Int. J. Production Economics ∎ (∎∎∎∎) ∎∎∎–∎∎∎

Contents lists available at ScienceDirect

Int. J. Production Economics

journal homepage: www.elsevier.com/locate/ijpe

Achieving competitive advantage through supply chain agility under uncertainty: A novel multi-criteria decision-making structure

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ARTICLE INFO

Article history:
Received 28 September 2015
Received in revised form
25 August 2016
Accepted 29 August 2016

Keywords:
Closed-loop analytical network process
Decision-making trials and evaluation laboratory method (DEMATEL)
Fuzzy Delphi method
Fuzzy set theory
Supply chain agility

ABSTRACT

The electronic industry suffers a rapid changing and highly rival environment. Thus, firms have an essential need to strive for acquiring the competitive advantage. Supply chain agility (SCA) is a tool which enable to assist firms to attain the competitive advantage. Therefore, this study benchmarks the core competencies from a case study within the supply chain network and establishes a set of attributes for augmenting SCA. A novel multi-criteria decision-making structure is proposed to deal with the complex interrelationships among the aspects and attributes. Fuzzy Delphi method uses for screening out the unnecessary attributes, then integrating fuzzy set theory with decision-making trials and evaluation laboratory method and closed-loop analytical network process to evaluate the SCA in determining the core competitive advantage. The empirical results indicate that flexibility significantly impacts by process integration, information integration and strategic alliances for eco-design in supply chain. Then, process integration has the highest influence in developing the competitive advantage of innovation. The managerial and theoretical implications are discussed.

1. Introduction

Electronics industry encounters rapid changes in market, intense competition, fast-paced technological innovations and customer's environmental awareness increasing. Hence, firms have an essential need to develop the agility for surviving in this rival environment. Agility exists in supply chain network can help firms to achieve the competitive advantage (Hayes and Wheelwright, 1984). Previous studies emphasized that supply chain agility (SCA) focuses on promoting innovation, flexibility and speed, and then reducing the costs of production (Lin and Tseng, 2016; Tseng et al., 2008). In addition, SCA not only consider as a tool to quick respond the changes in the markets (Fayezi et al., 2015; Lin et al., 2006; Wong et al., 2014; Yusuf et al., 1999), but also encourage individual firms to work together for enhancing the environmental credentials in terms of green raw materials, eco-product design, process integration and customer-based measures (Tseng, 2010, 2011; Tseng et al., 2015). Although supply chain network is a collaborative group that formed together to attain the mutual benefit in the economic and environmental performance, it still lacks a logical and crystal structure to guide the group in achieving the competitive advantage through SCA.

To address this gap, this study proposes a closed-loop hierarchical decision-making structure to explore the key drivers of SCA for developing the competitive advantage. In addition, SCA has to be structured from multidimensional considerations to reflect the real situation, which might enhance the challenge and complex in the evaluation. Thus, Van der Vorst and Beulens (2002) proposed an evaluation model to reduce the uncertainty and enhancing effectiveness in searching the key drivers. This model contained the information integration, estimating the impact of alternative actions, lean production, organizational agility, quick response and individual actions. DeGroote and Marx (2013) demonstrated that information technology can increases SCA through quick respond market changes and enhance supply chain collaboration, so firms enable to reach the cost reduction, quality improvement and the innovative processes and product design support. Several studies emphasized that developing a set of measurements for exploring the key drivers of SCA is an urgent task (Venkatraman, 1989; Agarwal et al., 2007). For filling up this gap, a comprehensive measure is required to consider in

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http://dx.doi.org/10.1016/j.ijpe.2016.08.027
0925-5273/

integrating with interdisciplinary knowledge and real practices. Once the key SCA drivers have been found, firms enable to improve the competitive advantage under limited resources.

The measurement of SCA belongs to qualitative analysis, which uses for capture the interrelationship and interdependence within firms (Tseng, 2011; Tseng and Chiu, 2013; Tseng et al., 2015). These data are generally described into subjective ways and linguistic terms rather than numbers, so the conventional assessment approaches suffer the difficulty to deal with non-numeric analysis. Then, fuzzy set theory offers an effective means to overcome these imprecise and vague phenomena (Lin et al., 2014; Tseng et al., 2014a, 2014b). The transformation process of fuzzy set theory enables to convert these qualitative measures into comparable scales. This study adopts closed-loop decision making structure in order to reduce the complexity and emotionally burdened decision with resembling the existing real situation. Subsequently, decision-making trial and evaluation laboratory (DEMATEL) applies to determine the interrelationships among the selected attributes (Tseng, 2009, 2010; Tseng and Lin, 2009). Closed-loop analytical network process (ANP) method is used for gathering the ranking and dealing with the hierarchical structure through interdependence measures (Lin and Tseng, 2016; Tseng, 2011; Tseng et al., 2015; Uygun et al., 2015).

Therefore, the objective of this study is to develop a SCA decision-making hierarchical structure and explore the key drivers for leading firms to achieve the competitive advantage under uncertainty. Previous studies have been proposed several necessary attributes for assessing SCA, nevertheless, these attributes haven't been integrated as a comprehensive consideration in the measurement. In view of this, a hybrid method and systematic analysis procedure are required to overcome the interrelationships, interdependence and the hierarchical structure. This is the first study to consider SCA as a closed-loop hierarchical decision-making structure and adopts hybrid method to conquer the uncertainty. The detail discussion is organized as following. Section 2 presents the theoretical basis and extensive literature review. Hybrid method is composing of fuzzy Delphi method, fuzzy set theory, DEMATEL and closed-loop ANP, which illustrate in the Section 3. Empirical results and significant findings are stated in Section 4. Section 5 expresses the implications. Conclusion, research limitations and future researches are provided in the final section.

2. Literature review

This section contains the background of competitive advantage, SCA, proposed measures and the proposed analytical method. These discussions provide a comprehensive theoretical basis to support the concept of this study and forming structure.

2.1. Theoretical background

Competitive advantage refers to a capability, which acquires from the attributes and resources to perform in a higher level within the industry (Hayes and Wheelwright, 1984; Tseng et al., 2008). Blome et al. (2013) presented that SCA is a complex set of dynamic aspects, these are the necessary for developing the competitive advantage. These dynamic aspects enable to underpin the performance in changing market conditions through integrating, building and reconfiguring internal and external competences (Wu et al., 2015). However, several obstructions contain insufficient collaboration, lacking information technology integration, inadequate alliance with eco-design, and failing to satisfy customer's needs, which might generate the gaps in achieving competitive advantage (Cao and Zhang, 2010; MacDonald and She, 2015; Ngai et al., 2011; Sharifi et al., 2006; van Hoof and Thiell, 2014; Xu, 2006).

Undoubtedly, SCA is a tool for enhancing the competitive advantage in terms of reducing cost through operational process integration, maintaining customer-based measures, speeding up the reflection of customer's needs, improving information access and transparent, supporting eco-design alignment with supply chain partners, increasing flexibility in production and suppliers (Eisenhardt et al., 2010; Yusuf et al., 2004; Wong et al., 2014; Yang, 2014). However, the linkage between SCA and competitive advantage still remains the uncertainty and undiscovered relationship in previous studies (Zhang et al., 2003). To fill up the gap, it requires a comprehensive structure to measure and relies on a hybrid method to overcome the uncertainty.

Agility uses for transferring and applying the winning strategy to the newly accepted units of business under environment changing. To increase the agility among entire supply chain, it not only requires upstream and downstream collaboration from suppliers to customer, but also seeks the lateral collaboration with competitor for integrating the total value creation process (Gligor, 2014). Once these collaborations are aligned, it can generate the agility to use for responding short-term changes in demand or supply, mitigating the external disruption occurrence, and generating the value adding to customers for ensuring the uninterrupted service (Lee, 2004; Van der Vorst and Beulens, 2002). In addition, outsourcing function, downstream customer-based functions with eco-product design and process integration are required firms to concern in developing the agility through collaboration (Tseng et al., 2014a, 2014b; Wong et al., 2014; Yusuf et al., 2004).

SCA can consider as flexibility, which possess a capability to assist firms in reflecting the rapid market changing and preventing the disruption among supply chain (Christopher and Towill, 2001). Swafford et al. (2006) presented that internal integration, cross-functional alignment and external integration between customers and suppliers play important roles in developing the flexibility. Agarwal et al. (2007) emphasized that information integration, networking and collaboration are stimulated the performance of agility in quality improvement, cost minimization and lead-time reduction respectively. Therefore, Vinodh and Prasanna (2011) considered SCA as the operational dynamics, which reflects an ability to deal with the uncertainties around business environment and reflect the rapid changes.

However, SCA not only promotes the competitive advantage in terms of flexibility, speed, innovation and cost to some specific customers and markets, but also assists firms in improving their capability of collaborations, process integration, information integration and so on (McCullen et al., 2006; Zhang et al., 2003). It retains the individual firms' competitive advantage in satisfying the extensive range of needs for responding the rapid changes in the market (Braunscheidel and Suresh, 2009; Yusuf et al., 2004). Hence, SCA has to consider as a multi-level hierarchical structure in minimizing uncertainty and resistance among the entire supply chain (Li et al., 2008; Sangari et al., 2015). This study proposes a close-loop hierarchical structure and concern the interrelationships and interdependence among proposed measures to develop the competitive advantage through SCA.

2.2. Proposed SCA measures

Ngai et al. (2011) proposed a set of competencies that included information technology, operations and management, which shows the effective operational functions to improve the performance through SCA. It is composed of a sequence or network of interrelationships fostered through strategic alliances, collaborations, process integration, information integration and customer-

Please cite this article as: Wu, K.-J., et al., Achieving competitive advantage through supply chain agility under uncertainty: A novel multi-criteria decision-making structure. International Journal of Production Economics (2016), http://dx.doi.org/10.1016/j.ijpe.2016.08.027