PressAcademia Procedia - (PAP), ISSN: 2459-0762

PressAcademia Procedia

2nd World Conference on Technology, Innovation and Entrepreneurship
May 12- 14, 2017, Istanbul, Turkey. Edited by Sefer Şener

APPLYING FUZZY LOGIC THEORY TO PERFORMANCE MANAGEMENT

DOI: 10.17261/Pressacademia.2017.584
PAP-WCTIE-V.5-2017(22)-p.153-161

Cemal Ardil[1]
[1]Okan University, cemalardil@mail.com

ABSTRACT

Organizations usually apply classical methods of employee performance evaluation. In this classical system, employee performance depends on work results, and it is evaluated only as success or failure in job behaviors. The non-classical performance evaluation methods such as fuzzy logic may mainly be used to many forms of decision-making including artificial intelligence systems. This research proposes a new employee performance evaluation method based on fuzzy logic systems. The process of performance measurement for evaluating the effectiveness, efficiency, and productivity of employees encompasses data collection, data design, and data analysis stages and it involves a level of uncertainty associated with performance measures. In evaluating employee performance, it usually involves granting numerical values or linguistic labels to employee performance in the organization. The scores accorded by the appraisers are only approximations, which are then, used to represent each employee's achievement by reasoning incorporated in the computational methods. In this paper, the fuzzy logic theory approach is used to represent the uncertainty caused by performance measures during its design, use and analysis stages. This research seeks to describe and execute the fuzzy logic theory approach for decision making in the employee performance appraisal process. Finally, reasoning based on fuzzy logic theory provides an alternative way in dealing with imprecise data, which is often reflected in the way humans think and make judgments in real life.

Keywords: Performance management, performance appraisal, performance tracking, evaluation parameters, performance measurement.

1. INTRODUCTION

The evaluation of employees in the organization is the appraisal of the extent to which the employees have met their professional obligations with regard to organizational goals and objectives. The process of performance appraisal is a structured interaction between superiors and their subordinates in the organization. The work performance of the subordinates is usually considered and discussed by the process of embracing a periodic and systematic interview. As an instrument creating competitive advantages amongst employees, performance appraisal system is mostly used by organization management to evaluate the management of the effectiveness, efficiency, and productivity of employees within the organization. In the modern organizations, each employee is evaluated through a performance appraisal system that is designed to be a systematic annual process which involves evaluating employee's set targets, perceived behavior evaluation, and work achievement during the annual evaluation. This evaluation may be considered by the organization management in making decisions with respect to appointments, salary and any other purposes where an employee's performance may be a relevant consideration. Therefore, systematic performance appraisal and ranking of employees applying for evaluation and promotion is important in strategic human resource management. Performing performance appraisal of employees with skills and expertise in relation to a specific position is an important task for managing an organization's human resource information system. Superiors within organizations are concerned with performance appraisal, recognition decisions, and evaluations that they have to make on their subordinates. Nevertheless, subordinates in organizations increasingly realize the importance of performance appraisal system, which is affecting their rewards and future career path in the business domain. Global knowledge-based economy reminds all organizations of the importance of maintaining their highly skilled and talented knowledge employees (Moon et al., 2007).

Organization management essentially needs to discover, evaluate and promote qualified employees because valuable human skill and expertise are the main sources of competitive advantage for organizations. Thus, the creation of

performance evaluation criteria is an important requirement towards performance appraisal in organizations. The performance evaluation criteria also ensure fairness, objectivity, and transparency since appraisers determine the metrics of performance evaluation and the weighting among the metrics before aggregating the appraisal scores to determine the ranking of each subordinate in the organization. Superiors must objectively maintain a certain level of professional distance so that they can assign tasks, review and evaluate employee performance without bias in the workplace. The performance appraisal mainly focuses on the integration and achievement of employee targets, behaviors, and performance at work in comparison to the goals of the organization. Performance appraisal procedure is periodically conducted within an organization to track and examine the work performance of subordinates so as to identify the strengths and weaknesses as well as opportunities for engagement and improvement among employees. As an employee development and coaching instrument for organization management, the performance appraisal results are then used to determine if a particular employee should be eventually terminated or reinforced to give an essential evaluation of an employee's readiness for promotion and serving as the foundation for giving merit bonus. Thus, the employee ranking is determined by applying the fuzzy set operations and membership functions. In order to make the decision for the promotion rank of subordinates in the organization, it is proposed a fuzzy evaluation and ranking procedure in conjunction with integrated performance appraisal and promotion ranking system for organization management (Shaout and Al-Shammari, 1998).

The fuzzy logic theory is based on the notion of relatively graded membership, as inspired by the processes of human perception and cognition. Following the awareness and understanding of the conceptual framework of fuzzy sets, and fuzzy logic theory, researchers from diverse fields, have increasingly applied the fuzzy logic theory to the performance appraisal process. Fuzzy logic theory presents proper ways of managing multiple variables that have imprecise data to apply fuzzy logic concept reasoning, which reflects the way of human thinking and inference mechanism of action. So far various studies have been largely conducted to improve the application of fuzzy logic theory in areas of performance appraisal and performance measurement. The fuzzy logic theory is highly suitable and applicable basis for developing knowledge-based systems in performance appraisal for tasks such as the selection of employees, the evaluation of various training methods, the team ranking, and the real-time monitoring of employees data. Performance appraisals are mainly used for judgmental and developmental purposes in order to make good administrative decisions (Schweiger and Sumners, 1994).

Performance measures are meant to provide complete and precise information about an entity's performance. Organizations usually rely on the appraisers' skills and expertise, when they are expected to supervise and make an accurate judgment of how well their subordinates have performed over a period of time. However, the process of performance appraisal is often flawed by the appraisers own biases and information-processing problems. Therefore, the evaluation process may be involved with information of uncertainty and subjectivity. The process of employee performance evaluation is usually involved with awarding numerical values or linguistic labels to employee performance. In most evaluations, these values and labels are used to represent the employee's achievement by reasoning using computational methods. However, in the evaluation using the fuzzy logic method, the performance of the appraiser usually involves the measurement of ability, competence, job behaviors, and skills, which are fuzzy concepts that may be captured during the performance appraisal process (Shaout and Yousif, 2014).

Therefore, in this paper, it is proposed a new fuzzy evaluation method using fuzzy rule approach in the multicriteria analysis, an application of fuzzy logic theory to decision making process in the domain of performance appraisal system. Consequently, the fuzzy logic theory approach can be implemented to handle the uncertainty information involved in employee performance evaluation in the organization. This paper is basically divided into four sections. First, the introduction describes the conceptual topic of this research paper. Second, some related works along with the approach and methods in this study were explained. The third section discusses the results of this study and the final section concludes the study.

2. RELATED WORK AND BACKGROUND

2.1. Performance Appraisal and Performance Management

A performance appraisal, performance review, performance evaluation, or employee appraisal is an evaluation method by which the work performance of an employee is grounded and evaluated. Performance evaluation method and evaluation model have extensively been applied in many fields such as decision analysis, supporting system, and system engineering as well as in performance management. Performance appraisal is a formal performance management information system that ensures the evaluation of the quality of an employee's performance in an organization. There are a vast number of applicable performance appraisal systems in organizations. Organizations use a variety of methods for evaluating employee performance. There are so many types of performance management methods, understanding how each of them works assists determine the proper one to use within an organization. Each type of performance management methods has benefits and drawbacks; however, an assessment of the workforce, management style, and business environment makes the decision easier for evaluators (Shaout and Trivedi, 2013).

Performance appraisal provides the means to evaluate an employee's current and past performance relative to the employee's performance standards in the organization. It is a systematic process which involves creating work standards, evaluate employees' actual performance relative to those work standards, and giving feedback to employees so as to motivate them to improve the job performance or to eliminate performance deficiency. Some potential aims of performance appraisal system might include identifying particular job behaviors, abilities or skills. Various appraisal methods including graphic rating scale, behavioral checklist, management-by-objectives, forced distribution, multi-rater feedback, performance ranking, combined manager-employee appraisal, work planning and review, trait scales, critical incident, narrative, and criteria-based and peer review have been proposed to evaluate the performance of an employee in organization (Venclová et al., 2013).

As a consequence, with all the available applicable methods, it is crucially essential to understand that different organization might use different methods for assessing employees' performance. Since all the aforementioned methods have their own advantages and disadvantages, most organizations might mix and match different methods for their own performance appraisal system that can realize their organizational needs. Performance appraisal system has already become one of the most valuable management instrument by which organization management use to achieve collective goals and objectives. In order to ensure that the results of the performance appraisals are useful and reasonable to the supervisor when evaluating their subordinates, the performance appraisal system should consistently produce reliable and valid results for the management of an organization.

Table 1: Comparison between Performance Appraisal and Performance Management

Performance Appraisal	Performance Management
top down assessment	joint process through dialogue
performed annually	continuous reviews
use of ratings is very common	use of ratings is less common
linked to traits and characteristics	linked to quantifiable objectives,values, and behaviors
monolithic systems	flexible systems
often linked to pay	is not directly linked to pay
rigid structure / system	supple / flexible process
operational	strategic
usually housed in the human resource department	conducted by managers and supervisors
individualistic	holistic / collective
quantitative approach	combines qaulitative and qualitative approaches
retrospective for corrections	prospective, future-oriented for growth
not linked to business needs	linked to business needs
often linked to compensation	not usually linked with compensation
bureaucratic-complex paperworks / documents	less concerned with documentation

The contemporary organizations are experiencing a transformation for coping with the changing needs of the environment and excelling in the business for managing change proactively. The performance appraisal system is no longer adequate the needs of the changing environment as it was an employee evaluation process in which the appraisers were impelled to make subjective decisions and judgments about job behaviors, and the performance of the employees against the predetermined job standards. Performance appraisal system exercises control and monitors the activities of the employees through disciplinary actions and management of rewards and promotions . As a result of the globalization of competitive business, and internationalization of human resources, the organizations have changed their focus from performance appraisals to performance management that focuses on observed job behaviors, and concrete results from the previously established strategic goals and objectives.

2.2. Fuzzy Logic Theory and Performance Management

The fuzzy logic theory method has largely been applied to several performance appraisal systems. The fuzzy logic theory based multi-criteria assessment study in the group decision-making of promotion screening recommended that the methodology is a good model for a transparent and fair multi-criteria performance evaluation in military organizations (Moon et al., 2007). In many circumstances, the fuzzy set theory is successfully used to solve multiple criteria problems; appraiser tends to use vaguely defined qualitative criteria in evaluating the performance of subordinates (Jing, R.C et al., 2007). When applying fuzzy set theory to fuzzy group decision support system, it assists the decision maker to make better decisions and recommendations under different circumstances and alternatives. The multifactorial evaluation model is proposed for the application of the fuzzy logic theory to a decision-making process in information, decision, and control systems. The reviewed works on fuzzy approach support the fuzzy logic theory as a conceptual framework for use in the development of the performance appraisal system because fuzzy logic theory allows performance appraisal system to be developed by using fuzzy variables and relationships (Moon et al., 2007).

3. RESEARCH METHODOLOGY

The decision making is a process of problem-solving that involves pursuing of goals under constraints, while the outcome is a decision that results in an action (Chan, D.C.K. et al., 2002). This difficult process is basically involved with incomplete and imprecise information subjectivity, and linguistics factors, which tend to be present to some degree (Gokmen et al, 2010). As knowledge involved in employee appraisal evaluation is approximate, and fuzzy logic theory is successfully used for approximate reasoning in such circumstances, its application becomes significant to manage the uncertainty in the evaluation system. In fuzzy logic applications, fuzzy reasoning resembles human decision making with an ability to generate precise solutions from certain or approximate information (Berenji and Khedkar, 1998). The advantage of fuzziness dealing with imprecision, vagueness, and uncertainty of human expressions fits ideally into decision-making systems modeled in the fuzzy logic theory (Garibaldi and Ifeachor, 1999). Fuzzy logic theory approach has extensively been used to evaluate many types of performances and comprehensive evaluations such as environmental evaluation, weather forecast, teaching evaluation, risk management, power generation, car retrieval system, marketing, finance, manufacturing, consumers, government and so on (Zeng and Feng, 2014). In accordance, this research is also concerned with the fuzzy logic theory which mainly aims to handle the uncertainty information and human-like reasoning and approached the domain problem in performance management.

3.1. Fuzzy Logic Theory

The theory of fuzzy sets, whose members are vague objects, was introduced to model uncertainty in subjective information and analysis of complex systems (Zadeh, 1965). Crisp set of input data is generally received in terms of linguistic judgments and beliefs in natural language, which is then converted to the form of fuzzy sets in order to provide a base for logical and mathematical reasoning in information, decision, and control systems (Zadeh, 1975). A fuzzy set is represented by a membership function defined on the universe of discourse, where the fuzzy variables are defined.

Let X be a non-empty set, and fuzzy set A in X, the universal set, is characterized by μ_A ; its membership function described as

$$\mu_A : X \rightarrow [0,1] \tag{1}$$

where μ_A is interpreted as the degree of membership of element x in the fuzzy set A for each x ∈ X. [0,1] denotes the interval of real numbers from 0 to 1. Thus, the value 0 is used to represent complete non-membership, and the value 1 is used to represent membership fully, and values in between are used to represent intermediate membership degrees. The fuzzy set, A, is usually denoted by the set of pairs

$$A= \{ x, \mu_A(x)), x \in U \} \tag{2}$$

When *U* is a finite set $\{x_1,...,x_n\}$, the fuzzy set on *U* may also be represented as:

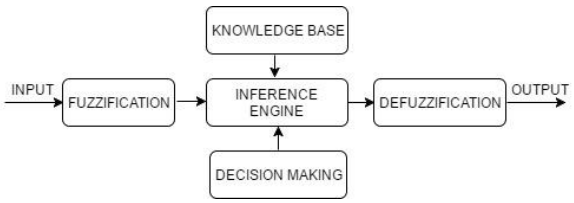
$$A = \sum_{i=1}^{n} x_i / \mu_A(x_i) \tag{3}$$

When *U* is an infinite set, the fuzzy set may be represented as

$$A= \int_x x / \mu_A(x) .$$

A fuzzy logic system with fuzzification, rule evaluation, and defuzzification parts as shown in Figure 1 can be defined as the nonlinear mapping of a crisp set of input data set to a scalar output data.

Figure 1: Fuzzy System Diagram



1) Fuzzification (using membership function to graphically describe situation in environment, crisp set of input data are gathered and converted to a fuzzy data set using fuzzy linguistic variables, fuzzy linguistic terms and membership functions)

2) Rule evaluation (application of fuzzy rules, an inference is made based on a set of rules)

3) Defuzzification (obtaining output data or actual results, the resulting fuzzy output is mapped to a crisp output using the membership functions)

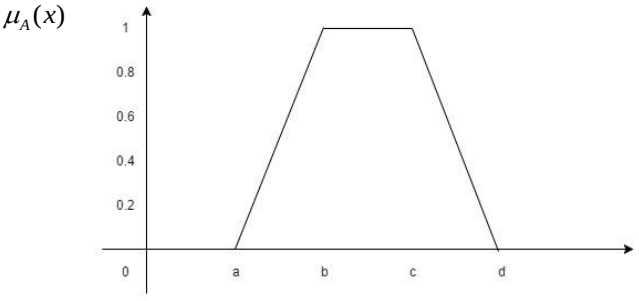
Fuzzy set theory, which generally involves three phases of fuzzification, fuzzy inference, and defuzzification, provides a means to represent uncertainties, and deals with problems in a vague environment of perception of things and human thinking. The fuzzy logic theory has successfully been applied in various fields with keywords “performance,” “evaluation,” “severity,” “possibility,” “importance,” and “satisfaction,” but their meaning varies with the situations (Yadav and Singh, 2011).

A fuzzy set contains elements that have varying degrees of membership in the set. This fuzzy logic theory transforms linguistic variables into fuzzy sets to replace the crisp sets. The values of linguistic variables are not just numbers, but verbal variables or sentences in a natural or artificial language. The fuzzy concept is very useful in complicated situations to be appropriately described by quantitative expressions.

The membership states all information contained in a fuzzy set. Membership functions of fuzzy sets must be precisely defined in respect of function type and function parameters. Both the parameters and shape of the membership functions strongly influence the accuracy. The well-known membership functions are namely triangular, trapezoidal, and Gaussian type. In this study, the trapezoidal membership function is preferred as shown in Figure 2. This function is very often used in practice for its simplicity. A small amount of data is needed to define the membership function. In addition, this type membership is very effective, especially for class interval-based works. Figure 2 shows the main parts of a trapezoidal membership function. The function specified by four parameters given by ‘‘A = trapezoid (x, a, b, c, d)’’:

Figure 2: Trapezoidal Fuzzy Membership Function

$$\mu_A(x) = f(x;a,b,c,d) = \begin{cases} 0, x \le a \\ \dfrac{x-a}{b-a}, a \le x \le b \\ 1, b \le x \le c \\ \dfrac{d-x}{d-c}, c \le x \le d \\ 0, d \le x \end{cases}$$



or,by $\mu_A(x) = f(x;a,b,c,d) = \max(\min(\frac{x-a}{b-a}, 1, \frac{d-x}{d-c}), 0)$

3.2. Fuzzy Multifactorial Evaluation

The fuzzy multifactorial evaluation method is used to quantify employee performance function in an organization. The method of trapezoidal distributed function is considered as a bridge in the mathematical method. Firstly, based on trapezoidal distributed function, the membership function of every grade (high, good, medium and low) is established about every target according to each target value of measurement of employee performance. Secondly, the number of

the weight of every target is considered based on work data and experience. Finally, the result is obtained based on the principle of maximal membership degree of multifactorial evaluation. The multifactorial evaluation method is explained with the targets of the performance function.

A multifactorial evaluation system requires three elements: A set of principal influence factors, $U = \{u_1, u_2, ...u_m\}$, A set of verbal grades, $E = \{e_1, e_2, ..., e_p\}$ and for every object $u \in U$, there is a single-factor evaluation matrix $R^{(u)} = (r_{jk}(u))_{mxp}$. With the preceding three elements, for a given $u \in U$, its evaluation result $D^{(u)} \in F(E)$ can be derived. The multifactorial evaluation model suggests that a mapping consists of factor weights (W) and relation matrix (R) which combines with an aggregation function as follows (Tutmez et al., 2007):

$$\zeta : U \to F(E) \tag{4}$$

$$u \to \zeta(u) \text{ and } D^{(u)} = f(W, R^{(u)}) \tag{5}$$

where ζ is the decision criterion, which is used to evaluate alternatives. Thus, the decision maker may choose a decision function that best reflects the goals of the decision. Aggregation operators which require different transformations for the judgments are used for evaluating different types of decision behaviors. The simultaneous satisfaction of all the decision factors can be modeled by using *t*-norm operators. *t*-Norms are fuzzy set versions of intersection operation on sets. In this sense, they are used for the conjunctive type of aggregation. Therefore, the *t*-norm based operator is considered for aggregation. The transformation function which leads to weighted minimum (and maximum) operators that can be applied in the setting of the possibility theory (Dubois and Prade, 1986). The weighted minimum is given by

$$D^{w}(\mu_1, \mu_2, ...\mu_m) = \Lambda_{i=1}^{m} \left[(1 - w_i) \vee \mu_i \right] \tag{6}$$

The set of principal influence factors on employee performance function can basically be described as follows:

U=(u1 , u2 , u3, u4) (7)

where,the principal influence factors ui (i=1 ,2, …4) may be fuzzy or non-fuzzy in nature, but the mathematical relation between ui and U is only given by ui$\in$U.

The four targets of performance function are selected as (Pmax100, Pmax80, Pmax60, Pmax40). The grade of evaluation of the performance function is targeted into four classes, and the standard of the grade is established based on work data of performance function. Thus, based on the needs of performance considerations, the rank of performance function is classified into four sorts as high, good, medium and low. Evaluation criteria should be based on the actual situation, and evaluation criteria are divided into four grade levels. Then, let V_I = high degree, V_2 = good degree, V_3 = medium degree, V_4 = low degree. Therefore, fuzzy sets of the rank of performance function for the evaluation set is given as follows

V = {V_I, V_2, V_3, V_4 } (8)

Evidently, the final evaluated results vj (j=1,2,3,4) are mainly obtained from fuzzy multifactorial evaluation approach. Indeed, fuzzy multifactorial evaluation process aims to obtain thoroughly assessed crisp results based on comprehensive consideration of principal influence factors ui.

The principal influence factor set is formed in vector U={u_I, u_2, u_3, u_4}. The level of influence of each factor for the evaluated results is not identical, for the purpose of representing the degree of influence of each factor, the appropriate weight should be given to each factor wi (i=1 ,2, … 4), thus, set of weight W is established. The distribution of a number of weights for all the factors, such as U_i is, respectively, shown in vector W.

W= (w1 , w2 , w3, w4) (9)

where W is fuzzy set on U. Evidently, W is a part set of fuzzy sets of U, indicated as follows

$$W = \frac{w_1}{u_1} + \frac{w_2}{u_2} + \frac{w_3}{u_3} + \frac{w_4}{u_4} \tag{10}$$

Therefore, W is determined with the four principal influence factors ui, as follows

W=[0.20,0.35,0.3,0.15], W(1-weights)=[0.80, 0.65, 0.70, 0.85] (11)

The key to treating the problem with fuzzy multifactorial evaluation is building the appropriate subordinate functions of the influence factors.

Fuzzy multifactorial evaluation is mainly considered by the method of compound operation denoted as follows

D= W **O** R = (d1 ,d2 ,d3, d4) (12)

where R is a fuzzy relation matrix between the set U and V, and it decides a fuzzy reflection. W is the set of weight of factors, and the original image of fuzzy reflection, D is reflected image of fuzzy reflection, or, assessed result.

In fuzzy relation matrix R, Ri =(ri1, ri2, ri3, ri4) is single-factor evaluation of ui, and part set of fuzzy sets of V. d_j is evaluation target as follows

$$d_j = \sum_{i=1}^{n=4} a_i r_{ij} \tag{13}$$

d_j represents the calculation of fuzzy matrix. The proposed model not only considers the effect of the factors but reserves the information of single-factor evaluation of ui.

The single-factor evaluation-relationship matrix R based on membership function between factor set and evaluation set is given by.

$R^{(u)}$ = {(U_i, V_j, U_{rij}) / i == l, ..., 4; j=l, ...4.}

The operation is performed by $D^{(u)} = f(W, R^{(u)})$

$$D^{(u)} = f(W, R^{(u)}) \tag{14}$$

$$= [W1, W2, W3, W4]\mathbf{O}\begin{bmatrix} R11 & R12 & R13 & R14 \\ R21 & R22 & R23 & R24 \\ R31 & R32 & R33 & R34 \\ R41 & R42 & R43 & R44 \end{bmatrix} = (D1, D2, D3, D4)$$

$$D_j = \sum_{i=1}^{n} W_i R_{ij} \quad (j = 1, ..., 4) \tag{15}$$

This is the final result of the fuzzy multifactorial evaluation.

3.3. Applying Fuzzy Multifactorial Evaluation

A normal standard of every target is established (Pmax100, Pmax80, Pmax60, Pmax40). The high range is 80%-100%; the good degree is 60%-80%; the medium degree is 60%-40%; the low degree is under 40%. Therefore, the range of each grade is shown V_1[100, 80], V_2 [80, 60], V_3 [60, 40], V_4[40, 00]. The membership function is established between every factor and each class. The trapezoidal distributive function is adopted for computation. If f_{ij} (1) (i = 1, . . . , 4; j = 1, ..., 4) shows respectively trapezoidal membership function, which is factor U_i relative to the grade V_j.

The fij (x) is lined up in part as follows but others fij (x) are omitted for convenience.

$$fij(x) = \begin{cases} 1, & (80 <= x <= 100) \\ x/80, & (80 > x > 0) \end{cases} \qquad fij(x) = \begin{cases} \frac{1}{40}(100 - x), & (80 <= x <= 100) \\ 1, & (80 <= x <= 60) \\ 1/60(x), & (60 > x > 0) \end{cases}$$

$$fij(x) = \begin{cases} (100 - x)/60, & (60 <= x <= 100) \\ 1, & (60 >= x >= 40) \\ x/40, & (40 > x > 0) \end{cases} \qquad fij(x) = \begin{cases} (100 - x)/80, & (40 <= x <= 100) \\ 1, & 40 > x > 0) \end{cases}$$

For the above trapezoidal membership function, the value of membership function of each target can be reckoned respectively, and it is shown in relation matrix R. The four performance measurement results of an employee Pmax are 50%, 80%, 65% and 35% respectively. The relationship matrix R_I is formed accordingly.

Let the Pmax100, Pmax80, Pmax60, Pmax40 are subordinated to x respectively. Then every value of f_{ij} (Pmax 100) is computed as follows:

f_{11} (Pmax100) = 0.625 , f_{12} (Pmax100)= 0.833 , f_{13} (Pmax100) = 1, f_{14}(Pmax100)= 0.625 ... then R is obtained:

In the last stage of the evaluation, the evaluation vector is found by using the Dubois–Prade decision operator as follows:

then $D = f(W,R)$ = [0.80, 0.65, 0.70, 0.85] **O** $\begin{bmatrix} 0.625 & 0.833 & 1.000 & 0.625 \\ 1.000 & 0.500 & 0.333 & 0.250 \\ 0.812 & 1.000 & 0.583 & 0.437 \\ 0.437 & 0.583 & 0.875 & 1.000 \end{bmatrix}$

d1(u)= (w1 v r11(u)) ^ (w2 v r21(u)) ^ (w3 v r31(u)) ^ (w4 v r41(u))

d1(u)= 0.80 similarly,

d2(u)= 0.65 d3(u) = 0.65 and d4(u)= 0.65

Finally, the evaluation vector is obtained:

$D = f(W,R)$ = (d1, d2, d3, d4) = (0.80, 0.65, 0.65, 0.65)

Therefore, referring to the verbal grades V= {V_1=High[100-80], V_2=Good[80-60], V_3=Medium[60-40], V_4=Low[40-00], }, the obtained employee performance function should be rated as "Good". Finally, the method of fuzzy analysis of multiple-stage is used to get the result of evaluation for performance function of the employees based on the center principle of fuzzy gravity.

4. CONCLUSION

In this paper, the method of multifactorial evaluation is applied to the evaluation of employee performance function. The method of the trapezoidal distributive function is considered as a bridge in the mathematical method approach. The trapezoidal membership function is established between each evaluation target and evaluation object. The method of multifactorial evaluation is used to conduct performance management based on the assessment of employee performance function. Performance classification of employees can reasonably be executed using multifactorial fuzzy approach. With the fuzzy decision-making system, the employee performance function can be evaluated, and information can reasonably be obtained by data processing and different decision functions. The classification of employee performance function is very useful in the evaluation of scheduling, budgeting, and planning of the organizations. It can also be evaluated in employee selection and project scheduling as a decision parameter. The fuzzy multifactorial evaluation approach can reasonably be used in performance measurement.

REFERENCES

Adnan Shaout and Jaldip Trivedi (2013). "Performance Appraisal System – Using a Multistage Fuzzy Architecture".International Journal of Computer and Information Technology, Volume 02– Issue 03, pp.405-411, May 2013.

Adnan, S. and Minwir, A. (1998). "Fuzzy Logic Modeling for Performance Appraisal Systems – A Framework for Empirical Evaluation", Expert Systems with Applications, Vol. 14, No. 3, p. 323-328, 1998.

Adnan Shaout and Mohamed Khalid Yousif (2014). "Employee Performance Appraisal System Using Fuzzy Logic". International Journal of Computer Science and Information Technology, Vol 6, No 4, pp 1-19, August 2014.

B. Tutmez, S. Kahraman, O. Gunaydin.(2007)."Multifactorial Fuzzy Approach to the Sawability Classification of Building Stones". Construction and Building Materials 21, (2007), 1672–1679.

Chan, D.C.K., Yung, K.L., Ip, A.W.H. (2002). "An Application of Fuzzy Sets to Process Performance Evaluation", Integrated Manufacturing Systems, Vol. 13 Issue: 4, pp.237-246, 2002.

Dubois D, Prade H. (1986)."Weighted Minimum and Maximum Operations in Fuzzy Set Theory". Information Sciences, 39(2), pp. 205–210.

Garibaldi, J.M. and Ifeachor, E.C. (1999). "Application of simulated Annealing Fuzzy Model Tuning to Umbilical Cord Acid-base Interpretation", IEEE Transactions on Fuzzy Systems, Vol.7, No.1, pp. 72-84, Feb 1999.

G. Gokmen, T. C. Akinci, M. Tektas, N. Onat. G. Kocyigit, N. Tektas,(2010)."Evaluation of Student Performance in Laboratory Applications Using Fuzzy Logic", Procedia Social and Behavioral Science, 2(2010), pp 902-909.

Hamid R. Berenji, Pratap S. Khedkar(1998)."Using Fuzzy Logic for Performance Evaluation in Reinforcement Learning".International Journal of Approximate Reasoning 18, pp.131-144,1998.

Jing, R.C, Cheng, C. H. and Chen, L. S. (2007). "A Fuzzy-Based Military Officer Performance Appraisal System", Applied Soft Computing, Vol. 7, Issue. 3, p. 936-945, 2007.

L. A. Zadeh, (1965). "Fuzzy Set," Information Control, Vol. 8, No. 3, pp. 338-353, 1965.

L. A. Zadeh, (1975). “The Concept of a Linguistic Variable and its Application to Approximate Reasoning,” Information Science, Vol. 8, pp. 199-249, 1975.

Moon, C., Lee, J., Jeong, C., Lee, J., Park, S. and Lim, S. (2007). “An Implementation Case for the Performance Appraisal and Promotion Ranking”, in Proceedings of the IEEE International Conference on Systems, Man and Cybernetics, Montréal, Canada, 7-10 October 2007.

Ramjeet Singh Yadav, Vijendra Pratap Singh (2011)."Modeling Academic Performance Evaluation Using Soft Computing Techniques: A Fuzzy Logic Approach".International Journal on Computer Science and Engineering,Vol. 3, No.2,Feb 2011,pp.676-686.

Schweiger, I. and Sumners, G.E. (1994), "Optimizing the Value of Performance Appraisals", Managerial Auditing Journal, Vol. 9 Issue: 8, pp.3-7, 1994.

Venclová Kateřina, Šalková Andrea, Koláčková Gabriela (2013).”Identification of Employee Performance Appraisal Methods in Agricultural Organizations”. Journal of Competitiveness.Vol. 5, Issue 2, pp. 20-36, June 2013.

Wenyi Zeng and Shuang Feng (2014)."An Improved Comprehensive Evaluation Model and its Application". International Journal of Computational Intelligence Systems, Vol. 7, No. 4, 706-714, 2014.