

Identification and ranking of technology risks in the field of natural gas energy distribution by the integrative approach of FMEA and TOPSIS The Case of Chaharmahal and Bakhtiari Province Gas Company

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Purpose: One of the most important risks of organizations is technology risk. In gas companies, due to the expansion of activities, increase in the number of subscribers, and increase share of gas in energy basket, technology has a very important role in delivering appropriate service. Risk assessment in gas technology development projects is very vital. In fact, the existence of numerous risks in the gas industry is one of the main obstacles to the technology development in the country's gas industry. In other words, the implementation of plans and projects of the gas industry are highly risky due to the uncertainty of the specific elements of this industry. The purpose of this study is to provide a suitable framework for identifying and ranking the risks of gas companies using the integrative technique of FMEA and TOPSIS. The distinguished aspect of this paper compared to previous studies is the new method developed based on failure modes and effects analysis (FMEA), Shannon Entropy approach, and Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) for ranking technological risks of the gas company.

Design/methodology/approach: In this paper, technology risks in gas distribution have been determined based on literature and expert's viewpoints. Then, the identified risks were sent to 33 of the company's experts via the FMEA worksheet. After rating the risks by the experts in the FMEA worksheet, instead of obtaining the Risk Priority Number (RPN) number for each risk, the risks were prioritized using the TOPSIS technique. The FMEA method considers three kinds of attributes, namely, occurrence, detection rate, and severity. Occurrence is the probability of the risk, detection rate is the ability of detecting risk, and severity is applied as severity of the effect of risk. The judgment about determination of indicators has been proposed by experts. In this paper, TOPSIS has been used instead of applying an RPN to assess potential failure modes by multiplying indicators of occurrence, detection rate, and severity. TOPSIS is a ranking method with the aim of selecting alternatives that simultaneously have the shortest and farthest distances from the positive and negative ideal solutions, respectively.

Findings: Findings indicated that the most important technology risks in gas distribution are i) variation in macroeconomics index (exchange and inflation rate) in country; ii) inability to access required equipment and machinery; iii) inability to access manufacturing technologies; and iv) limited financing for technology development.

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Research limitations/implications: One of the limitations of this study was separate access to the projects of this industry. In this study, the gas distribution project was defined generally and included all projects in the gas distribution industry. In fact, it was not possible to individually access the gas distribution projects. Analyzing and presenting solutions for each risk separately was another limitation of this study. In other words, considering each risk separately according to the structure of the industry was another limitation of this study.

Practical implications: The results were valid based on the reasonable method and experts' confirmation and could be suitable for this industry. The technique presented in this study was based on information obtained from the Chaharmahal and Bakhtiari Province Gas Company, while due to the similar structure of provincial gas companies in gas technology and distribution, the method and results obtained in this study can be applied in all gas companies in the field of gas distribution.

Social implications: The results of this study could decrease the cost of gas distribution industry by determining the most important technological risks of the gas company.

Originality/value: The aim of this study was to propose a new method of FMEA for ranking technological risks of the gas company by integrating Shannon Entropy approach and TOPSIS. The contribution of this study was the investigation of the technological risks of the gas company. In addition, in this paper, a new method was applied by the integration of FMEA and TOPSIS.

Keywords: Ranking, Gas energy, Technology risks, FMEA, TOPSIS