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Supplier selection in automobile industry: A mixed balanced scorecard–fuzzy AHP approach

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Abstract This study proposed an integrated Balanced Scorecard–Fuzzy Analytic Hierarchical Process (BSC–FAHP) model to select suppliers in the automotive industry. In spite of the vast amount of studies on supplier selection, the evaluation and selection of suppliers using the specific measures of the automotive industry are less investigated. In order to fill this gap, this research proposed a new BSC for supplier selection of automobile industry. Measures were gathered using a literature survey and accredited using nominal group technique (NGT). Finally, a fuzzy AHP was used to select the best supplier.

1. Introduction

In today's competitive markets, companies have realized the importance of selecting proper suppliers who can supply their requirement with their desired quality and in a scheduled time. With the advent of supply chain management (SCM), performance measurement can be considered as the best strategy for manufacturers to evaluate and select the best supplier to achieve supply chain surplus. Although the concepts of supplier evaluation and selection have been discussed by many researchers [1–6] only a very few attempts have been made to propose specific supplier selection frameworks for automotive industries [43]. In this context, proposing, incorporating,

merging, quantifying, and deploying the exact variables and measures to proficiently and efficiently observe and assess the performance of suppliers are a confront for many practitioners, managers, and researchers [7–10]. While managers know about the importance of evaluating suppliers from different perspectives, this is less happening in the real world. This is partially due to the availability and complexity of many measures for the aim of supplier evaluation, which make the process of selecting measures very complicated and time consuming. In addition, BSCs should be fitted to the characteristics of specific industries to be efficient. However, considering specific performance measures for the supplier selection of automotive companies can be beneficial due to following reasons:

1. In real life, managers aim to consider the most important measures for the aim of evaluating their suppliers and considering the economic issues (e.g. waste of time and human resource).

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2. Performance measures must be categorized in specific perspectives. This helps managers to assign different importance to some perspectives (e.g. assigning a higher weight to financial issues comparing to customer related concerns).
3. Mathematical models are precise tools to combine all the supplier evaluation results together and select the best one. This will be more precise when the decision maker has the option of making his/her decision in fuzzy environments.

Therefore, developing a BSC–FAHP model to evaluate the performance of different suppliers of automobile industries is the main objective of this study. By doing this, it attempts to address the following research questions:

1. How a specific framework can be proposed for the aim of choosing suppliers in automobile industries?
2. How different suppliers can be evaluated using the proposed framework?
3. How a fuzzy AHP can be used to combine the proposed framework to supplier selection process?

The scope of this study is limited to Iran's automotive industry. However, the research structure, methodology, and framework can be helpful to researchers and practitioners who are interested in evaluating and selecting suppliers for specific industries. This study contributes to proposing a new BSC framework for the aim of evaluating and selecting suppliers for manufacturers in automotive industries along with using a fuzzy AHP in order to combine all the performance measures concurrently. It introduces a new idea for the integration of specific measures used for the process of supplier selection in automotive industries when there are so many performance measures which may make the decision makers confused. From the hypothetical and methodological point of view, to the best of our knowledge, this study also contributes to offer a new approach for automotive manufacturers to select their suppliers based on the specific measures since very few researches have been conducted before. The rest of this paper is organized as follows. Section 2 is a review of recent works on supplier evaluation and selection. A summary of research methodology is discussed in Section 3. Section 4 presents the proposed BSC. Section 5 shows the supplier performance measurement and section 6 concerns the supplier selection process.

2. Literature review

2.1. Supplier selection

Since 1980s, company's procurement processes have changed from fundamental supplies and raw materials to a network of joint enterprises. Consequently, supplier selection is a significant player of the procurement process [1,2]. Basically, selecting a proper supplier is considered as a non-trivial task. To achieve this goal, the majority of the decision makers empirically choose suppliers [3,4]. Fundamentally, supplier selection is a decision procedure with the goal of decreasing the preliminary group of prospective suppliers to the ultimate choices [5–9]. Supplier selection has been discussed by many researchers within the available literature [10–14].

2.2. Performance measurement

Performance measurement is a subject which is frequently argued, but seldom described. Based on the marketing perspective, organizations attain their objectives by fulfilling their clients with superior efficiency in comparison with their competitors. Performance measurement is a fundamental approach to achieve this progress. In other words, progress will not happen except the proper metrics are created, evaluated, measured and tracked. A performance measure can be described as a metric deployed to quantify the efficiency and/or effectiveness of an action. A performance measurement system can be described as the set of metrics deployed to quantify both the efficiency and effectiveness of actions [15,44,45].

With the advent of technology and increasing market competitiveness, companies understood about the significance of assessing their performance not only based on financial perceptions, but also based on other perspectives such as customer satisfaction and innovation [46–50]. BSC framework was developed in order to assist companies to balance the financial perspectives. Financial perspectives are appropriate to explain the past occurrences which are mostly long-term categories and not appropriate for critical success [16,17]. BSC was proposed to assist managers to assess the performance of their enterprise based on financial, customer, internal business, and learning and growth perspectives.

2.3. BSC–FAHP integration

Sharma and Bhagwat [18] suggested an incorporated BSC–AHP method for supply chain assessment. This paper suggested a balanced performance assessment structure for supply chain. While offering BSC, diverse SCM performance measures were allocated into four viewpoints. Lee et al. [19] proposed a fuzzy AHP and BSC method for assessing the performance of IT department in the manufacturing business of Taiwan. The BSC idea was used to identify the hierarchy with four major perspectives and performance. A FAHP approach was then developed to tolerate vagueness and ambiguity of information.

Cebeci [20] offered a method to choose an appropriate ERP system for textile industry. The developed methodology provides suggestion prior to ERP selection. The criteria were concluded and subsequently compared in relation to their significance. Wu et al. [6] suggested a fuzzy MCDM method for assessing banking performance based on BSC. The research developed a Fuzzy Multiple Criteria Decision Making (FMCDM) method for banking performance assessment. Considering the four perspectives of a BSC, this study first reviewed the assessment indexes created from the literature connecting to banking performance. Then, for viewing these indexes, 23 indexes proper for banking performance assessment were chosen through expert questionnaires. In a similar study, Tseng [21] developed four BSC aspects and 22 criteria for a private university of science and technology in Taiwan.

Yüksel and Dağdeviren [22] did a case study analysis for a manufacturing firm using the FANP–BSC. This research revealed that BSC framework can be merged with fuzzy ANP method. Wang et al. [23] used a non-additive fuzzy set function and algorithm method to solve the BSC, hard to count and cause-and-effect relationship between different