Comparison between Candidates for the Position of Manager based on Fuzzy Logic

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***Abstract*— The process of selecting a manager is a vital and important process in the management of any organization or institution, as the manager is considered the person who bears responsibility for making important decisions and directing the team towards achieving the organization's goals. Fuzzy logic is one of the artificial intelligence systems that helps make decisions that contain uncertain or unreliable information. In this research, four fuzzy inference systems were used to choose the appropriate manager based on four qualities (personality, scientific, leadership, administrative). Through the results applied to the group of candidates to whom the test questions were distributed, we found that there is a variation in the characteristics. One of the conclusions of this research is that the proposed method of selecting the appropriate manager can be applied in different organization.**

***Index Terms*— Fuzzy logic, Fuzzy inference system, manager selection.**

I. INTRODUCTION

The manager plays an essential role in achieving the organization's goals [1]. Choosing the right manager is of utmost importance as it increases the chances of reaching the organization's ultimate goals [2]. In addition, the right manager can motivate the team and increase their productivity, thus improving the organization's performance [2], on the other hand the competent manager plays an important role in achieving the organization's goals [3].

One of the most important challenges that institutions face is the process of selecting a manager . The process of selecting a manager is a vital and important process in the management of any organization or institution, as the manager is the person who bears responsibility for making important decisions and directing the team towards achieving the organization's goals. In this introduction, we will take an overview of the manager selection process, its importance, and how to address it using intelligent techniques [4].

Disaggregated data within predefined criteria have been widely used in employee selection for a long time, mainly due to their predictive validity in different contexts, lack of falsification, and positive applicant reactions [5], [6].

At present time, it is necessary to highlight some drawbacks, as the purposeful discriminatory content of managerial selection within pre-defined criteria is a major concern. In order to shed light on these issues, the objectives of the current research are twofold: first, we aim to develop data items classified within pre-defined criteria for selecting managers to provide managerial positions in public administration, and second, we aim to test the fuzzy logic method. As a valid approach to developing biometrics, with the aim of selecting the best biometric data elements in terms of functionality, fairness and privacy, according to the manager and applicant's point of view.

Manager selection is a critical process in various industries, such as logistics, construction, and finance. Research indicates the importance of using multi-criteria decision-making methods for selecting competent managers [7], [8]. For instance, in logistics companies, the experience criterion is highlighted as crucial for selecting human resources managers [9]. Moreover, the finance literature suggests that institutional investors may not add value through manager selection, possibly due to inappropriate benchmarking practices.

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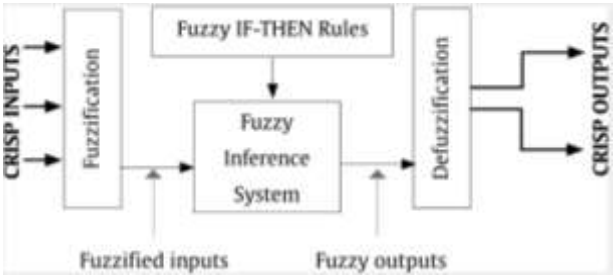
Literature review

The challenges in change management include differences in leaders, management mechanisms, markers of changes, the process of selecting a manager is one of the most difficult challenges facing the organization, as it is the company's duty to determine the skills, experience, and requirements that the nominated manager possesses, based on the organization's needs and the nature of the work [10]. The relationship between management teams' configuration, leadership motivation, and national culture impacts change mechanisms [10], The manager selection process includes searching for suitable candidates, whether inside or outside the organization, and then conducting evaluations [10].

In [11], the authors provide theoretical knowledge that provides a good basis for improving operational practices aimed at properly identifying candidates for managers, their proper education and training throughout their working lives and career development. Proper manager selection involves considering knowledge, desirable traits, attitudes, authority, and group dynamics. Continuous training and career development are crucial for effective managerial performance.

In [12] The authors have used four qualities (Wealth, Prestige, Professionalism Leadership) on different weights to choose the best manager with fuzzy logic, the four qualities are evaluated as following: (a) Wealth (poor, good, excellent), (b) Prestige (poor, good, excellent), (c) Professionalism (poor, good, excellent), (d) Leadership (poor, good, excellent). The most important conclusions of [12] that a developed fuzzy system can be successfully used for assessing candidates with their goals and for making of a decision making strategy in choosing the possible selected manager .

In [4] The study shows that Human Resources HR is suitable for making multi-criteria group decisions using the Mamdani method in FIS, where applied on a group of job applicants to select qualified candidates, the authors of [4] that using fuzzy logic will increase productivity within the organization when hiring the right person. In Figure 1 show simple structure of FIS.



a) Figure 1 : Fuzzy inference system [4]

Methodology

In this research we present a 20 questions that were used in northern technical university in Mosul- Iraq applied on 10 candidates as a manager, these 20 questions divided into four basic administrative skills (personality, scientific, leadership, administrative). Then, apply the four FIS on each group. Finally, summation all results to find the final result for the best candidate.

Administrative skills encompass a range of competencies crucial for effective management in various settings. Research findings highlight key dimensions of administrative skills essential for school administrators, including human, technical, and organizational skills [13]. Additionally, a study focusing on the informal trading sector emphasizes the significance of administrative practices for both local and foreign traders, pointing out weaknesses such as inadequate shelters, security, and formal accounting systems [14]. Furthermore, the importance of administrative skills in public services is underscored, indicating a significant relationship between administrative skills, information systems, and service quality [14].

In this section a short description of stages of work presented as following:

1. A twenty questions are prepared for candidates and divided into four groups, each five questions representing one of the four

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administrative skills. Table 1 represent all 20 questions as a Google form.

2. A special membership functions for each question were prepared, that used in fuzzy logic (and according to the question answers , two, three, four-answer). Each question contains several options and an average score of 0-60 , 0-80 or 0-100 marks for represent membership function.
3. Then, Entering the answers of candidate into the Fuzzy Inference System (FIS) in the MATLAB program through four groups, for each group of administrative skills a 18 conditional (if then rules) built to test all attributes, using the Mamdani fuzzy inference system.
4. Each value of each question of each candidate was tested by fuzzy inference system, then took the results for each characteristic.
5. A final results obtained from summation of the four fuzzy inference systems for each candidate.

Table 1: The 20 administrative skills (personality, scientific, leadership, administrative)

No.	**Questions**	**Answers**			
1	Are you good at dealing with technology?	Yes	No		
2	The ability to negotiate with working individuals who are difficult?	Effectual	formality	Don't negotiate	
3	Ability to withstand working conditions in which the severity of complexity and ambiguity?	I endure it Obvious	I limit endure	Very limited endurance	
4	Wearing the mantle of diplomacy in dealing with others?	Always	Limited	Rarely	
5	Do you deal with employees according to the situational data facing their work environment?	Always	Limited	Rarely	
6	Contributions to the administrative specialization	Obvious	Limited	Very limited	
7	Your contributions to solving the problems facing your colleagues in the field of work?	I contribute significantly	I don't care	I refuse any contribution	
8	The lack of suitable working conditions for me makes me constantly criticize my department	Always criticize	Criticize according to the circumstances	I don't criticize	
9	Do you have a clear vision of the organization's employees?	I see thing that I can feel from actions	It hard for me to feel outcome of actions		
10	Raised by complaint	Yes	No		

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	s and grievances issued by others?				
11	Compare yourself with others in the framework of developing the work of the institution in which you work?	Yes	No		
12	Do you give legal aspects of a moral nature over the material gains they obtain?	I put the material ahead of the morale	I focus on morals	Pairs between morale and materialism	I don't care
13	Do you show sympathy for the bad people in the hope of reforming them, or do you see deterrence as the best way?	I sympathize to fix or maintenance the situation	I sympathize temporarily	I don't sympathize	
14	Seriously keep the secrets of working in your organization?	I absolutely keep	I hesitate to keep	I keep according to my perspective on the topic	
15	Do I focus on my well-being at work without caring about others?	Yes	No		
16	Do you accept the doubts issued by others against me despite their condemnation of me?	Yes	No		
17	Scientific contributions in the field of authorship?	I have	I don't have		
18	Do you teach subjects outside the scientific discipline?	Yes	No		
19	How many subjects have you taught?	Never taught	One subject	Two subjects	Three or more
20	Have you lectured in continuing education courses?	Yes	No		

Fuzzy inference system

A fuzzy inference system (FIS) is a computational model based on fuzzy set theory and fuzzy rules, commonly following an "IF-Then" structure [15]. FISs are utilized in various applications like decision analysis, expert systems, and predictions due to their ability to handle uncertainty and imprecision effectively [3]. These systems typically consist of an inference unit for processing fuzzy logic and a control unit for managing operations [16] . In cases where numerical values are missing from the fuzzy knowledge base, a calculation processing device is employed to compute and provide the necessary information back to the FIS for continued inference processing [17].

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Results

In this part, the organic functions of the four Fuzzy Inference Systems (FIS) were designed according to the four spirit characteristics (personal, leadership, administrative, scientific), and conditional (if..then rules) were introduced using linking operations for fuzzy sets (And, Or, Not). Each question has (two, three or four) membership function for representing the all range of all questions.

A five variables build to represent five questions, which are a group of personal qualities, see figure 2. A range is variables was from (0-60), (0-80) or (0-100) based on question form, where the output of FIS take a range (0-100), here a fuzzification will be applied by using Mamdani method [18]. Then the (If.. Then ..Rules) created to calculate the results by using FIS in MATLAB [19], see Figure 3.

The Fuzzy Inference and Fuzzy Rule Base. According to Mamdani and Assilian (1975) [20], fuzzy inference and fuzzy rule base uses a fuzzy expert rules structured as:

IF Antecedent THEN Consequent; …… (1)

Or more explicitly as:

IF X is A AND Y is B THEN Z = C;……. (2)

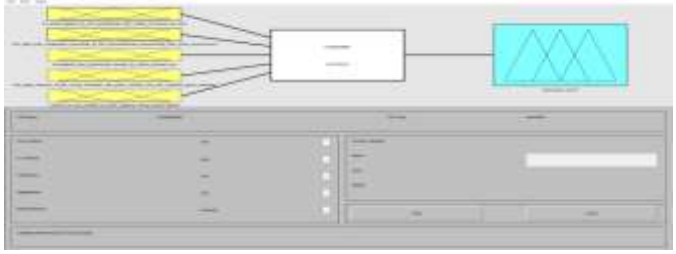

Figure2 : Represent five Variables in FIS personal qualities

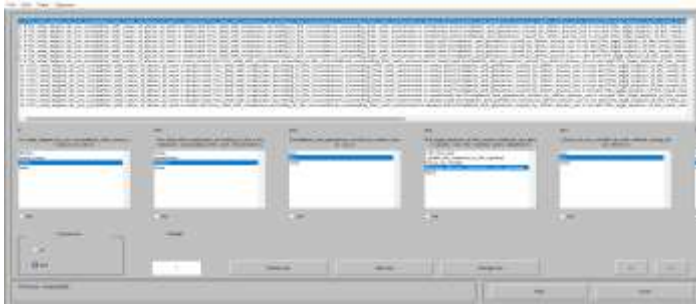

Figure 3 : sample of (If… Then .. Rule) statements personal qualities

After that, entering values for variables in Fuzzy Inference System (FIS), that taken from answers of each candidate, see Figure 4. In Figure 4 the yellow rectangular are represents the input for one candidate for the first five questions, where the blue rectangular represent the output of difuzzification from (if .. then rules), final result of difuzzification was taken from red line.

After this, the questionnaire results for each candidate are placed according to their group in the Input box, and the result of the candidate's first group is noted in the Output box, or what is called participant score. The trimf structure is formed.

Figure 4 : result of entering the personal qualities for one candidate

As same as a procedure of all previous steps applied for other three characteristics (leadership, administrative, scientific) respectively, then, we collected the results of four (FISs) to find the final results for the all candidates, Table 1 shows the final results for ten candidate, it is clear that the candidate number 9 has got the best result (264.5) points while the candidate number 5 has got the best second result (236.9), and so on.

Where the final results is calculate as follows:

$$final\ results = \text{leadership} + \text{scientific} + \text{personality} + \text{managerial};$$ ……(3)

Where the leadership, administrative, scientific, managerial are results from fuzzy inference systems from each group.

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Table 1 : Results obtained from the fuzzy inference system of all skills (personality, scientific, leadership, administrative)

No.	leadership	scientific	personality	managerial	results
1	82.9	54	21.3	50	208.2
2	50	21.3	50	79.8	201.1
3	50	50	50	50	200
4	50	50	50	79.8	229.8
5	82.9	54	50	50	236.9
6	50	84.7	33.2	50	217.9
7	50	54	50	50	204
8	50	50	50	50	200
9	50	84.7	50	79.8	264.5
10	50	54	50	50	204

Conclusions

In this research, we conclude from the results that are found using Fuzzy Inference System of four separate types of attributes (personal, administrative, leadership, and scientific) has an efficient value. Also, ease and speed in making the appropriate decision. The results have accuracy and impartiality, as there is no favoritism to oppress one party. On the other hade clarity and transparency in the course of the process. The recommends of this work is using the proposed system governmental and private facilities. Also, for developing this work in new research can use artificial neural networks instead of fuzzy logic and compare the results.

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