Expert Systems With Applications 55 (2016) 145–156

Contents lists available at ScienceDirect

Expert Systems With Applications

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

Risk assessment of co-creating value with customers: A rough group analytic network process approach

Jintao Cao[a,*], Wenyan Song[b]

[a] Department of Industrial Engineering & Logistics Management, Shanghai Jiao Tong University, 800 Dongchuan Road, Minhang District, Shanghai 200240, China

[b] School of Economics and Management, Beihang University, Beijing 100191, China

ARTICLE INFO

Keywords:
Value co-creation
Risk assessment
Analytic network process
Rough set theory
Multi-criteria decision making

ABSTRACT

Co-creating value with customers is becoming an important competition strategy for companies. It provides a feasible way to meet customers' personalized requirements. However, the strategy needs effective management to obtain benefits because it may involve many potential risks. Neglecting these risks may lead to extra-budgetary costs, wrong decision of product investment or loss of customers. To the best of our knowledge, little attention has been paid so far to the risk assessment of co-creating value with customers.

This study mainly focuses on assessing the risks of co-creating value with customers under uncertainty. First, the scattered literature is combed systemically to determine the risk factors of co-creating with customers. Then, a novel approach called the rough group analytic network process is proposed to assess these risks quantitatively. The proposed approach can intelligently handle decision maker's subjectivity and vagueness, and the interdependences/feedbacks among risk factors. Finally, an industrial case study is presented to illustrate the application of the proposed approach, and the proposed approach is compared with other existing methods to demonstrate its the advantages.

1. Introduction

Co-creating value with customers, which can enable companies to provide an individual personalized product to each customer, is becoming an important competition strategy for companies in recent years (Durugbo & Pawar, 2014; Grönroos & Voima, 2013; Vargo & Akaka, 2009; Zhang & Chen, 2008). The strategy based on co-creating value with customers is significant different from the traditional value network strategy. In a traditional value network, customers are only the receivers of the final offering (products/services), whereas in a value co-creation environment, customers are not only the receivers but also one of the creators/producers of the value network (Grönroos, 2008). This difference will increase the uncertainties of the value network; however, to seize the benefits from co-creating value with customers, companies must avoid risks derived from these uncertainties by carefully managing the co-creating process. Companies should enhance the interaction with the customer to catch the customer's true requirements accurately. Simultaneously, companies should enhance the interactions with suppliers to serve customers more efficiently in the early stage of designing the offering (Thomke & Fujimoto, 2000). The interactions with customers and suppliers will require companies to share information and define the product architecture with them. Both the customers and suppliers are possible risk sources in these interactions. The risks of customer involvement include customers' capability to articulate needs, customers' bias on radical innovations, and damaged relationships with key customers. Suppliers' role is decided by their capabilities and the responsibilities being undertaken by them (Ward, Liker, Cristiano, & Sobek, 1995). The risks of supplier involvement include the degree of design customization by suppliers and the supplier coupling index. If companies neglect these risks, they may end up incurring extra-budgetary costs, making wrong decisions on product investment, or suffering loss of customers. Therefore, it is necessary to identify the weak links, assess the associated risks of customer and supplier involvement, and minimize the adverse effects of the risks.

The current literature on supply chain risk management include studies on various risks in supply chains, quantifications of their impacts, and methods to mitigate risks (Cavinato, 2004; Ho, Zheng, Yildiz, & Talluri, 2015; Jüttner, Peck, & Christopher, 2003; Tang, 2006; Tang & Musa, 2011). However, so far, little attention has been paid to the risk assessment of co-creating value with customers, which should be considered as a holistic supply network

* Corresponding author. Tel.: +86 18801970714.
E-mail address: caojintao005@163.com (J. Cao).

http://dx.doi.org/10.1016/j.eswa.2016.02.012
0957-4174/

including customer and supplier involvement. Song, Ming, and Xu (2013) study risk factors of customer integration during new product development, but customer integration here only refers to choosing some customer representatives and allowing them to participate in company activities. Chaudhuri, Mohanty, and Singh (2013) propose a group decision making approach to handle supplier involvement in supply chain risk assessment. However, hardly any theoretical steps or practical approaches have been proposed that provide a holistic framework to assess or manage undesired risks of customer and supplier involvement in value co-creation environment. To our knowledge, no method, or integrated method, for this purpose has been discussed in the literature so far. Because of the complexity of the supply network, the risk assessment will contain many factors, some of which are difficult to describe precisely. When companies want to co-create value with customers, it is difficult to assess its risks accurately, because of lack of a large amount of prior information and subjective and vague judgments. In this paper, by integrating the rough set theory and analytic network process (ANP), a novel risk assessment approach is proposed to evaluate risks in the context of co-creating value with customers. The proposed approach does not need a large amount of prior information and can simply and efficiently handle subjectivity and vagueness of judgments using rough logic.

The remainder of the paper is organized as follows. Recent literature about the research topic is presented in Section 2. The development of the rough group ANP approach is described step-wise in Section 3. In Section 4, a case study is presented to demonstrate the proposed approach. The approach is discussed and compared with other methods in Section 5. In Section 6, conclusions and future research directions are presented.

2. Literature review

2.1. Risks of co-creating value with customers

"Do It Yourself (DIY)" is an important form that customers participate in a value co-creation process. Lifestyle choice is the main reason that motivates high-income populations to engage in DIY activities (Williams, 2004). Whatever the reason, companies should satisfy customers' reasonable requirements as best as they can and keep related risks at the lowest extent possible to achieve good incentive outcomes.

To co-create value with customers, a company must integrate their relationships with both customers and suppliers. In a value co-creation environment, a customer act as a designer or producer in different stages, to complete a product design or manufacturing task together with the company (Alam, 2006; Ho & Huang, 2009). Although allowing a customer to participate in the value co-creation process gives companies the notable advantage of capturing the customer's unique needs, it also triggers many uncertainties that may impair production activities. The company has to invest extensively in time and resources management to adapt to customer's involvement in product development (Campbell & Cooper, 1999). In case the co-innovation project fails, opportunity costs may be lost, and specific conflicts may arise because the involved customers may demand rewards to cover their costs (Brockhoff, 2003). Based on some qualitative interviews, Schrader and Gopfert (1998) deduce the co-development of a new product might be inefficient in cases where the customers' domain of expertise is limited. For instance, if no similar products are available for reference, users would find it difficult to evaluate virtual concepts and prototypes of radical innovations (Veryzer, 1998). Other literature also emphasizes the uncertainties related to customer integration in new product development (Leonard-Barton, 1995).

The diversity of the demand makes the fulfillment of supply more difficult, and companies need to find a reasonable way to adapt to the new production requirements and mitigate the risks triggered by supply chain integration. Lin and Germain (2004) confirm that a decentralized organization has a negative effect on customer integration in new product development. The innovational ability of companies is strongly determined by their organizational factors (Koc, 2007). Moreover, the increased product complexity caused by customization requires the integration of company–customer knowledge during the co-innovation process (Kleinsmann, Buijs, & Valkenburg, 2010) because product customization needs to knowledge, experience and skills from different fields. If the productive process is not monitored well, the offering may not meet its performance criteria or its cost target.

Personalized products make production control more complex and difficult, so it is essential for companies to select a reliable supplier (Tang, 2006). In addition, personalized products usually need more nonstandard parts or components. This requires the suppliers to have the ability to manufacture such parts efficiently (Chaudhuri & Singh, 2012). Engineering metrics used by the company and suppliers should be consistent, or else, they may cause product failure. Different engineering metrics for risk assessment have been developed by Esterman and Ishii (2001). Suppliers should not only be capable of producing customized parts, but also be able to complete and deliver them on time because customers might not wait too long, even if it is a custom-built product (Holweg, Disney, Hines, & Naim, 2005). It is necessary for customized components to be packaged and transported specially, which adds to the complexity of logistics. Assembly schedules must be planned carefully to avoid delays because of logistical issues. In a concurrent engineering environment, it is important to involve logistics in the early stages of development (Dowlatshahi, 1999). If companies integrate the suppliers in the early stage of product development, it might be easier for the suppliers to deliver the components successfully. However, at the same time, supplier involvement may be a major source of new risks in the product development process (Ragatz, Handfield, & Scannell, 1997).

A company's target market may also present some risks. If the company considers only the current customers' requirements, there is a potential for failure because product development strategies would be limited because of extensive customer involvement (Callahan & Lasry, 2004). The actual customer perception of new products may not be the same as that expected by the company (Foster & Franz, 1999), and this difference might bring about loss of customers or even threaten the overall business performance (Langerak, 2001). If value co-creation fails, the interaction between customers might negatively influence potential customers (Amini, Wakolbinger, Racer, & Nejad, 2012).

The risk factors of co-creating value with customers are summarized into four types (Table 1): corporation management risk, capacity risk, supply risk, and market risk. As mentioned above, many risks and uncertainties pertaining to co-creating value with customers have been presented, but they are scattered in the literature. An overall risk analysis and a quantitative assessment approach are still lacked. This is the main aim of this study. First, the scattered literature is combed systematically to determine the risk indicators. Then, a suitable quantitative assessment approach is developed to manipulate the uncertainties effectively.

2.2. Supply chain risk assessment

In a value co-creation environment, customers, suppliers, and the company form a supply network. Thus, supply chain risk assessment methods can be used to evaluate the risks of this network. The purpose of supply chain risk management is the identification and management of risks in the supply chain so as to increase supply chain performance as a whole (Jüttner et al., 2003). Appropriate risk management strategies can significantly improve