

BENEFIT REASONING IN PERFORMANCE APPRAISAL FUNCTION IN THE FIELD OF HUMAN RESOURCE MANAGEMENT: A FUZZY LOGIC APPROACH

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ABSTRACT

This paper examines the utilization of fuzzy logic in human resource management (HRM) to tackle the complex nature of performance assessment in organizations. Conventional performance appraisal techniques frequently neglect the uncertainties and ambiguities associated with evaluating qualitative metrics like leadership, teamwork, and communication. Conversely, fuzzy logic provides a methodical framework for addressing these ambiguities, so improving the equity, precision, and thoroughness of assessments. The study examines the application of fuzzy inference algorithms to evaluate six fundamental performance metrics: job knowledge, work quality, productivity, leadership, teamwork, and communication. The study uses verbal and numerical quantifiers to formulate probabilistic principles and categorizes performance results into five classifications: never, seldom, sometimes, often, and always. The dual-variable methodology facilitates comprehensive assessments at the individual, team, and organizational tiers. Research indicates that fuzzy logic markedly improves decision-making in performance management by incorporating expert information and mitigating subjective uncertainties. The fuzzy modelling outcomes correspond with real-world applications in the university setting, providing a solid foundation for measuring qualitative advantages such as employee engagement, organizational efficiency, and value. This study utilizes fuzzy techniques, such as Mamdani and Tsukamoto systems, to offer organizations practical insights for optimizing their appraisal systems in accordance with evolving HR requirements. Subsequent investigations may broaden these methodologies to more sectors, evaluating their enduring influence on organizational achievement. This study highlights the transformative capacity of fuzzy logic as a mechanism for fair and efficient performance assessments in intricate settings.

KEYWORDS: Human Resource Management, Fuzzy Logic, Performance Evaluation

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1. INTRODUCTION

The application of fuzzy logic in human resource management offers several benefits. Fuzzy logic methods provide an alternative for decision-making processes in employee selection for structural positions, enhancing the effectiveness and efficiency of the decision support systems (Ramadhani and Susanto, 2022). It aids in improving career orientation by customizing HR management based on students' orientations, leading to better performance outcomes (Nghiem, Dinh and Nguyen, 2022). Additionally, fuzzy logic systems offer a new approach to evaluating employee performance, considering uncertainties and imprecise data, which aligns with the way humans think and make judgments in real life (Ardin, 2017). Moreover, the use of fuzzy logic in personnel selection helps in solving multicriteria decision problems, ensuring excellence in the field by addressing uncertainties and subjectivity in evaluations through qualitative linguistic values (Sirb and Dragolea, 2013). Overall, the integration of fuzzy logic in HRM practices enhances decision-making processes, employee performance evaluations, and personnel selection, contributing to organizational efficiency and effectiveness (Kaur, Mittal and Jain, 2022). Therefore, the current study tries to understand the factors influencing the performance evaluation and to measure the extent to which performance can be monitored by existing performance management system. Further, the study evaluates the level at which the performance evaluation is conducted using the fuzzy logic approach.

Today Fuzzy logic is dynamically used to quantify the qualitative benefits emerging from the HR system. Therefore, the most essential aspect is to quantify the benefits of performance evaluation like cost savings, effectiveness and financial goals including people value and employee engagement. Fuzzy logic focuses on the combined input, process and output of fuzzy data because HR information is ambiguous, uncertain and dynamic in today's complex organizational environment. For instance, the project recruits system engineers and demands high skills of technical knowledge. However, the managers are not able to quantify the skill of engineering and technicality. In

this light fuzzy evaluation is the optimum approach in management.

2. LITERATURE REVIEW

Recent research has compared fuzzy logic approaches to traditional performance evaluation methodologies in several sectors, including education, employee appraisal, and lecturer assessment. Traditional techniques often use numerical values or binary outcomes to evaluate performance (Manuja, Singh and Gupta, 2018). However, fuzzy-logic-based models offer advantages by adding expert knowledge and addressing uncertainty in performance metrics, allowing for more nuanced evaluations (Ardin, 2017; He and Dong, 2023). Fuzzy logic methodologies have proven to be effective in assessing the performance of educators in the field of education. In specific areas, fuzzy models have demonstrated superior performance compared to conventional methods (Farouk, Shamsu-Deen and Kwame, 2017). Similarly, fuzzy logic has been discovered to streamline the assessment of lecturers by considering many input variables and generating linguistic output words.

Organizational management must actively seek for, assess, and advance competent personnel due to their significant value. The primary sources of competitive advantage for organizations are the abilities and knowledge possessed by human beings. Therefore, the establishment of performance evaluation criteria is a crucial prerequisite for conducting performance appraisals in organizations (Shaout and Al-Shammari, 1998). Typically, organizations utilize traditional approaches for assessing employee performance. In this traditional framework, the performance of employees is contingent upon the outcomes of their work, and it is assessed only based on whether they have achieved success or failure in their job-related behaviours. Fuzzy logic, among other non-classical assessment approaches, is primarily employed in various decision-making processes, including artificial intelligence systems (Ardin, 2017).

The application of fuzzy logic theory has been widespread in many performance rating systems. The study conducted by Moon et al. (2007) suggests that the use of fuzzy logic theory in multi-criteria

assessment is an effective approach for promoting transparency and fairness in the evaluation of performance in military organizations. The fuzzy set theory is commonly applied to effectively address numerous criteria difficulties. Appraisers often utilize loosely defined qualitative criteria while assessing the performance of subordinates (Jing, R.C et al., 2007). By integrating fuzzy set theory to a fuzzy group decision support system, it aids the decision maker in making superior decisions and suggestions in various situations and options. The suggested model applies the fuzzy logic theory to a decision-making process in information, decision, and control systems, using a multifactorial evaluation approach. The literature review on fuzzy approach provides evidence that supports the use of fuzzy logic theory as a conceptual framework for developing performance appraisal systems. This is because fuzzy logic theory enables the use of fuzzy variables and relationships in the development of such systems (Moon et al., 2007).

Fuzzy logic techniques, such as Fuzzy Mamdani and Tsukamoto fuzzy approaches, are employed in the evaluation of employee performance to analyze factors such as attendance, quality of work, and communication (Qian and Yin, 2022; Sumanto et al., 2022). These methods offer a systematic strategy to analyze employee data and calculating weighted average values, which helps in rating individuals according to their performance levels. In human resource management, fuzzy clustering algorithms can be used to segment employees according to predetermined rules, which improves the comprehension of employee performance (Yu and Chen, 2022). Moreover, including fuzzy evaluation models into performance appraisal systems can provide equitable and quantifiable assessments by taking into account linguistic values such as good or bad, hence enhancing the quality of job evaluations (Dang, Truong and Huynh, 2021). The utilization of these fuzzy models facilitates a thorough and unbiased assessment of employee performance, which is vital for improving productivity and attaining organizational objectives.

3. METHODOLOGY

The variables are fuzzy in nature which means these are future oriented, uncertain and ambiguous.

The measurability and uncertainty causes the inability to specify the extent to which performance evaluation can be measured. Job Knowledge, quality of work, productivity, team work, leadership & communication are fuzzy variables. The study adopts a rather novel approach which integrates computing with words and computing with numbers. Accordingly, the fuzzy system will accept a coupled two variables into the system and generate a singular fuzzified output which is computation by words. Simultaneously a fuzzy linguistic quantifier is generated and the value numerically given to the quantifier. This approach is used to analyze the behaviour of the fuzzy variables and quantify each output in order to realize the extent to which performance evaluation is measured.

Conceptual framework

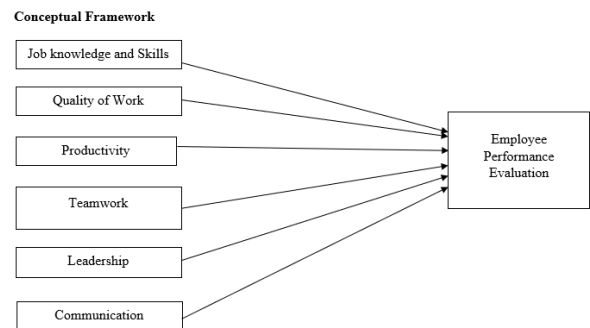


Figure 1: Conceptual framework

4. FUZZY RESULTS AND FINDINGS

The variables are regarded as symbolic factors with an impact on the benefit of performance evaluation for employees. The dualistic effect of the combined variables can result in a resultant variable of interest, the dependent variables performance evaluation. Let us input to the fuzzy inference system the quality of work (QW) and productivity (P) to measure performance evaluation (PE).

If QW is “low” & P is “high” then; PE is “sometimes”

If QW is “low” & P is “medium” then; PE is “seldom”

If QW is “low” & P is low then; PE is “never”.

If QW is “medium” & P is “high” then; PE is “on most occasions”.

If QW is “medium” & P is “medium” then; PE is “sometimes”

If QW is “medium” & P is “low” then; PE is “seldom”

If QW is “high” & P is “high” then; PE is “always”.

If QW is “High” & P is “medium” then; PE is “on most occasions”.

If QW is “high” & P is “low” then; PE is “sometimes”.

The fuzzy linguistic modelling results in nine (09) probabilistic rules of performance evaluation and they are practically evidenced in the university environment. There are five (05) realization variances of performance evaluation. The PE realizations are namely; **never, seldom, sometimes, on most occasions & always**. The fuzzy inference system provides a mapping of values for the five fuzzy linguistic quantifiers as depicted below.

PE status	Fuzzy linguistic quantifier input	Numerical value
Never	<N>	=1
Seldom	<S>	=2
Sometimes	<So>	=3
On most occasions	<OMO>	=4
Always	<A>	=5

The Quality of work & Productivity are coupled in the Fuzzy inference system (FIS) in order to ascertain the performance evaluation level and extent of it at the individual level particularly at the employees’ specific point of focus. This enables the employee to realize the performance evaluation degree and extent in order to make progressive improvements and uplift human resources value to the organization.

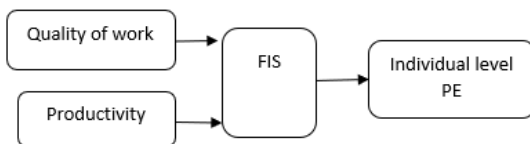


Figure 2: Input variables and fuzzification for PE realization at individual level (Source: Developed by the researcher)

Let us input to the fuzzy inference system the leadership (L) & Communication (C) to measure performance evaluation (PE).

If L is “low” & C is “high” then; PE is “sometimes”

If L is “low” & C is “medium” then; PE is “seldom”

If L is “low” & C is “low” then; PE is “never”.

If L is “medium” & C is “high” then; PE is “on most occasions”.

If L is “medium” & C is “medium” then; PE is “sometimes”

If L is “medium” & C is “low” then; PE is “seldom”

If L is “high” & C is “high” then; PE is “always”.

If L is “High” & C is “medium” then; PE is “on most occasions”.

If L is “high” & C is “low” then; PE is “sometimes”.

The fuzzy linguistic modelling results in nine (09) probabilistic rules of performance evaluation and these are practically evidenced in the university environment. There are five (05) realization variances of performance evaluation. The PE realizations are namely; **never, seldom, sometimes, on most occasions & always**. The fuzzy inference system provides a mapping of values for the five fuzzy linguistic quantifiers as depicted below.

PE status	Fuzzy linguistic quantifier input	Numerical value
Never	<N>	=1
Seldom	<S>	=2
Sometimes	<So>	=3
On most occasions	<OMO>	=4
Always	<A>	=5

The Leadership & Communication are coupled in the Fuzzy inference system (FIS) in order to ascertain the performance evaluation level and extent of it at the individual level particularly at the employees’ specific point of focus. This can also be reduced to understanding the extent to which performance evaluation is achieved at the team or organizational level at the university. This enables the employee to

realize the performance evaluation degree and extent in order to make progressive improvements and uplift human resources value to the organization.

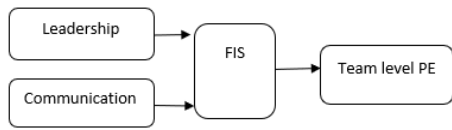


Figure 3. Input variables and fuzzification for PE realization at team or organizational level (Source: Developed by the researcher)

Let us input to the fuzzy inference system the Job knowledge and Skills (KS), Leadership (L) & Teamwork (T) to measure performance evaluation (PE).

If KS is “low” & T is “high” then; PE is “sometimes”

If KS is “low” & T is “medium” then; PE is “seldom”

If KS is “low” & T is “low” then; PE is “never”.

If KS is “medium” & T is “high” then; PE is “on most occasions”.

If KS is “medium” & T is “medium” then; PE is “sometimes”

If KS is “medium” & T is “low” then; PE is “seldom”

If KS is “high” & T is “high” then; PE is “always”.

If KS is “High” & T is “medium” then; PE is “on most occasions”.

If KS is “high” & T is “low” then; PE is “sometimes”.

The fuzzy linguistic modelling results in nine (09) probabilistic rules of performance evaluation and these are practically evidenced in the university environment. There are five (05) realization variances of performance evaluation. The PE realizations are namely; never, seldom, sometimes, on most occasions & always. The fuzzy inference system provides a mapping of values for the five fuzzy linguistic

PE status	Fuzzy linguistic quantifier input	Numerical value
Never	<N>	=1
Seldom	<S>	=2
Sometimes	<So>	=3
On most occasions	<OMO>	=4
Always	<A>	=5

quantifiers as depicted above.

Job Knowledge Skill & Teamwork are coupled in the Fuzzy inference system (FIS) in order to ascertain the performance evaluation level and extent of it at the individual level particularly at the employees’ specific point of focus. This can also be reduced to understanding the extent to which performance evaluation is achieved at the team or organizational level at the university. This enables the employee to realize the performance evaluation degree and extent in order to make progressive improvements and uplift human resources value to the organization.

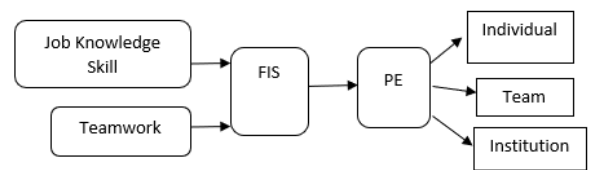


Figure 4: Input variables and fuzzification for PE realization at individual, team or/and organizational level (Source: Developed by the researcher)

The variables in the institution can be observed in the manner of fuzziness that can be quantifiable to extents. The performance evaluation occurs at the individual, team & institution levels which can be summarized as follows:

Srl. No.	PE variable	Specific level of the institution in realization		
01.	Job Knowledge Skill	Individual	Team	Institution
02.	Teamwork	Individual	Team	Institution
03.	Communication	Individual	Team	Institution
04.	Leadership	Individual	Team	Institution
05.	Quality of work	Individual	Team	Institution
06.	Productivity	Individual	Team	Institution

Table: Levels of realization of PE at fuzzification stage

5. CONCLUSION

This study demonstrates the effectiveness of fuzzy logic as a transformative tool in performance evaluation within human resource management. By incorporating fuzzy logic methodologies, such as the Mamdani and Tsukamoto methodologies,

organizations can mitigate uncertainties and imprecisions inherent in conventional evaluation methods. Nuanced insights into individual, team, and institutional performance levels were provided by the fuzzy inference systems that were applied to variables such as job knowledge, quality of work, productivity, leadership, collaboration, and communication.

Organizations are provided with a structured yet adaptable framework that enables them to quantify qualitative aspects of employee performance through the use of fuzzy linguistic modelling and the derived probabilistic principles. This method enables decision-makers to gain a more profound comprehension of performance indicators, thereby offering actionable insights that can be used to improve organizational value, efficiency, and employee engagement.

The results emphasize the potential of fuzzy logic to transform performance appraisal systems by introducing precision, transparency, and impartiality. It adapts to the dynamic and complex environments of contemporary organizations and aligns with modern HR practices as a decision-making support instrument. These methods can be expanded to other domains in future research, and their influence on long-term organizational outcomes can be investigated.

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