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Performance Appraisal using Fuzzy Evaluation Methodology

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Abstract*— Performance is a blend of what you do and how you do it. Performance appraisal is a formal management system that provides for the evaluation of the quality of an individual's performance in an organization. Performance Appraisal is based on quantitative as well as qualitative parameters. Adherence to a specific work schedule, good interpersonal communication and ability to integrate well with other employees are some of the factors that govern the result of performance appraisal. Evaluating such factors involve vagueness, uncertainty and imprecision as they are based on judgment making ability of the reviewer. The paper is aimed at facilitating the performance appraisal process through Fuzzy evaluation technique as the use of fuzzy logic allows reviewers to express themselves linguistically and to draw definite conclusions from vague, ambiguous or imprecise information. The paper discusses parameters that effects the performance evaluation along with their fuzzy membership functions as well as system architecture for Fuzzy methodology based performance appraisal.

***Index Terms*— Evaluation parameters, Fuzzy Logic, Membership functions, Performance Appraisal**

I. Performance Appraisal

Performance appraisal is a formal management system that provides for the evaluation of the quality of an individual's performance in an organization [1]. Performance appraisal has the means to evaluate an employee's current and past performance relative to the employee's performance standards. It is a process of evaluating employee's actual performance relative the standard performance so as to give feedback to the employee that will help him or her to improve the job performance [2].

II. Need of Fuzzy logic for Performance Appraisal

Fuzzy logic is a powerful problem solving methodology that capture the way humans represent and reason with the real-world knowledge in the face of uncertainty. Uncertainty arises due to generality, vagueness, ambiguity, chance, or incomplete knowledge [3]. Fuzzy logic provides a simple way to draw definite conclusions from vague, ambiguous or imprecise information. Fuzzy logic's approach to control problems mimics how a person would make decisions, much faster only [4]. It resembles human decision making with its ability to work from approximate data and find precise solutions.

Unlike classical logic which requires a deep understanding of a system, exact equations and precise numeric values, fuzzy logic incorporates an alternative way of thinking, which allows modelling complex systems using a higher level of abstraction originating from our knowledge and experience. The classical logic do not allow for degrees of imprecision, indicated by words of phrases such as poor, average and good. Instead of truth values such as true or false, it is possible to introduce a multi-valued logic consisting of Unsatisfactory, Satisfactory, Average, Good, and Excellent. Fuzzy systems implement fuzzy logic, which uses sets and predicates of this kind.

Most organizations use numerical values like 7 in 10 point scale or linguistic labels like Good, Very Good, Outstanding, etc. in their performance appraisal system. However, these scores are merely imprecise approximations as they are based on judgment making ability of the reviewer. The use of fuzzy logic allows reviewers to express themselves linguistically and to make assessments that are subjective in nature. Employee evaluation is based on many parameters like Commitment, Attitude, Communication Skills, Leadership qualities, Innovativeness, Responsibility, etc. These parameters are very fuzzy and not just black and white. It employs spectrum of colours, accepting that things can be partly true and partly false at the same time. Such human like approach is well implemented using fuzzy logic, which models human like decision making and common sense.

III. Existing Fuzzy Logic Solutions for Performance Appraisal

C.C. Yee and Y.Y. Chen proposed a performance appraisal system using multi-factorial evaluation model in dealing with appraisal grades which are often expressed vaguely in linguistic terms [5]. The project was carried out in collaboration with one of the Information and Communication Technology Company in Malaysia with reference to its performance appraisal process. Ming-Shin Kuo and Gin-Shuh Liang presented a performance appraisal method for tackling fuzzy multi-criteria decision-making (MCDM) problems based on combining VIKOR and interval-valued fuzzy sets [6]. To illustrate the effectiveness of the method, a case study for evaluating the performances of three major intercity bus companies from an intercity public transport system is conducted. GMeenakshi proposed a Multi source feedback or 360-degree feedback based performance appraisal system using Fuzzy logic and implemented it in academics especially engineering colleges [7]. The 360 degree appraisal system includes self-appraisal, superior's appraisal, subordinate's appraisal student's appraisal and peer's appraisal. A project is carried out by the AXIOM SW

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Company, Czech Republic, which specializes in the implementation of the Microsoft Dynamics NAV information system [8]. A competency model is created for any given role with different normalized weights assigned to various competencies. Evaluators fill in a questionnaire indicating to what extent, in their view, the tested employee meets his/her competencies. These evaluations are expressed using fuzzy scales. Adam Golec and Esra Kahya presented a comprehensive hierarchical structure for selecting and evaluating a right employee [9]. The process of matching an employee with a certain job is performed through a competency-based fuzzy model.

IV. Design Methodology

Performance appraisal helps measure the productivity of the employee and assesses the quality of work delivered by him. Adherence to a specific work schedule, timely completion of assignments, good interpersonal communication and ability to integrate well with other employees are some of the factors that govern the result of performance appraisal. Performance appraisal also seeks to determine whether an employee is able to blend with the organizational culture while introducing values that would promote the cause of the company. It's evident that the results of a performance appraisal hinge on both qualitative and quantitative factors [10]. Anything that cannot be quantified is subject to bias. Justifying ratings based on qualitative factors is difficult. Quality of the output is as important as the quantity. An employee, who meets his targets but finds it difficult to adhere to the strict standards of quality, would have accomplished only a part of the assigned job. Again, a salesperson that generates a huge volume of sales without focusing on building a loyal customer base is not really good at marketing. An impartial assessment of these factors is difficult, if not impossible. The evaluation parameters that are subjective, vague and imprecise can be well implemented using fuzzy logic. After reviewing evaluation criteria of various multinational companies and performance appraisal reports of different organizations evaluation parameters shown in Table 1 have been considered:

Table 1: Employee Evaluation Parameters

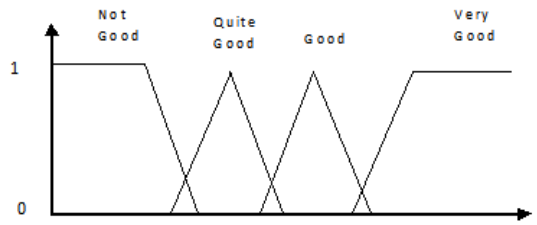
Personality	Communication skills
Attendance	Cooperative
Punctuality	Qualifications
Initiative	Work Experience
Self control	Job Knowledge
Responsibility	Leadership
Quality of Interpersonal Relationships	Innovativeness
Quality of work	Accomplishments
Attitude	Effectiveness
Commitment	Result-Oriented

A. Fuzzy Membership functions

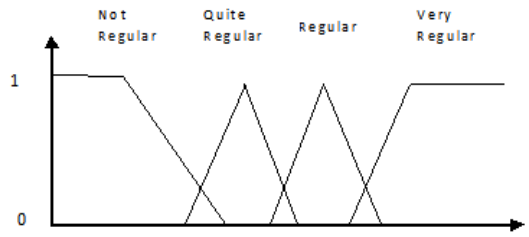
Fuzziness is a type of deterministic uncertainty. Different kinds of uncertainty are to some extent characteristics of practically any situation of making decision in which the expert information is used. The nature of uncertainty is essentially different. Secondly, the subjective uncertainty is peculiar to human's nature on the whole and to his abilities to evaluate the information in particular.

Numerical evaluation is difficult in case of parameters with deterministic uncertainty. It would be preferable if an evaluator gets an opportunity to consider fuzzy parameters in form of intervals or with the help of rough sets pointing out the degree of belonging of fuzzy parameters to these sets. In this case objectiveness can be associated with fuzzy parameters by defining weights for each such fuzzy parameter. So, the application of fuzzy sets and the function of belonging allow formalizing factors of uncertainty and unclearness which might happen in expert evaluation situation by some means [11]. Hence for each fuzzy evaluation parameter, we define following fuzzy membership functions:

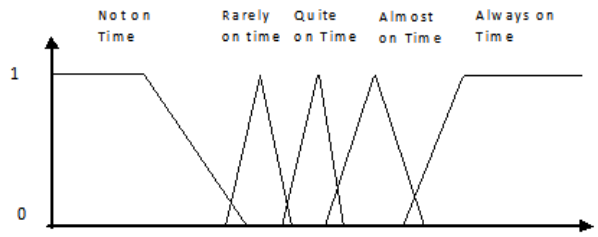
Personality:



Attendance:



Punctuality:



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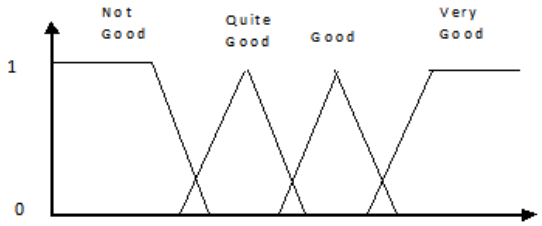
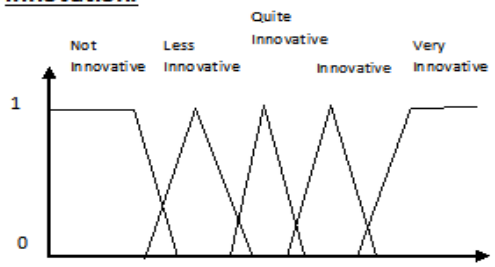
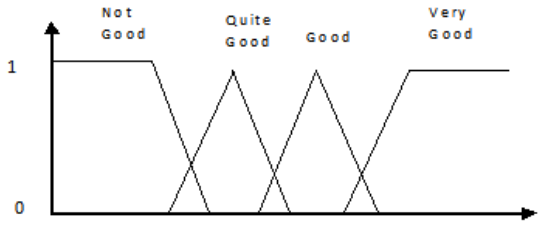
Self Control:



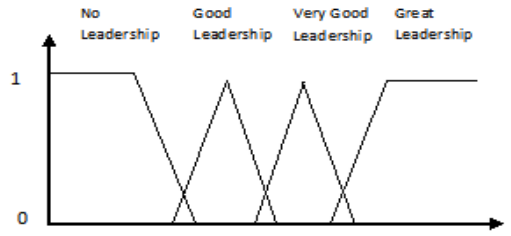
Innovation:



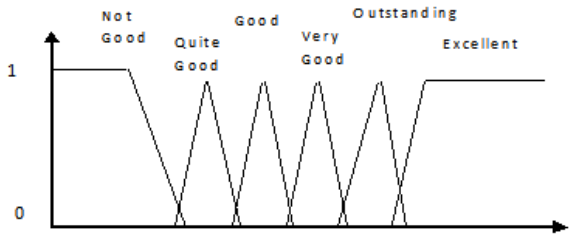
Quality of InterPersonal Relationships:



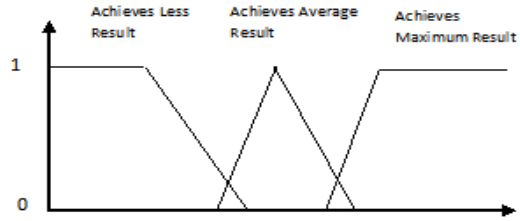
Leadership:



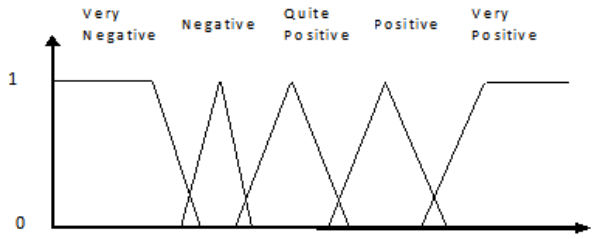
Quality of Work:



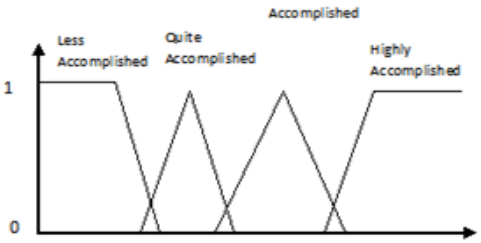
Result-Oriented:



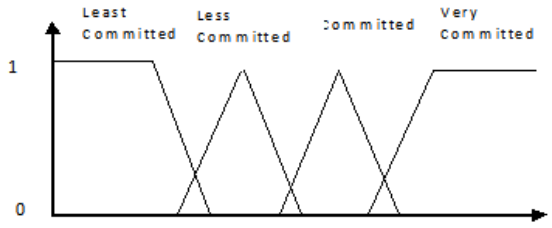
Attitude:



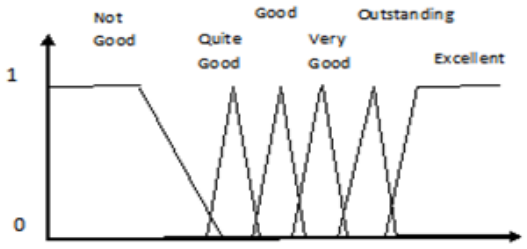
Accomplishments:



Commitment:



Communication Skills:



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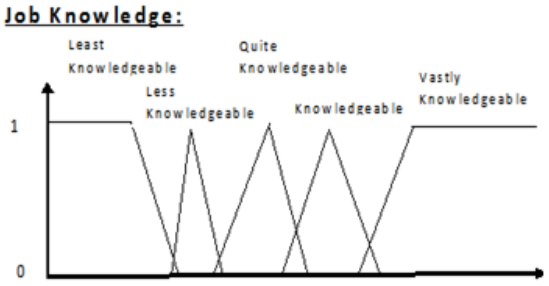

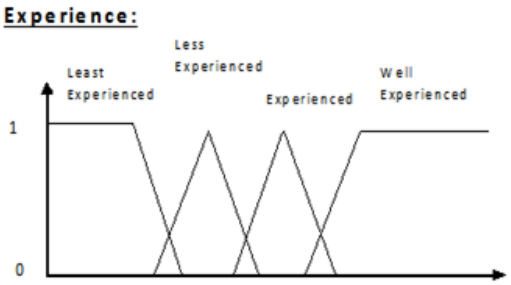

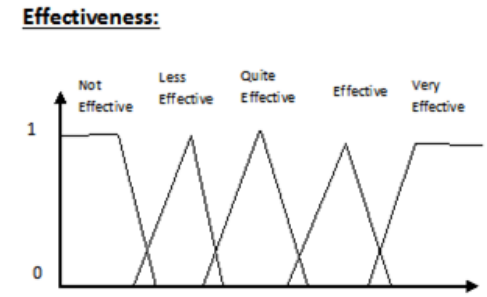

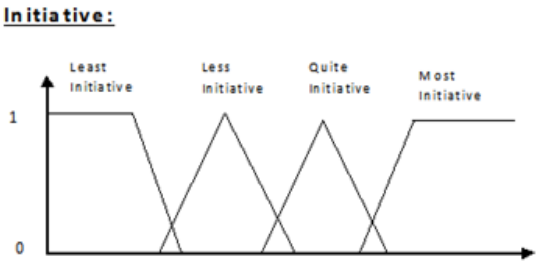

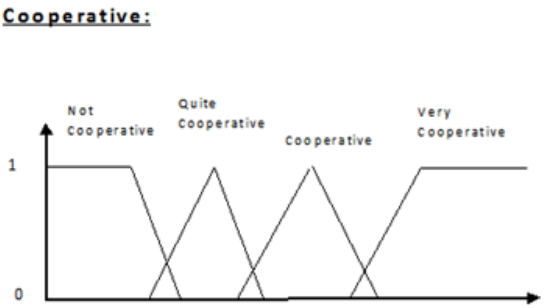

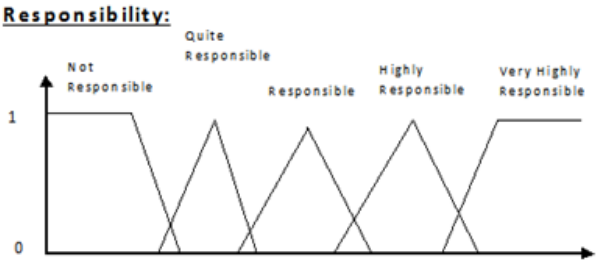

B. System Architecture

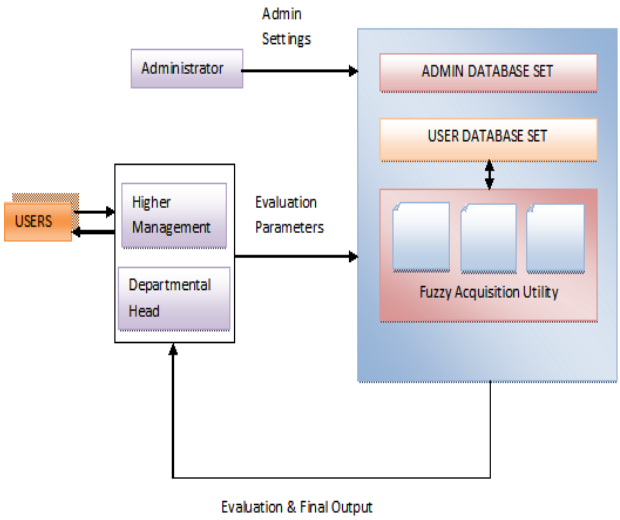

Fig.1 System Architecture for Performance Appraisal using Fuzzy Evaluation Methodology

Fig.1 shows system architecture for Performance Appraisal using Fuzzy Methodology. There are higher level management employees and departmental heads as users who have evaluation rights to evaluate employees who are at organizational level lower than they are at. The fuzzy employee evaluation parameters are provided by users through fuzzy acquisition utility.

System has Administrator who has all the rights including creating user logins. The administrator can add new parameters for evaluation of employees, set and change weights of different parameters as and when required. Admin database set shown in Fig.1includes:

Login table: Records the list of users

Parameter table: Records details of evaluation parameters

Parameter weight: Records the weight given to different fuzzy values for the Evaluation Parameters

Parameter Expected Weight: Records the weight expected for different evaluation parameters for employees of different organizational level.

User database set shown in Fig.1includes:

Employee table: Records employee information for different organizational level

Employee parameters: Records evaluation details of employee in terms of evaluation parameter, its expected weight and actual weight obtained.

The fuzzy acquisition utility in Fig.1 represents the fuzzy input interface where user inputs fuzzy value for each evaluation parameter. When user selects any evaluation parameter in the given list, corresponding fuzzy value options display. On selection of fuzzy value applicable for the employee the corresponding fuzzy value and weights for an employee get stored year wise.

Weight matrices for different parameters are decided as not all the parameters are equally important for all the organizational levels. Weight Matrix indicates the

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significance of particular parameter for an employee of a particular organizational level. Considering weight matrices weights are assigned to each fuzzy value for each parameter for different organizational levels. Also the expected weight for each parameter for an employee of a particular organizational level is assigned.

When the evaluation is done as per the employee's performance and attitude different fuzzy values for each parameter are selected. As per the selection actual weight for each parameter for each employee is obtained. The weighted average method is used to calculate aggregate value for evaluation parameters. The weighted average method is given as follows:

$$\sum_{i=1}^{m} Wexp(i) * W(i) \quad (1)$$

$$AV_{EP} = \frac{\sum_{i=1}^{m} Wexp(i) * W(i)}{\sum_{i=1}^{m} Wexp} \quad (2)$$

$W_{exp}(i)$ is expected weight for i^{th} evaluation parameter
$W(i)$ is actual weight for i^{th} evaluation parameter.
AV_{EP} is Aggregate value for evaluation parameters

The result obtained using weighted average method is passed through the fuzzy rule set that defines threshold values for three possible outcomes i.e. *Retain*, *Neutral* or *Layoff* Employee. The result is compared against these threshold values and relevant fuzzy rule is fired and final decision is obtained.

V. Future Implications

The Fuzzy Evaluation methodology can be used for different other domains like student evaluation, production evaluation or software quality assurance, etc with minor modifications. Future work can be done in area of extracting dynamic domain specific fuzzy membership functions through interactive user interface.

VI. Conclusion

Performance appraisal is important from the perspective of assessing the contribution of the employee to the organization. Performance appraisal is based on both qualitative and quantitative factors. The inability to justify a rating based on these qualitative factors makes employee evaluation a nerve-racking task. The research paper addresses this problem that is faced by almost all the organizations since the performance appraisal is equally objective as well as subjective. The proposed fuzzy evaluation methodology identifies significant evaluation parameters and presents system architecture that set up a consistent evaluation standard for facilitating a decision process. It is complete approach for handling uncertainty inherent in performance appraisal. Fuzzy logic help represent higher level of abstraction originating from our knowledge and experience. The use of fuzzy logic in performance appraisal allows inputting evaluation parameters in the form of linguistic variables that do not have sharp distinction like black or white but have colours of spectrum. Thus fuzzy logic based performance appraisal allows the decision maker to introduce vagueness, uncertainty, and subjectivity into the evaluation system, which models human like decision making approach.

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