Implementing Fuzzy Logic and AHP into the EFQM model for performance improvement: A case study

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ABSTRACT

In the current volatile and demanding business environment, managers are so eager to demonstrate that their organizations are excellent which can mainly be achieved through continuous performance improvement. The most applicable and suitable tools that by the assessment of organizations shows how successful they are in the organizational excellence path is European Foundation for Quality Management (EFQM) Excellence Model. This study aims at presenting a new integrated approach based on EFQM model using Fuzzy Logic, Analytical Hierarchy Process (AHP) technique and Operations Research (OR) model to improve the organizations' excellence level by increasing the quality of business performance evaluation and determining of improvement projects with high priority. A case study in Yazd Regional Electricity Co. in Iran is presented to demonstrate the applicability of the proposed approach. In a way that, primarily, performance assessment by crisp method and the proposed method, Fuzzy method, is carried out. Then, strength points and the areas for improvement are identified by defining the scores for sub-criteria. Next, sub-criteria are prioritized to define the improvement projects by using AHP technique and Operations Research model. Finally, improvement projects with high priority are determined and some action plans for improvement projects are defined.

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1. Introduction

Each organization, regardless of its activity, size, structure, experience or success to meet its own organizational goals, requires measuring its success to achieve its ideal goals and business strategies. In different organizations, there are various models such as EFQM for evaluating performance. EFQM model was developed in Europe in 1998. At present, it is applied as an executive tool to help organizations to measure how much they are in the path of organizational excellence and evaluate their balanced growth. This model helps organizations to identify discrepancies by comparing their current and ideal positions, define some solutions to optimize their current position, implement them according to these discrepancies, and examine their causes. The aim of self-assessment is to analyze the strength points and the areas for improvement. Therefore, to achieve this goal, EFQM model most applied in the process of self-assessment by organizations, considering a cause and effect relationship between enablers and results criteria. Since the nature of assessment is qualitative, the framework definition by itself cannot solve all assessment problems.

Nowadays, decisions are made in increasingly complex environments, as multi-criteria decision-making problems and stakeholders dealt with many issues. For instance, on the one hand, there is not enough precise information about the preferences of decision-makers. On the other hand, the decision-makers are usually unable to explicit about their preferences due to the Fuzzy nature of the decision process; they give point judgments instead of interval ones. Meanwhile, in more and more cases today the use of experts in various fields is necessary, such as self-assessment. As the self-assessment results are partly varied depending on various opinions, thus the scores of various assessors will be different. It sounds that Fuzzy Logic can be an appropriate tool to solve the above problems by providing the flexibility and robustness needed for the decision makers.

Leading organizations to stay ahead in today's dynamic competitive business market and in order to continue on the path of excellence require continuous implementation of performance improvement projects. The matter in the first instance through a detailed performance evaluation and then determining and implementation of improvement projects with high priority is possible.

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In contrast, as mentioned earlier, self-assessment using EFQM model has some shortcomings. According to the literature, it seems that applying Fuzzy Logic in some performance assessment models such as EFQM excellence model has not yet been considered in the literature and particularly, there is no study aimed at evaluating the performance by EFQM excellence model and obtaining the prioritization using Fuzzy Logic, AHP technique and OR model in the related literature. The main purpose of this study is to provide practitioners and academics with a methodology in which Fuzzy Logic used, in the performance evaluation using the EFQM model for dealing with imprecision and applying AHP and OR in the priority setting of improvement projects in order to accelerate achieving the goal. The use of Fuzzy Logic for EFQM excellence model simplifies the process of assessment. Additionally, the results of assessment do not depend on various opinions. Therefore, it can be a definite and comprehensive alternative for evaluating all organizations. Based on Fuzzy Logic, the tasks of assessors for defining the scores for the enablers comprising of the elements of approach, deployment, and assessment & refinement and for the results consisting of the elements of performance, relevance, and usability are facilitated; regarding assessments scores, there are decreased discrepancies among various assessors. Moreover, using AHP technique and OR model leads to considerable savings in the resources of organization caused by improvements in the areas for improvement with low priority. In summary, the proposed method has not only the advantage of mathematically represent uncertainty, and provide a formalized tools for dealing with the imprecision intrinsic to performance assessment process and in the priority setting of improvement projects, but also it can provide the simple, flexible, and adaptable solution for better organizational excellence management. These merits of the approach developed would facilitate its use for making efficient performance improvement projects. The contribution provides originality to this study is not only employing Fuzzy Logic as well as using AHP technique and OR model to improve the excellence level of organizations by EFQM excellence model for the first time, but also releasing a comprehensive literature review of applying EFQM model and its combination with other models, techniques and methodologies, development and using of Fuzzy Logic, studies conducted by using combined Fuzzy Logic and AHP, development of Fuzzy AHP technique and examples of its applications, and using of expert system and its combination with Fuzzy Logic and Fuzzy AHP methods. In addition, by stating the steps of implementing Fuzzy Logic, AHP technique and OR model into the EFQM model clearly and numerically, this study can be a comprehensive guide of the practical methodology to be implemented to other performance improvement projects in any field of study.

The rest of this paper is organized as follows: Section 2 illustrates literature review. Section 3 presents EFQM excellence model, Fuzzy Logic and Analytical Hierarchy Process. Section 4 describes the proposed method in a way that, primarily, performance assessment is conducted by a Fuzzy method. Next, the order for implementing improvement projects is defined by using AHP technique and OR model. Then, the results for applying this method are provided. Finally, the conclusions and future work directions are discussed in Section 5.

2. Literature review

In line with the already discussed critical issues and challenges, for articulation of research problem, research literature will be studied in a way that, primarily, the implementation of EFQM model and its combination with other models, techniques and methodologies, then, Fuzzy Logic, a combination of Fuzzy Logic and AHP technique, Fuzzy AHP technique and finally, applying expert system will be discussed in more detail.

Various articles introduced on applying EFQM model in organizations in the literature, can be categorized in the following two general groups:

1) There are some articles which have presented a discussion only about the implementation of EFQM model and have led to applying and analyzing EFQM model and moving towards the excellence as follows: Mariscal et al. [1] have aimed at finding evidence of the safety culture that was in place at the Sta María de Garona nuclear power plant in Spain, and at identifying both the strengths of that culture and any areas in which it could be improved. For this aim, the identification of perceptions and evidence, the agreement on the strong points and the areas for improvement and the quantification of the safety culture performed by groups comprising volunteers who worked at the plant. The score obtained from an analysis of those strengths and areas for improvement made it possible to prioritize the actions to be taken. Research of Bayo-Moriones et al. [2] which is conducted in the region of Navarre in Spain, tries to analyze the differences between the two most frequently used quality management approaches implemented by firms, ISO 9000 and EFQM, in terms of their impact on the adoption of innovative work organization practices. In order to accomplish this objective, they selected a sample of 665 establishments with at least 20 employees, from the manufacturing, building and service sectors. Results indicated that, as expected, EFQM involves an advance over ISO 9000 regarding the use of innovative work practices. Sozuer [3] has surveyed four-star city hotels in Istanbul and has found areas for improvement. The survey tool was the EFQM excellence model and applied to eight hotels as a multiple-case studies design. Findings demonstrated that, while hotels are managing customer related processes properly, there appears a big gap between the current approaches and the model's leadership, strategy, and people criteria. Research of Nazemi [4] which is conducted in Iranian companies from different business sectors from manufacturing to service but almost in automotive supply chain, tries to analyze EFQM model integrity and its appropriateness for improvement plans. Results showed that the model does not have a structured approach about how to exploit strengths, classify and prioritize areas of improvement. Research of Michalska [5] which is carried out in a selected company of the machine industry in Poland aimed at showing the EFQM excellence model approach. Therefore, the EFQM excellence model is applied not only in the whole organization but also in the selected processes in the company. The best result was obtained in customer results, and the worst was society results. Through this approach, the organization is better able to balance its priorities, allocate resources and generate realistic business plans. Research of Shafaei and Dabiri [6] which is conducted in a selected Iranian company which manufactures industrial components, tries to propose an EFQM based model to assess the readiness of an enterprise for effective and successful Enterprise Resource Planning (ERP) implementation. The proposed model is applied to assess the readiness of the company intending to implement an ERP system. Finally, the results of the assessment are discussed and concluding remarks are presented.

2) The articles which have provided a combination of EFQM model with other models, techniques and methodologies, such as Data Envelopment Analysis (DEA) [7], intellectual capital management [8], DEMATEL technique [9], and Systems Dynamics [10–12], improve the effectiveness of EFQM model.