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An integrated fuzzy AHP and fuzzy MOORA approach to the problem of industrial engineering sector choosing

Gökay Akkaya, Betül Turanoğlu, Sinan Öztaş*

Department of Industrial Engineering, Atatürk University, Erzurum 25240, Turkey

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ABSTRACT

Industrial engineering is a field of profession that offers various work areas around the world. Since it has a wide variety of work areas, students encounter with the problem of taking a decision on which sector to work in the future. Therefore, a questionnaire has been conducted on 60 students who study at Industrial Engineering department at different universities in Turkey. Fuzzy AHP (Analytic Hierarchy Process) and fuzzy MOORA (Multi-Objective Optimization by Ratio Analysis) methods have been applied to the results of the questionnaire that has been done for 7 sectors (manufacturing, logistics, finance/ banking, health, technology, software/ informatics and academics) and 10 criteria (payment, job satisfaction, career opportunities, being productive, having a goal, status, guidance/ pressure, social opportunities, employment deficit and easiness of job). The significance of criteria has been determined by using the fuzzy AHP method while the sectors that have been preferred mostly within the certain criteria have been determined using the fuzzy MOORA method. Finally, the most commonly preferred sectors have been identified as technology, software/informatics and finance.

1. Introduction

The word “kariyer” in Turkish derives from “carriere” in French and also “career” in English. Career is used in order to refer to occupation, life-long progress and the job of one’s life. Turkish Language Association generally defines career as the occupations that are to be progressed at only one work area and that are to be specialized in the profession. One can be satisfied emotionally, socially, economically and vocationally if s/he prefers a work area in which s/he can continuously improve herself/himself and focus on (Taş, 2011).

In the process of career planning, one needs to know oneself and be aware of his/her strengths and weaknesses. In this sense, s/he decides on which occupation is more appropriate for him/her by evaluating his/her abilities and subject of interest. Choosing an occupation considered as the starting point of career planning has been affected by the factors such as advantages of the job, ability and interest of the person, advantages and disadvantages of that job and family (Taş, 2011). Another important decision to be made after choosing an occupation is to choose the sector to work in.

In literature, there has not yet been encountered a study in which the problem of choosing a sector for any occupation has been addressed to. Therefore, a research has been conducted for such a decision problem in this study. In this research, the sectors that the students want to work at in the future have been ranked with the help of the questionnaires on the students who are graduates of the department of Industrial Engineering and who are still studying at that department. The reason why industrial engineering has been chosen in the study as the occupation is that it has a variety of work areas; therefore, it offers students lots of work areas. It has been recently seen that service industry as well as manufacturing industry need industrial engineers, since one of the fundamental duties of industrial engineers is carrying out the processes of designing, planning and conducting all the integrated systems including human being, machines and materials in the best way by making use of the sources at maximum level with minimum cost.

Fuzzy AHP and fuzzy MOORA methods have been applied to the data obtained from the questionnaires on industrial engineers and prospective industrial engineers. Finally, for the subject occupation, the work areas of manufacturing, logistics, finance/ banking, health, technology, software/ informatics and academics have been prioritized and ranked under 10 criteria determined as payment, job satisfaction, career opportunities, being productive, having a goal, status, guidance/pressure, social opportunities, employment deficit and easiness of job.

* Corresponding author. Tel: +90442 231 4723
E-mail addresses: gakkaya@atauni.edu.tr (G. Akkaya), b.turanoglu@atauni.edu.tr (B. Turanoğlu), sinanoztas@atauni.edu.tr (S. Öztaş).

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There are mainly three reasons that we choose MOORA over other multi criteria decision making (MCDM) methods. The first one is that MOORA is the newest MCDM method which is constructed already knowing weak aspects of the older methods. Hence, we considered that it should be the most effective one. The second reason is the computational time MOORA requires for the problem solution as literature about MCDM points out. Finally, MOORA requires very low setup time and has a stable nature as the literature indicates.

2. Literature survey

The fact that fuzzy set theory was developed by Zadeh in 1965 has enabled doing various studies based on fuzzy on those situations that cannot be stated quantitatively. The studies that have been done recently and used the fuzzy AHP, MOORA and fuzzy MOORA methods which have been also applied in this article can be ranged as the following:

Somsuk and Laosirihongthhong have used fuzzy AHP method in order to identify the factors affecting the success of the university business incubators in Thailand. The data obtained from the questionnaires have been applied to this method and it has been seen that the most effective factor among 14 factors is administrative and political suggestions (Somsuk & Laosirihongthhong, 2014).

Jung has made use of fuzzy AHP method during the process of evaluating the manufacturing collaborators in the problem of an integrated manufacture planning. The related significance of those collaborators has been found so as to decide on which manufacture collaborator to work with (Jung, 2011).

Cakir and Canbolat have proposed the inventory classification system based on fuzzy AHP in a company producing electrical small household appliances. In the study, a decision support system has been designed integrating the fuzzy concepts and real inventory data (Cakir & Canbolat, 2008).

Chan et al. have emphasized that designing environment friendly products has been a critical task for modern business in the growing competition environment and they have proposed an integrated fuzzy AHP approach which is to decide on the choice of alternative green designs (Chan, Wang & Raffoni, 2014).

Zheng et al. have used the fuzzy AHP method to evaluate the job security in hot and humid places. The effectiveness of the proposed method has been demonstrated with a sample of engineering application (Zheng, Zhu, Tian, Chen, & Sun, 2012).

Tan et al. have proposed the fuzzy AHP method for the problem of choice faced in process engineering (Tan, Aviso, Huelgas, & Promentilla, 2014).

Javanbarg et al. have turned the non linear optimization problem to fuzzy prioritization problem by using the fuzzy AHP method and proposed an integrated approach solving this model with the optimization of particle flock (Javanbarg, Scawthorn, Kiyono & Shahbodaghkhan, 2012).

Isaai et al. have presented a new frame which includes the fuzzy AHP method and offer the best option for train path to passengers. In this study, performance measurements have been used such as weighted wait time and the average of unit waiting (Isaai, Kanani, Tootoonchi & Afzali, 2011).

Mangla et al. have developed a two phased methodology for risk evaluation in green supply-chain. At the second phase of this methodology, the prioritization of risks has been identified with the help of fuzzy AHP (Mangla, Kumar & Barua, 2015).

Büyüközkan et al. have identified the factors affecting the service quality in health services and used the fuzzy AHP method in the evaluation stage of suggested service quality frame (Büyüközkan, Çiftçi & Güleryüz, 2011).

Rezaei et al. have proposed an integrated fuzzy AHP method for the supplier choice in airline retail industry (Rezaei & Fahim, 2014).

Abdullah and Zulkifli have proposed an integrated fuzzy AHP and interval type-2 fuzzy DEMATEL approach for human resources management (HRM). The case study results have showed the criteria of education as most efficient criteria in HRM (Abdullah & Zulkifli, 2015).

Dong et al. have developed a triangular fuzzy power geometric operator and a triangular fuzzy weighted power geometric operator for decision makers' preferences into the group preferences in multi-criteria group decision making problems. Investment project selection has been analyzed by using triangular fuzzy AHP to combine these two operators (Dong, Li, & Zhang, 2015).

Calabrese et al. have made evaluation of investments in Intellectual Capital (IC) management by using fuzzy AHP. The opinions of experts have been expressed by the use of linguistic variables in the evaluation process of a group ICT service companies (Calabrese, Costa, & Menichini, 2013).

Patil and Kant have aimed to rank the solutions of Knowledge Management (KM) adoption in supply chain. They have proposed a framework including fuzzy AHP and fuzzy TOPSIS to prioritize these solutions. The weights of criteria have been found by fuzzy AHP, and ranking of the solution of KM adoption has been made by fuzzy TOPSIS (Patil & Kant, 2014).

Shaw et al. have presented an integrated approach including fuzzy AHP and fuzzy multi-objective linear programming for selection of suitable supplier in supply chain, addressing the carbon emission reduction. The results have showed the efficiency of proposed approach (Shaw, Shankar, Yadav, & Thakur, 2012).

Brauers et al. have proposed project management as an answer to a modern transition economy with strong market aspects. They have tested different multi-objective optimization methods after their robustness resulting in seven necessary conditions. MOORA and MULTIMOORA have been used in this study. These methods have satisfied the seven conditions (Brauers & Zavadskas, 2010).

Brauers and Zavadskas have said that MOORA is composed of ratio analysis and reference point theory. If MOORA is joined with full multiplicative form, a total of these methods are formed under the name of MULTIMOORA. The authors have emphasized that MULTIMOORA reflects the most robust approach for multi-objective optimization (Brauers & Zavadskas, 2012a).

Yıldırım and Önay have done the evaluation of some companies using cloud technology by making use of fuzzy AHP and MOORA methods (Yıldırım & Önay, 2013).

Karande and Chakraborty have stated that a correct choice of ERP is very significant for the companies and done the application of fuzzy MOORA method in order to solve this decision making problem (Karande & Chakraborty, 2012a). In another study, they have proposed an optimization model based on MOORA which will make the choices of correct materials for an unproblematic ultimate product (Karande & Chakraborty, 2012b).

Archana and Sujatha have indicated that the best network connection is necessary since nowadays there is a need for unproblematic wireless internet access everywhere and all the time. They have proposed an integrated fuzzy MOORA- Gray method to realize this choice (Archana & Sujatha, 2012).

Vatansever and Uluköy have made the choice of ERP software system for a company by using the fuzzy AHP and fuzzy MOORA methods (Vatansever & Uluköy, 2013).

Baležentis et al. have performed an application in which the fuzzy MULTIMOORA method has been used in the process of choosing personnel targeting the best employee defined for a company (Baležentis, Baležentis, & Brauers, 2012).

Baležentis, in his study, has proposed a fuzzy MULTIMOORA method in order to predict the agricultural productivity of agricultural products (Baležentis, 2011).

Özçelik et al. have applied a fuzzy AHP-MOORA method to the problem of choosing three different centers in Kayseri, which will