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A fuzzy sequential model for realization of strategic planning in manufacturing firms

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ABSTRACT

Strategic planning is a vital management tool for projecting the long-range business goals and is not only for big businesses, but also applicable to small businesses in spite of their limited resources. To do this effectively, organizations should determine their strengths and weaknesses. Organizations have to produce appropriate action plans to overcome these weaknesses and it is very important to prioritize the action plans according to limited resources. In the current practice, a sequential model for overcoming this prioritization problem has not been studied in the related literature. Therefore we proposed a fuzzy sequential model (FSM) to help organizations in strategic planning process. This model includes four steps which are; determining open to improvement areas (OIAs), determining the root cause, developing action plans for each root cause and determining priority of OIAs hence action plans respectively. The proposed model was applied in a local manufacturing small medium enterprise (SME) as a real world case study. Results of the case study show that relatively more prioritized OIAs for the SME are, "mid-level managers take inadequate initiatives", "failure to comply with the design calendar in Research & Development (R&D) and Product Development (P&D) processes", "small lot sizes", respectively.

1. Introduction

Strategic planning is a management tool that enables employees to canalize the organization's targets. Strategic planning approach helps to identify long-term goals, current status and future plans of the organization via identifying root causes of problems in all levels of the entire organization. Organizations define visions after determining strategies and goals that help achieve objectives which are related to the vision with strategic planning. Also organizational performance are monitored with measurable criteria. The first step of strategic planning is the situation analysis. This analysis is aimed at identifying the current situation. Organizations can clearly see open to improvement areas (OIAs) by analyzing internal and external environment through SWOT (strengths, weaknesses, opportunities and threats) analysis.

Heuristic techniques are applied in strategic planning process in the related literature. Moynihan, Raj, Sterling, and Nichols (1995), described the design of a microcomputer-based decision support system that utilizes heuristic simulation techniques to planning at a strategic level. Also, Li, Ang, and Gay (1997), proposed a neural networks application, which consists of scenario generation for strategic business planning. There are studies of multi-criteria decision making (MCDM) methods with specific strategic decisions such as supplier evaluation and selection (Arabzad, Ghorbani, Razmi, & Shirouyehzad, 2015; Ayhan & Kılıç, 2015; Büyüközkan & Çifçi, 2012; Chen, Lin, & Huang, 2006; Dulmin & Mininno, 2003; Razmi, Rafiei, & Hashemi, 2009; Zeydan, Çolpan, & Çobanoğlu, 2011), however the number of studies on strategic planning are limited. Chiou, Tzeng, and Cheng (2005) proposed a fuzzy hierarchical analytic process to derive the weight of considered criteria and rank the importance of the criteria for sustainable development strategies. Dodangeh, Yusuff, and Jassbi (2010) proposed a model for selection and ranking of strategic plans in balanced scorecard using TOPSIS method and goal programming model. Perçin (2010) used ANP for selecting appropriate knowledge management strategies. Wu, Lin, and Lee (2010) proposed the marketing strategy decision making model by using ANP and TOPSIS method. Azimi, Yazdani-chamzini, Fooladgar, and Basiri (2011) proposed an integrated model for prioritizing the strategies of Iranian mining sector. They applied ANP in order to obtain the weight of SWOT factors and ranked the strategies by using VIKOR technique. Zavadskas, Turskis, and Tamosaitiene (2011) developed a methodology for determining management strategies in construction enterprises management by applying SWOT and MCDM methods, analytic hierarchy process (AHP) and permutation.

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Baby (2013) proposed a model to optimize the strategies built by SWOT – QSPM (Quantitative Strategic Planning Matrix). The optimizing and rationalizing of the strategies were performed with the concept of AHP/ANP utilizing MCDM software. Ocampo, Clark, and Tanudtanud (2015) presented a decision framework that integration of manufacturing strategy by using probabilistic F-ANP method.

In this study we proposed a sequential model which consists of SWOT analysis, Root Cause Analysis (RCA), modified Bolden's taxonomy and fuzzy ANP methodologies. We used SWOT analysis to determine the strengths and weaknesses of the company. We used RCA to define main and sub-causes of the weaknesses. We improved Bolden's taxonomy by adding a new aspect (a fifth row) that helps to evaluate problems from social point of view. We used the modified Bolden's taxonomy to match OIAs, which was derived from the root causes of weakness, with probable action plans. Finally, we used fuzzy ANP to prioritize these action plans according to importance of OIAs. Fuzzy Sequential Model (FSM) helps in identifying which action plan will affect organization more. Thus FSM supports managers while making decisions on realization of strategic planning. Our contributions to the related literature are the development of a sequential model which enables effective usage of limited resources in strategic planning and extending Bolden's manufacturing taxonomy with the aspect of social impact.

2. Methodology

In this section we briefly described SWOT analysis, RCA, modified Bolden's taxonomy and F-ANP method that are used in the proposed model.

2.1. SWOT analysis

SWOT is an acronym for strengths, weaknesses, opportunities, and threats. SWOT analysis is a useful method for assessing organizations' internal factors (strengths and weaknesses) and external factors (opportunities and threats) in strategic planning process. The SWOT framework as a specific strategic tool was developed by Learned, Christensen, and Andrews (1965), from earlier efforts at the Harvard Business School to analyze case studies (Chermack & Kasshanna, 2007). The basic framework of SWOT analysis is shown in Table 1.

2.2. Root cause analysis

Root causes are the real reason behind the problems. RCA is a process application that focuses on permanent solutions to the problems rather than smooth over the cracks. Root cause analysis techniques can be listed as; failure mode and effect analysis, Ishikawa diagram, change analysis, Pareto analysis and fault tree analysis. In this study, Ishikawa diagram is used in determining the root causes. The Ishikawa diagram which is also known as fishbone diagram, was proposed by Kaoru Ishikawa in the 1960s, who founded quality management processes in Kawasaki shipyards (Jayswal, Li, Anand, Loua, & Huang, 2011).

Table 1
The basic framework of SWOT (Chermack & Kasshanna, 2007).

	Strengths	Weaknesses
Opportunities	Achieve opportunities that greatly match the company's strengths	Overcome weaknesses to attain opportunities
Threats	Use strengths to reduce the company's vulnerability to threats	Prevent weaknesses to avoid making the company more susceptible to threats

2.2.1. Modified Bolden's taxonomy

Bolden, Waterson, Warr, Clegg, and Wall (1997) proposed a taxonomy to provide a multi-disciplinary overview of the manufacturing fields. They contribute to the literature with an overall framework, summarizing and interrelating all the principal activities found within current manufacturing organizations as seen in Table 2.

The benefits of a manufacturing practices taxonomy according to Bolden et al. include the following;

- Enables the identification of inter-relationships between practices in a clear manner.
- Assists in the identification of the differences and commonalities between practices.
- Enhances the identification of practices for researchers and practitioners from a variety of backgrounds.
- Promotes the identification of gaps between theory and practice (Walden, 2007).

Bolden's taxonomy helps to find out which areas to focus on, for related problems of the company. Bolden's classification scheme for development of their taxonomy is shown in Table 2. For instance, if a company is dealing with inventory and stock problems, and wants to reduce costs they should seek solution in those 5 practices (IIB1-Reduced inventory, IIB2-Single sourcing, IIB3-Just in time inventory control, IIB4-Forecasting, IIB5-Logistics management) listed in second row (row II), second column (column B).

Bolden et al. proposed this taxonomy in 1997. However, with the help of rapidly developing internet and communication technologies (ICT), social aspect is crucial for the companies in today's competitive world. Both internal and external stakeholders of the company have arising awareness to their new responsibilities to each other and to the environment. Organization for Economic Co-operation and Development (OECD) reports indicate that ICT, green growth and social impact are prioritized areas (OECD Innovation Strategy, 2015). For these reasons, our contribution to this taxonomy with the aspect of social impact can be seen in the fifth row.

2.3. Fuzzy analytic network process (F-ANP)

MCDM is a sub-discipline of operations research that explicitly considers multiple criteria in decision making environments (Achillas, Moussiopoulos, Karagiannidis, Banias, & Perkoulidis, 2013). These methods deal with decision making processes and are appropriate research methods that can be used in selecting and sorting out alternatives. In the decision process, objectives, quantitative or qualitative criteria are assessed for each alternative at the same time. AHP is one of the popular MCDM methods which works on priority theory and was developed by Saaty (1980). ANP is the general form of AHP (Saaty, 1996).

The first phase of ANP compares the measuring criteria in the overall system to form a super-matrix. This can be accomplished using pair-wise comparisons (Liou, Tzeng, & Chang, 2007). Triangular fuzzy numbers and fuzzy linguistic terms for using pairwise comparisons are given in Table 3. Experts use linguistic expressions while evaluating criteria. For this reason, the fuzzy linguistic scale shown in Table 3 is used in the experts' opinions.

We used a simple extent analysis method proposed by Chang (1996) for F-ANP weight derivation. Extent analysis method is selected in this study because of a broader use in related literature and also it has less computational complexity by using triangular fuzzy numbers. We described extent analysis method below.