Competency Assessment Based on Fuzzy Logic and Artificial Intelligence Mechanism: A Study of Competency Assessment Document for the Algerian SEROR Company

Mohammed Sahnouni, https://orcid.org/0009-0007-7937-7730
PhD, Lecturer 'A', University of Algiers 3 Ibrahim Sultan Cheibout, Algeria
Riad Benghebrid, https://orcid.org/0009-0002-7152-2300
PhD, Senior Researcher, Centre for Research in Applied Economics for Development, Algeria
Corresponding author: Mohammed Sahnouni, elnhari_05@yahoo.fr
Type of manuscript: research paper

Abstract: Addressing the issue of how automating the quantitative assessment of competencies through a competency assessment document came to remove the assessment process from the descriptive side and an attempt to propose a new model aligned with modern management requirements. Competency assessment is considered one of the most important indicators for managing competencies in organizations, as it offers valuable insights into the strengths and weaknesses of human resources, which is essential for strategic planning. Organizations are actively seeking a cost-effective and accurate system, aiming to minimize the impact of subjective biases in the evaluation process. Additionally, there is a need for a solution that facilitates swift assessment of a large workforce, ultimately reducing overall costs. To meet these requirements, the current study employs Fuzzy Logic and Artificial Intelligence mechanism to develop a contemporary and precise evaluation model. The study, which analyzed competency assessment data from the Algerian SEROR Company, showcased the possibility of creating a sophisticated quantitative model for competency evaluation using Fuzzy Logic and Artificial Intelligence Mechanism. The results imply that the institution has the potential to embrace a cutting-edge and forward-thinking approach, enhancing objectivity, particularly in dealing with complex systems. Developing a quantitative competency evaluation model requires a comprehensive database that includes relevant factors in the evaluation process, encompassing details about each employee's position, skills, knowledge and experience. The research emphasizes that creating a quantitative model through Fuzzy Logic and Artificial Intelligence Mechanism is highly achievable, with the applied study indicating an 85% success rate for the model.
Keywords: competence, competency assessment, FisPro, fuzzy logic, artificial intelligence mechanism.
JEL Classification: J24, M12, M53.

Competency Assessment Based on Fuzzy Logic and Artificial Intelligence Mechanism: A Study of Competency Assessment Document for the Algerian SEROR Company

Introduction

Competence in management refers to the combination of cognitive, practical, and organizational skills that an individual possesses and employs to achieve high organisational performance (Benghebrid, 2023). In this context, assessing individuals' capabilities in professional settings is one of the crucial processes designed to facilitate the discovery and redirection of their knowledge and skills to effectively mobilise their abilities to carry out present or future tasks. This process is a basic system in human resources management in organisations and one of the approved tools to implement discretionary management of jobs and competencies. Evaluating individuals, referred to in management as competencies assessment, is one of the strategic functions through which the organization seeks to judge the performance of its human resources and overall performance. This strategic function, which differs from one company to another, allows to choose methods for evaluating individuals and to measure the gaps between established strategic plans and the competencies available. Accurate evaluation of competencies is a dynamic and interactive approach that aims to harmonize the targeted skills and the actions taken to develop them. It is essential for evaluating the importance of skills/experiences (know-how), knowledge related to performing tasks (soft skills) and, from it, the creation of a comprehensive profile of each individual's competencies (Levey-Leboyer, 2009).

Competency assessments can only be truly effective when appropriate tools are utilized to ensure fair evaluations, where the companies often rely on internal actors, particularly those with close relationships to individuals being evaluated. This brings up the issue of how objective the evaluation approach is, particularly when we shift from using objective quantitative criteria to favouring qualitative standards and analysis processes. In such cases, there is a potential for the evaluation results to be influenced by subjectivity and personal relationships (Feutrie, 1998). The assessment procedure may involve subjectivity stemming from errors committed by the evaluator, whether deliberate or inadvertent. Consequently, the evaluator should exercise caution and implement necessary measures to avoid making mistakes.

The organisation generally seeks to make the evaluation process effective and accurate. Still, despite this, we find that these methods are financially expensive, so evaluating employees in an organisation with a large human resource takes time and requires multiple means and effort (Le Boterf, 2011). In addition, the inherent psychological influences on the evaluator, of the evaluator, which he cannot control and can impact impartiality among employees, processing information in a large amount requires thinking about new mechanisms and methods likely to provide solutions to organisations and facilitate the evaluation process. Hence, the challenge of assessing proficiency within organisations led us to consider an automated quantitative approach that provides more precise results, and accordingly, measuring linguistic variables, such as high-level competence, weakness, and subject to improvement, is possible. In other words, the current study seeks to propose a new model for competencies assessment. To this end, we will try to answer the following question: *How can a model be developed to assess human competencies within an organization that enables the employer to distinguish the competency of its employees?*

Addressing the issue of how to find an automated quantitative method for assessing competencies came to take the evaluation process out of the descriptive aspect and as an attempt to propose a new model consistent with the requirements of modern management. Assessing competencies is considered one of the most important indicators for managing competencies in an organisation because developing plans and strategies requires full knowledge of the strengths and weaknesses within the workforce. Therefore, organisations need to search for an effective, accurate, and inexpensive system that ensures proper evaluation, reduces the impact of the psychological aspect of the evaluator when carrying out the evaluation process, and helps to evaluate the largest number of workers in a short time and at the lowest costs. For that, we relied in our analysis for the competency assessment document of the SEROR Company, which holds an ISO certificate, on quantitative data collection tools through the use of *Fuzzy Logic*, which is a useful framework for dealing with uncertainty in logic programming (Angelov, 2004), a data processing base (*FisPro*) which allows the creation of fuzzy inference systems (Koohsari & al., 2023), and an Artificial Intelligence Mechanism, with a discussion before presenting the general conclusion of our research.

Literature Review

Assessment is the process of understanding oneself and others in some situations, often criticized for its random and arbitrary nature. The need for assessment aims to gain better insight into the individual's contribution to the team to benefit both the evaluator and the evaluated, provided that it is not limited to a simple administrative procedure (Neu-Stein, 2023). Successful human resources management requires a precise evaluation and depiction of existing competencies alongside an efficient alignment of the competencies essential for specific roles. Employing a detailed quantification chart with a mathematical methodology serves as a means to bolster competency analyses. The integrated utilization of software technologies, coupled with mathematical and statistical techniques, facilitates assessing and examining competencies. Leveraging human resources information systems grounded in a standardized competency model, a versatile proposed framework furnishes corporate-level experts with tools to evaluate employees or streamline recruitment processes. This system has undergone testing using actual human resources datasets (Bohlouli et al., 2017).

Referring to the Algerian context, several studies addressed the status and importance of competency assessment in healthcare institutions knowing the extent of its contribution to achieving the quality of health services provided and identifying methods that, in turn, determine and modify the components of competency. According to the results of Gataff and Abid (2020) study, adapting to the dynamic challenges in health organizations requires a thorough evaluation of their human competencies, aiming to enhance the effectiveness, fairness, and quality of healthcare services for both patients and society. Among the common errors in the assessment process is the manifestation of bias and the failure to operate with objectivity, resulting in the dissatisfaction of employees. The second critical error lies with the evaluator, who must possess competencies that equip them with the ability to arbitrate according to scientific evaluation standards. The absence of such competence in evaluation can result in an unjust assessment process (Gataff & Abid, 2020).

Competency assessment can be approached in two distinct manners: through proficiency levels or point or percentage-based metrics. Opting for proficiency levels is preferred as it offers a clear framework for evaluators. On the contrary, utilizing effectiveness or percentage ratings without specific criteria poses challenges for evaluators, introducing a substantial degree of subjectivity into the results. Additionally, in adopting information technology, it is crucial to consider aspects such as automating competency management processes and gathering employee-related information to accurately gauge the extent of their competence (Goldman & Scott, 2016). Typically, in Algerian companies, competencies are assessed through oral evaluations conducted in committee meetings organized by the administration, with little consideration given to the competency assessment document (Sahnouni & Bandi, 2015). The Tuzinsk and Fetzer study presented an advanced automated model designed for employee selection and competency evaluation. This technology-driven model reduces the impact of biased human judgment during hiring by providing an efficient system. It employs artificial intelligence to streamline decision-making, utilizing objective data associated with essential competency criteria (Fetzer & Tuzinski, 2013).

Methodology

As previously stated, the present study aims to tackle the issue of competency assessment within Algerian companies. To delve deeper, we opted for an essentially quantitative approach with a diversity of the sample (Cadre, Mastery, Executive) active in SEROR Company. The assessment method relied on the document allocated for this process by the company, where 110 documents were distributed to the party in charge of the evaluation. The direct official officer of the labor team completes the following document. This officer is responsible for marking or annotating information, which is then communicated to the human resources representative. The purpose is to process the data provided and to assess the individual's competency level, whether it is deemed competent, average, incompetent, etc.

Table 1. Professional Competence Assessment Card

Cadre	C
Mastery	M
Executive	E

ASSESSMENT CRITERIA	Note (0-20)
WORK KNOWLEDGE Does the person concerned know his or her job satisfactorily?	A
Specific knowledge possessed by the employee	B
Strategic value of competence	C
WORK QUALITY – FACULTY OF WORK Ability to perform work	D
Quality of work performed	E
ADAPTABILITY	
Possibility of acquiring new knowledge?	F
PERSONNEL QUALITY	
Professional conscience	G
Spirit of cooperation	H
Self control	I
Sense of communication	J
Discipline	K
LEADERSHIP POTENTIAL	
a) Initiative	L
b) Sense of responsibility	M
c) Tenacity	N
EXPERIENCE	
Duration of work	O
Positions occupied in other companies:	P
Number of companies	Q
Number of positions	R
Number of domains	S

Source: Authors elaboration based on FisPro outputs

This assessment card includes a set of criteria developed by human resources officials, and each criterion has a set of standards through which the assessment process is carried out with observations (good, average, etc).

Our discussion with the human resources official regarding the organization's assessment document revealed that although there is a supervisor tasked with assessing individuals charge of recording determinants, the overall processing of this document lacks meaningful outcomes. Consequently, the organization schedules meetings specifically for the evaluation process, attended by the person in charge of human resources, a union representative, the direct supervisor of the worker and a committee comprised of workers elected. The evaluation unfolds through oral discussions, with participants mentioning names and providing opinions after hearing from the direct supervisor. In this context, the document designed for the evaluation process holds limited significance, indicating a flaw and issue in the current process.

Creating a model involves envisioning the acquired data, and assessing immeasurable variables poses significant challenges. Traditional methods for evaluating organisational competencies are costly and time-consuming, particularly in large-scale settings. In response, our proposal came up depending on quantitative methods, including Fuzzy Logic to facilitate competency-level decision-making because the Fuzzy programming yields effective solutions (Kumar & Kaur, 2011), the data processing base FisPro (Guillaume & Chamomordic, 2011), and an Artificial Intelligence Mechanism, that simulates human thinking and intelligence based on the automated programming system. We organized the acquired information into a matrix table for quantitative analysis. The data was encoded using letters, with the initial letters of "Cadre" (C), "Mastery" (M), and "Executive" (E). For determinants, we followed the order of foreign letters. The table below displays the evaluation results for 50 workers in the organisation.

Table 1. Data Matrix Related to the Company's Worker Evaluation Process

Assessment criteria / Staff	A	B	C	D	E	F	G	H	I	J	K	L	M	N
C 1	18	18	18	17	17	18	15	15	15	17	18	16	17	11
C 2	17	16	18	15	15	17	16	16	17	18	18	15	17	12
C 3	14	15	14	12	11	15	14	14	12	16	17	14	17	11
C 4	13	14	15	16	15	17	15	14	15	17	16	16	16	10
C 5	15	15	15	14	14	17	16	17	15	18	18	15	17	12
C 6	17	17	17	18	18	19	19	19	18	18	19	18	18	18
C 7	17	17	18	17	17	18	18	18	18	18	18	19	18	17
C 8	18	17	17	16	18	17	18	17	17	19	19	18	18	18
C 9	17	15	18	15	16	17	17	18	14	19	17	15	14	12
C 10	9	10	3	11	10	12	12	7	6	10	13	7	9	5
C 11	13	14	6	11	10	14	15	12	11	14	16	12	13	10
C 12	12	10	8	13	11	14	11	10	12	14	15	11	13	10
C 13	14	15	11	14	16	17	18	16	14	18	17	13	15	14
C 14	8	13	5	10	11	7	11	9	6	10	12	12	8	6
C 15	11	10	7	9	8	13	10	11	6	5	13	11	4	7
M 1	17	15	15	18	16	17	17	19	18	18	18	18	16	17
M 2	9	8	6	10	10	11	7	6	5	11	13	9	10	3
M 3	17	17	16	14	14	15	14	14	12	13	15	11	10	6
M 4	10	12	10	11	10	13	14	13	11	14	15	10	12	7
M 5	15	15	14	16	16	17	15	14	13	13	14	12	12	8
M 6	18	18	18	16	17	16	17	15	14	19	19	16	18	12
M 7	10	11	6	7	4	8	7	5	4	6	5	3	2	1
M 8	13	15	12	14	15	13	13	14	11	16	16	13	15	10
M 9	11	10	10	9	10	12	12	8	9	11	14	9	12	5
M 10	10	11	6	10	8	6	9	5	4	8	12	10	6	3
M 11	17	14	15	14	15	14	12	13	15	16	18	14	15	11
M 12	14	13	12	15	13	11	11	13	10	14	15	11	12	7
M 13	13	12	10	12	10	10	8	7	8	10	13	11	10	5
M 14	15	16	15	15	15	14	14	15	15	16	14	15	14	8
M 15	16	14	15	17	17	15	17	17	18	18	!	16	16	15
E1	17	16	14	13	13	11	15	14	16	17	18	12	15	7
E 2	8	9	4	6	7	11	8	7	4	9	14	7	10	3
E 3	13	12	10	14	12	14	10	12	10	14	16	12	15	9
E 4	16	14	15	13	12	11	13	14	17	18	17	15	17	12
E 5	19	19	19	17	16	18	16	18	17	15	18	15	18	14
E 6	15	15	17	13	14	12	11	13	14	15	17	12	14	6
E 7	12	11	10	13	14	11	13	13	12	15	17	12	11	8
E 8	14	15	16	14	16	17	14	15	13	15	18	12	14	17
E 9	18	18	16	14	15	18	15	13	15	14	18	13	16	12
E 10	17	18	16	14	15	17	16	14	15	13	16	14	15	10
E 11	7	6	5	8	6	9	5	4	5	7	10	9	6	3
E 12	11	10	8	11	9	7	11	6	9	6	7	5	4	3
E 13	17	17	18	14	17	18	15	15	14	17	19	14	16	14
E 14	13	14	12	11	13	14	11	12	13	14	17	12	14	11
E 15	16	15	17	18	18	17	17	15	16	14	13	14	18	15
E 16	15	13	14	13	14	13	12	14	14	14	15	12	11	13
E 17	12	11	12	11	10	10	9	11	11	10	9	9	8	9
E 18	17	16	17	16	15	15	14	16	16	15	14	14	13	14
E 19	15	14	15	14	13	13	12	14	14	13	12	12	11	12
E 20	14	13	14	13	12	12	11	13	13	12	11	11	10	11

Source: Compiled by the authors based on FisPro outputs

Using the provided in the table above is related to the competency assessment of 50 workers at the SEROR Company based on six evaluation factors, each comprising 14 criteria. We calculated the arithmetic average for each determinant through the programming process to limit the criteria. We obtained the following table:

Table 2. Evaluation Determinants of the Outputs of FisPro System

The sample	Work knowledge	Work quality	Adaptability	Personnel quality	Leadership potential	The sample	Work knowledge	Work quality	Adaptability	Personnel quality	Leadership potential
Cadres	18.0000	17.0000	18.0000	16.0000	14.6667	Mastery	15.3333	14.5000	14.0000	14.8000	13.3333
Cadres	17.0000	15.0000	17.0000	17.0000	14.6667	Mastery	13.0000	14.0000	11.0000	12.6000	10.0000
Cadres	14.3333	11.5000	15.0000	14.6000	14.0000	Mastery	11.6667	11.0000	10.0000	9.2000	8.6667
Cadres	14.0000	15.5000	17.0000	12.2000	14.0000	Mastery	15.3333	15.0000	14.0000	14.8000	12.3333
Cadres	15.0000	14.0000	17.0000	16.8000	14.6667	Mastery	15.0000	17.0000	15.0000	14.0000	15.6667
Cadres	17.0000	18.0000	19.0000	18.6000	18.0000	Executive	15.6667	13.0000	11.0000	16.0000	11.3333
Cadres	17.3333	17.0000	18.0000	18.0000	18.0000	Executive	7.0000	6.5000	11.0000	8.4000	6.6667
Cadres	17.3333	17.0000	17.0000	18.0000	18.0000	Executive	11.6667	13.0000	14.0000	12.4000	12.0000
Cadres	16.6667	15.5000	17.0000	17.0000	13.6667	Executive	15.0000	12.5000	11.0000	15.8000	14.6667
Cadres	7.3333	10.5000	12.0000	9.6000	7.0000	Executive	19.0000	16.5000	18.0000	16.8000	15.6667
Cadres	11.0000	10.5000	14.0000	13.6000	11.6667	Executive	15.6667	13.5000	12.0000	14.0000	10.6667
Cadres	10.0000	12.0000	14.0000	12.4000	11.3333	Executive	11.0000	13.5000	11.0000	14.0000	10.3333
Cadres	13.3333	15.0000	17.0000	16.6000	14.0000	Executive	15.0000	15.0000	17.0000	15.0000	14.3333
Cadres	8.6667	10.5000	7.0000	9.6000	8.6667	Executive	17.3333	14.5000	18.0000	15.0000	13.6667
Cadres	9.3333	8.5000	13.0000	9.0000	7.3333	Executive	17.0000	14.5000	17.0000	14.8000	13.0000
Mastery	15.6667	17.0000	17.0000	18.0000	17.0000	Executive	6.0000	7.0000	9.0000	6.2000	6.0000
Mastery	7.6667	10.0000	11.0000	8.4000	7.3333	Executive	9.6667	10.0000	7.0000	7.8000	4.0000
Mastery	16.6667	14.0000	15.0000	13.6000	9.0000	Executive	17.3333	15.5000	18.0000	16.0000	14.6667
Mastery	10.6667	10.5000	13.0000	13.4000	9.6667	Executive	13.0000	12.0000	14.0000	13.4000	12.3333
Mastery	14.6667	16.0000	17.0000	13.8000	10.6667	Executive	16.0000	18.0000	17.0000	15.0000	15.6667
Mastery	18.0000	16.5000	16.0000	16.8000	15.3333	Executive	14.0000	13.5000	13.0000	13.8000	12.0000
Mastery	9.0000	5.5000	8.0000	5.4000	2.0000	Executive	11.6667	10.5000	10.0000	10.0000	8.6667
Mastery	13.3333	14.5000	13.0000	14.0000	12.6667	Executive	16.6667	15.5000	15.0000	15.0000	13.6667
Mastery	10.3333	9.5000	12.0000	10.8000	8.6667	Executive	14.6667	13.5000	13.0000	13.0000	11.6667
Mastery	9.0000	9.0000	6.0000	7.6000	6.3333	Executive	13.6667	12.5000	12.0000	12.0000	10.6667

Source: Compiled by the authors based on FisPro outputs

In terms of experience, we lack an assessment from the individuals in charge of the evaluation process. This absence of data poses a significant issue, mainly because experience is a crucial factor in determining competence.

Results

1. Membership Equation. Expressing these factors involves employing a mathematical equation called membership and belonging. In this study, these factors are depicted through curves rooted in linguistic variables: a high level, a level open to improvement and a low level. This representation is applied to each determinant using a belonging equation that ranges between one and zero (1-0). We will delve into each determinant individually, aiming to unravel its role in determining the efficiency level within the system and the model that we obtained.

Work Knowledge. Through the membership function represented in the curve, we find that when work knowledge takes the values 6, 8, and 9, it receives a degree of belonging, 1 meaning total belonging at the weak level. However, at a value of 10, there is potential for improvement, with a belonging percentage of 0.25. As the work knowledge value reaches 13.8, it achieves a perfect belonging score of 1 in the category open to improvement, signifying complete alignment. The belongingness score is divided at a value of 15, with 0.5 in the improvable category and 0.5 in the good level. When the value is 16, the belongingness score is 0.25 for the improvable level and 0.75 for the good level, but when the value is 16.5 and above, it is a complete belonging to the good level, meaning you get a degree of belonging of 1.

The Role of Work Knowledge in Determining an Individual's Competence. From our working model, we extracted the following data that shows whether work knowledge determines an individual's competence or not. At the value of 11.8, we notice the presence of two factors that take the two characteristics: the characteristic of efficiency that can be improved and the characteristic of good efficiency. Therefore, work knowledge does not precisely determine the final result for each individual and does not significantly impact determining competency.
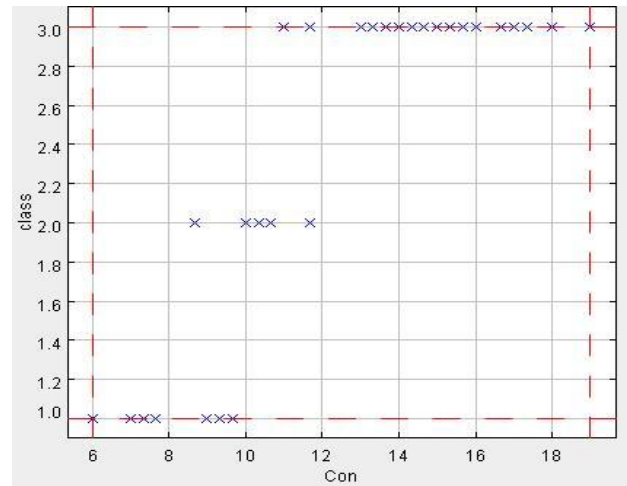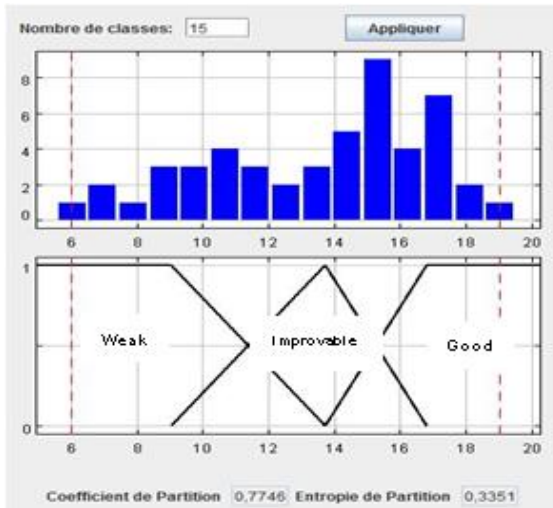
Figure 1. The Membership Equation for Work Knowledge and Its Role in Determining the Individual's Competence

Source: Authors' elaboration based on FisPro outputs

Work Quality. The quality of work is among the factors influencing the competency evaluation process. For evaluation points ranging from 6 to 7.8, a full belonging degree of 1 is assigned to the weak level, indicating complete alignment. At evaluation point 10, there is a split, with 0.5 set to the level open to improvement and another 0.5 to the weak membership category. Progressing to point 12, a total belonging score of 1 is awarded to the group susceptible to improve. At point 14, there is an even distribution with a score of 0.5 for both the improvable and good levels. Moving to point 15, a score of 0.25 is given for the improvable level, while a score of 0.75 is assigned to the good level. However, from point 16 onward, there is a complete belonging degree of 1 to the good level.

The Role of Work Quality in Determining an Individual's Competence. By examining the graphical curve, we notice that when work quality and ability values reach 10.25, workers make judgments across three levels: weak, improvable, and good. It is noteworthy that quality alone cannot determine competency, indicating that it does not substantially influence overall comptency.
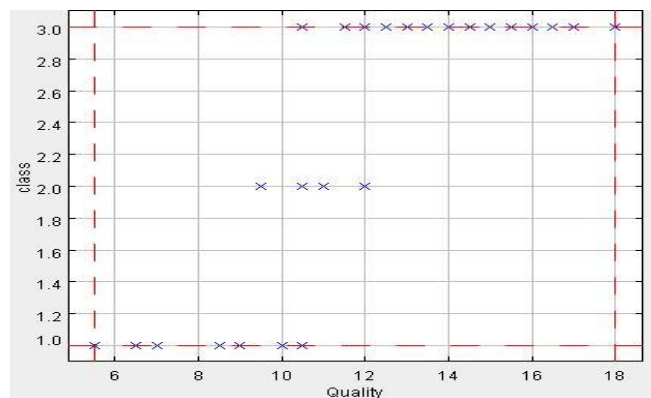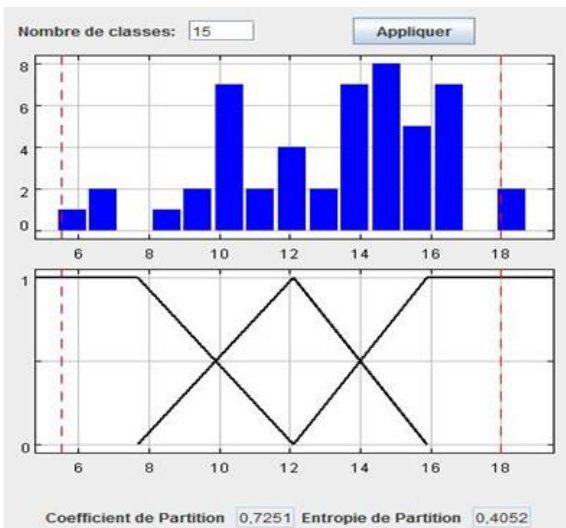

Figure 2. The Membership Equation for Work Quality and Its Role in Determining the Individual's Competence

Source: Authors' elaboration based on FisPro outputs

Adaptability. Adaptability is among the determinants of the SEROR Company's competence evaluation. When the evaluation score is between 0 and 8, the degree of belonging takes the value 01 at the weak level, the degree of total belonging. However, at point 11, the belongingness degree is 0.5 at the weak level and 0.5 at the improvable level. At point 12, the degree is 0.25 at the weak level and 0.75 at the improvable level, while at point 13, it is a full affiliation at the improvable level. At point 14, the degree is 0.25 at the good level

and 0.75 at the improvable level. Point 15 shows a degree of 0.5 at the good level and 0.5 at the improvable level. For points 17.2, and above, the overall affiliation degree is 1, indicating total affiliation.

The Role of Adaptability in Determining an Individual's Competence. At points 13 and 12, we find two workers who take the three judgments: weak, subject to improvement, and good. This implies that the capacity to adapt is not a precise indicator of competency level.
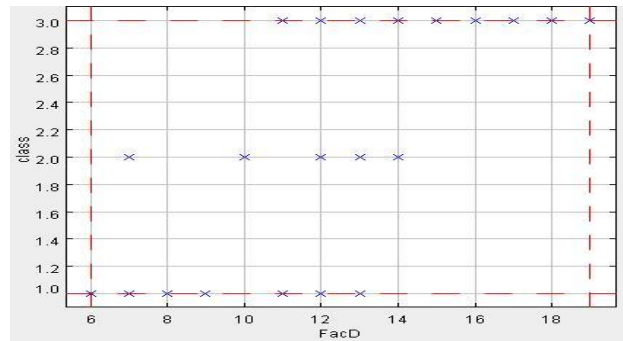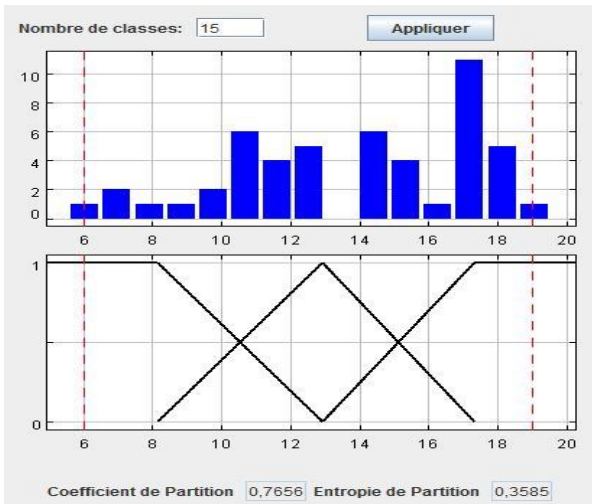

Figure 3. The Membership Equation for Adaptability and Its Role in Determining the Individual's Competence

Source: Authors' elaboration based on FisPro outputs

Personnel Quality. The SEROR Company assesses its employees' effectiveness based on professional and personal attributes. When personal characteristics take a value between 0 and 8.4, they receive a degree of total belonging at the weak level. However, when they take the value 10, we find a degree of belonging estimated at 0.27 for the improvable level and 0.73 for the weak level. However, when you take point 14, we find a degree of complete belonging to the immovable level, i.e. 1. When the point given is 17, we see a degree of belonging estimated at 0.5 for the level that can be improved and 0.5 for the good level. Still, when you take 16, we find a degree of belonging estimated at 0.25 for the improvable level and 0.75 for the good level, and from 17 and above, a degree of total belonging to the good level, i.e. 1.

The Role of Personnel Quality in Determining an Individual's Competence. In point 10.2, three employees share identical scores. However, each employee is assigned a different performance rating-one at the lower competency level, another at the intermediate level with room for improvement, and the third at the proficient level. Therefore, personal quality is insufficient to gauge effective work performance.
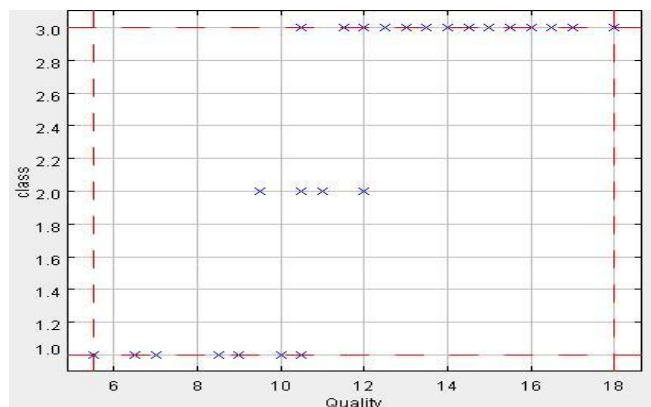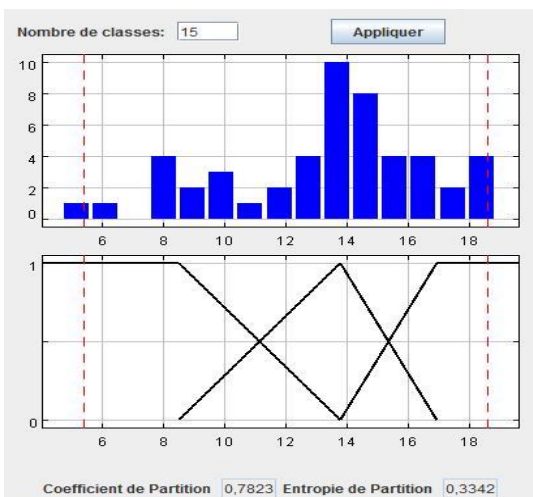

Figure 4. The Membership Equation for Personnel Quality and Its Role in Determining the Individual's Competence

Source: Authors' elaboration based on FisPro outputs

Leadership Potential. Institutions assess competencies using leadership ability as a key factor in the membership equation. A score between 0 and 6 indicates a weak level of complete belonging, specifically 1. However, a score of 8 suggests a potential for improvement, with an estimated belonging of 0.49 in the improvable category and 0.51 in the weak category. A score of 10 indicates an estimated belonging of 0.2 in the weak category and 0.8 in the improvable category. Beyond this, a score of 11 signifies total belonging to the improvable level (1). For a score of 13, there is an estimated belonging of 0.5 for the improvable level and the same for the good level. Finally, a score of 14 suggests a belonging of 0.25 for the improvable level and 0.75 for the good level. Scores of 15 and above indicate a total belonging to the good level (1).

The Role of Leadership Potential in Determining an Individual's Competence. At point 10.8, we observe the same point for the workers, but for each worker and their classification, we find one capable of improvement and the other good. Leadership ability is not insufficient to determine the degree of competence.
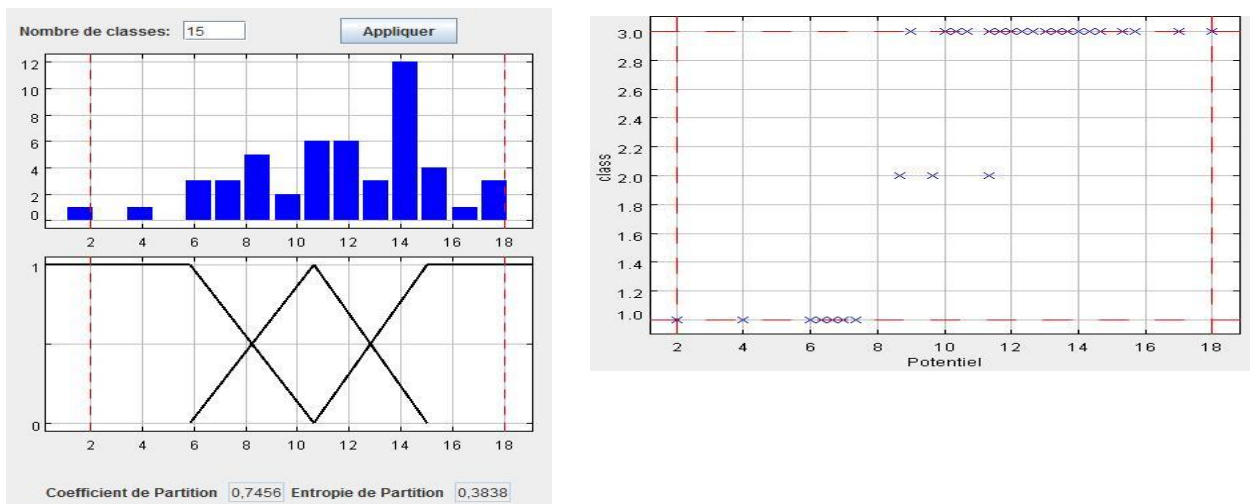

Figure 5. The Membership Equation for Leadership Potential and Its Role in Determining the Individual's Competence

Source: Authors' elaboration based on FisPro outputs

Note: It is important to recognize that each determinant in isolation cannot solely determine individual competence. Instead, we propose examining the interplay between determinants through the dualities, relying on the Three-Dimensional Space.

2. Determine the Level of Competency through Three-Dimensional Space. We try to find out the extent of the impact of the binaries in assessing the level of competence, i.e., whether they can know the status of competence in the organization, through our extraction of them from the system model that we have acquired.

Work Knowledge and Work Quality. Based on the observations from three-dimensional space, the three levels of competency good, improvable, and weak - appear. Still, they exist at a level that is difficult to determine the rank, so they appear somewhat but remain ambiguous.

Work Knowledge and Adaptability. By analyzing the relationship between these two determinants and their role in adjusting the individual's level of competence, the three levels appear but remain ambiguous based on this duality. The observations made by the three-dimensional space imply that the connection determining competence levels is ambiguous and challenging to ascertain.

Work Knowledge and Personnel Quality. We aim to understand how these dual factors influence competency levels. In this context, the three-dimensional space shows that the three competence levels stay ambiguous and challenging to determine. Therefore, it is impossible to determine the effect of these two factors in adjusting competence level based on the view mentioned above.

Work Knowledge and Leadership Potential. From the three-dimensional space, we notice that the degree of influence of the two determinants in adjusting the level of proficiency remains weak despite the appearance of the ranks. It remains ambiguous through observational observation of the space teacher, and we cannot determine the degree of their influence in determining the ranks.

Figure 6. The Three-Dimensional Space of Work Knowledge and The Determinants of Competency Assessment

Source: Authors' elaboration based on FisPro outputs

Adaptability and Work Quality. Through observation of the three-dimensional space of the specifiers, we notice the three levels. However, the degree of influence in determining the competence levels remains difficult and ambiguous.

Adaptability and Leadership Potential. Through observing three-dimensional space, we notice that dualism needs to show the levels better and determining the competence levels remains difficult and ambiguous.

Adaptability and Personnel Quality. From the three-dimensional space, we notice that it is difficult to determine the three competence levels and the degree of influence of the specifiers in making the decision about the level, meaning there is ambiguity.

Work Quality and Adaptability. From a three-dimensional space, the ranks do not appear somewhat well, which always means difficulty determining the degree of influence in controlling competence and ambiguity.

Personnel Quality and Leadership Potential. Competency levels appear to some extent through observing three-dimensional space, but we always notice ambiguity in this, so the level of competence cannot be determined precisely.

Work Quality and Personnel Quality. By analyzing the relationship between these two determinants and their role in adjusting the individual's level of competence, the ranks of competency levels appear, but not always in the required capacity – difficulty in determining and the presence of ambiguity.
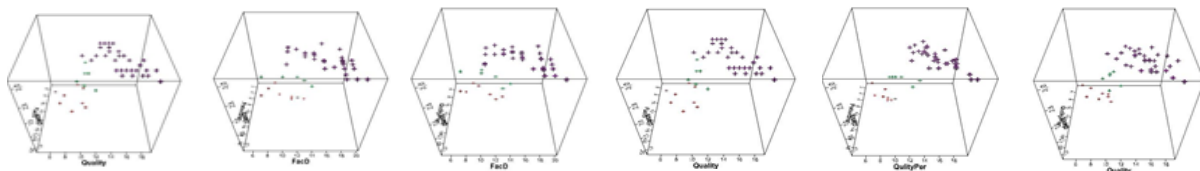

Figure 7. The Three-Dimensional Space of Adaptability, Personal Qualities, and the Determinants of Competency Assessment

Source: Authors' elaboration based on FisPro outputs

Discussion

Our study explored the intricacies and ambiguity of assessing individual competence by examining the three-dimensional space and the interplay between various determinants. We discovered inherent challenges and uncertainties in making such determinations (Johanyák & Kovács, 2006). The system we have formulated contains rules derived from a programming process, mimicking human thought processes. This is what is called artificial intelligence. This form of intelligence rapidly processes extensive amounts of information, providing summarized results (Table 3). Most of these results manifest as rules integrating diverse determinants to determine an individual's evaluation outcome.

Table 3. The Results of the Outputs of Fispro System

The Rules	Work knowledge	Work quality	Adaptability	Personnel quality	Leadership potential	Rank	The Rules	Work knowledge	Work quality	Adaptability	Personnel quality	Leadership potential	Rank
1	Weak			Weak	Weak	Weak	13	Weak	Improvable	Good	Improvable	Improvable	Good
2	Weak			Improvable	Weak	Improvable	14	Weak	Good		Improvable	Improvable	Good
3	Weak	Weak		Weak	Improvable	Improvable	15	Weak				Good	Good
4	Weak	Improvable	Weak	Weak	Improvable	Improvable	16	Improvable				Weak	Improvable

Table 3 (cont.). The Results of the Outputs of Fispro System

5	Weak	Improvable	Improvable	Weak	Improvable	Improvable	17	Improvable	Weak			Improvable	Improvable
6	Weak	Improvable	Good	Weak	Improvable	Good	18	Improvable	Improvable	Weak	Weak	Improvable	Improvable
4	Weak	Good		Weak	Improvable	Good	19	Improvable	Improvable	Improvable	Weak	Improvable	Improvable
8	Weak	Weak	Weak	Improvable	Improvable	Improvable	20	Improvable	Improvable	Good	Weak	Improvable	Good
9	Weak	Weak	Improvable	Improvable	Improvable	Improvable	21	Improvable	Improvable	19	Improvable	Improvable	Good
10	Weak	Weak	Good	Improvable	Improvable	Good	22	Improvable	Improvable	10	Good	Improvable	Good
11	Weak	Improvable	Weak	Improvable	Improvable	Improvable	23	Improvable	Good	14		Improvable	Good
12	Weak	Improvable	Improvable	Improvable	Improvable	Improvable	/	/	/	/	/	/	/

Source: Compiled by the authors based on FisPro outputs

There are two rules for reading the table:

The first rule: If work knowledge is weak, personal qualities are weak, and leadership ability is weak, then the individual's competence is weak.

The second rule: If work knowledge is weak, personal qualities can be improved, and leadership ability is weak, then the individual's level of competence can be improved.

The model also gave us the number of individuals and the competency level of everyone through the following figure and table:
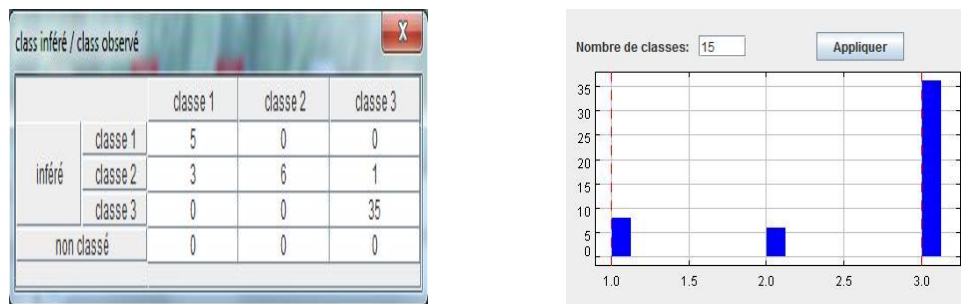

Figure 8. The Results of Competency Assessment Process

Source: Compiled by the authors based on FisPro outputs

Through the figure and table, the model determined the level of each individual for us, and the results were as follows:

➢ 05 individuals whose level of competence is weak.
➢ 06 individuals whose level of competence can be improved.
➢ 35 individuals with good competence.
➢ The model could not identify four individuals, as shown in the second line of the table.
➢ The success rate of the model is 85%.

Conclusions

In our study of the SEROR Company, we uncovered a significant flaw in the competency assessment process. Despite having an assessment document for each individual, it functions more as a formality without undergoing any substantive analysis. Consequently, it falls short in producing results that truly impact the professional trajectory of the individual. Moreover, the company conducts evaluations through meetings attended by an official, human resources, the employee's immediate supervisor, and a workers' representative. The evaluation process relies on verbal assessments from the perspectives of these evaluators, leading to inaccuracies in the results. Additionally, distributing a uniform document to all employees poses a challenge, as each job position requires specific competencies. Hence, it is imperative to customize evaluation documents according to the distinctive requirements of each position and the nature of the work. Our work with the SEROR Company demonstrated the feasibility of developing a quantitative competency assessment model using Fuzzy Logic and artificial intelligence mechanisms. This confirms that the organization can adopt a modern and innovative approach to assessing competencies. Therefore, to establish an effective evaluation

system, the company must invest in a robust information system containing comprehensive details about its human resources, such as professional paths and experiences. Unfortunately, our sample of individuals lacked this crucial information, particularly professional expertise, which is a significant factor in the evaluation process. It is essential to emphasize that the foundation for constructing an automated quantitative model lies in a reliable and well-maintained database, serving as the cornerstone for creating an accurate and practical model.

Author Contributions: Conceptualization: Mohammed Sahnouni and Riad Benghebrid; data curation: Riad Benghebrid; formal analysis: Mohammed Sahnouni; investigation: Riad Benghebrid; methodology: Mohammed Sahnouni; project administration: Mohammed Sahnouni; resources: Mohammed Sahnouni; software: Riad Benghebrid; supervision: Mohammed Sahnouni; validation: Riad Benghebrid; visualization: Riad Benghebrid; writing-original draft preparation: Mohammed Sahnouni; writing-review and editing: Riad Benghebrid.

Conflicts of Interest: Authors declare no conflict of interest.

Data Availability Statement: Not applicable.

Informed Consent Statement: Not applicable.

References

1. Angelov, P. (2004). An approach for fuzzy rule-base adaptation using on-line clustering. *International Journal of Approximate Reasoning*, *35*, 275-289. [Google Scholar] [CrossRef]
2. Benghebrid, R. (2023). Voluntary turnover of competencies and its impact on thesustainability of Algerian economic enterprise competitiveness: NAC Rouiba case study. *El Acil Journal for Economic and Administrative Research*, *7*(1), 189-210. [Google Scholar]
3. Bohlouli, M., Mittas, N., Kakarontzas, G., Theodosiou, T., Angelis, L., & Fathi, M. (2017). Competence assessment as an expert system for human resource management: A mathematical approach. *Expert Systems with Applications*, 83-102. [Google Scholar] [CrossRef]
4. Feutrie, M. (1998). Evaluate, validate and certify professional competencies. *International training days* (pp. 1-91). Paris: CNPF. Available at: [Link]
5. Gataff, A., & Abid, F. (2020). Evaluating human competencies and their role in improving the quality of health services : a case study at the Public Hospital. *Economic issue studies*, *11*(02), 91-107. Available at: [Link]
6. Goldman, E., & Scott, A. (2016). Competency models for assessing strategic thinking. *Journal of Strategy and Management*, 258-280. [Google Scholar] [CrossRef]
7. Guillaume, S., & Chamomordic, B. (2011). Learning interpretable fuzzy inference systems with FisPro. *Information Sciences: an International Journal*, pp. 4409–4427. [Google Scholar] [CrossRef]
8. Johanyák, Zs. Cs., & Kovács, Sz.. (2006). Fuzzy rule interpolation based on polar cuts. *Springer Berlin Heidelberg*, pp. 499-511. [Google Scholar]
9. Koohsari, H., Alielahi, H., Najafi, A., & Adampira, M. (2023). The application of articial intelligence methods onthe optimizing improvement depth of dynamic compaction. *Research Square*, *29*(3-4), 1-33. [Google Scholar] [CrossRef]
10. Kumar, A., & Kaur, A. (2011). Application of linear programming for solving fuzzy transportation problems. *Journal of applied mathematics & informatics*, 831-846. [Google Scholar]
11. Le Boterf, G. (2011). Engineering and competency assessment. Paris: Éditions Eyrolles. Available at: [Link]
12. Levey-Leboyer, C. (2009). Competencies management: an essential approach for business competitiveness. Paris: Editions Eyrolles. Available at: [Link]
13. Neu-Stein, S. (2023). Competencies assessment, a performance factor? What are the challenges for the health framework? *Proyéctica/Projectics/Projectique*, pp. 105-123. [Google Scholar]
14. Sahnouni, M., & Bandi, A. (2015). The Problematic of Competency Assessment and evaluation and its reality in SEROR Company at Tlemcen. *Abaad Iktissadia review*, pp. 88-106. Available at: [Link]