APPLICATION OF FDAHP AND FTOPSIS FOR RISK ASSESSMENT IN SUPPLY CHAIN
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ABSTRACT
Supply chain risk management is a systematic process for coordinating the elements of supply chain to use risk management tools, which is essential for responding to the risks and uncertainties affecting the supply chain activities. Ranking of supply chain risks, especially when the number of risk factors is increased, is considered as an important part of the complicated process of supply chain risk management. In this study, a comprehensive structure of the major risks of supply chain has been provided in three levels, and then the risks have been assessed and ranked in Esfahan Steel Company (ESCO) as a case study. For this purpose, the group decision-making techniques have been used to gather expert opinions. Afterwards, Fuzzy Delphi Analytic Hierarchy Process (FDAHP) was used to determine importance weights of risk assessment criteria, and Fuzzy Technique for order performance by similarity to ideal solution (FTOPSIS) was used to assess and determines rank of risks. The assessment criteria have been presented in two groups: primary and secondary (supplementary). The primary index has been determined based on probability and impact of risks on project goals (including: time, cost, quality and scope). The second group of criteria includes social-economic and environmental effects of risks, risk proximity, risk frequency, risk familiarity, risk mitigation, risk detectability, etc. Using the approach presented in this study, the risks are identified and assessed better, more accurately and more scientifically, and are thus more realistically ranked. Based on the results, the risks related to supply process (procurement and supplier Risks) have been recognized and introduced as the most critical risks in ESCO.

INTRODUCTION
Supply chain management includes the efficient planning, implementation and control process of flow of raw materials, manufacturing process inventories, finished goods as well as related information from the initial point to the point of consumption, which is conducted with the aim of meeting consumer needs. Therefore, it affects all activities in the organization, company, etc. Thus, considering the opportunities and threats in industry and commerce and assessment of the capacity of industries and companies to face uncertainties and risks is important, and supply chain risk assessment is critical for increasing the tolerance of chain and decreasing its vulnerability. Supply chain risk management means integration of supply chain elements to use risk management tools to address the risks and uncertainties influencing the activities of the supply chain, such that the supply chain profitability and continuity is ensured [1]. In other words, supply chain risk management is the interface of supply chain and risk management [2]. Risk management involves identifying, assessing and ranking the different risks. Risk assessment is considered a key part of risk management, and its goal is risk measurement according to different criteria such as impact and probability. The more accurate the results of this part, the higher the reliability of the risk management process. Risk ranking is an important part of risk assessment process, since ranking determines the superiority of each risk against other risks, and the decision maker can thus plan the allocation of available resources to deal with the risk [3]. Several studies have discussed the risk assessment and management in general and specifically in the supply chain: some researchers have reviewed risk management concepts and literature in their studies, and have discussed various aspects of it [ii, iv, v]. In other studies, supply chain risk has been considered as product of probability multiplied by an event impact, and the "impact" and "probability" criteria have been used in the form of probability-impact risk rating matrix [vi, vii, viii, ix, x]. In addition, other risk assessment techniques like FMEA have been used in other methods, in which the magnitude of risk is calculated as product of intensity, detection and probability of risk [xi, xii]. However, a number of researchers have noted weaknesses in risk measurement and assessment method in the above-mentioned studies, and have emphasized the unreliability of the results of techniques like FMEA, probability-impact matrix and the like [xiii]. As it can be seen risk assessment is fulfilled on the basis of only two attributes (risk impact and occurrence probability) and the other fundamental