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Risk evaluation of customer integration in new product development under uncertainty

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ABSTRACT

This study mainly focuses on the risk evaluation of customer integration in new product development. Customer integration in product innovation projects has been widely recognized a best practice to enhance innovation success rate and reduces the development cycle time, but it also has many potential risks including loss of know-how, much dependence on customer, and limitation to incremental innovations, etc. Unfortunately, there are few researches about risk evaluation for customer integration which is important to the risk management of the co-innovation process. Further, evaluating customer integration risk involves much subjectivity and vagueness. To manipulate this problem, a novel evaluation approach for assessing customer integration risk under uncertainty is proposed. The novel approach integrates the merit of rough set theory in handling vagueness and the strength of group analytic hierarchy process (GAHP) in modeling hierarchy evaluation. Finally, an application in a project of mobile phone development is provided to demonstrate the application and potential of the methodology.

1. Introduction

New product development is becoming an important competitive advantage in current industrial market (Wang & Lin, 2009). In times of decreasing R&D budgets and shorter innovation cycles, companies have to rethink the fundamental ways of managing their product development activities. It is increasingly more important for company to open up organization boundaries to utilize external innovation resources, and customers are frequently seen as an important source of product innovation (Chesbrough, 2003; Gassmann & Enkel, 2004; von Hippel, 2005). It was a very attractive proposal to take measures to encourage users' involvement in product innovation because it increases a company's potential for innovation. Customer integration in company innovation activities can increase the amount of diversified and customer based knowledge in companies which helps to well understand the customer, enhance the customer relationships with company, and reduce the innovation failure rate. Meanwhile, customer integration also helps to create innovative ideas and feedbacks regarding concepts or prototypes for new products. Other benefits of customer integration includes better satisfying the current and future market, improving product performance (Prahalad & Ramaswamy, 2004), enabling product innovation more sustainable, constituting reliable buyer potential, etc. Therefore, customer integration into the innovation process is about to become best practice.

Although customer integration in new product development brings many opportunities, it also has considerable risks. These risks include loss of know-how due to disloyal integrated customer, too much dependence on customer, and limitation to incremental innovations, wrong product investment, etc. However, as Enkel, Kausch, and Gassman (2005) state, the risks of not integrating customers are greater than the risks of integration. Because company would neglect important source of ideas, increase R&D costs, develop less market-driven products (service). Therefore, it is necessary for companies to evaluate the customer integration risk, maximize the possible benefits and simultaneously minimize the risks involved. Unfortunately, the risk assessment of customer integration has so far met with little attention. There is little theory or practice providing systematic evaluation framework and recommendations on how to assess or manage undesired risks of customer integration. In fact, lack of much prior information, subjective and vague judgments always make it difficult to conduct risk assessment of customer integration accurately. This is particularly true in the early product development phase (Raharjo, Brombacher, & Xie, 2008). Thus, in this work, the authors propose a novel risk evaluation method based on rough set theory and group AHP approach to evaluate the risk factors in customer integration quantitatively and intelligently. The pro-

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posed method provides a more rational risk evaluation framework without requiring much prior information. Besides, the risk evaluation approach has a good mechanism to deal with subjectivity and vagueness of judgments using rough logic under uncertain environment. To our knowledge, there is no method, or integrated method, in the literature until now.

After the introduction, the remainder of the paper is structured as follows: Relevant previous research and basis of the proposed method are presented in Section 2. The proposed rough group AHP approach is explained in Section 3. Then, the proposed method is illustrated with a case study of the mobile phone development in Section 4. In Section 5, conclusion and future research directions are remarked.

2. Related work

2.1. Customer integration and its risk

Customer integration in product development has been researched during these years. Campbell and Cooper (1999) propose that customer integration is a formal relationship established between customers and company, and customers are invited participated in the development process. In the integration process, company and current or potential customers jointly engage in innovation projects and exchange ideas (Alam, 2006). To facilitate the implement of customer integration, many practical methods have been developed, such as Internet-Toolkits for customers' designing concepts (Von Hippel & Katz, 2002), Ideas Competitions (Walcher, 2007), Ideas Communities (Ebner, Leimeister, & Krcmar, 2009), and IT-based virtual customer integration (Dahan & Hauser, 2002). With the aid of purpose-designed toolkits and communities, companies attempt to collect innovative ideas from customers. The customer integration in product innovation project may bring benefits and potential opportunities for company. This is true especially when customer involvement in the early product development process (Millson & Wilemon, 2002; Souder, Sherman, & Cooper, 1998). Customer integration can also reduce the product development cycle time (Sherman, Souder, & Jenssen, 2000). Johnson and Luo (2008) believe that positive influence of customer integration on new product development would increase with the customer integration intensity. Similarly, Youngdahl, Kellogg, Nie, and Bowen (2003) have also shown that increased levels of customer involvement can increase levels of customer confidence when making product choices.

Although customer integration in product innovation has many notable advantages, it entails risks that may impair the success of innovative activities. Enkel et al. (2005) propose that risks of customer integration include leakage of technical knowledge, manufactures' being over-dependent on customers, new product being limited to incremental innovation and niche market and misunderstanding between employee and users involved, etc. The extent to which a firm communicates with its outside customers would determine the speed and frequency of customer integration innovation (Parthasarthya & Hammondb, 2002). Campbell and Cooper (1999) points out that customer involvement in product development requires huge investment of company in managerial time and resources. Once the co-innovation project fails, opportunity costs may significantly be lost. Furthermore, the involved customers might compete for the same scarce resources and call for rewards to cover their costs, which could lead to specific conflicts (Brockhoff, 2003). One of the common conflicts is the ownership of intellectual property, and the core of this problem is the question of who owns the results of the combined innovative efforts: the company, the customer, or both (Hagedoorn & Cloodt, 2003; Masurel, 2002). It is apparent that customer who takes part in the innovation process unavoidably acquires company know-how while contributing his own knowledge or ideas (Li & Calantone, 1998; Lukas & Ferrell, 2000). Therefore, companies must draft reasonable incentive measures and intellectual property regulations to motivate customers and maintain their agreement and passion on collaboration. It is necessary for companies try its best to satisfy customers' reasonable demands and requirements so as to achieve good incentive outcomes and lower relevant risks for collaborative innovation. A cooperative manufacturer may end up as nothing more than a subcontractor for key customers if lack of some effective organization. Unreasonable company organization would bring risks to customer integration, Lin and Germain (2004) propose that decentralization of the organization is considered to have negative effect on customer integration in new product development. The organizational factors strongly determine a firm's ability to innovate (Koc, 2007). Johnson, Zorn, Kai Tam, Lamontagne, and Johnson (2003) emphasize the importance of the organization culture's effect on collaborating agencies. Difficulties may arise in new product development partnerships due to disagreements on the allocation of property rights (Bruce, Leverick, Littler, & Wilson, 1995), which may offset possible economic and technological advantages (Bidault & Cummings, 1994). In a series of qualitative interviews with both customers and suppliers, Schrader et al. (1998) conclude that customers' limited domain of expertise may lead to inefficient co-development of new product. For example, it is difficult for users to evaluate concepts and prototypes of radical innovations as no reference products exist (Veryzer, 1998). Leonard-Barton (1995) also highlights the uncertainty associated with integrating customers in new product development. These uncertainties arise from issues such as partner selection, determination of the customer involvement timing and intensity (Gales & Mansour-Cole, 1995), customers' ability and willingness to provide the right kind of knowledge, and the nature and extent of the knowledge to be embodied, etc. Thus, it is important for firms to involve the 'right' users at the 'right' time in the 'right' form. Whether the users have a high motivation toward new solutions, are open to new technologies, possess diverse competencies, and are embedded into a very supportive environment would determine the final results of customer integration innovation (Lettl, 2007). Besides, the increased product complexity also requires knowledge, experience and skills from different fields and disciplines. Thus, company–customer knowledge integration is important during co-innovation process (Kleinsmann, Buijs, & Valkenburg, 2010). Gruner and Homburg (2000) further reveal that the involved customers' characteristics determine the success of customer integration in new product development. For example, parts of customers' information often disappear in the course of the integration process due to customers' inability to express their needs and wishes and to articulate the ideas they have for new developments (von Hippel, 1998), which may finally lead to failure of the co-development. There are also some risks about markets including damaged relationships with key customers, negative publicity due to premature dissemination of positive test results, and the generation of inaccurate or unrepresentative feedback (Dolan & Matthews, 1993; Kausch, 2007). Furthermore, customer's point of view may influence the direction of the search for innovative ideas, and bias the direction of the search in an unwelcome way (Gruner & Homburg, 2000). This is because they tend to prevent radical innovations and encourage incremental ones, and they always have 'functional fixedness' to improve the familiar product rather than to create a radically new solution (Leonard, 2002; von Hippel, 1986). Therefore, firms may fail to develop new products if they are only attentive to the needs of certain current customers (Callahan & Lasry, 2004; Christensen, 1997; Frishammar & Horte, 2005; Katz, 2003). Callahan and Lasry (2004) also argue that extensive customer involvement in product development could lead to