Technovation 31 (2011) 320–335

Contents lists available at ScienceDirect

Technovation

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

Roadmapping for technology push and partnership: A contribution for open innovation environments

Mauro Caetano *, Daniel C. Amaral

Federal University of Goias (UFG)/University of Sao Paulo (USP), São Carlos School of Engineering (EESC) / USP - Avenida Trabalhador São-carlense, 400, CEP 13566-590, São Carlos, São Paulo, Brazil

ARTICLE INFO

Available online 12 February 2011

Keywords:
Partnerships
Innovation
Integration strategy
Technology development

ABSTRACT

There are several tools in the literature that support innovation in organizations. Some of the most cited are the so-called technology roadmapping methods, also known as TRM. However, these methods are designed primarily for organizations that adopt the market pull strategy of technology–product integration. Organizations that adopt the technology push integration strategy are neglected in the literature. Furthermore, with the advent of open innovation, it is possible to note the need to consider the adoption of partnerships in the innovation process. Thus, this study proposes a method of technology roadmapping, identified as method for technology push (MTP), applicable to organizations that adopt the technology push integration strategy, such as SMEs and independent research centers in an open-innovation environment. The method was developed through action-research and was assessed from two analytical standpoints: externally, via a specific literature review on its theoretical contributions, and internally, through the analysis of potential users' perceptions on the feasibility of applying MTP. The results indicate both the unique character of the method and its perceived implementation feasibility. Future research is suggested in order to validate the method in different types of organizations

1. Introduction

The technology roadmapping (TRM) is a method that helps organizations plan their technologies by describing the path to be followed in order to integrate a given technology into products and services. These, in turn, reach the market and meet the strategic objectives of the organization (Kostoff and Schaller, 2001; Phaal et al., 2004).

It is possible to find many proposals for TRM in the literature, e.g., Albright and Kappel (2003), Daim and Oliver (2008), Holmes and Ferrill (2005), Lee et al. (2009a), and, especially, the method proposed by Phaal et al. (2001). These methods, empirically attested by scientific research, assist in the planning of new products and technologies.

When organizations plan their technologies, they may combine two technology–product integration strategies: technology push and market pull (Dodgson, 2000; Porter, 1985; Schumpeter, 1982). These integration strategies have a direct impact on innovation management, as seen in the innovation model presented by Brem and Voigt (2009). However, their use is largely linked to the organization characteristics (Pearson, 1990). In the case of business organizations that sell products directly to consumers, the market pull integration strategy predominates because their aim is to improve existing product lines according to consumer market trends.

Conversely, technology push predominates at some research centers and small and medium-sized enterprises (SMEs) because their focus is on their core competence. In these organizations, such as independent research centers, government-run research centers, and technology-based enterprises (TBEs) devoted to developing new technologies, the predominant integration strategy is technology push. These organizations possess rare and exclusive competencies and employ them to create and transfer innovations to traditional enterprises in the form of consulting services, licensing, and generation of spin-offs (Kostoff and Schaller, 2001; Lee et al., 2007; Mohan and Rao, 2005, Spithoven et al., 2011).

Kappel (2001) and Rinne (2004) mention the importance of taking integration strategies into account when performing TRM. However, the roadmapping methods found in the literature were created to suit the context of large corporations, which combine R&D and product development structures, i.e., organizations that mainly adopt the market pull strategy and closed innovation to define technologies to be developed based on specific market needs.

These methods are applied to planning which involves the R&D, marketing, and production sectors at the same organization,

* Corresponding author. Tel.: +55 (16) 3373 8289; fax: +55 (16) 3373 8235.
E-mail addresses: maurocaetano1912@gmail.com (M. Caetano), amaral@sc.usp.br (D.C. Amaral).

0166-4972/$ - see front matter © 2011 Elsevier Ltd. All rights reserved.
doi:10.1016/j.technovation.2011.01.005

which is not possible in the case of organizations that focus on the technology push strategy, such as the aforementioned research centers and SMEs.

The possible solution for these SMEs is the use of external sources for technology mapping effort and making use of the open innovation approach to absorb market and technology information. Therefore, open innovation theory emerged from the same source. According to Spithoven et al. (2011), this new paradigm was "…originated from case studies in large R&D intensive companies such as Xerox" (Spithoven et al., 2011, p. 133). The concepts and tools following the big corporations point-of-view, as TRM, and there is a lack of methods and guidelines that describe how these methods could be used by SMEs (Di Benedetto, 2010; Spithoven et al., 2011).

Gassmann et al. (2010, p. 219), in an editorial about open innovation, adequately introduce the issue by affirming that "SMEs are the largest number of companies in an economy, but they are under researched in the open innovation literature." The authors assert that "the operational functioning of open innovation depends on firms' ability to manage decentralized innovation processes and often includes participants who are not even on the company's payroll."

The pioneer research about open innovation and SME's, developed by Van de Vrande et al. (2009), identified open innovations practices on Neetherlands SME's and, more importantly, demonstrated that they are increasing. The most important motive to pursue these practices was the market-related ones according to total of 605 respondents from SMEs. The Van de Vrande et al. (2009) research is strong evidence that open innovation is an important way to SMEs that have access to market information and necessary technologies to combine with your own core competence technology, in order to create value for customers.

The practical application of the open innovation approach on SMEs starts with technology planning. Using the concept of open innovation is possible to think about a method such as TRM, specifically designed for SMEs and technology push environments. A method which information about associated technologies and market, required during mapping process, would be obtained through a network of partners. This would provide mechanisms to deal with the market information gap, identified by Van de Vrande et al. (2009), and to absorb complementary technologies, that SMEs needs to combine with their own core technology to introduce them into products.

The TRM method, in this case, helps to expand the absorptive capacity of SMEs, bringing benefit from open innovation paradigm, a problem identified by Spithoven et al. (2011). In addition, the TRM will serve as the support tool to the "external networking" open innovation mechanism, as identified by Van de Vrande et al. (2009), and an instrument for the co-innovation process, according to Kohler et al. (2009) acceptation. Huizingh (2011) reinforced it by suggesting that less resources to build and maintain collaborative networks at the SME case. Finally, the TRM could facilitate information exchange and increase the commitment of the SME partners on open innovation, a major problem according to co-innovation case study conducted by Müller-Seitz and Reger (2010).

The challenge is to establish a link between open innovation framework and TRM methods, able to adapt TRM, enabling TRM compliance to SMEs or research centers in an open innovation environment. This relation is a research problem identified as important by authors who are leading open innovation area of knowledge as Lichtenthaler (2010), Huizingh (2011) and Badawy (2011), justifying this paper.

The goal of this research is to contribute to the subject by proposing a technology roadmapping method directed mainly to SMEs and research centers that adopt the technology push integration strategy and consider partnership planning in the context of open innovation.

The research question is what adjustments are needed in technology roadmapping to adapt it to the specific case of technology push strategy and open innovation? The response was performed using an action research, which was carried out at the technology planning of an organization with the characteristics mentioned. The result of the action was synthesized in an improved method identified as method for technology push (MTP), that is a roadmapping method for technology push innovation strategy and open innovation environments. The changes in the script of TRM, included in this method, and the discussions about it are the contributions to the research problem.

2. Background

The first innovation models, back in the 1950s and 1960s, already proposed a series of stages, with activities and decisions needed for technology–product integration. These stages and activities have been presented as two different sequences, known as integration strategies.

Technology push is one of these integration strategies; its activities focus on invention without concern to market attractiveness and applications of developed technologies to products. The other integration strategy is known as market pull, in which market needs to determine investments in the development of technologies and their integration into previously determined products (Cooper et al., 1998; Khilji et al., 2006; Pearson, 1990). Several studies approach the conditions and characteristics needed to achieve better integration of technology and product, which affect the use of these strategies (Iansiti, 1998; Schulz et al., 2000; Drejer, 2002; Johansson et al., 2006; Lakemond et al., 2007; Nobelius, 2004).

In their theoretical conceptual model for the front end of innovation, Brem and Voigt (2009) assume that both strategies, technology push and market pull, are equally important to all kinds of organizations. They propose the creation of scenarios with experts from different fields of expertize so that market needs, economic, legal, and scientific issues, and others, are taken into account when conceiving new products. This model assumes that neither strategy is better and adopting a single strategy may undermine the competitiveness of the organization on the long run.

Pearson (1990) proposes that the use of just one of the integration strategies predominates in organizations. Those that operate in established markets, offering a range of products and services, favor the market pull strategy, e.g., multinational enterprises that concentrate their efforts on developing technologies demanded by functionalities of pre-determined products.

The analysis of organizations that adopt the technology push strategy indicates some common features, such as their personnel's high level of initiative and creativity, their need to be always ready to solve problems within their specificities, their enduring efforts on basic and applied research, and their complex scientific and technical expertize, acquired in the course of a long period of time (Mohan and Rao, 2005).

These organizations do not usually have the structure needed for product development, only for technology development, which forces them to partner with other organizations to conclude the innovation cycle, i.e., to spread the newly developed technology into products and services. A scenario that is coherent with the open innovation movement.

Open innovation is defined as an approach that makes the most of organization networks, such as customers, suppliers, teaching institutions, and research institutes in order to increase the innovation capability of an organization (Chesbrough, 2003a, b). It is an approach that seeks the systematic adoption of partnerships in the innovation process rather than resorting to internal R&D structures as in the classic model of innovation.