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The application of the radar approach in the European Foundation Quality Management (EFQM)

Miami Hamid Khalif [1], Kareem Radi Hassan [2]
[1,2]Department of Computer Science, College of Computer Science and Information Technology, Basra University, Basra, Iraq

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ABSTRACT

Managers seek to demonstrate that their businesses are exceptional in the dynamic and tough business world of today. The most typical method for doing this is to consistently improve your performance. The most precise and pertinent tool for measuring an organization's progress toward organizational excellence is the European Foundation for Quality Management (EFQM) Excellence Model. In this study, a novel integrated approach for enhancing overall organizational performance was presented using the EFQM model. To show the applicability of the suggested method, which is presented using the (EFQM) framework to identify strengths and chances for development, the RADAR methodology and the proposed technique based on fuzzy logic were employed in a case study at the Iraqi Oil Tanker Company. It produced excellent outcomes for the Iraqi Oil Tanker Company after identifying the vulnerabilities using the radar methodology and contrasting the two methods. The provided approach has helped to improve the level of the company's evaluation over the last three years, and the suggested strategy was implemented using a Matlab program because the differences between them were so minimal that they weren't even noted.

Corresponding Author:

Miami Hamid Khalif
Department of Computer Science, College of Computer Science and Information Technology, Basra University, Basra, Iraq

Email: tpq.miami.kleef@uobasrah.edu.iq

1. INTRODUCTION

Rapid technological developments and constant economic-social problems advantage many corporations in today's global economy. Adaptable, pure, and customer-focused, they exploit current and new resources to provide superior goods and services. A consistent model for function evaluation helps reveal the company's weak spots. They can prioritize planning and recover recoverable zones. Participation can lead to organizational transcendence [1].

To attain business excellence and maintain a competitive edge in response to the unstable business environment, more firms are utilizing quality management. A predetermined set of evaluative norms is what most of these systems rely on [2].Organizational excellence is a collection of guiding principles and practices contributing to high-quality output and sustainability. Institutions use external evaluation to maximize resources and competition. Companies examine business performance to advance strategic goals. Several studies have concentrated on establishing effective performance evaluation systems. Institutions can excel by examining their Performance. Excellence measures institutionalization [3].

Three models are frequently used to gauge an organization's quality, commercial viability, and institutionalization. The Deming Model, Baldrige Scales of Performance Excellence, and EFQM Model are just a few examples of criteria that can be used to assess the level of organization inside a business. In contrast to the other two models, the EFQM model has a greater effect on the organization's level of excellence. Human resource planning, employee empowerment, and capacity building are also included in the EFQM Excellence Model [4]. For reaching excellence, consider the value added, procedures, tactics, customer focus, personnel, and a sustainable future.

Despite this, firms use EFQM because it helps them adopt Total Quality Management (TQM) and reach perfection. Manufacturing and service industries employ EFQM to speed up improvement. This paradigm improves products [5],[6]. The popularity of EFQM's TQM application model and management excellence paradigm. EFQM supports European Union (EU) quality management (EU). In 1992, the EFQM Model was created for European Quality Award [7]. This is Europe's and the world's most prevalent organizing form. The EFQM excellence model incorporates customer and employee happiness and societal and business impacts. It emphasizes quality management among European firms and executives [8]. Companies use EFQM's excellence model and TQM to reach perfection. The EFQM enhances customer happiness, employee loyalty, export revenues, innovation management, and knowledge-management projects [9]. Model attributes increase the business's competitiveness and advantage. The EFQM management toolkit integrates financial and non-financial data, creating a system-oriented company performance model.

EFQM encourages staff performance. Analyzing and improving the organization's procedures [10]. The Excellence Framework for Quality Management helps gather cause-and-effect information. Removes duplication and checks structure [11]. EFQM gives model firms a competitive edge, helping all interest groups [12]. EFQM's self-evaluation model [13]. Expert decisions change the model's subjectivity and applicability. Due to the model's score, we are unable to obtain accurate experimental data and expert opinions [14]. Uncertain linguistic characteristics impair EFQM's reliability. Fuzzy Logic simplifies uncertainty. Fuzzy Logic was used. Fuzzy Logic's 0-1 membership functions allow the model to have numerous interpretations. Fuzzy Logic is ambiguous [15]. Fuzzy Logic improves EFQM's accuracy. Standardized EFQM results from speed implementation [16]. Fuzzy EFQM was constructed using MATLAB's fuzzy inference editor to integrate RADAR scoring with maximum aggregate. FEFQM was created. FEFQM rules are "if-then." Iraqi Oil Tanker Company matched its score to EFQM using FEFQM.

Literature review The literature indicates that there are two methods for applying EFQM. Excellence is assessed with linguistic factors first when utilizing EFQM and fuzzy logic, and then with fuzzy logic. As seen in the graphic, the EFQM model criteria employ fuzzy multicriteria decision-making. Fuzzy Logic is used in the EFQM paradigm to simplify the procedure.This study evaluates if the RADAR rating system is employed in EFQM. Business results are sensitive. Researchers seek to determine which fuzzy models best reflect EFQM and produce more accurate judgments. For the most accurate and precise outcomes, fuzzy logic management of the EFQM model is recommended. Fuzzy Logic and EFQM were coupled for selfassessment in uncertain circumstances. Kiraz Alper and Açikgöz Nilay's [8] research aims to increase Performance through fuzzy-logic EFQM. The Fuzzy EFQM (FEFQM) model was employed in this study to close the gap between professional judgment and institutionalization. The rules created using CN2 and FEFQ were compared against the rules created using this rule base when they were applied to ten corporate institutions. For both the Traditional and FEFQM CN2/sum models, MAPE was 2.33. Researchers claim that the model can help in EFQM evaluations and policymaking. Abreu and co. [17] fuzzy logic R&D quality control This research proposes an integrated strategy for improving business Performance using fuzzy logic and EFQM. The application of RADAR's logic was demonstrated in a case study that examined the performance of an R&D unit. Using fuzzy logic, the EFQM framework evaluates their strengths and flaws. Following that, urgent changes are made. Khosravi et al. [18] The EFQM-Fuzzy Network Data Envelopment Analysis Paradigm for Organizational Efficiency Assessment assesses organizational units based on a model of organizational excellence. The suggested approach to evaluating an organization's efficiency makes use of EFQM and fuzzy network data envelopment analysis. Uygun et al. [19] a vague multicriteria strategy for institutionalizing EFQM. Fuzzy multicriteria approaches are used to evaluate EFQM criteria. Fuzzy DEMATEL is used to determine EFQM interactions. The Fuzzy DEMATEL relationship diagram is used to calculate the sub-criteria weights using the fuzzy analytic network approach. Daniel Jay et al. [20] Fuzzy inference systems (FISs) are used in a fuzzy multi-layer assessment method to manage inaccurate data and varied assessor experiences. The process was evaluated and found to be effective in a local electric provider. Jamal Ezzabadi Hosseini et al. [21] By assessing business performance and identifying high-priority improvement tasks, a novel integrated strategy built on the EFQM paradigm and integrating fuzzy Logic, an AHP, and OR can increase organizational excellence.

a. EFQM Excellence Model

A framework for quality management without strict rules is the (EFQM) Model [22]. That any firm can apply, regardless of industry, size, structure, or maturity level. With EFQM [23], you can integrate strategic, managerial, and operational management. In 1988, 14 European corporations created this strategy. They aim to teach European firms about continuous improvement and help them compete globally [24]. All the company's stakeholders must have high expectations and work hard to meet them.

EFQM launched the EQA in 1991 to honour businesses committed to excellence. European EQA-certified companies have a quality management system. Applicants must exceed customer and staff

expectations. EQA software encourages teamwork and improves quality management. European Commission recommends a list of Europe's most successful firms and the EOQ insignia. Enterprises, cost centres, medium-sized organizations, and public sector groups with fewer than 250 employees can apply. Over 20,000 companies utilize EFQM for continuous improvement [25].

In 1992, professionals invented EFQM. This management method prioritizes quality, efficiency, and long-term viability [26]. Weight signals are needed for accurate control. Academics endorse EFQM because it helps organizations find their gaps, limits, and potential [27]. Leadership, management, and program assessment are linked in a learning and improvement framework [28].

The presentation says EFQM helps managers understand results and cause-and-effect. Continuous learning, source relocation, knowledge enhancement, and service innovation produce business excellence. EFQM reduces redundancy and reveals faults [29]. Use this technique to uncover organizational difficulties and focus on KPIs for senior management [30]. The latest version is EFQM 2020 (2019). Some say the 2013 edition isn't better than the 2012 edition due to the following issues:

Many practitioners may find the model challenging to execute since some notions aren't evident, are improperly defined or aren't described. Many guidelines are unclear and one-dimensional. Figure1 shows their EFQM (EFQM, 2012). This non-prescriptive paradigm uses Enablers and Results. Upper management to operational details is all facilitators. The full results viewpoint includes customers, society, and important outcomes. Enablers reflect results and organizational operations. Current EFQM values enablers and results at 500 points each. No exclusions. This framework has three parts:

a- Fundamental concepts: eight items

b- EFQM model criteria: five enablers and four results

C- RADAR logic: the four elements.

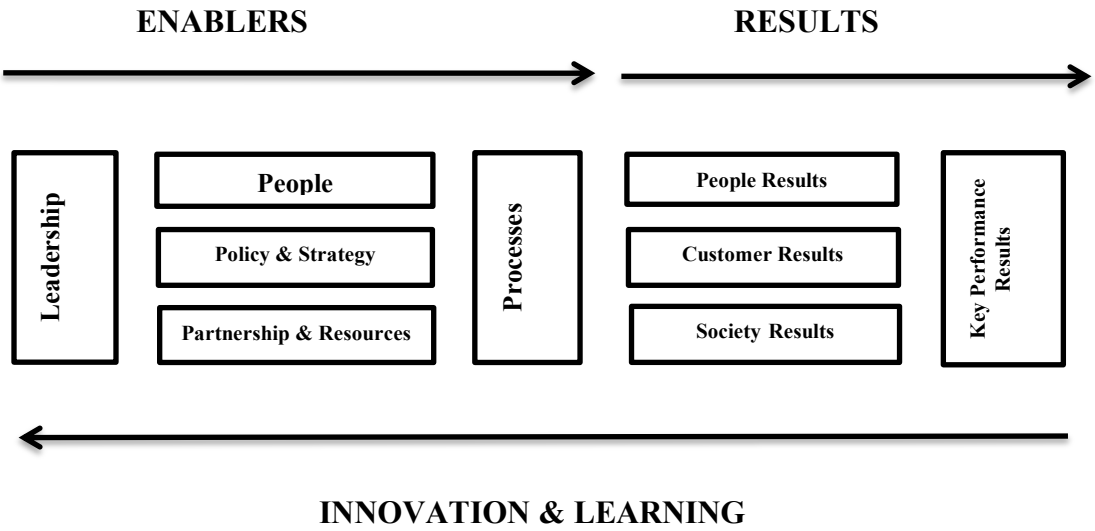


Figure 1. EFQM Model

b. Fuzzy Logic System

FL is a method of decision-making that Lotfi Zadeh developed in 1965 [31]. Enhancing human-computer interactions is fuzzy logic. In addition to defining membership functions, Zadeh also constructed Aristotle's 0-1 logic [32]. Membership in fuzzy sets may range from 0 to 1 [33], [34]. Fuzzy sets, logic, algorithms, and control are examples of "fuzzy systems." Fuzziness is used in all "fuzzy domains". Instead of a sudden and abrupt change, it offers a smooth transition from 0 to 1. Only discrete values are considered in conventional set theory and logic. Binary Membership exists in regular sets (crisp sets) [35]. Typical logic statements have two possible outcomes: true (represented by 1) or false (expressed by 0). Fuzzy systems introduce partial veracity, which broadens the scope of study topics. Continuous fog is especially prevalent in isolated fields [36]. Data can be recorded using FL on everything from tiny embedded microcontrollers to massive multichannel networked PCs or workstations. One of its strongest qualities is how well it responds to input

data that is unclear, wrong, or missing. IF X AND Y THEN Z rules are used in place of mathematical modeling. Data input is converted into a single output value using this mapping. The FL system's components include fuzzification, rule base, inference engine, and defuzzification [37],[38].

c. Description of the Problem

EFQM Model is commonly used to evaluate enterprises. EFQM professionals evaluate institutions. Criteria and results are used. Evaluation help. Tables 1 and 2 list input and output evaluation criteria. Based on the results evaluation table. This is every condition. The highest score for a criterion is 5 out of 100. This study employed EFQM RADAR. Evaluation is unclear. MATLAB fuzzy logic solved the problem. The operation. Matlab has all traditional values.

2. METHOD

Fuzzy logic was applied to the RADAR registration system of the EFQM Excellence Model at the corresponding level. The max-aggregation method and the fuzzy inference system editor were used to create the FEFQM model in MATLAB. According to the model, Table 1.(a) was used for the enabling criteria, while Table 1.(b) was used for the result criteria. The model for the FEFQM empowerment criteria has already been defined.

Table 1. (a) Enablers' suggested score

Elements	Attributes	Bad	Insufficient	Sufficient	Good	Very Good
Approach	Sound	No evidence	Some evidence	Remarkable evidence	Precise &clear evidence	Complete & comprehensive evidence
	Integrated	No evidence	Some evidence	Remarkable evidence	Precise &clear evidence	Complete & comprehensive evidence
Deploy	Implemented	No evidence	Implemented in 1/4 of relevant areas	Implemented in 1/2 of relevant areas	Implemented in 3/4 of relevant areas	Implemented in all of the relevant areas
	Systematic	No evidence	Some evidence	Remarkable evidence	Precise &clear evidence	Complete & comprehensive evidence
Asses & Refine	Measurement	No evidence	Some evidence	Remarkable evidence	Precise &clear evidence	Complete & comprehensive evidence
	Learning & Creativity	No evidence	Some evidence	Remarkable evidence	Precise &clear evidence	Complete & comprehensive evidence
	Improvement & Innovation	No evidence	Some evidence	Remarkable evidence	Precise &clear evidence	Complete & comprehensive evidence

Table 1. (b) Possible outcomes scoring

Elements	Attributes	Bad	Insufficient	Sufficient	Good	Very Good
Performance	Trends	No results	Positive trend for about 1/4 result over at least 3 years	Positive trend and sustained about 1/2 result over at least 3 years	Positive trend for about 3/4 results over at least 3 years	Positive trend for all results over at least 3 years
	Targets	No results	Set appropriate & achieved for about 1/4 of key results	Set appropriate & achieved for about 1/2 of key results	Set appropriate & achieved for about 3/4 of key results	Set appropriate & achieved for all key results
	Comparison	No results	Established favourable for about 1/4 results	Established favourable for about 1/2 results	Established favourable for about 3/4 results	Established favourable for all results
	Causes	No results	Enabling effect visible for about 1/4 of results	Enabling effect visible for about 1/2 results	Enabling effect visible for about 3/4 of results	Enabling effect visible for all results
Relevance & usability	Scope	No results	Results presented & relevance established for about 1/4 of areas involved	Results presented & relevance established for about 1/2 of areas involved	Results presented & relevance established for about 3/4 of areas involved	Result presented & relevance established for all of the areas involved

To develop an ambiguous system of enabling criteria, seven groups of input membership were used Sound, integrated, implemented, Systematic, measured, learn and creativity innovation and improvement and one. Set the output membership to "Output" and display the criteria result from scores (Figure 2)

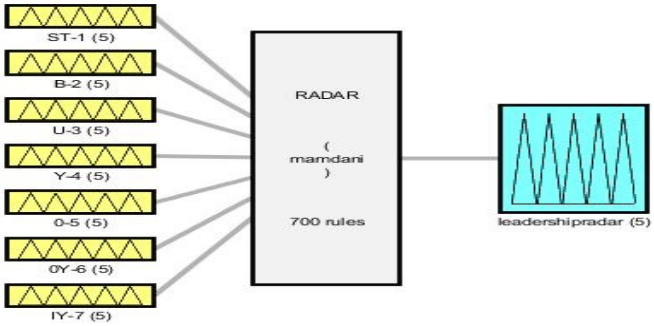


Figure 2. Fuzzy system for EFQM results criterion (RADAR)

Table 2 shows the fuzzy system membership functions and parameter values for each category separa tely. If, then, is the next step after defining membership functions. Choose from "Bad," "Not enough," and "Enough, Good, and Very Good" to get an idea of the quality. The factors and outcomes that made this possible have their own set of rules. They were discovered by an EFQM evaluation team of five people. Creates the right conditions. Basic rules are included in the standards. Each item was evaluated using the same subcriteria items and a table. Based on the amount of evidence, several actions were taken.

Table 2. Membership algorithms and fuzzy sets

Ne.	Fuzzy Set	Membership Function [α, β, γ]
1	(“Bad”) a small segment of regions/ No evidence	(0,10,20)
2	(“Insufficient”) limited evidence/≈ ¼ of regions	(21,30,40)
3	(“Sufficient”) remarkable evidence/ ≈ ½ of regions	(41,50,60)
4	(“Good”) high evidence/≈ 3/4 of regions	(61,75,80)
5	(“Very Good”) complete evidence/≈ entire region	(81,90,100)

There are five possible outcomes in this chaotic system. Trends, Targets, Comparisons, Causes and Scope are examples of membership groupings. Indicators, objectives, comparisons, trust, and the following organic function. The criteria results are listed under the heading "Outputs" (Fig. 3). Membership is an outcome criterion. Table 3's functions and values were used as enabling factors. To keep your Membership, you'll need a comparison of results derived from the model using traditional EFQM metrics and experts. Each of the 32 sub-criteria is used to weigh the various points of view.

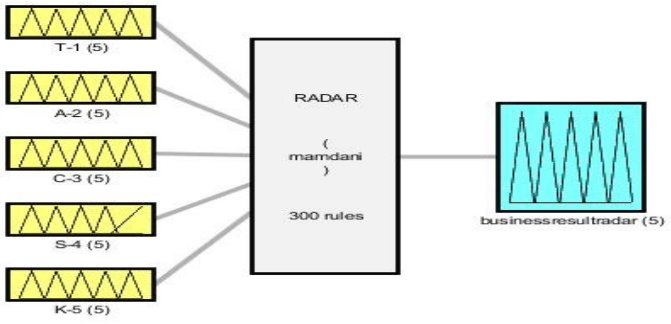


Figure 3. Fuzzy system for EFQM input(enablers) criteria

3. RESULTS AND DISCUSSION

The effectiveness of the company was assessed from within. Table 1 shows the scoring table that was used to compute the overall score as well as the scores for each of the sub-criteria. The Iraqi Oil Tanker Company was assessed with the EFQM Award simulation approach. The first stage was to conduct self-assessment reports. Each sub-score criteria was then determined, as indicated in tables 3 and 4, and the overall organization's score. The values were then documented by the Logic of radar and the Iraqi Oil Tankers Company's fuzzy Logic.

Table 3. RADAR's methodology is used to evaluate the Iraqi Oil Tanker Company.

	1-leadership		2- Policy & Strategy		3-people		4-partnerships& resources		5-processes	
Enablers	1a	10.8(54%)	2a	18.5(74%)	3a	18(90%)	4a	17.3(86.5%)	5a	19(95%)
	1b	12.4(62%)	2b	21(84%)	3b	13.9(69.5%)	4b	17(85%)	5b	16.7(83.5)
	1c	14.5(72.5%)	2c	17.9(71.6)	3c	16(80%)	4c	16.8(84%)	5c	15(75%)
	1d	15.5(77.5%)	2e	19.3(77.2)	3d	18.2(91%)	4d	15(75%)	5d	18.3(91.5%)
	1e	17(85%)			3e	14.6(73%)	4e	13(65%)	5e	14(70%)
	Total	70.2%	Total	76.7%	Total	80.7%	Total	79.1%	Total	83%
	mean	14.04	mean	19.2	mean	17.14	mean	15.82	mean	16.6

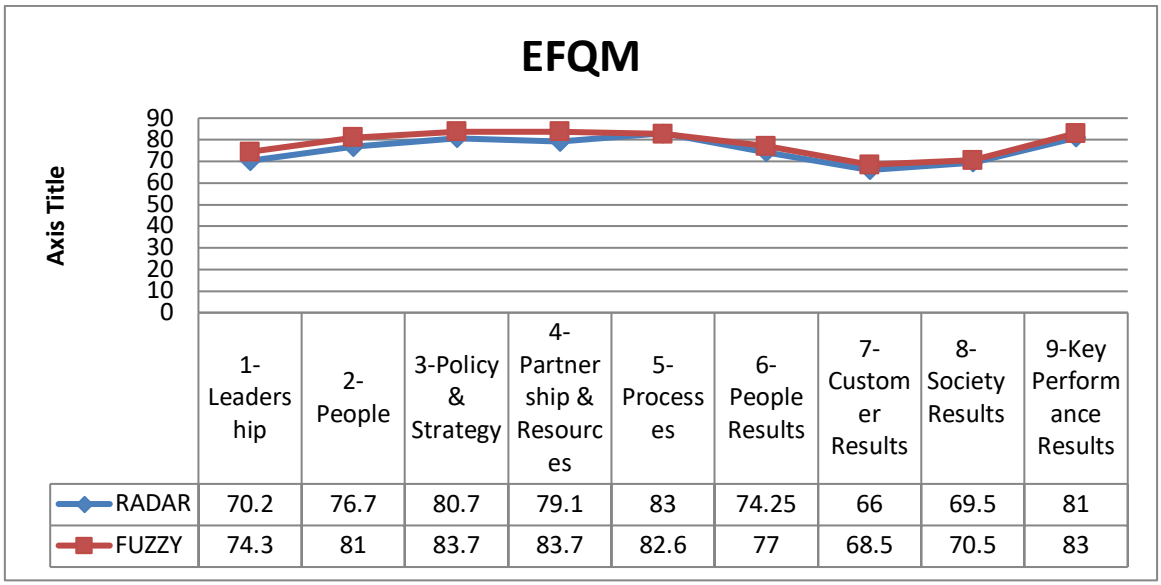
	6-people				7-customers				8-society				9-Key Performance				Final score
Result	6a	75	*0.75	56.25	7a	68	*0.75	51	8a	70	*0.5	35	9a	83	*0.5	41.5	
	6b	72	*0.25	18	7b	60	*0.25	15	8b	69	*0.5	34.5	9b	79	*0.5	39.5	
	Total		74.25%		Total		66%		Total		69.5%		Total		81%		680.45

Table 4. Fuzzy method evaluation of the Iraqi Oil Tanker Company

	1-leadership		2- Policy & Strategy		3-people		4-partnerships& resources		5-processes	
Enablers	1a	12.5(62.5%)	2a	20(80%)	3a	19(95%)	4a	16.5(82.5)	5a	18(90%)
	1b	13.3(66.5%)	2b	23(92%)	3b	15(75%)	4b	18(90%)	5b	14.5(72.5?%)
	1c	15(75%)	2c	18(72%)	3c	18(90%)	4c	18.4(92%)	5c	17.3(86.5%)
	1d	16(80%)	2e	20(80%)	3d	15.7(78.5%)	4d	16(80%)	5d	19(95%)
	1e	17.5(87.5%)			3e	17.3(86.5)	4e	14.8(74%)	5e	13.8(69%)
	Total	74.3%	Total	81%	Total	85%	Total	83.7%	Total	82.6%
	mean	14.86	mean	20.25	mean	17	mean	16.74	mean	16.52

	6-people				7-customers				8-society				9-Key Performance				Final score
Result	6a	78	*0.75	58.5	7a	70	*0.75	52.5	8a	72	*0.5	36	9a	85	*0.5	42.5	
	6b	74	*0.25	18.5	7b	64	*0.25	16	8b	69	*0.5	34.5	9b	81	*0.5	40.5	
	Total		77%		Total		68.5%		Total		70.5%		Total		83%		705.6

Quality management standards such as the EFQM emphasize the importance of "enabling factors" and "outcomes." The overall score also takes into account the sub-criteria. A comparison of the two approaches is shown in Figure 4. Compare the overall results from both ways to notice the difference more clearly (Tables 4 and 5, respectively). Regarding the generated scores for each sub-criteria, there is a relative difference between the two numbers for each technique (Fig. 4). It's nearly impossible to tell the difference between the two approaches.



	1-Leadership	2-People	3-Policy & Strategy	4-Partnership & Resources	5-Processes	6-People Results	7-Customer Results	8-Society Results	9-Key Performance Results
RADAR	70.2	76.7	80.7	79.1	83	74.25	66	69.5	81
FUZZY	74.3	81	83.7	83.7	82.6	77	68.5	70.5	83

Figure 4: Results of the two methods used to assess the Iraqi Oil Tanker Company using the EFQM methodology

4. CONCLUSION

An integrated plan to raise the overall performance of the Iraqi Oil Tanker Company was supported by fuzzy logic decision-making. It was decided to employ RADAR and fuzzy logic for assessing the sub-criteria in the EFQM publication. Improvement measures are put in place after the organization's strengths and weaknesses have been identified. After developing and implementing improvement activities, action plans were drawn up for each area covered (intensifying educational activities and courses, in addition to encouraging employees for achievement and innovation by honoring them and giving them material and moral incentives and praising them). good driving, etc.). In an evaluation using the EFQM and Fuzzy Logic model, and after applying the approach to the company, their evaluation rates increased after the company's evaluations were less than the required level during the last two years. The approach contributed to raising the level of the company's performance and the Iraqi Oil Tanker Company found that other Iraqi oil companies can use it To evaluate and improve its performance. One way to take advantage of the proposed technology is to combine several Fuzzy Logic standards with one of these methods, such as (AHP), "OR", "DEMATEL" and "ELECTER", among others. With the aim of integration, the approach presented here has been improved by arranging the areas that require installation and the procedures to be followed based on the established criteria.

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