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A SWOT framework for analyzing the electricity supply chain using an integrated AHP methodology combined with fuzzy-TOPSIS



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ABSTRACT

Supply chain refers to the integrated chain of organizations, loops, persons who are involving in stuff generation and customer servicing. One of these services is the electricity which can be consumed as domestic, industrial, agriculture and etc. It can be considered that the electric power supply chain network has four stages which are electricity generation, transmission, distribution and consumption. In this paper, a framework of Strengths-Weaknesses-Opportunities-Threats (SWOT) is presented to analyze the electricity supply chain in north-west Iran. In this regard, some interviews are done with several experts of electricity industry. In addition, integrated AHP method which is combined with fuzzy-TOPSIS is proposed to prioritize the SWOT factors for the proposed electricity supply chain. The results show that the proposed method can be used effectively in order to determine a strategy plan with high prioritizing for planning and decision-making in electricity supply chain.

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1. Introduction

Supply chain refers to an integrated network between various producers which has different transmission stages until stuff approaches to the final user [1]. A supply chain network consists of various elements such as suppliers, producers, stocks, distribution centers and customers, which means stuff supplying, using raw material produces outputs, and then transmits production to the stores and distribution centers to satisfy customers' demands [2]. Planning and coordination in optimized direction and effectiveness of supply chain activities is called supply chain management, which means competitive market needs on-time delivery with low inventory for the lowest price of servicing by the chain [3]. Supply chain management is actually a method in which the materials and services reach to the customers in the proper amount and place with the least monetary and with proper combination of suppliers, producers, stores and shops. Supply chain management affects every part of the chain and also has some influences on each part related to the final customer [4].

It is argued by Forrester [5], that how the management encounters the changes related to information process, material, stock and equipment would affect organization success. Chopra and Meindl [6] believe that supply chain is the all of elements of an organization which are included supplying of customers' demands, directly or indirectly.

Most of the research in supply chain network majority is for profitability improving and service increasing within a supply chain. For validating service and activity of supply chains, various methods are presented in the literature. These methods consist of analytic hierarchy, Balanced Score Card (BSC), Analytic

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Hierarchy Process (AHP) and Data Envelopment Analysis (DEA) to name but a few. Cho et al. [7] proposed a framework for measuring service level in supply chain according to level operation of tactical and plan strategy in the supply chain. The methodology presented in [7] is on the base of fuzzy-AHP. In other research for operational measuring, balanced scoring was used [8]. Zhang et al. [9] checked the uncertainly effects in demands, material price and other parameters in supply chain operation by the use of sensitivity analysis. They used diffused combination from Evolutionary Algorithm (EA) and fuzzy random programming. Chen [10] discussed one structural methodology for supplier selection in supply chain network in Taiwan textile industry with SWOT analysis and a Multi Attribute Decision Making (MADM) method for prioritizing potential suppliers. A closed-loop model is configured in [11] for validating and selecting the best suppliers of one supply chain network. In this model, the uncertainty in demands was also mentioned. The results show that the proposed model can be useful in closed-loop supply chain networks management. Awasthi et al. [12] used one fuzzy multi criteria model for evaluating the suppliers in supply chain environment.

The SWOT analysis is a powerful strategic tool for evaluating an organization according to internal and external key factors [13]. Strengths and Weaknesses are often internal to the organization, while Opportunities and Threats generally relate to external factors. After identifying SWOT factors, every organization should use its strategies in protecting or improving strengths and eliminating weaknesses and usage of opportunities and collation with threats [14]. Quantitative SWOT methodology first was presented by Kurttila et al. [15] that named A-WOT and was used in AHP method. Other authors have used the A-WOT in their surveys [16-18]. Yuksel and Dagdeviren [19] used Analytic Network Process (ANP) in a SWOT analysis. Gao and Peng [20] used Multiple Criteria Group Decision Making (MCGDM) for prioritizing SWOT factors. This methodology is evaluated by an example in their survey. Lee et al. [21] proposed one quantitative SWOT-fuzzy method for competitive environment evaluating in distribution centers of international transmission in Pacific Ocean. According to the literature review, other quantified SWOT methods have been proposed with or without uncertainty considerations [20, 21]. However, the application of quantified SWOT methodology in energy programming has been relatively scarce [22, 23]. In this paper, a Strengths- Weaknesses- Opportunities- Threats (SWOT) framework is proposed for electricity supply chain in Iran and SWOT factors are prioritized in order to determine a strategy plan. The innovation of this research is in considering of both internal and external factors as an integrated way for strategic analysis. For this reason, by the help of experts in each stage of generation, transmission, electric distribution and consumption, strength and weakness factors related to internal conditions of chain and opportunities and threats related to external conditions are identified. Figure 1 shows SWOT evaluating framework fits into a strategic evaluation.

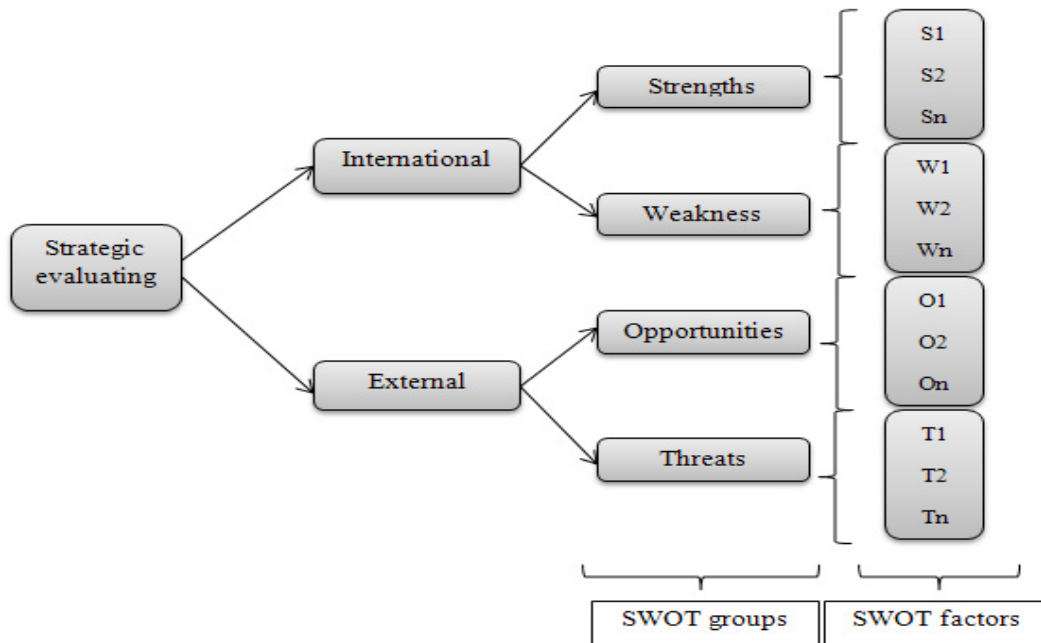


Fig. 1. SWOT evaluating framework

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