are considered and it is observed that the 'Teaching methodology' criterion has the maximum impact on this evaluation process with the highest priority value. Based on these criteria, the performance of fourteen faculty members are evaluated and subsequently ranked.

Key Words : *Performance evaluation, Faculty member, Analytic hierarchy process, Criteria, Priority value.*

1. Introduction:

To cope with the new challenges faced by the technical education sector, a systematic and preventive approach is required to be developed where the concepts of quality management comes into play. The productivity of an educational institution is difficult to assess and measure. Indeed, the faculty members and even the administrators are uncomfortable with the terms, such as 'value-added', 'customers', 'processes' and 'productivity' [1] etc. The output or products of a technical university/institution are the educated students. But, apart from teaching, it is more important that faculty members must engage themselves in research and professional services under contract. They contribute to the state-of-the-art in their respective fields through scholarly research. In some cases, they also contribute to economic development or provide services to the community. In the present day educational scenario, public spending on research and education is constantly constrained and students are becoming more and more conscious on their role as customers.

In the long run, survival and performance of an organization mainly depends on balancing the needs of all its stakeholders. Long term success in the education sector therefore requires a permanent striving for excellence

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regarding the content and didactics of courses as well as administrative issues. In this context, self-assessment can be considered as a powerful tool for controlling an organization's continuous improvement process and thus, the focus shifts from mere product to corporate quality, summarized in the vision of excellence.

By implementing a regular self-assessment process, an organization can establish a permanent learning cycle [2]. Therefore, a systematic approach is needed to evaluate the performance of the faculty members in an educational institution, which will systematically highlight the strengths and areas for improvement, deduce and prioritize definite measures and provide a continuous development and improvement process. While evaluating the performance of the faculty members, the evaluators should be concerned about the attitudes, behaviors, methodologies and pedagogies of various faculties and not just what is taught. Since the faculty performance evaluation is judgmentally based, it varies depending on an evaluator's conception of teaching. In the conventional system of performance evaluation, evaluator's competencies probably the most controversial aspect, since the administrators, whose background may be in widely different fields, are forced to rely on simplistic measures, such as checklists, databank etc. Controversy also arises about the extent to which an observer's account is an adequate match for what usually occurs during evaluation in a classroom, especially when, the teachers and students take on 'artificial roles that they believe to be appropriate to the occasion'.

While evaluating the performance of the faculty members in an educational institution, it is often being specifically talked about various models of performance evaluation. Many of these models can be found in different well known areas of personnel evaluation. These models are based on either the tape of criteria that are regarded as most important (criterion model) or some method of determining the value of the relevant criteria for a particular case (method model). The most interesting state-of-the-art criterion model for teaching faculty evaluation, called as 'Research-Based Teacher Evaluation'(RBTE) method, is found to be completely invalid for logical, scientific and ethical reasons and hence, incurs all the penalties of the conventional evaluation system [3]. 'Consumer rating' method is widely used to take the opinions from one or more groups of consumers, usually students but sometimes also from the parents or employers. So this method is judgment based. With the judges being the direct consumers instead of supervisors or peers as with other types of models.

As the faculty performance evaluation problem involves different criteria with conflicting objectives, a multi-criteria decision-making (MCDM) tool is required to be employed to solve these types of problems. Analytic hierarchy process (AHP) technique is a very powerful MCDM tool, which has wide applications in various fields of decision-making problems. In this paper, analytic hierarchy process is used to solve the faculty performance evaluation problem in an engineering department of a reputed Indian university.

2. Analytic Hierarchy Process:

Saaty [4] developed the analytic hierarchy process (AHP) technique, which enables the decision maker to represent the interactions between multiple criteria in complex situations. This method requires the decision maker to develop a hierarchical structure for the criteria, which are explicit in the given problem, provide judgments about the relative importance of each of these criteria and specify a preference value for each decision alternative with respect to each considered criteria [5]. It provides a prioritized ranking order indicating the overall preference for each of the decision alternatives. An advantage of AHP over other multi-criteria decision-making methods is that the AHP can be designed to incorporate tangible as well as intangible factors specially where the subjective judgments of different individuals constitute an important part of the decision-making process.

The procedural steps of the analytic hierarchy process using the radical root method is illustrated as below:

Step1 : Determine the overall goal or objective and the relevant criteria and sub-criteria associated with the given problem. Develop a hierarchical structure with the goal/objective at the top level, criteria at the second level, sub-criteria, if any, at the third level and alternatives at the lowest of the hierarchy.

Step 2 : Find out the relative importance of different criteria and sub-criteria with respect to the goal of objective. The steps are as follows:

a) Construct a pair-wise comparison matrix using a scale of relative importance. The judgments are entered using the fundamental scale of the AHP [6]. Assuming 'n' criteria to be compared, the pair-wise comparison of criterion i with respect to criterion j yields an element a_{ij} in the square matriax $A1_{nxn}$. In the pair-wise comparison matrix, a_{ij}= 1and a_{ji}= 1/ a_{ij}.

b) Find the relative normalized weight (wi) for each criterion by calculating the geometric mean of rows in the comparison matrix.

$$GM_i = \left(\prod_{j=1}^{n} a_{ij} \right)^{1/n}$$

$$W1 = \frac{GM_i}{\sum_{i=1}^{\eta} GMI}$$

And

c) Construct matrix A3 and A4 such that A3 = A1 x A2 and A4 + A3/A2 where, A2 = $[W_1, W_2, \ldots, W_i, \ldots, W_n]^T$.

d) Find the maximum eigen value, λmax, which is the average of matrix A4.

e) Calculate the consistency index, CI = (λmax – n)/(n – 1). Smaller the value of CI, the smaller is the deviation from the consistency.

f) Obtain the random index (RI) value for the given number of criteria as used in the decision-making process.

g) Compute the consistency ratio value, CR = CI/RI. Usually, a CR value of 0.10 or less is considered to be acceptable as it reflects a consistent judgment that can only be attributed to the knowledge of the decision maker about the problem under study [7].

Step 3 : The next step is to pair-wise compare the alternatives with respect to how much better the alternatives are in satisfying each of the considered criteria. For m number of alternatives, there will be n number of m x m square matrices of judgments as there are n criteria in the given problem. The judgments are entered using Saaty's 1-9 scale of the AHP.

Step 4 : The last step is to obtain the composite weights for the alternatives by multiplying the relative normalized weight (W_i) of each criterion with the corresponding normalized weightage value for each alternative and making summation over all the criteria for each alternative.

3. Selection of Different Criteria for Faculty Performance Evaluation:

As the analytic hierarchy process (AHP) is observed to be a simple multi-criteria decision-making tool useful for solving various complex real life problems,an attempt is made to employ this technique for some educational problems, i.e. to judge and evaluate the performance of various faculty members in an engineering department of a reputed Indian university. At first, all the departmental students are asked about their requirements to direct the evaluation process. Their requirements are then categorically analyzed and grouped together to form a set of six most predominant criteria, as detailed below.

a) Teaching methodology (TM): This criterion is associated with the process of teaching a particular engineering/technological subject and encompasses factors like understandability, analytical/theoretical coverage, explaining ability, timely completion of syllabus, regularity in classes etc. of the respective faculty member.

b) Personal traits (PT): It includes characteristics such as personality, intelligence, communication skill, leadership, industrial/institutional contacts, responsibility, impartiality, innovative and motivation power etc. of the concerned faculty member.

c) Student-teacher relationship (SR): It deals with the approachability and co-operative relationship of the respective faculty member with the fellow students.

d) Evaluation methodology (EM): It mainly concerns with the type and pattern of questions set by the concerned faculty member and coverage of the completed syllabus. The impartiality of the faculty regarding evaluation of the answer-scripts and timely submission of marks are also considered under this criterion.

e) Theoretical/practical knowledge (KN): This criterion is basically associated with the depth of theoretical/practical knowledge that the concerned faculty member has.

f) Project/Research/Guidance (PRG): It considers the number of Post Graduate and Doctoral these guided by the respective faculty member and also includes the number of successfully completed industrial projects. It takes into consideration the number of research papers published by the faculty member in renowned national/international journals.

The hierarchical structure developed for evaluating the performance of the faculty members in an engineering department is shown in Figure 1. The top level of the hierarchy represent the overall goal or objective of performance evaluation. The second level consists of all the relevant criteria short-listed for the evaluation process and the lowest level lists fourteen faculty members as considered from the department.

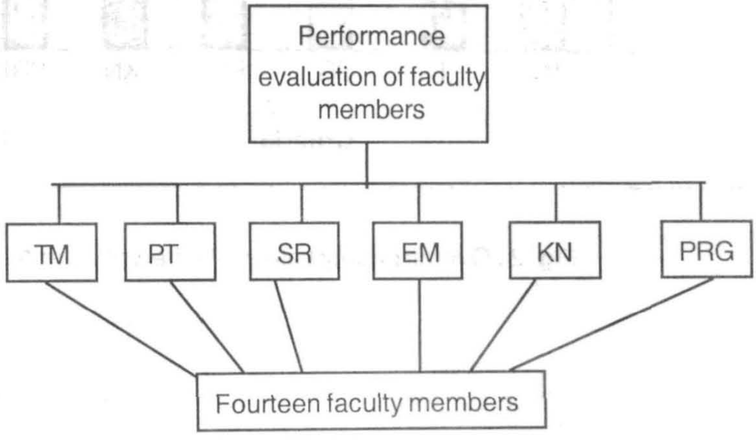

Fig.1: Hierarchy for faculty performance evaluation

The students of the concerned department are individually asked to pair-wise compare the six important criteria based on Saaty's fundamental scale of relative measurement and their decisions are then assembled together and analyzed. The radical root method of AHP is now used to determine the priority values of different criteria based on the decisions of the students and Table 1 exhibits a pair-wise comparison matrix arising out of the decision from one specific student. As it is a case of group decision-making, the overall priority values of different criteria are evaluated by aggregating the decisions of all the concerned students, as shown in Figure 2.

Table 1: One pair-wise comparison matrix for computing criteria priority values

Criteria	TM	PT	SR	EM	KN	PRG	Priority value
TM	1	2	1	3	1	4	0.2410
PT	1/2	1	1/2	2	1/2	3	0.1385
SR	1	2	1	3	1	4	0.2410
EM	1/3	1/2	1/3	1	2	3	0.1389
KN	1	2	1	1/2	1	5	0.1944
PRG	1/4	1/3	1/4	1/3	1/5	1	0.0462

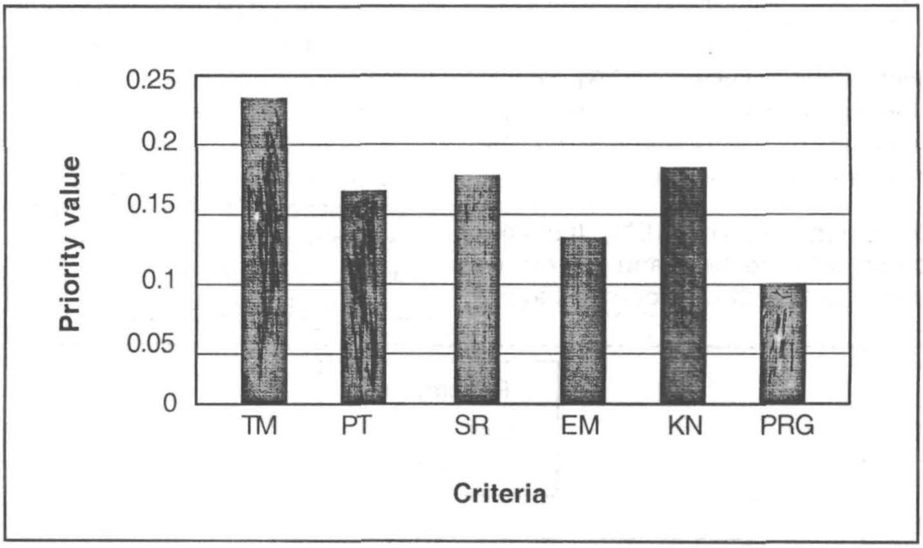

Fig. 2 : Overall priority values of different criteria

4. Faculty Performance Evaluation:

In order to determine the performance values of the considered faculty members, each of the departmental students are again asked to pair-wise compare the teaching capabilities of the alternative faculties with respect to different relevant criteria. These performance values as estimated by the individual students are then aggregated. Based on the aggregated performance values of the faculty members with respect to different criteria, the overall Score/ performance value for each of the alternative faculty is now calculated. For this, each element of the overall criteria priority vector is multiplied by the corresponding element of the performance vector for the faculty members and the results of these multiplication are added up to give the overall score of each alternative faculty. Table 2 exhibits the computation of the overall scores for the fourteen faculties and Figure 3 shows the relative position of those faculties when their performance are evaluated and judged using the AHP technique.

Criteria	TM	PT	SR	EM	KN	PRG	Overall score
Weightage	0.2356	0.1712	0.1808	0.1298	0.1839	0.0987	
Alternative							
A	0.1530	0.1453	0.1367	0.1075	0.1570	0.1325	0.1415
B	0.0582	0.1014	0.0977	0.0499	0.1127	0.1086	0.0867
C	0.0377	0.0364	0.0643	0.0503	0.0290	0.0377	0.0423
D	0.0879	0.1145	0.0980	0.0809	0.0927	0.1527	0.1007
E	0.0685	0.0727	0.0619	0.0768	0.0707	0.0588	0.0685
F	0.0253	0.0536	0.0283	0.0225	0.0279	0.0312	0.0314
G	0.0736	0.0487	0.0679	0.0786	0.0791	0.0446	0.0671
H	0.0905	0.0642	0.0605	0.0967	0.1012	0.0496	0.0793
I	0.0721	0.0764	0.0473	0.0691	0.0665	0.0749	0.0672
J	0.0730	0.0904	0.0770	0.0864	0.0623	0.1018	0.0793
K	0.0737	0.0575	0.0972	0.0917	0.0609	0.0909	0.0769
L	0.0194	0.0256	0.0581	0.0464	0.0161	0.0206	0.0305
M	0.1462	0.0930	0.0830	0.1157	0.1095	0.0773	0.1081
N	0.0210	0.0201	0.0220	0.0275	0.0144	0.0188	0.0204

Table 2: Computation of the overall scores

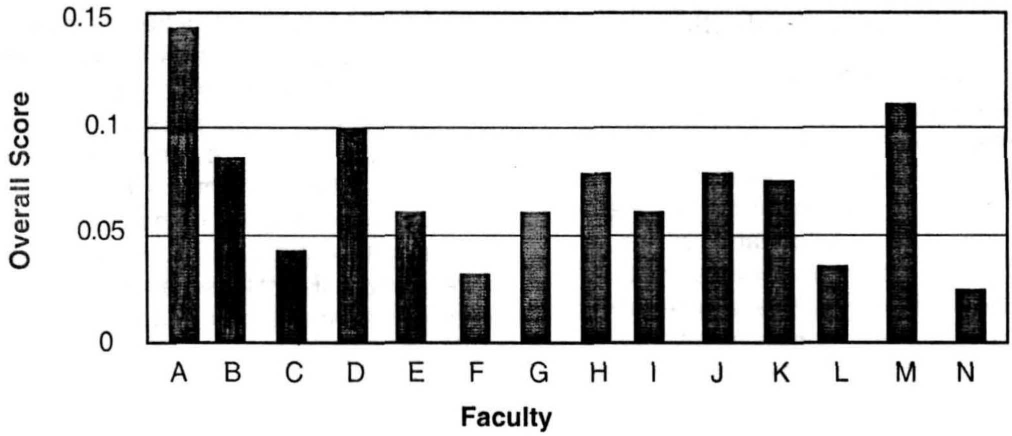

Fig. 3: Relative position of the faculty members

It is observed that the faculty member A dominates all his colleagues with respect to teaching capability as he has the highest overall score value of 0.1415. It is also found that the overall ranking of the fourteen faculty members is more or less same as that of the present ranking verbally done by the students of the concerned department.

Conclusions:

This paper indicates that the proposed AHP-based methodology provides a practical quantitative decision-making and planning tool for solving a real life faculty performance evaluation problem and will systematically highlight the strengths and areas for refinement, implement and prioritize suitable measures, and help in building up continuous development and improvement process. Progress will be systematically monitored as a reassessment, leading to further improvement activities. Thus, self-assessment can be identified as a powerful tool to direct towards organizational excellence.

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