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A conceptual framework of faculty performance evaluation

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ABSTRACT

Every organization is having an objective towards optimum performance and the employees are the key in achieving that. It is necessary that the employees' performance should reach optimality for the success of the organization. Many organizations are having performance appraisal system to evaluate the effectiveness and efficiency of their employees using linguistic labels to their performance. In a production unit, employee performance is proportional to the quality and quantity of production, where as, in case of an Educational Institute, there is no such direct tool available to evaluate the productivity of its faculty members. In judging efficiency of a faculty member, often the institutes deal with vague or imprecise data resulting to an inconsistent performance evaluation. In this paper an attempt has been made to design a performance appraisal system in generating performance score of the faculty member involving non-fuzzy inputs and fuzzy criteria weights. This study attempts to show how crisp scores multiplied by fuzzy criteria weights can effectively generate performance score in faculty performance evaluation.

Key words: Performance appraisal, Educational Institute, Fuzzy pair-wise comparison,

1. Introduction

The beginning of formal Technical Education in India can be dated back to the mid 19th Century. All India Council for Technical Education (AICTE) was set-up to conduct survey on the facilities on technical education and to promote development in the country in a coordinated and integrated manner. And to ensure the same, as stipulated in, the National Policy of Education (1986), AICTE be vested with statutory authority for planning, formulation and maintenance of norms and standards, quality assurance through accreditation, funding in priority areas, monitoring and evaluation, maintaining parity of certification and awards and ensuring coordinated and integrated development and management of technical education in the country.The economic progress of a country is strongly linked with Quality Education with values for all. It is therefore, necessary for any technical education to undertake periodic review of the curriculum and subject content of the technical programmes to ensure that they are up to date not outmoded or obsolete and effectively fulfill the technological requirements of the country. The Vision of AICTE is "To be a world class organization leading to technological and socioeconomic development of the Country by enhancing the global competitiveness of technical

manpower and by ensuring high quality technical education to all sections of the society." And one of its most important objectives is 'Promotion of Quality in Technical Education'. The quality of an educational institute largely depends upon the performance of the faculties therein. With the supporting environment and conducive infrastructural facilities the quality of teaching learning process is the most important criteria for judging the products of an institute. In a manufacturing process the quality of the output is the prime indicator to judge the performance of the human resources involved in the process of manufacturing. But here in an academic institution the quality of output varied in a great extent. From the same class room one product (student) may emerge as a university topper where the other may not succeed even to get the degree. How this varied quality of output can be the judgmental parameter to determine the performance of the faculty? A good number of institutions use to follow the opinion survey method to rate the performance of the faculty. But the rating process mostly are of either biased or of qualitative in nature. The same matter has also been identified by New Zealand government to recognize appropriate appraiser with a defined objective in appraising a faculty. As a basis for the "quality assurance" component of appraisal, all faculty members must have a written statement of performance expectations that describes the key tasks and outcomes of the position (Tae-heon Moon et.al, 1999). There are a plethora of literatures available on performance appraisal. Armstrong and Baron defined it as a "strategic and integrated approach to increasing the effectiveness of organizations by improving the performance of the people who work in them and by developing the capabilities of teams and individual contributors". In Saba Performance Suite, it is expressed that in an era where technological and market differentiators come and go rapidly, success means tapping into your most sustainable competitive advantage: your employees. Today's transformational companies are not just automating paper-based processes to meet compliance requirements; they are changing the game with high levels of talent visibility and top talent that is mobilized and prepared to tackle the most critical growth initiatives. Gaining the right insight into your workforce is a foundational requirement for any people performance initiative. Henry Ford used scientific management as the foundation of his engineered, moving assembly line and created the next phase in performance management a phase that has dominated most of the twentieth century. Rao shared his experience as 'when I look back from my experiences of the last thirty five years with performance appraisal systems in India and across the world, I realize that we are still struggling with the implementation of appraisal systems. Many an organization uses "numbers" or scores to assess performance. Such a system reduces an entire year's work to a mere figure. This figure has caused a few people to get promoted and some of them undeservingly, a few others to leave their jobs and yet a few others to walk into office every day with low interest and motivation and carry on with their jobs. Also, no two numbers are comparable in appraisals. Expectation sharing and reviewing is the most important part of performance management' (Mehdi, 2008). Various techniques or methods have been used by human resource management experts to evaluate the performance of an employee. As outlined by Vicky, some of the appraisal methods include ranking; trait scales; critical incident; narrative; and criteria-based (Rajkumar Ohdar, 2004). Terrence and H. M. and Joyce mentioned few other methods including management-by-objectives (MBO), work planning and review, 360^{o} appraisal and peer review (Pan, 2008). Rajkumar Ohdar and Pradip Kumar Ray used an evolutionary fuzzy-based approach in the performance measurement and evaluation of suppliers in supply chain management(Saba.com, 2011). C C Yee and Y Y Chen stated that with all the available techniques, it is essential to understand that different organization might use different technique in assessing staff performance among which fuzzy set theory would be a

good concept to use in the development of the performance appraisal system (C.C.Yee, 2009). This is because fuzzy set theory allows the performance appraisal system to be developed by using some fuzzy variables and relationship. Form the literature it is understood that although there are a plenty of works available in measuring performance of employees but exists a scarcity in measuring performance of faculty members in an academic institution using fuzzy evaluation. In this paper an attempt has been made to use fuzzy linguistic variables in assessing performance criteria weights together with crisp scores generated by the performance of the individual faculty in different dimensions.

2. Objective

1. The objective of this piece of work is
2. To identify the criteria in measuring faculty performance in a Business school
3. To model the performance evaluation using crisp scores related to the individual performance of a faculty and fuzzy criteria weights in assessing performance in different dimension.
4. To illustrate the results using a software

3. Methodology

3.1 Locale of the study

The study had been conducted taking the Management Institutes and Business schools of the state of West Bengal.

3.2 Respondents' selection

The Experts (Faculty members) having more than 15 years of work experience (in the related field) and with an expert knowledge over all the areas (in the Institute) were selected for obtaining the necessary information. A number of thirty experts participated in the interview sessions for pair-wise comparisons. However, Okoli and Pawlowski believed that 10-18 could be an ideal number of experts in such a process (Ministry of Education, New Zealand, 2011).

3.3 Tool and techniques for the study

The entire process of data collection and processing there after is done using Microsoft Visual Basic as the front-end tool and Oracle as back end. In the first phase, questionnaires are developed to generate criteria weights. At first three questions are used to compare the major criteria of performance evaluation. The second set of 42 questions comparing different sub-criteria of faculty performance are used as the tool for data collection. Personal interviews are conducted for obtaining relevant information from those experts who are willing to participate in the interview sessions. The identified criteria and sub criteria of the study are as described in Table 1.

Table 1: Criteria and sub-criteria of evaluation

Main Criteria	Sub Criteria
Teaching	Lecture plan and follow up, Class test per semester, Use of Advance teaching methods, Class discipline, Result of Students, Use of Advanced teaching Tools
Research & Development	Publication, Seminar presentation, Workshop/MDP Conducted, Workshop/MDP attended, Project guidance, Sponsored programme, Research guidance
Service/ behavior	Attendance, Punctuality, Involvement in extra and co-curricular activity, Obeying administration

In the second phase, expert's opinions are taken to generate crisp performance scores. Experts are requested to give scores for different performances in the area of teaching, research and others. For example, a paper published in international referred journal will carry what score in the scale of 10, has to be identified by the expert. Delphi method has been implemented for developing consensus among the expert opinions in the identification of various scores corresponding to different sub criteria used in the study. The details of crisp scores obtained through this phase are demonstrated in Table 2.

Table 2: Crisp performance scores

		max	normal	min
Teaching	Lecture plan and follow up	10	5	0
	Class test per semester	6	3	0
	Use of Adv teaching methods	5	3	0
	Class discipline	5	3	0
	Result of Students	4	2	0
	Use of Adv teaching Tools	4	2	0
Research & Development	Publication			
	NATIONAL	20	5 per pub	0
	INTERNATIONAL	30	10 per pub	0
	Seminar presentation			
	NATIONAL			
	SINGLE AUTHOR	9	3 per insert	0
	JOINT PAPER	6	2 per insert	0
	INTERNATIONAL			
	SINGLE AUTHOR	15	5 per insert	0
	JOINT PAPER	12	4 per insert	0
	Workshop/MDP Conducted	40(15 days or +) 20(15 days +)	20(7 days or +)	2 per day
	Workshop/MDP attended	10	10(7 days +)	1 per day
	Project guidance			
	Sponsored programme as Principal Investigator	30	5	0
	Sponsored programme as Co Investigator			
	Research guidance (PG+ Level & Felicitated)	10	3 PER	0

	Research guidance (PG+ Level & Continuing)	15 per candidate 5 per candidate	LAKH 1 PER LAKH	 0 0 0
Service/ behavior	Attendance Punctuality Involvement in extra and co-curricular activity Obeying administration	35 10 10 5	3 PER 10 % 5 5 2	24 2 0 0

The faculty evaluation process diagram is also described in Figure 1.

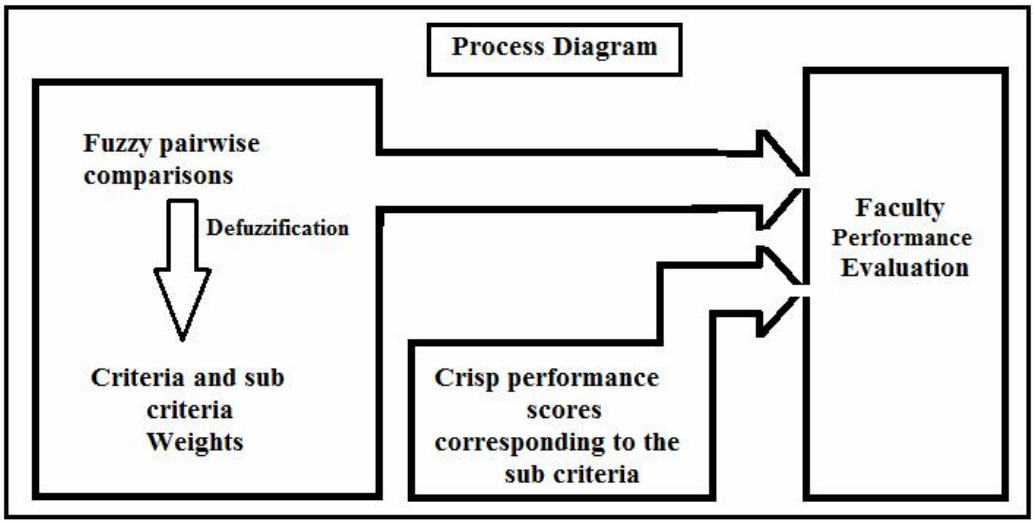

Figure 1: Faculty performance evaluation process diagram

3.4 Methods of processing data

3.4.1. Discussion about Fuzzy sets and TFN

To deal with vagueness of human thought, Zadeh first introduced the fuzzy set theory, which was oriented to the rationality of uncertainty due to imprecision or vagueness [10]. A major contribution of fuzzy set theory is its capability of representing vague data. A fuzzy set is a class of objects with a membership function ranging between zero and one. Fuzzy set theory resembles human reasoning in its use of approximate information and uncertainty to generate decisions. It was specifically designed to mathematically represent uncertainty and vagueness. Fuzzy set theory implements groupings of data with boundaries that are not sharply defined (i.e. fuzzy). Any methodology or theory implementing "crisp" definitions such as classical set theory, arithmetic, and programming, may be "fuzzified" by generalizing the concept of a crisp set to a fuzzy set with blurred boundaries. The benefit of extending crisp theory and analysis methods to fuzzy techniques is the strength in solving real-world problems, which inevitably entail some degree of imprecision in the variables and parameters measured and processed for the application.

A triangular fuzzy number (TFN) is the special class of fuzzy number whose membership is defined by three real numbers, expressed as (*l, m, u*). Figure 1.1 displays the structure of a Triangular Fuzzy Number (TFN). The triangular fuzzy numbers is represented as follows [7].

$$\mu_A = \begin{cases} \dfrac{x - l}{m - l}, & l \le x \le m \\ \dfrac{u - x}{u - m}, & m \le x \le u \\ 0, & otherwise \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

3.4.2. Fuzzy pair wise comparison method

For the generation of priorities of the criteria affecting stress, fuzzy linguistic pair wise comparison evaluation takes place. All the criteria on the same level are compared to each other in one-to-one basis. The comparison is performed by using Fuzzy linguistic terms described by the Triangular Fuzzy Numbers in the Table 3.

Table 3: Fuzzy linguistic preference scale

Verbal judgment	Explanation	Triangular Fuzzy number
Extremely Unimp	A response is Extremely Unimportant	(0, 1, 2)
Unimp	A response is Unimportant	(1,2.5,4)
Equal	A response is Equally Imp	(2.5,4,5.5)
Imp	A response is Important	(5, 6.5,8)
Extremely Imp	A response is Extremely Important	(7,8,9)

To reflect pessimistic, most likely and optimistic decision making environment, triangular fuzzy numbers with minimum value, most plausible value & maximum value are considered. Here the fuzzy comparison matrix is defined as

$$\tilde{A} = \begin{pmatrix} \tilde{1} & \tilde{a}_{12} & \ldots. & \tilde{a}_{1n} \\ \tilde{a}_{21} & \tilde{1} & \ldots. & \tilde{a}_{2n} \\ \tilde{a}_{31} & \tilde{a}_{32} & \tilde{1}\ldots & \tilde{a}_{3n} \\ .. & .. & \tilde{a}_{nn-1} & \tilde{1} \end{pmatrix} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where $\tilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij})$ is the relative importance of each criterion in Pair wise comparison.

3.4.3. Generation of Criteria and Sub-Criteria weight

The triangular fuzzy comparison matrix is expressed as
$\tilde{A} = \left[a_{ij} \right]_{n \times n}$ where $\tilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij}) = \tilde{a}_{ji}^{-1} = (1/u_{ij}, 1/m_{ij}, 1/l_{ij})$ for $i, j = 1, 2, ..., n, i \neq j.$
Firstly all the fuzzy judgments are aggregated using average means as

$$\tilde{A} = \left(\frac{1}{n} \sum_{i=1}^{n} a_L^{(i)}, \frac{1}{n} \sum_{i=1}^{n} a_M^{(i)}, \frac{1}{n} \sum_{i=1}^{n} a_U^{(i)} \right) \ldots\ldots\ldots\ldots (3)$$

and the elements of the comparison matrix are prepared. Secondly sum up each row of the fuzzy comparison matrix as

$$w_i = \sum_{j=1}^{n} \tilde{a}_{ij} = \left(\sum_{j=1}^{n} l_{ij}, \sum_{j=1}^{n} m_{ij}, \sum_{j=1}^{n} u_{ij} \right), i = 1, ..., n \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

The global weight of i[th] sub criteria under k[th] main criteria is obtained by

$$W_{gi} = (w_k \times sw_{ki}) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

where w_k is the k[th] main criteria weight and sw_{ki} is the weight of i[th] sub criteria with respect to k[th] main criteria. The crisp weight (non fuzzy) of the i[th] sub criteria finally generated by defuzzifying $W_{gi} = (l_{gi}, m_{gi}, u_{gi})$ as $W_i^C = \left(\frac{l_{gi} + 2m_{gi} + u_{gi}}{4} \right) \ldots\ldots\ldots\ldots\ldots (6)$.

Finally the crisp performance scores obtained in Table 2 are multiplied with the corresponding defuzzified weights [4] of the sub-criteria (W_i^C of equation (6)) and added together to generate the overall performance score of an individual faculty.

4. Findings

To generate the main criteria weight, they are compared in the linguistic scale as illustrated in Figure 2.

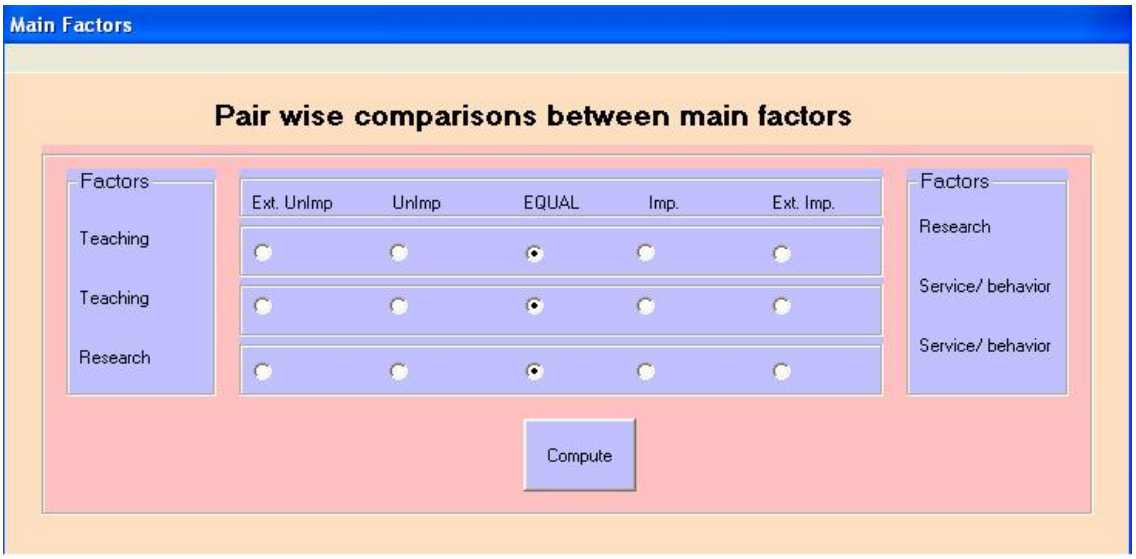

Figure 2: Main criteria weight

Figure 3, 4 and 5 describes the input screen for the generation of sub criteria weights corresponding to Teaching, Research/ publication and Service/ behavior. The questionnaire for taking crisp performance score for an individual faculty is demonstrated in Figure 6.

Figure 3: Sub-criteria weight (Teaching)

To put his or her opinion, the expert has to select the option button created with Visual Basic and once the questionnaire is filled in and compute button is selected, the entire data will be stored in Oracle for calculations. Mathematical calculation for criteria weight is done following equation number (2) to (6) and described along with the final score of an individual faculty in Figure 7.

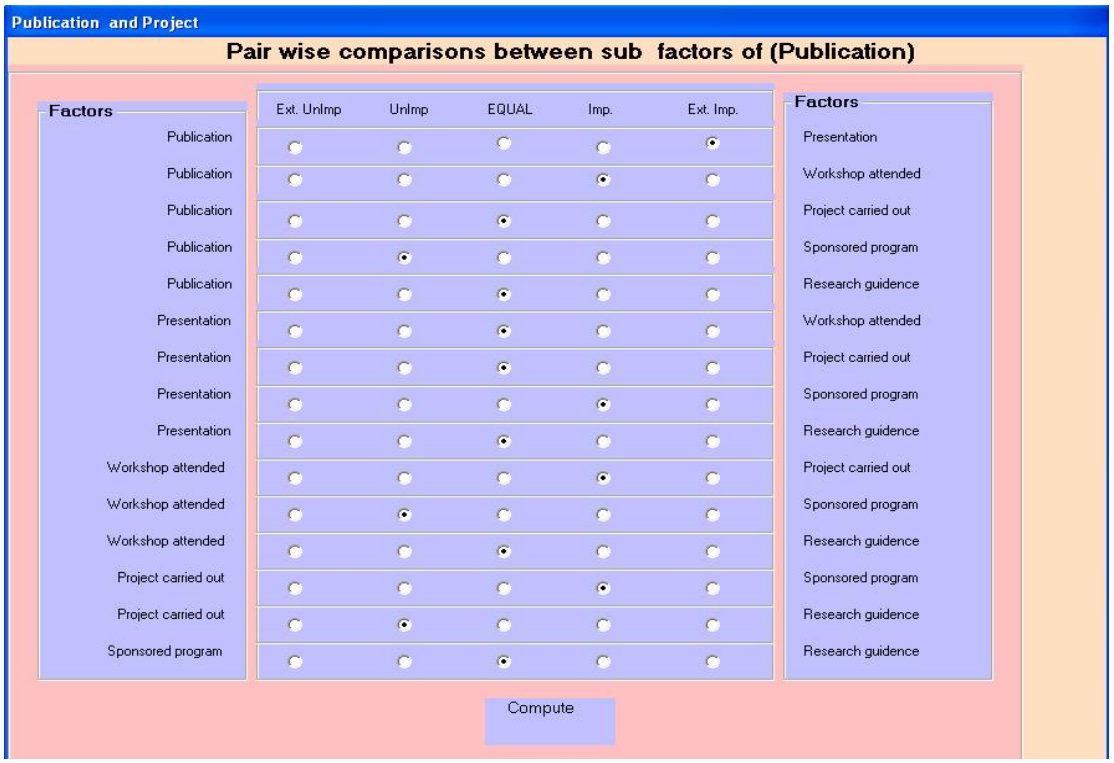

Figure 4: Sub-criteria weight (Research/ Publication)

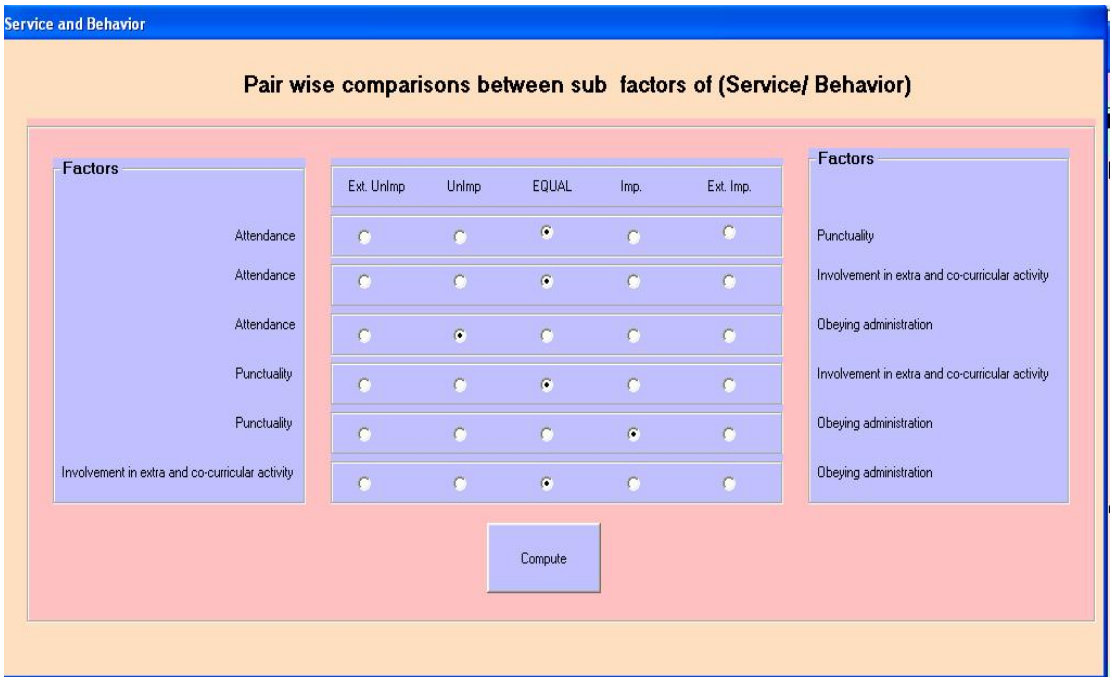

Figure 5: Sub-criteria weight (Service/ Behavior)

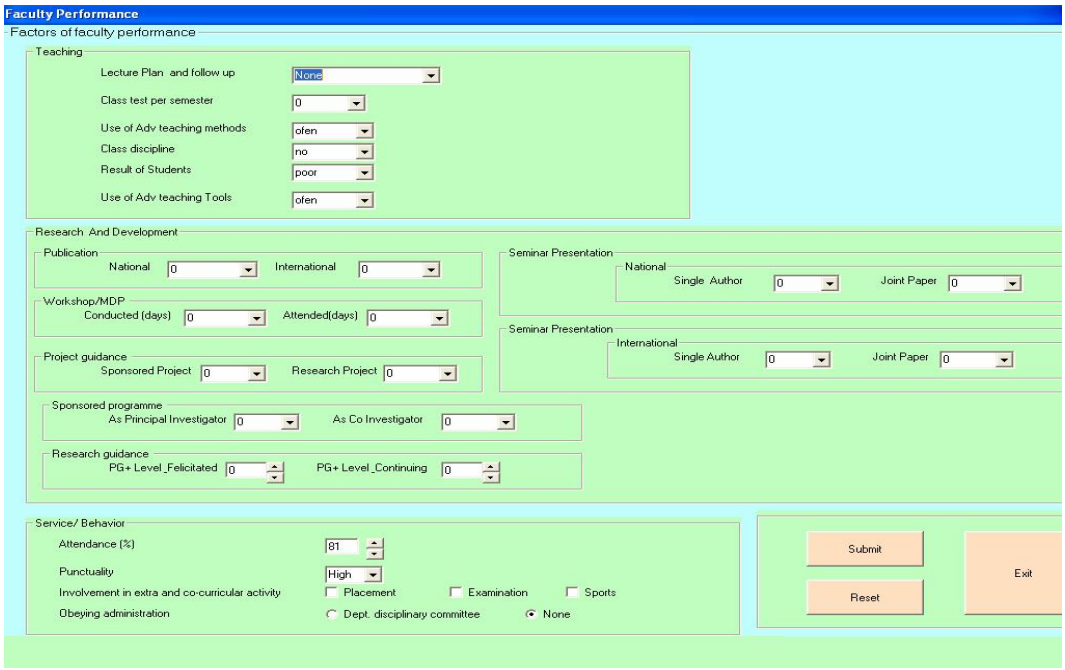

Figure 6: Crisp inputs for faculty

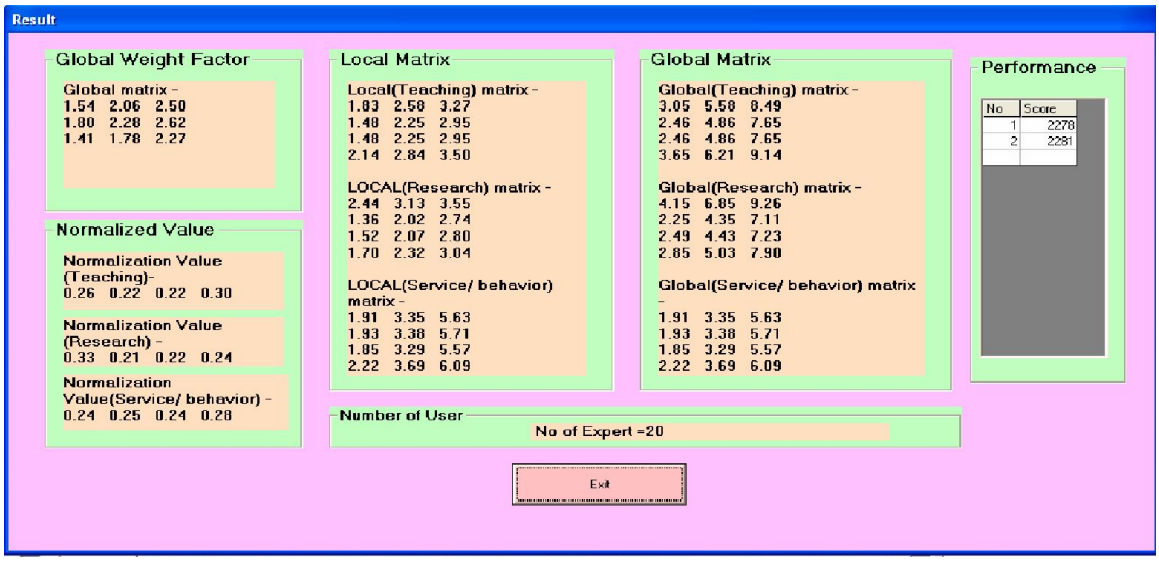

Figure 7: Criteria weight calculation & overall score

Using the global weight of the sub criteria and the individual performance score, the overall faculty performance index can be generated as shown in the right hand top of figure 7.

5. Conclusion

The model proposed in this paper along with the demonstration is flexible in comparison to other models as it grabs the decision maker's confusion and minimizes the vagueness in human (expert) decision-making. The imprecision of human judgment is removed using linguistic

variables. All the feedbacks are taken keeping the view of optimistic, most likely and pessimistic decision making environment. The model presented in this piece of work is also taking care of crisp inputs for exact evaluation of faculty performance along with fuzzy criteria weights to make the overall performance evaluation more realistic. This method could be applied to measure faculty performance in the different fields of education with greater efficiency. Further the use of software not only makes the data collection more easy and comfortable but the outputs error-free and easy to interpret.

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