

Measuring innovation best practices: Improvement of an innovation index integrating threshold and synergy effects

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Abstract

Innovation, as a competitive economic factor, is a process that requires a continuous, evolving and mastered management. Therefore innovative companies need to measure their innovation capacity. Literature attests of research in the field of innovation measurement or the innovation abilities evaluation. One major theoretical problem consists in elaborating mathematical models that consider the threshold effect and synergy between innovation practices and verify their validity. In this article, mathematical approaches supplementing multi-criteria models are suggested.

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Keywords: Innovation capacity; Metrology; Index; Ranking; Data mining

1. Introduction

Top management attention was formerly directed toward cost reduction, delivery time reduction and quality in order to become and remain competitive on the market. By extension, new criteria are emerging to successfully face competitors: among others—innovation. The ability of companies to meet consumer expectations depends deeply on their ability to innovate and deliver new products at competitive prices. Innovation is a key driver to achieve sustainable competitive advantages and, more particularly, becomes one of the key challenges for small and medium enterprises (SMEs) (O'Regan et al., 2006).

Many definitions of innovation are proposed in the literature. According to Schumpeter (1934), it consists in the introduction of new products and production methods, the opening of new markets, the discovery of new raw materials and the implementation of new organizations. Innovation affects manufacturing and process industries, trade activities and social services. The Organization for Economic Co-operation and Development (OECD) states that innovation is “either the transformation of an idea into a new product or the improvement of an existing

product or an operational process” (OECD, 1981). Taxonomies have been developed aiming at a better understanding of this complex process (Garcia and Calantone, 2002). Sternberg et al. (2003) established a classification through eight reference groups of companies. “Replication” represents the lower level of Sternberg's scale, while “Integration” is the higher.

Other authors outline the cognitive dimension of the innovation process. According to Vandervert, one major aspect is the relationship between the short-term memory and the cognitive perception function, i.e. brain function, and more precisely the construction of new representations of the environment from perceptions. He demonstrates that the concept of generalization capacity and the establishing of dynamic cerebral models (commands that allow generalization capacities) are innovation key factors (Vandervert, 2003). As a consequence, value creation through innovation is depending on the restructuring of the cognitive dimension of those involved in the process. Moreover, innovation relates to a learning process.

Furthermore, evidence of a necessary constructivist approach in innovation management was demonstrated, particularly within the SME's sector (Boly et al., 1999). Success of an innovation relies on the ability to identify and seize opportunities. Hence, top management has to: direct attention toward the definition of global development

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orientations, launch projects and organize an on-going improvement of innovative project management approaches. As a result evaluation of the innovation capacity becomes a major concern in order to ensure a continuous development of these management practices.

This article focuses on the measurement of the innovation capacity of industrial firms. More precisely, innovation measurement integrates both the evaluation and the comparison of the innovation capacity of companies. This capacity is correlated to a set of competencies, knowledge, tools and financial resources. Our research is in concern with various aspects of metrology, including: criteria definition, data collection and treatment methods and reference model elaboration.

In the field of metrology, “measuring” is defined as an operation allowing the determination of the value of a variable through various features. For instance, measuring is inseparable from social practices. Besides mathematical knowledge, measuring requires knowledge related to institutions, social practices (Vuola and Hameri, 2006) and measuring techniques (Jedrzejewski, 2002).

Literature attests of researches in the field of innovation capacity evaluation (for a company or a country) (Furman, 2003). These approaches are generally based on the evaluation of the innovation process outcomes and of the resources devoted to it. All these statements may be considered through three analytical levels (setting aside the individual and collective cognitive level) (Boly, 2004):

- *Level A*: The *permanent and global* innovation management of the company. This level integrates all the strategic tasks, the organization of new projects launching and the improvement of innovation management practices.
- *Level B*: The outcomes or inputs of a particular *project*. This level is characterized by a limited period and is concerned with the transformation of an idea up until an innovative product.
- *Level C*: The material characteristics of the innovative *product* resulting from the new product development process. This level represents the artefact of Level B.

This approach suits our special interest in establishing links between evaluation and operational management tasks.

The evaluation of Level C is very common in engineering through the definition of the future specifications of the innovative product and its relating performances.

Literature is mostly concerned with Level B evaluation. Many authors propose approaches to determine the balance between the outcomes and inputs of innovation. Generally, financial and commercial variables are taken into account (Griffin and Page, 1996; Huang et al., 2004; Kangmao et al., 2005). Financial evaluations are based on classical ratio including financial margins and returns on investment (Crepon et al., 2000). Moreover, specific financial criteria dedicated to innovation resources are

suggested: they generally measure time and cost development (Grant and Pennypacker, 2006). Marketing variables include qualitative and quantitative aspects, such as new market shares and customer satisfaction (this last example is dedicated more to product’s Level C than to the project’s Level B). Strategic considerations, such as competitive advantage, are integrated to evaluate the balance between outcomes and inputs. Several authors (Archibugi and Pianta, 1996; Abraham and Moitra, 2001) add technological criteria, such as the number of patents, to conduct this evaluation.

Chiou et al. (1999) suggest a technology-oriented productivity measurement model (TOPMM), more suitable with global management Level A. TOPMM takes into account all the outcomes of the innovation process: the final new product but also intermediary results (prototypes, models, as well as competencies).

From a systemic point of view a strong limitation exists: the activities linking the resources to the outcomes of the innovation process are not evaluated. Thus, our special focus is the innovation management activities evaluation at Level A. Chiesa et al. (1996) has elaborated a scorecard to evaluate four phases of a project (Level B): concept generation, product development and related production process elaboration and technology acquisition. We proposed the calculation of an index based on 13 innovation practices identified by Boly as the best practices for innovation (Boly, 2004; Corona Armenta, 2005). Our objective is to take into account threshold effects in the realization of the practices. Hence, innovation management activities are not independent from each other. Moreover, the choice of preference profiles has to be possible according to the fundamental needs of the evaluator.

2. Proposition of an innovation measurement system

Our research is based on two hypotheses:

- the innovation capacity of a company is measurable and
- the principles of an innovation measurement system depend on the properties (practices) of the innovation process. A reference list of innovation process practices is determined. They are measurable only if they are expressed in terms of directly observable innovation management sub-practices (Boly, 2004).

Literature attests of researches about innovation best practices. Among others, Cormican and O’Sullivan (2004) defined five key factors that facilitate product innovation management: strategy and leadership, culture and climate, planning and selection, structure and performance, communication and collaboration. Innovation practices can also be classified according to three aspects: operational, internal and external best practices (Beaumont, 2005). Bessant et al. distinguish firstly best practices for “steady state” innovation process, essentially formal innovative

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