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A reference model to determine the degree of maturity in the product development process of industrial SMEs

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ABSTRACT

Along with the emergence of new competition rules, namely, the need to reduce the time to launch a product in the market and the capacity to modify and adapt it based on the identification of consumer choices, the approach of an interactive innovation model requires that small and medium industrial enterprises have a technological innovation strategy. This paper presents a support model to small and medium enterprises, starting from the diagnosis (definition of their degree of maturity) of technological innovation factors. This mapping aims to guide the technological innovation effort by offering a set of guidelines to be used, in this category of companies, as a strategy to select and manage the most suitable tools and technologies for the development of new products, according to their specific activities and contingencies. This reference model is exemplified by its application, using actual data, in industrial SMEs in the region of São Paulo, Brazil. A case study is also presented for the definition of the degree of maturity of an industrial SME of the metal-mechanical sector, including the resulting proposals of guidelines to the company.

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1. Introduction

With few exceptions, innovation results from an exceptional effort and may occur when the company expands in scale and/or scope, and consequently needs new knowledge (Porter, 1998). The company that successfully implements new and improved ways to compete is the company that tirelessly pursues its approach, even in the face of obstacles. In other words, innovation often results from pressure, necessity or even adversity.

The search for new knowledge is extremely important and should be continually supported, for it means an understanding of intrinsic processes in nature, in humans and in their relation with the environment. There is, however, a long time gap between the appearance of new knowledge and the moment when it becomes a technological application. And after a new technological application emerges, there is another long period of time before the new technology is transformed into products in the market (Drucker, 1985).

The knowledge base within a company allows it to observe situations and symptoms that lead to the design of diagnoses and alternatives. Knowledge also encompasses the capacity to

innovate, and technological innovation is a decisive strategy in this scenario of fast changes: it is one of the important objectives of any company.

Consequently, there is a clear need to formulate strategies that can combine technologies with market opportunities, so as to achieve a dynamic correspondence between an innovative attitude and market demands. It is only by means of such dynamic strategies that the objective of effective and long-lasting competitiveness may be reached through innovation. Innovation that is thus generated will enable the company to improve its competitive position substantially by means of a greater correspondence between market demands for a certain characteristic or product and the company's ability to provide it.

1.1. International concern with innovation in industrial SMEs

The main difficulties faced by small and medium industrial enterprises (SMEs) concerning strategic management of technological innovation traditionally involve their lack of administrative skills, insufficient attention generally dedicated to technology as a strategic variable, reduced scope and instability in their market fields or niches, and the lack of qualified competitors.

A strong resurgence of the importance of small and medium enterprises has been observed lately, as can be verified in the multiplication of new company registrations and the generation

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of jobs and wages (La Rovere, 2003). Since then, interest in this category of company has increased and expanded worldwide.

Italian researchers Calderini and Cantamessa (1997), from Politecnico di Torino, in their study about manufacturing companies in that industrial area, concluded there are evidences that the essence of the innovation process in small and medium enterprises, at the stage of product design and development, will depend on their ability to be flexible in their integration, both with customers and suppliers or partners.

In Italy, 47 SMEs were analyzed to identify similarities between the companies in the areas of knowledge and innovation management (Corso et al., 2003). The study explains the trends that are currently emerging in the selection of information technology standards and approaches for knowledge management in the development of new products according to internal and external sources. In North America, 235 professionals from research and development departments were interviewed in order to identify sources of innovation in SMEs (Bommer and Jalajas, 2004).

A study carried out in Greece, with 150 small and medium manufacturing enterprises (Salavou et al., 2004), considered the determinants of organizational innovation, that is, the number of product innovations adopted, the importance attached by the companies to characteristics of strategic orientation, such as market orientation and continued learning. The study concluded that small and medium enterprises with such characteristics, when submitted to factors related to strong competition, tend to become more innovative.

An empirical research conducted to analyze critical factors for success in the product development process in small and medium industrial enterprises (March-Chordà et al., 2002) was based on a sample of 65 SMEs located in Valencia, a region of medium development in Spain. The study analyzed the main obstacles to innovation by sector, stressing the excessive cost to maintain an innovation process and the uncertainty regarding the acceptance of new products in the market.

In certain peripheral regions of the European Union, the economies and standard of living are below the European average. A study presented by Mcadam and Mcconvery (2004) concluded that one of the main reasons for that is the low level of innovation in small and medium industrial enterprises. The study involved 41 SMEs in Northern Ireland and explored success and difficulty in the incorporation of innovations. The authors observe that, in those small and medium enterprises, deficiencies in innovation lead to difficulties to grow and export, which leaves them out of successful production chains.

Because it is a source of competitive advantage for SMEs, the regional context is important, explains Bagchi-Sem (2001), both in terms of availability, costs and quality of production factors, as well as due to the presence and quality of suppliers and service providers. The author's project, conducted in Canada, illustrates how industrial SMEs located in peripheral regions and focused on traditional production models struggle to survive in a highly competitive global environment.

Kaufmann and Tödtling (2002) conclude that the region is especially important for the innovation process in SMEs, since their external relations are more restricted to their region as compared to big companies. Except for partners in their own business sector, mainly customers, small and medium enterprises have few external relations in the innovation process. The lack of interaction with knowledge providers (universities, for instance) outside their business sector seriously restricts the external influences that enable or encourage innovation. The region that was investigated in the research (Upper Austria) is one of nine Austrian provinces (*Bundesländer*).

Moultrie et al. (2007) in a longitudinal study of design practices, with four American SMEs, concludes that there is clear

evidence of the importance of design in small firms. However, there is also a strong indication that effective design practices are marginalized in such organizations. A symptom of design marginalization is the completion of design activities by people who have no design training or aptitude.

Radas and Bozié (2009), based on a postal survey of 448 SMEs performed in Croatia in 2004, find out that market scope is very important in fostering innovativeness, that is, firms operating on wider markets are more likely to innovate. This result is important for small open developing economies, because it suggests that by encouraging exports it may be possible to encourage innovations as well.

According to Rammer et al. (2009), the New Product Development Sector is central to develop successful new technologies and innovations. However for SME's, innovate through development of new products can be a great challenge, due its exposure to big risks, high fixed costs and serious financial restrictions to investments in R&D area. The researchers, studying SME's in Germany, conclude that the success factor for these kind of companies are the learning process and the application of "good practices" in innovation; also, cooperation agreements, the use of external sources of R&D and tools of human resources management, for instance.

Zeng et al. (2010) find that there is a significant positive relationship among inter-firm cooperation, cooperation with intermediary institutions, cooperation with research organizations and innovation performance of SMEs. From those, inter-firm cooperation has the most significant positive impact on the innovation performance of SMEs.

Subrahmanya (2011) concludes that innovative SMEs largely comprise technically qualified entrepreneurs, exclusive design offices, and carry out innovations with external support. Together they determine, particularly for younger firms, the innovation performance of SMEs in terms of innovation support.

With data collected from 270 managers of SMEs located in Turkish science and technology parks, Ar and Baki (2011) find out that both product and process innovation have a strong and positive association with firm performance.

In a research carried out with 32 SMEs of the metal-mechanical sector in São Paulo, Brazil (Kaminski et al., 2008), it was verified that joint work with suppliers in the development of new products is a routine for approximately 75% of the companies in the research. A similar situation was found in customer participation (in around 72% of the companies) and it is mainly related to product customization or to the identification and evaluation of trends for the products in mass production. In both situations, the relation basically aims at improving production processes, new materials, incorporation of software etc. The researchers stress, as a result, the importance of the involvement of customers and suppliers towards a solid long-term relationship, in which the interaction may generate innovative design solutions.

As shown in the presented studies, an internal sector of research and development of new products is essential for SMEs that aim complex innovations which really make their competitive standings better – although the authors are aware that many other elements and conditions can influence the success of a SME (economical environment, government regulations and international competition). This importance turned to be in focus of this work, giving directions to this research, in agreement with its purposes.

2. Diagnosis of the technological innovation effort in the best project practices

As a business opportunity, innovation may be present not only in new technologies, but also in the design of a new product,

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