



An evaluation method for innovation capability based on uncertain linguistic variables



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ABSTRACT

Due to new challenges from emergent markets, companies increasingly expect to be able to offer innovative products and improve the innovation ability. Thus it is necessary to use a comprehensive evaluation method to evaluate the innovation capability for companies. Firstly, the evaluation indicators system is developed in terms of process capability, organization capability and knowledge capability. Secondly, the evaluation method based on uncertain linguistic variables is proposed. Finally, the evaluation method and the indicators system are applied into a practical problem.

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1. Introduction

During the last decade, as the market becomes more dynamic, companies need to innovate in response to the change of customer demands. Innovation has been considered as the major factor for strengthening competitiveness of companies and gaining the new opportunity of the new market [1,2]. Innovation is a mechanism through which companies develop the new products, processes and systems required [3,4]. Innovate or die becomes a slogan in modern companies.

Therefore, how to maintain a sustainable innovation, that is the development of innovation capability, is one of the top priorities of innovative companies [5]. Since innovation capability can only be improved if it is well understood first, it follows that the evaluation of innovation capability is paramount for most companies. There are two important components in the evaluation of innovation capability: the evaluation indicators system and the evaluation method.

The evaluation indicators system of innovation capability provides the holistic view to examine the innovation process, thereby facilitating optimizing the resource allocation and improving the innovation process. Innovation capability allows companies to adapt rapidly changing markets and customers expectation in achieving innovation-driven growth. Several researchers have suggested that innovation capability is a multi-faceted construct, including organization innovation, process innovation and technological innovation. Furthermore, several current studies has concentrated on the evaluating the innovation capability by defining the types of capabilities, such as product innovation capability, process innovation capability, organizational innovation capability, manufacture capability, marketing capability, etc. [5–8]. However, these studies fail to make a distinction between these capabilities. It leads to misinterpretation of different capabilities. Thus, it is necessary to construct innovation capability from a much clearer framework, thereby being as the evaluation indicators system of innovation capability.

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In literatures, several researchers have proposed various methods to evaluate the innovation capability. For example, Zhao and Zeng [9] adopted the method of experts scoring for the operational evaluation index system. Xia et al. [6] proposed a multi-objective DEA projection model to analyze the relationship of competitiveness and technological innovation capability based on the model. Lu and Su [10] developed an evaluation model of innovation capability for SMEs and presented its evaluation method using the factor analysis model. Cao and Ren [11] thoroughly identified the influence factors of the enterprise's technical innovation by the rough set theory, and then adopted the unascertained measure model to gain the synthetic judgment.

The evaluation methods above are all quantitative methods. However, the determinants of innovation capability involve intangible aspects that are difficult to acquire the precise data. Moreover, the evaluators who make evaluations are always be restricted by some objective factors, resulting in that the evaluation results are fuzzy. Therefore, So it is difficult to use the quantitative methods to evaluate the innovation capability. Instead, using uncertain linguistic information is appropriate for these intangible information.

Additionally, within the quantitative evaluation methods above, the weighting approach just focus on the subjective weighting methods (e.g. Delphi, AHP), or the objective weighting methods (e.g. the variation coefficient method, the entropy evaluation method). The two kinds of weighting approach have their advantages and disadvantages, and there is no agreed weighting method. So it is reasonable to combine the subjective weighting method with the objective weighting method to evaluate the weights of the evaluation indicators.

In order to address these issues, Section 2 constructs the evaluation indicators system. Section 3 indicates the evaluation method of innovation capability. It first introduces the unbalanced uncertain linguistic variables, and then proposes the weighting method integrating subjective and objective evaluation, finally develops the evaluation procedure. Section 4 performs a practical application to verify indicators system and the evaluation method. Section 5 concludes the paper.

2. The evaluation indicators system

2.1. Company capability

The company capability is important in providing and sustaining its competitive advantage, and in the implementation of the entire strategy. In the literatures, a series of company capability theories (resource-based view, core competency theory and knowledge-based view) are successfully proposed to explain why a company grows since 1980s. These views greatly contribute to our understanding of how company to gain and sustain competitive advantage over others within the same industry, thereby facilitating the definition of innovation capability.

In the view of resource-based view (RBV), company capability is defined as the capacity of a set of individual resources to perform some tasks or activities [12]. Companies own different resources and capabilities. These special resources and capabilities consist of the base of competitive advantages if matched with an external environment [6]. However, they neglect the importance of intangible aspect and do not pay more attention on the external, thereby resulting in the difficulty to adopt the dynamic market environment for companies.

The core competency theory (CCT) argues that the core competency is the source of company competitive advantage, including the core knowledge capability and core operation capability. Researchers explore the definition and components of core competency in terms of different views. With the dynamic change in the environment, this CCT does not explain well why some companies have sustainable competitive advantages.

The knowledge-based view (KBV) overcomes the limitations of the first two theories and explores the core elements of company's competitive advantage. By analyzing sustainable competitive advantage, this view suggests that transferring tacit knowledge to explicit knowledge is the source of sustainable competitive advantage [8]. The successful management of knowledge-based resources is the central to the competitive advantage.

Innovation involves not only the utilization of the existing knowledge, but also the pursuit of new field of knowledge. The characteristic requires that the realization of innovation calls for knowledge management. Thus, acquiring innovation capability is a process of learning to advance existing knowledge in terms of the knowledge-based view.

2.2. Innovation capability

According to [5], innovation capability is a theoretical framework aimed at describing the actions that can be taken to improve innovation activities. Innovation capability is an intangible asset of a company, which will produce value in the future [13]. Based on prior analysis of knowledge-based view, [5] defined innovation capability as the ability to continuously transform knowledge and ideas into new products, processes and systems for the benefits of the company and its stakeholders. Chandler et al. [14] considered it as the potential ability of an organization to position itself in an arena of modernism such as new product development, technology and other advancements that result in competitive advantages over its rivals. Similarly, in our paper, in order to facilitate evaluating innovative company, innovation capability is defined as the influence dimensions that affect company's ability to manage innovation.

Thus, a legitimate question that follows from this is what dimensions innovation capability includes. Several researchers have proposed their definitions about innovation from different standpoints. For example, innovation has been defined as

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