

Effects of Open Innovation Practices in Technology Prospecting in the Innovation Value Chain

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Abstract

The present study aims to present a modeling to check the list of open innovation practices in technology prospecting from value creation experience in the innovation value chain. The survey was conducted based on the literature, seeking theoretical cutouts for a consistent presentation, and consulting Science Direct and Emerald bases, and secondary searches on Google Scholar and Microsoft Academic Search, totaling two hundred forty five consulted titles. From this research was extracted information that makes up the conceptual framework of this study, as well as its possibility. Two hundred ninety four open innovation practices, grouped into fifteen variables were selected. Regarding the dependent variables, four variables were defined, considering the prospection of technology - as knowledge - in the innovation value chain. In order to check the state of the practice, we conducted a survey through which data were collected from professionals involved in areas related to the topic. They selected one hundred and two experts who were contacted by email, from which, twenty seven of them answered. The results were satisfactory and they show the relationship between the results raised by research on the literature and the views expressed by the experts..

Keywords: Innovation, Open Innovation Practices, Innovation Value Chain, Prospecting Technology.

Introduction

Innovation has assumed a prominent role with regard to competitiveness factors and performance of organizations, permeating several chains of production and it becomes an ongoing process, as it evolves (Costa, 2011). In the literature analyzed in this research, it appears that as production processes have been transformed or modernized, several understandings were assigned to the definition of innovation (Cassiolato & Lastres, 2005; Klerovick et al, 1995 as cited in Cassiolato & Lastres, 2005; Rothwell et al ., 1974 as cited in Cassiolato & Lastres, 2005; Nelson and Winter, 1982 as cited in Cunha, 2010; Cunha, 2010; Costa, 2011). Innovation, as in the linear view of its concept, was seen as occurring in successive stages and independent research - basic or applied - development, production and dissemination (Costa, 2011).

However, it will be deemed to this research, one of the current concepts in which innovation is understood as an idea or even an abstract model for something new or an improvement of something that already exists (Nelson & Winter, 1982 as quoted in Cunha, 2010; Costa, 2011). Innovation can be defined in three ways: as a process; as products, programs, or services; as an attribute of organizations (Kimberly, 1981; Damanpour; 1991; Kanter, 2000). However, in order to understand this article, innovation is only realized by economic bias, whenever it makes profit from commercial transactions involving certain idea or model (Schumpeter, 1988).

Innovation is relevant to consider the need for organizations to interact with external environment, highlighting the importance of external sources of information to the firm (Klerovick et al, 1995 as quoted in Cassiolato & Lastres., 2005; Cunha, 2010; Costa, 2011). The literature presents several models for the innovation process, including the Open Innovation. Its concept suggests the disruption of organizational boundaries; therefore, the innovation process might have internal and external contributions to the organization (Chesbrough, 2003). This new innovation model comes with the realization that internal resources of an organization are not enough to meet innovation demands, and from that, companies start to use sources of ideas and external resources to develop their technologies and thus achieve the market (Chesbrough, 2003; Perkmann & Walsh, 2007). By opening its borders to external environment, a company can achieve and access relevant knowledge that will contribute to the innovation process (Gassmann & Enkel, 2004; Chesbrough, Vanhaverbeke & West, 2006). The project to be developed may have its beginning within the organization itself, or by an external one, and these projects can be transferred or incorporated among organizations in several stages of development (Lazzarotti, Manzini & Pellegrini, 2010; Huizingh, 2011). In this mentioned model, there are several practices for conducting technology and resource transfer (Moreira et al, 2008; Lopes & Teixeira, 2009), which will be explored throughout this article.

As the effects of Open Innovation practices shall be measured in technologies, technology prospecting can be understood as a technical knowledge that can be applied in a physical artifact, so as to improve the ability to offer products and services (Custer, 1995; Bohn 1998; Phaal, Farrukh & Probert, 2004; Kaplan & Tripsas, 2008 as quoted in Kurumoto, 2013). New social demands and requirements guide the technological progress and the development of new technologies, which are conceived in terms of influencing the whole set of customs and values of a society, adding up to culture (Veraszto, 2010).

Considering the technology prospecting, it can be understood as a systematic way of exposing scientific developments and future technological presenting skills to significantly influence industry, economy and society, in order to identify and respond to emerging market opportunities and technologies (Kupfer, 2004; Havas, 2005). This carries out a survey of existing technologies, identifying how they are embedded in society, as well as their level of maturity, investigation of competing technologies, gaps to be filled (Quintella et al, 2011). So, technology prospecting proposes to add information that aim to predict possible future states of technology or conditions that interfere with their contribution to established goals (Coelho, 2003).

The historical analysis of the value chain concept refers to the work of Michael E. Porter, *The Competitive Advantage: Creating and Sustaining Superior Performance* (1985). In this work, the value chain is described as a system or a network of interconnected actors that receive raw materials as input, add value to them through different processes, and finally, delivery value to consumers through a final product (Govindarajan & Gupta, 2001). The value chain is a tool that divides a business in strategically relevant activities, enabling the identification of the source of competitive advantage by performing these activities more cheaply or better than its competitors (Brown, 1997). Analyzing the concept of value in a competitive environment, this is the total that buyers are willing to pay for a product offered by a company or individual (Cardoso & Son, 2014). The value chain analysis enables the decoupling of relevant activities – designing, producing, commercializing, delivering, and supporting its products - a company (Moori & Zilber, 2003). The activities of value are divided into two types: primary activities - internal logistics, operations, external logistics, marketing, sales, technical assistance and support activities - acquisition, technology development, human resources management and company infrastructure (Moori & Zilber, 2003; Cardoso & Son, 2014).

Based on these concepts and considering that one concept permeates the other, this article aims to present a modeling to check the list of practices of open innovation in technology prospecting from the value creation experience in the innovation value chain.

2. Methodology

2.1. Conceptual Model and Hypothesis

In this section, the conceptual model is presented (Figure 1) and so is the hypothesis to be verified throughout the work. From the literature, variables that compose the conceptual model in this study were verified, as well as its hypothesis. For the independent variables, two hundred ninety four open innovation practices were selected and grouped into fifteen variables. For the dependent variables, the technology prospecting- as knowledge- was considered in the innovation value chain into four variables.

Independent variables for this study, Open Innovation practices were raised and they are presented as independent variables, namely: (P1) acquisition, exploration and technology integration / external knowledge (West & Gallagher, 2006; Vanhaverbeke, Van De Vrande & Cloudt, 2008; Lichtenthaler, 2008; Moreira et al, 2008; Lopes & Teixeira, 2009; Fu & Xiong, 2011; Huizinh, 2011); (P2) Marketing technologies via Technology broker (Moreira et al., 2008; Fu & Xiong, 2011; Oliveira & Alves, 2014); (P3) Crowdsourcing (Bueno & Balestrin, 2012; Muller, Hutchins & Cardoso Pinto, 2012); (P4) Establishment of noncompetitive consortia (Moreira et al, 2008; Lopes & Teixeira, 2009; Porath, 2011; Oliveira & Alves, 2014); (P5) two-way flow of knowledge critical for success (Lee, 2010; Fu & Xiong, 2011; Bianchi, 2011; Spithoven, Clarysse and Knockaert, 2011); (P6) Source of information based on the market (Mention, 2011; Diaz-Diaz & Saa Perez, 2014; Felin & Zenger, 2012); (P7) Mergers and Acquisitions (Muller & Hutchins, 2012; Oliveira & Alves, 2014); (P8) Generating ideas through the value chain (Chesbrough & Appleyard, 2007; Moreira et al, 2008; Hughes & Wareham, 2010; Fu & Xiong, 2011; Janeiro, Proença & Gonçalves, 2013; Oliveira & Alves, 2014); (P9) New business from Corporate Venturing (Moreira et al, 2008; Lopes & Teixeira, 2009; Lichtenthaler, Hoegl & Muethel, 2011; Oliveira & Alves, 2014); (P10) co-development partnerships (Chesbrough and Schwartz, 2007; Kolk & Püümann, 2008; Lopes & Teixeira, 2009; Mortara & Minshall, 2011; Oliveira & Alves, 2014); (P11) Research and internal spin-off development and spin-out (West & Gallagher, 2006; Moreira et al, 2008, Lopes & Teixeira, 2009; Schroll & Mild, 2011; Fu & Xiong, 2011; Oliveira & Alves, 2014); (P12) value opportunity Networks (VOW - Value Opportunity Web) (Moreira et al, 2008; Lopes & Teixeira, 2009; Oliveira & Alves, 2014); (P13) Relationship between companies and the scientific and technological system (Moreira et al, 2008; Nunes, 2010; Huizingh 2011; Schroll & Mild, 2011; Oliveira & Alves, 2014); (P14) Transfer of knowledge through R & D (open internal, shared and external) (West & Gallagher, 2006; Enkel & Gassmann, 2009; Moreira et al., 2008); (P15) Transfer of knowledge through intellectual property (patents, copyrights or trademarks) (Chesbrough, 2006; West & Gallagher, 2006; Lopes & Teixeira, 2009; Oliveira & Alves, 2014).

Dependent variables: for this study were defined as dependent variables to technology prospecting - as knowledge - in the innovation value chain, considering: (T1) Research and development in the innovation value chain (Shelanski & Klein, 1995; Williamson, 1999; Katila & Mang, 2003); (T2) Universities and Research Centers in the innovation value chain (Bouter, 2010; Ganotakis & Love, 2010); (T3) Relationship with external agents in the value chain of innovation (Husman & Allé, 2001; Sacchetti, 2004); (T4) and consulting partnerships in the value chain of innovation (Nonaka & Takeuchi, 1995; Child, Faulkner & Tallman, 2005).

The following research hypothesis is presented.

Research Hypothesis: Open Innovation practices cause effect to a greater or lesser degree in technology prospecting in the innovation value chain.

2.2 Research Project

2.2.1 Study Scope

Competitive factors and performance of organizations feature the search for innovation, influencing several chains of production and forming an ongoing process, as innovation evolves. This study verifies the influences of open innovation practices in technology prospecting from the value creation experience in the innovation value chain. In addition to searching the literature, experts in the field we were also consulted in Brazil.

2.2.2 Sample and data collection

This research is characterized in its goals as an exploratory one, conducted through literature, in addition to using interviews with people who have had practical experience with the presented problems in order to provide greater understanding of the theme (Gil, 2010), facilitating the application of knowledge acquired in the following step (Lakatos, 1992).

In the literature review, relevant issues to the discussed theme shall be considered, such as the main open innovation practices, technology concepts and what its prospecting consists, as well as providing a background for better understanding of value creation in the innovation value chain. In the search for theoretical cut-outs for this study, searches were made in the Emerald and ScienceDirect databases in order to provide an enrollment of publications - articles, theses, dissertations and monographs, which major open innovation practices were investigated, surveys about the innovation value chain and other necessary information to support the research. Extra searches were also made on Google Scholar listing the main items selected in the first search.

Thus, the study is grounded in a selection of texts that consistently present the state of the art, enabling a consistent data collection and contributing to the understanding of the mentioned subject. In the first search, two hundred forty five titles with potential were identified and included in the literature. Later, this total, using as criteria the reading of the title and abstract, eighty eight titles were selected by completing at first affinity criteria with the theme and the relationship to work. Finally, nineteen titles were selected to be used effectively in surveys of the variables used in this work. Through second search, which used the same criteria as the first, it included over thirty-five titles related to the first and with the potential to be included in literature. The flowchart of these steps can be seen in Figure 2.

From the selected titles, information was extracted and the variables that make up the conceptual framework of this study were verified, as well as its possibility. Two hundred and ninety four practices of open innovation were selected, which were grouped into fifteen variables as independent variables. Regarding the dependent variables, four of them were defined, considering the technology prospecting- as knowledge - in the innovation value chain.

In order to ascertain whether the state of the practice is consistent with the state of the art, the second step was conducting a survey through which data were collected from the professionals involved in areas related to the topic. We selected 102 (one hundred and two) experts from the affinity with the topic, based on the Lattes curriculum, considering their performance in the area, or even researches and publications related to the theme. These professionals were contacted by email, and 27 (twenty seven) have answered. Some of these were deleted after analysis, and 16 (sixteen) were used for this work. Data were extracted from an array of judgment, in which, experts with scientific and technical knowledge about the research object answered questions by assigning greater or lesser weight effect of the practices presented to them. As the universe of experts had different profiles, responses were validated taking into account both the level of participation of the experts in specific projects of open innovation, among other control issues that verified whether the respondent was fit or not to give an opinion on the subject in question. Still, the responses were statistically tested in order to reduce the subjectivity of the results.

The results are presented below and show the relationship between the results raised by research on the literature and the views expressed by experts presented based on the conceptual model previously shown.

3. Analysis of the Results

This section provides procedures for verification for the conceptual model. In order to achieve the proposed objective and thus solve the research problem, open innovation practices grouped into fifteen independent variables were raised. Still, four dependent variables were raised considering the technology prospecting - as knowledge - in the innovation value chain. After this survey, the relationship between the independent and dependent variables was presented in the form of judgment matrix for experts, which validated or not each of these intersections and pointed out the impact that each open innovation practice variable raised causes on each dependent variable.

The questionnaire that was submitted contained control issues that verified whether the expert was really able to give an opinion on the subject. They selected 102 (one hundred and two) experts, and 27 (twenty seven) of them have responded. However, in order to validate the answers of respondents that did not meet the fitness criteria were discarded, as from control issues. That means only the answers of respondents who actually has an affinity with the theme, so selected only 16 (sixteen) answers were considered.

3.1 Applications and Analysis

For a better viewing, the data were compiled from the average of the answers and yet, from this table, a graph was mounted showing the intensity of the relationship between the independent variables, according to the experts' opinions. The results are shown below (Figure 3):

In addition to the investigation of averages, which show the intensity of the relations between the independent variables, the selected responses were statistically treated in order to reduce the subjectivity of the results that were presented and to confirm the averages as a reasonable response to the relations of each presented practice and technology prospecting. First, once it is a test of averages, the possibilities of realization of the Z-test and T test - Student's t-test (Paternoster, 1998; Lowry, 2014) were listed. However, since it is a small sample, it would be more viable to use the T test (Paternoster, 1998; De Winter, 2013).

By choosing the T test, it was necessary to determine whether the samples had a normal distribution and for that, the KS tests were used - Kolmogorov-Smirnov and SW - Shapiro Wilk (Lilliefors, 1967; Razali, 2011), however, only the results of tests SW were considered, since the KS presents no great reliability in small samples (Shapiro & Wilk, 1965; Razali, 2011). The SW test showed that the samples had a normal distribution and it was possible to carry out the t-test on the responses received and selected for the study (Figures 4 and 5).

3.2 Implications for practice

Finally, the presented results attest to the presented hypothesis: Open Innovation practices cause effect to a greater or lesser degree in technology prospecting in the innovation value chain. In general, the presented practices were considered to have an effect on the dependent variables between moderate and, even having less impact in some of them, none of the practices have presented null impact. In some cases it was possible to find a greater intensity, for example, the case of P13 (Relationship between companies and the scientific and technological system) and T2 (Universities and Research Centers in the innovation value chain) variables, which implies an affinity between the type of knowledge being sought and its source.

Literature allows one to view an indirect relationship between Open Innovation and Innovation Value Chain (Brown, 1997; Chesbrough, 2003; Perkmann & Walsh, 2007). Organizations have proposed redefining their strategies in order to take advantage of the principles of Open Innovation. Emphasizing that using external sources of information does not deny the existence of internal R & D, however, without an internal R & D, the organization loses the ability to capture the value generated by innovation. By understanding that an organization does not need to master every link in the innovation value chain, it becomes possible to specialize in one or more of them and use Open Innovation as a means for redesigning the organization's strategy of innovation (Chesbrough, 2003 Lazzarotti, Manzini & Pellegrini, 2010).

4. Conclusions

This article aims to evaluate the effects of Open Innovation practices in technology prospecting (knowledge) in the innovation value chain. For this, a search of Open Innovation practices was conducted in the light of literature. The study examined whether the state of the art reflected in the state of the practice through survey. To this end, an exploratory case study was conducted, seeking experts who could answer about the effects, based on their experience and on technical knowledge.

The data collected through judgment matrix validated the presented proposal. The presented practices were evaluated by experts who attributed weight impacts on them. From this, a positive response to the hypothesis tested in this study was obtained, verifying that Open Innovation practices cause greater or lesser effect on technology prospecting (knowledge) in the innovation value chain. Given the above, it appears that the search for better value creation in the innovation chain proposes a redesign of strategies.

In order to do this, using business models based on Open Innovation allows organization be more efficient in creating and capturing value. The inclusion of a variety of external concepts helps boosting new ideas. Thus, the use of Open Innovation practices is consistent for technology prospecting (knowledge) in the innovation value chain.

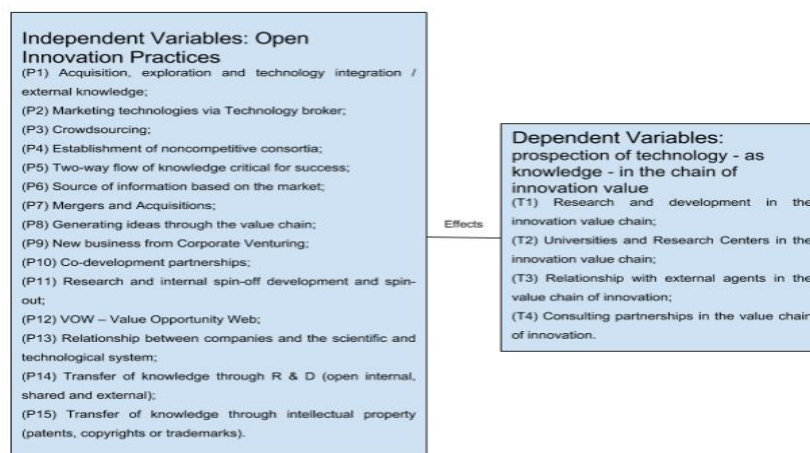


Figure 1: Conceptual Model

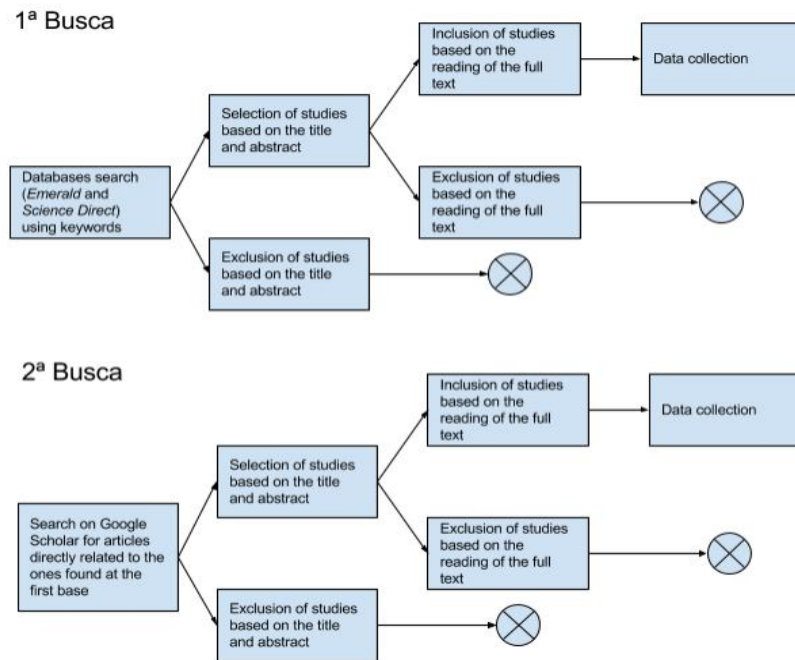


Figure 2: Review steps.

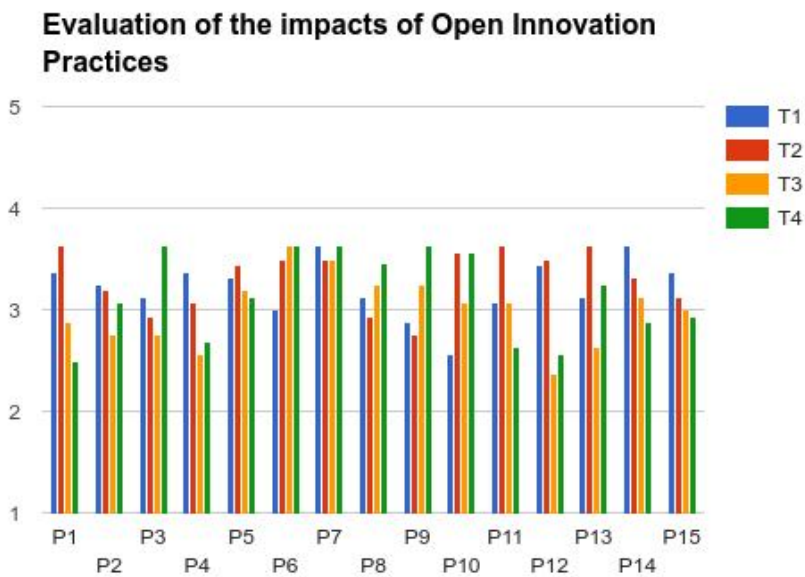


Figure 3: Evaluation of the impacts of Open Innovation practices on the dependent variables (1- lesser importance; 5- greater importance).



Figure 4: SW Test, where SIG > 0,05 shows normal distribution.

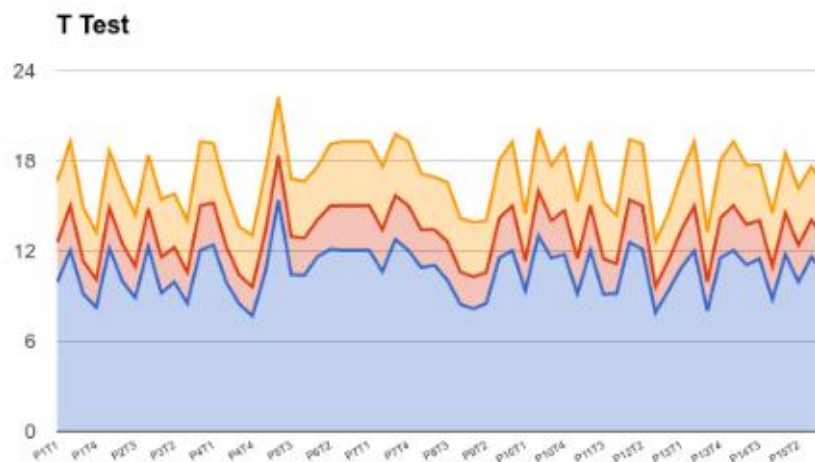


Figure 5: T Test showing the average difference among the lines of trust of superior and inferior difference.

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