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Innovation management: lessons learned from innovation diagnostic tools

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Abstract: Innovation management has been considered a basic element for sustainable growth in the long term for organizations. However, the implementation of initiatives that may lead an organization to be more innovative requires deeper investigation on the gaps that separate the current status of a particular organization from the "desired" organization. In this sense, applying a diagnostic tool is a useful way to identify these gaps and to define an action plan for the change process. Therefore, choosing an appropriate diagnostic tool is a very important decision and a company should take in consideration its very specificities and the strategic intent of the innovation management initiatives before performing a diagnosis. Many management models and, in the case of this study, innovation management models, offer a diagnostic tool as a practical way to a company to check its level of alignment with the model proposed. However, innovation management models do not constitute a cohesive and consolidated body of knowledge: each one carries its own subjective assumptions and biases. This research takes several innovation diagnostic tools and, from their analysis, key elements for innovation management in organizations and recommendations for defining adequate diagnostic tools emerge.

Keywords: innovation management, diagnostic tools, innovation diagnostics.

1. Introduction

According to Skarzynski and Gibson (2008), innovation is recognized today as being the fuel of all types of competitive advantages in the corporate world and is the basis for long-term sustainable growth. Indeed, Schumpeter (1934) reinforces that companies must become competitive through the development of new products, new technologies, new sources of supply and new forms of organization.

The growing need of companies to implement and operate innovation management systems and some associated organizational processes (O'CONNOR et al., 2008; BAGNO; SALERNO; DIAS, 2015; CASSEL et al., 2015), claims for tools that allow a more complete understanding of the gaps - between organization's current practices and outcomes - and those ones desired in a plannable future (HANSEN; BIRKINSHAW, 2007; TIDD; PAVITT; BESSANT, 2009).

Literature on innovation management contains several recommendations on how to manage innovation in organizations. Much of them are drawn from case studies of innovative companies (e.g. HAMEL, 1999; MAY, 2007; GOVINDARAJAN; TRIMBLE, 2010; CHIARONI; CHIESA; FRATTINI, 2011). However, discussion on the contingencies that make each experience a particular and not generalizable case is scarce. Besides that, Hansen and Birkinshaw (2007) affirm that the simple adoption of "innovation best practices" by an organization will probably not work as expected and may even bring adverse effects along the effort of building innovation capacity. In this context, innovation diagnostic tools emerge as a useful managerial instrument to evaluate a company in what concerns its innovation capacity. Normally, this kind of tool is part, or even comes as an attachment of a greater body of knowledge (a formalized innovation management model or even a set of practical recommendations). Such models/recommendations guide the nature and form by which questions are addressed, and evaluation criteria are set in a proposed diagnostic procedure. To the purposes of this paper, we will refer to these "bodies of knowledge" as "innovation management models" in a general form. The typical result of a diagnostic is a set of recommendations and actions to be undertaken by a team engaged in organizational change efforts (INSTITUTO..., 2004).

However, academic literature and other public information are plenty of diagnostic tools, each one with its own subjective assumptions and biases. So, some questions arise: what is the best option? What parameters should be used to guide this decision? What aspects related to innovation management should be addressed by a good innovation diagnostic tool? In order to seek answers to these questions, instead of studying the innovation management

models in their very fundamentals, this research takes a different path. Once innovation management models tends to carry their own subjacent assumptions and biases (SILVA; BAGNO; SALERNO, 2014; SALERNO et al., 2015), rarely clear in their formal statements, this paper is aimed directly at investigating the diagnostic tools - their structure, questions, topics, etc. A subsequent data analysis is done to understand the characteristics of each diagnostic tool, their convergences and differences. The final intent is to extract lessons on innovation management from the diagnostic tools. In doing so, this study performs a kind of reverse engineering, in which the discussion on innovation management emerges from the knowledge implicit in evaluation instruments.

The next sections are organized as follows: the theoretical basis about innovation is presented in section 2, including topics on concepts, process and management of innovation. This section finishes with some considerations on organizational diagnostics and innovation diagnostics in a more focused perimeter. The methodological aspects of the study are delineated in section 3 where procedures taken for searching diagnostic models and for their analysis are detailed. Section 4 is dedicated to the results, where analyzes regarding content and structure are discussed in specific subsections. The final remarks are done in section 5, which also elucidates the contributions of this study to theory and practice of innovation management in companies.

2. Theoretical basis

2.1. Concepts of innovation and types of innovations

Francis and Bessant (2005) define innovation as the recognition of opportunities for profitable change and the exploitation of these opportunities in business practice - what often involve new products and services, but also other aspects of a business operation. Similarly, innovation may be simply defined as the successful exploration of new ideas (DEPARTMENT..., 2003). Typologies for innovation are also common in literature. Schumpeter (1942) classifies innovation in the following types: new organizational arrangements, new sources of energy and raw materials, R&D, imitation, experimentation and adaptation of processes and products. Tidd, Pavitt and Bessant (2009) differ innovations in product, process, location (context in which products are introduced in the market) or paradigm (a model that guides actions in an organization). In turn, Sawhney, Wolcott and Arroniz (2006) identified twelve different dimensions for innovation. Such dimensions are associated with different forms and opportunities for a company to innovate. The authors group these forms in four key dimensions: (i) what is offered by the firm (What); (ii) which customers are served (Who); (iii) the processes employed (How); and (iv) the market points (Where) (Figure 1).

Several authors perceive innovation also in different levels of intensity such as basic, intermediate incremental, advanced incremental, architectural, radical (FIGUEIREDO, 2009), among others. The concentric circles of Figure 1 may be interpreted as different "levels" for innovation (an individual innovation project or even a portfolio of projects) in an organizational context.

2.2. Innovation as a process to be managed

For a company that aims at innovating in a systematic and sustainable manner over time, it is necessary that ideas and opportunities get across an organizational process (UTTERBACK, 1971; TIDD; PAVITT; BESSANT, 2009; SILVA; BAGNO; SALERNO, 2014). For instance, Hansen and Birkinshaw (2007) describes innovation as a value chain represented by three phases: (i) idea generation, (ii) selection and development; and (iii) diffusion. Tidd, Pavitt and Bessant (2009) alert that understanding innovation as a process has as main implication the need to manage it. Several models have been proposed in the literature to represent the innovation process, its stages and its associated management elements (SILVA; BAGNO; SALERNO, 2014). Among these, Jonash and Sommerlatte (1999) propose a model in which innovation is taken as a continuous and sustainable process at the organizational level, that results from reflection, change and learning (Figure 2). The authors argue that the company needs to align and harmonize the management efforts according to four main elements: (i) innovation strategy (in terms of platforms, projects and partners); (ii) organization for innovation (leadership, collaborations and alliances);

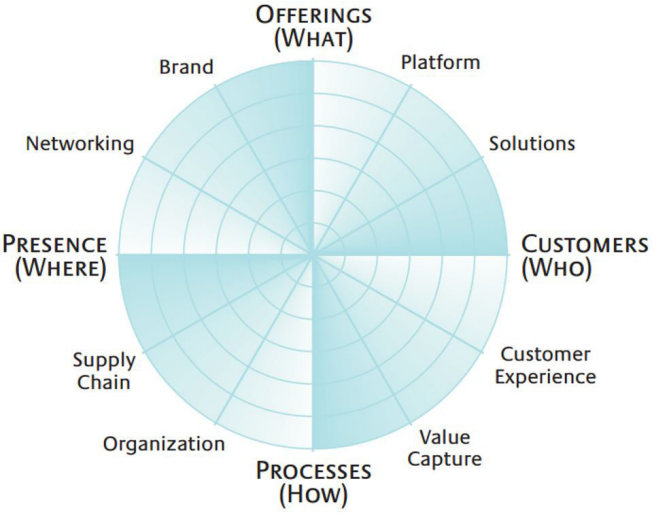

Figure 1. The Innovation Radar. Source: Sawhney, Wolcott and Arroniz (2006).

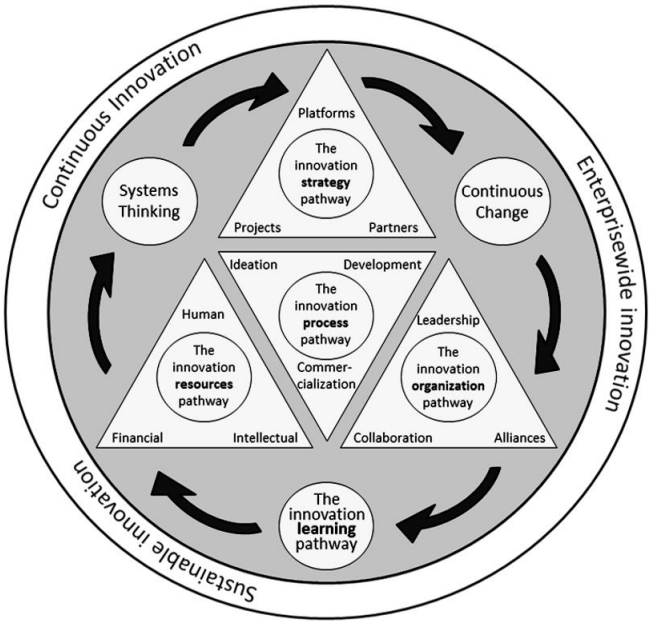

Figure 2. The advanced model of innovation. Source: Jonash and Sommerlatte (1999).

(iii) innovation resources (including financial and human); and (iv) innovation process (covering the stages of ideation, development and commercialization).

Jonash and Sommerlatte (1999) emphasize two fundamental characteristics of innovative companies: (i) the permeation of innovation throughout the company (from suppliers and shareholders to end customers, in order to create value, generate learning and change the prevailing culture); and (ii) the leverage of technologies and expertise to drive sustainable innovation and capture competitive advantage by building technological platforms and new competences.

2.3. Innovation diagnostics

According to Cummings and Worley (2014), an organizational diagnostic is a tool aimed at gathering relevant information to a certain change, desired in the organizational environment. Such kind of a tool is useful in identifying and assessing a set of variables or elements that support inferences on how the organization is (compared to an ideal status or model) and also nurture managerial decisions on how it should be. For instance, Kim and Wilemon (2003) and Barczak and Kahn (2012) propose similar tools for organizational assessment in product development field.

Therefore, an innovation diagnostic tool is an instrument of analysis and evaluation of a company in what concerns its internal environment (INSTITUTO..., 2004). Besides that, the use of such an instrument should take into account the peculiarities of each organization and the peculiarities observed in conceptual models that underlie it. This statement is supported by an interesting analogy used by Hansen and Birkinshaw (2007, p. 122): "[...] even the strongest dose of the best analgesic on the market won't help mend a broken bone". These authors reinforce the need for processes to innovate in the companies, identify their unique challenges, and develop ways to address them. The conduction of a diagnosis would take a managerial team to a better level of knowledge about the company, helping the team to determine the best form of intervention for the depicted situation.

Nevertheless, there are several approaches for assessing the capacity and performance of companies in what regards innovation, and almost all of them are associated with different concepts and models for innovation management. Sears and Baba (2011) criticize the efforts made in the literature of innovation management stating that opinions diverge on key assumptions and methodologies across disciplines involved, whereas there are few efforts focused on the integration of the knowledge generated.

3. Methodology

This study was conducted according to the following macro-stages: (i) gather innovation diagnostic tools available in academic literature, but also in other sources (such as consultancy firms websites or other organizations engaged in proposing models or practice sets for innovation management); (ii) compare them in order to identify biases, modes of application, building blocks and general assumptions in which they are based. From the analysis made in steps i and ii: (iii) discuss the general implications of diagnostic tools for innovation management in organizations; and (iv) propose a set of recommendations for companies in choosing an adequate innovation diagnostic tool.

Given this scope, it is important to consider the complexity and diversity of approaches that mark the literature in innovation management. To deal with this challenge, two models - previously discussed in literature review - are combined to make up the conceptual framework of our analysis. The first model is the "Innovation Radar" (SAWHNEY; WOLCOTT; ARRONIZ, 2006), which focuses on the types (and, in some extent, on the intensity levels) of innovations that may come from organizational efforts. This model was selected due to its perceived completeness in defining several types of innovation, extrapolating the classic product-process or product-process-organization-marketing perspectives. Therefore, such a model represents well the outcomes of innovation efforts undertaken in an organization, but it is not so effective to indicate how to achieve them. To do so, the "Advanced Model of Innovation" (JONASH; SOMMERLATTE, 1999) was then selected. This last model proposes an innovation process,

but focuses, above all, on how the company should organize the needed management elements that allow the systematic conduction of the process. This characteristic strongly influenced the decision for considering this model, but such a decision was also supported by the discussion present in Silva, Bagno and Salerno (2014), that critically compared many models of innovation management. These two models are combined in Figure 3 and served as basic categories to organize data from the innovation diagnostic tools identified.

The next step consisted in gathering innovation diagnostic tools available in academic databases, books and open internet sites of organizations associated with the general theme of innovation management. Online searches were conducted in Google Scholar, Web of Science and Sciencedirect databases, using terms in Portuguese, English and Spanish languages. The first twenty most cited documents from each search were analyzed according to two basic criteria: (i) the adequacy of the title and, after, the abstract and the main subject of this study; and (ii) the presence of a diagnostic questionnaire or other tool intended to evaluate innovation at the organizational level. After carrying out a number of searches in the mentioned databases, however, few documents could be considered closely linked to the central purposes of this study. So, the search was expanded to other sources of information such as thesis, websites of consultancy firms and other organizations and books on innovation management topics. Data collection efforts have finally pointed fourteen innovation diagnostic tools (Table 1), summing 730 questions. The numbers that identify each diagnostic tool in Table 1 will be used to refer to them in further analyzes when convenient along this text.

Each question of the selected diagnostic tools was analyzed individually and classified in an organizational element of Jonash and Sommerlatte's (1999) model or in an innovation dimension of Sawhney, Wolcott and Arroniz (2006). The next step was to perform qualitative and quantitative analysis over the data categorized, which finally served as the basis for discussion in the final sections. Figure 4 summarizes the steps applied in the methodological approach of this study.

Following the approach shown in Figure 4, the next sections present the results and conclusions of the study.

Table 1. The diagnostic tools selected.

#	Diagnostic Tool	#	Diagnostic Tool
1	Bachmann and Destefani (2008)	8	Fayet (2010)
2	Rede de Inovação (2013a)	9	Terré i Ohme (2002)
3	Scherer and Carlomagno (2009)	10	E-Innovacion (2013)
4	Pizyblski et al. (2012)	11	Edquist (2011)
5	Dalla Nora (2011)	12	Tohidi and Jabbari (2012)
6	Rede de Inovação (2013b)	13	Goffin and Mitchell (2010)
7	Silva (2006)	14	Tidd, Bessant and Pavitt (2009)

Source: Authors.

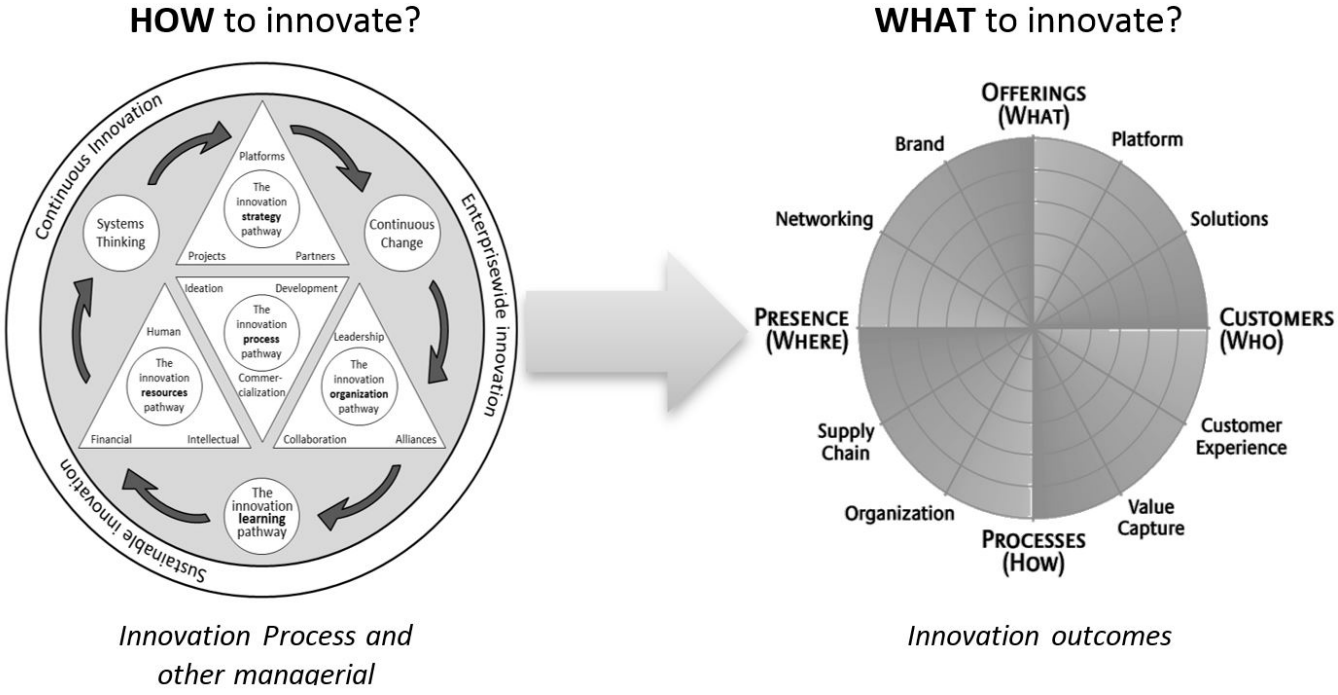

Figure 3. Conceptual framework for analyzing diagnostic tools. Source: Organized by the authors.

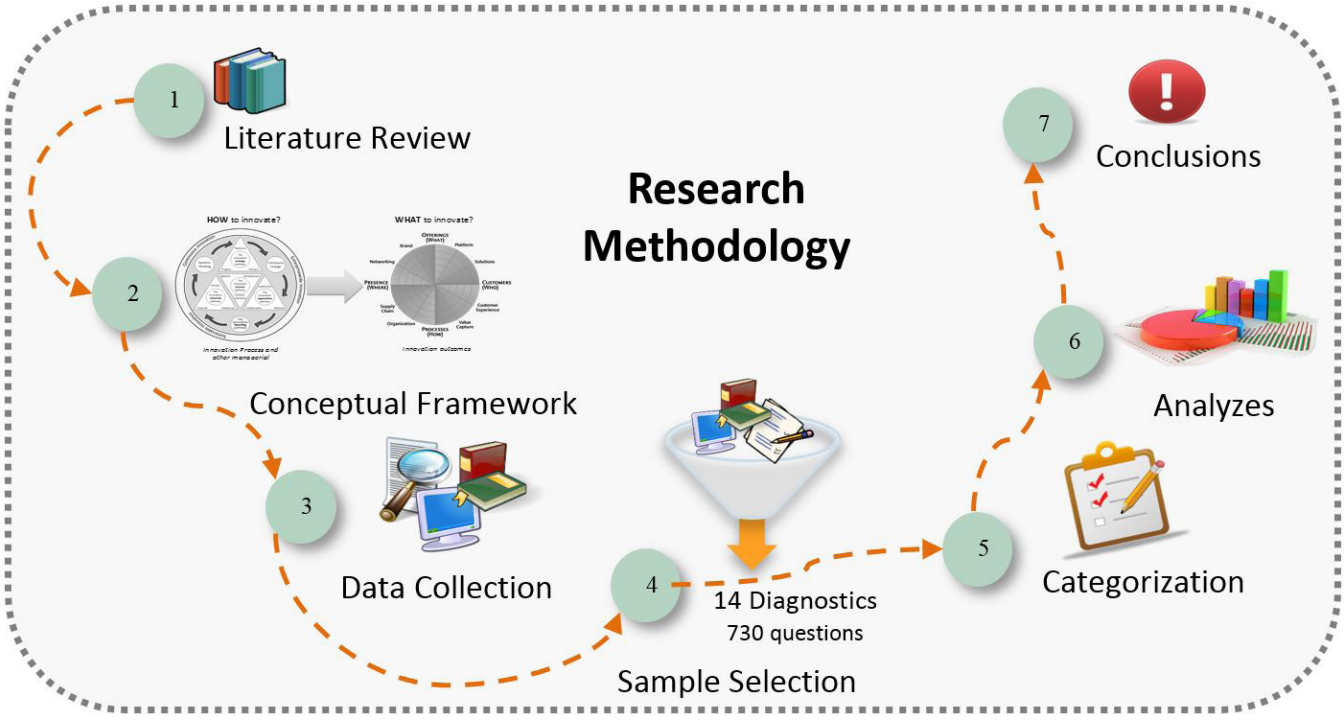

Figure 4. Research steps. Source: Authors.

4. Results

The analysis made over the data reinforces some considerations regarding the importance of innovation for business competitiveness. Another convergent observation is that efforts in performing a diagnosis of the organization represent an important requisite before engaging in further actions. Notwithstanding, innovation best practices generally found in literature (and, probably, practical actions triggered by them) may be not well aligned to the particular contingencies of a company. Also, the fact that some managerial elements play the role of enablers of innovation performance or even that innovation may be done in many distinct dimensions (that means different opportunities to innovate in a business context) do not mean that such managerial elements or types of innovation are well balanced among themselves.

Seeking for answers to these tensions, the 14 diagnostic tools taken in this study were analyzed according to two major prisms: content and structure. The following sections explore them in more details.

4.1. Content analysis

A first and clear difference found among the diagnostic tools regards the central concern of each one. Some of them are focused on innovation outcomes and could be synthesized by the question: *has this company been innovating?* Others are centered in innovation capacity (organizational dimension) and the question: *is this company [potentially] innovative?* explains them well in few words.

When outcomes (real and current) are the main concern, diagnostic questions tend to be more related to the direct impact of products and/or other actions in business profitability. Some typical statements are: *Percentage of revenues arising from new products or services* (FAYET, 2010) or *Has the company set market points different from the usual ones?* (BACHMANN; DESTEFANI, 2008). This type of question represents about 30% of the database analyzed. On the other hand, when innovation capacity is the focus, diagnostic questions try to capture if some elements - considered essential to an innovative company - are present and in what extent they are consolidated. Some typical statements, which correspond approximately to 70% of the total, are: *Are there incentives to employees to give new suggestions and ideas for innovation?* (REDE DE INOVAÇÃO, 2013a) or *Has the company set dedicated budget for projects related to innovation?* (SCHERER; CARLOMAGNO, 2009).

Initially, an organization that implements all the elements covered by Jonash and Sommerlatte's (1999) model adequately would be expected to generate, in some extent, outcomes regarding innovation. Such an observation could suggest that applying both capacity and outcomes-oriented questions would result in some redundancy in diagnosing a particular company - or even that contradictory results could not come from the same organizational context.

However, a considerable time lag may exist between starting innovation efforts in a company and collecting the expected outcomes (when they truly come - once an organizational change process involves many uncertainties and variables that are often out of management control). Gibson (2010) notes that an organization may take 3-5 years to acquire the skills, tools, process management, indicators, values and IT systems needed to support innovation across the whole company, whereas studies such as O'Connor et al. (2008), Bagno, Salerno and Dias (2015) and Hansen and Birkinshaw (2007) discuss other cases in which innovation outcomes and innovation efforts were not in phase. Therefore, applying outcome-oriented diagnostic tools as a way to establish metrics for implementing initiatives is an option to be considered under strong caution, mainly for just-created innovation programs. The risk is to undervalue intermediate achievements of a long term organizational change process and cut resources hastily, diminishing the power and legitimacy of the actions concerned to build innovation capacity.

The questions associated with innovation capacity were then classified according to the main elements identified in advanced model of innovation of Jonash and Sommerlatte (1999), viz, strategy, organization, resources and process, as shown in Figure 5. This activity revealed to be challenging for some of these questions that seemed to touch more than one element. These cases were discussed in more detail among the authors, but double classification or the use of correlation techniques were avoided. For instance, a question like *How the company selects ideas to receive financial resources to be developed?* was classified in "process" typology, once the conduction of ideas along a process is at the core.

The general distribution of diagnostic questions along the elements shown in Figure 5 reveals an interesting balance that is in line with the arguments of Jonash and Sommerlatte (1999). These authors state that the four dimensions considered in their model must be well integrated in an organizational environment in order to assure that actions aimed at promoting innovation are sustainable and continuous. Therefore, the absence of a predominance of an element over the others could be expected. Nevertheless, when we shed light in each diagnostic tool individually, this balance is not the rule and many of these diagnostic tools reveal some biases and characteristics of incompleteness (Figure 6). Another point to be considered is that Diagnostic 13 (as discussed further) is very extensive in terms of number of questions and, as a consequence, exerts relevant influence in this picture. This finding reinforces the fact that choosing an existing diagnostic tool requires some care, once an inadequate analysis may lead to managerial decisions based on incomplete or unbalanced information.

By turn, questions associated with innovation outcomes were classified according to the twelve dimensions proposed by Sawhney, Wolcott and Arroniz (2006) and the general results are shown in Figure 7.

Even though Sawhney, Wolcott and Arroniz (2006) argue that a company may lose many opportunities when a constrained perspective of innovation is present, the results shown in Figure 7 reveal a predominance of a strong product-process paradigm in diagnostic tools selected for this study (with an interesting inversion of emphasis between product and process). In an organizational context, however, the assumption that a balance among dimensions of innovation outcomes should be mandatory or even

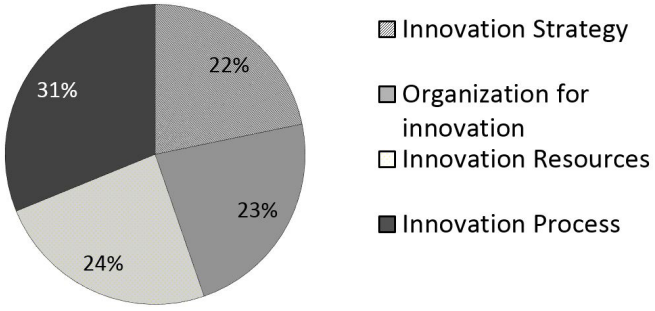

Figure 5. Diagnostic questions: organizational dimensions. Source: Authors.

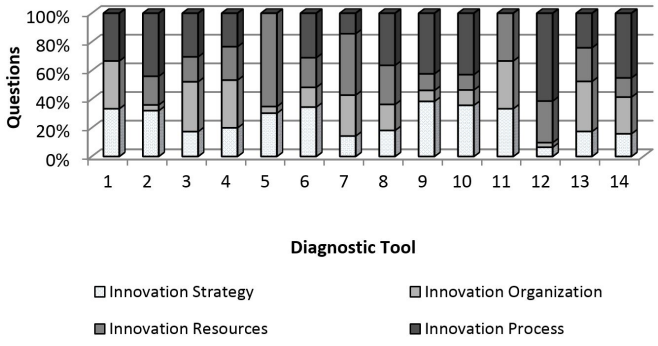

Figure 6. Questions per organizational dimensions and diagnostic tool. Source: Authors.

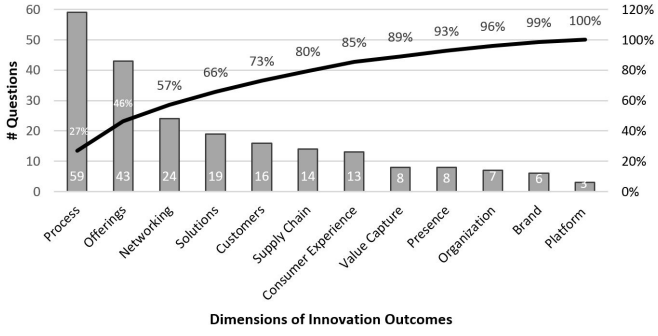

Figure 7. Diagnostic questions: outcomes. Source: Authors.

desirable is not valid. Specific kinds of outcomes may be chosen as part of a specific innovation strategy. This may occur due to the innovation strategy itself, the position of the firm in the value chain, technological paths, resource analysis, among others. Notwithstanding, the absence of a broader view of innovation in diagnostic tools designed to be generalizable, may be interpreted as a narrowness and should be avoided.

4.2. Structure analysis

The form by which a diagnostic tool is structured is linked to the feasibility of performing a diagnosis in an organization and also to the time and resources required for this challenge. The analysis here is focused on parameters like the extension of questionnaires, answer patterns used and the forms employed to report the results.

In what regards to the extension of questionnaires, a considerable diversity can be observed (Figure 8). In order to propose a reference for a diagnostic in terms of its number of questions, by eliminating two diagnostics from upper and bottom extremes and calculating the average number of questions of the remaining 10 ones, the result is 37 questions.

The more extensive diagnostic tool analyzed is the one proposed by Goffin and Mitchell (2010) with 259 questions (diagnostic tool 13). These authors propose a detailed and distinct analysis for each several organizational function that should be involved in innovation efforts of a company. However, the choice here has to take into account the purposes of performing a diagnosis. Certainly, the demand for a quick overview aimed at confirming some assumptions before a deeper discussion on innovation management in the company should be addressed to a simpler and objective tool. A thorough analysis might be made after a formal strategic decision for implementing/improving innovation management in the organization, which may be more intensive in timing and resources required along the change process.

In terms of answering patterns we could identify four distinct forms to collect information (Figure 9). One of them and the most used was to ask the level of agreement to a statement or to assign a grade to the statements (e.g. diagnostic 5: *what about the incentives to the employees to seek for competence improvements? Evaluate from 0 to 9*). There were also tools based on open questions like the case of diagnostic 13 - *how the organization ensures that a new product design is tested with final costumers?* Some diagnostic tools use quantitative approaches by asking for the number of patents, number of masters/doctors among the employees, innovation ideas proposed in a given period of time, etc. Another approach observed was to give some choices in a number of options as in diagnostic 9: *Innovation Culture - what is the role assigned to innovation in the long*

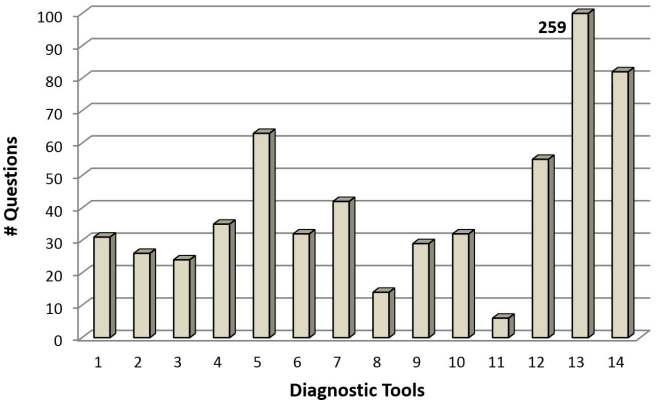

Figure 8. Extension of diagnostic tools. Source: Authors.

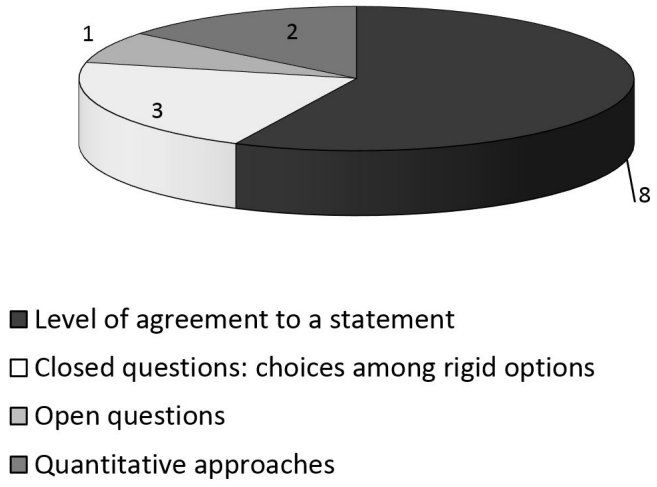

Figure 9. Different forms of gathering information. Source: Authors.

term planning? In this example, four different scenarios compose the possible answers for the question (Figure 10).

After collecting and analyzing data in a diagnosis effort, the results must be reported to a managerial team in order to inspire and support further actions that fuel the organizational change for innovation. Here, as evidenced by Figure 11, diversity prevailed again. Despite this, the majority of the diagnostic tools studied does not suggest any particular form to present such results. Diagnostic tools based on open questions are expected to be more complex to be analyzed, even though richer information may arise from them. In our sample, just the tool #13, proposed by Goffin and Mitchell (2010), adhere to this category and, in this case, text-based reports or presentations were the recommended ways to present the conclusions and remarks. Some tools - in our sample represented by Bachmann and Destefani (2008) and Silva (2006) propose pre-defined scenarios (e.g. "slightly or not innovative", "casually innovative" or "systematically innovative") that are the basic "boxes" in

Figure 10. Example of the use of closed questions in an innovation diagnostic tool. Source: Terré i Ohme (2002).

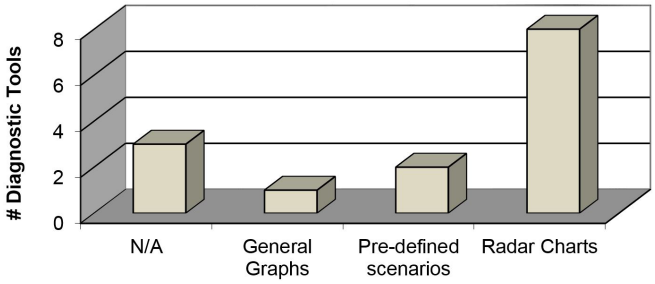

Figure 11. Different forms to present the results. Source: Authors.

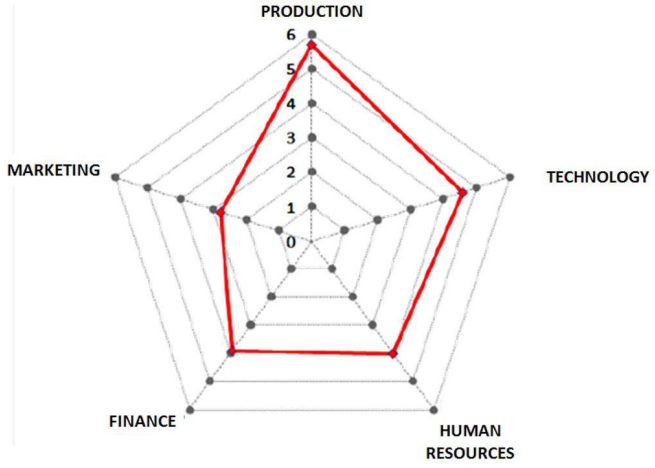

Figure 12. Example of a radar chart to present the results. Source: Adapted from Dalla Nora (2011).

which a firm fits after performing the diagnosis. However, the far more used way to synthesize the result of a diagnostic tool was the radar charts like the one shown in Figure 12.

5. Final remarks

This study aimed at extracting lessons for innovation management from diagnostic tools. To do so, we tried to capture key characteristics related to the contents and structure of innovation diagnostic tools, by raising samples from both academic and non-academic worlds. The analysis followed a path analogous to a "reverse engineering", once the most relevant information for the study was taken from the evaluation tools (diagnostics) rather than the main documents (articles, manuals or others) that, traditionally, formalize recommendations for innovation management. In this line, we have selected 14 diagnostic tools that summed 730 questions. The intent was not to explore an exhaustive set of proposals of innovation diagnostic tools, but to achieve a minimal diversity that allowed a detailed analysis over each question individually. Therefore it was possible to identify some patterns related to the structure and contents of the tools, subjacent ideas and to perform a general comparison among the different approaches.

A first and general finding is that, even if there could be a convergent idea of what is or is not an innovative company, there is no single way to ascertain this. Different assumptions about what is the right way to become an innovative company may underlie the many approaches available to perform an initial diagnostic. As different approaches in a diagnostic phase may lead to different interpretations about where the organization is in its path to become a truly innovative company, managerial team must be alert about the assumptions behind each proposal. Also, the proposition of a specific and tailor-made diagnostic tool for the company may also be a possibility. In that way, insights extracted from previous sections related to the balance of managerial elements, diversity of innovation outcomes and their commitment to the general strategy of the organization, extension, forms of result and others may serve as references to be taken into account.

Among the main recommendations for choosing an existing innovation diagnostic tool in an organizational context or even for creating a new one, are:

a) To perform a diagnosis before undertaking efforts aimed at increasing the company's innovative capacity is the first step to reduce the risks and uncertainty associated with the change process;

b) Choosing an adequate diagnostic tool requires care regarding some basic parameters (balance among elements, extension, forms of collecting data, etc.). Different organizations may respond differently to each option. There is no only way to assess a company and, probably, there is no best way that applies to every company;

c) It is important to maintain the balance among the organizational elements: strategy, resources, organization and innovation process to avoid that incomplete or unbalanced information fosters the change process;

d) There must exist consistency between the company's strategy and the types of innovation considered as desirable outcomes of innovation process, but a broader range of possibilities regarding such kinds of outcomes may inspire better innovation strategies;

e) To be performed, a diagnostic effort demands resources (in terms of time, people...). Some characteristics of the innovation diagnostic tool (such as the way questions are shaped, the extent of the questionnaire and others) should be designed according to the resources available for this task. By the other hand, the more accurately and in-depth is the analysis, the more consistent will be the managerial decisions derived from it. So, it is important to define the purpose of a diagnostic effort - objective and synthetic tools may be adequate to a pre-test, but more labored diagnostic tools may be more adequate to serve as basis for major changes;

f) Just as important as performing a good innovation diagnostic in a company is to show the conclusions and remarks that derives from it. Therefore, choosing rich and interesting visual forms to present the results (radar charts, written report, predefined scenarios) may be a key element to trigger richer discussions and propose a good action plan to guide the change process of building and increasing innovation capacity.

It is noteworthy in this research the barriers in identifying and collecting information regarding innovation diagnostic tools focused on the business contexts. This challenge resulted in a relatively scarce set of data collected. Although it restricts generalization of some conclusions it also represents an opportunity to continue the work in the extent that more models and tools come to be identified. New models can be also studied to meet specific business or even market niches. Another opportunity for the study and application of innovation diagnostic tools resides in the maturity models for innovation management once a company may apply a diagnostic tool periodically in order to capture the evolution/involution of its innovation capacity along the time.

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