

THE EMERGENCE OF INNOVATION FUNCTION IN BRAZILIAN COMPANIES

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ABSTRACT

In last decades, innovation has acquired increasing importance for organizations, especially in industrial sectors. However, unlike cases in which innovation occurs sporadically and randomly, special challenges are faced by organizations that are engaged in systematic generation of innovations. In this line, a set of initiatives in large companies seems to point towards the creation of workgroups dedicated to innovation management activities. Taking the concept of organizational function as an identifiable group with a specific mission within an organization, some recent studies have argued that innovation emerges as a distinctly new organizational function. In this context the central question posed in this study is: what characterizes the innovation function within organizations, considering different initiatives undertaken by large industrial companies engaged in building systematic innovation capability in Brazil?

The study discusses concepts of innovation and the management approaches found in the literature relating to the challenge of systematizing innovation within organizations. Case studies were conducted in fifteen large industrial companies in Brazil that, except for two control cases, have workgroups dedicated to activities related to innovation management. The analysis of these cases and their convergences reveals key characteristics of the innovation function (IF) that emerges in these companies. Such characteristics are divided into six perspectives, viz, general purpose, origins, legitimacy and guidance, people, assignments and future perspectives. Finally, among the main implications, the findings serve as a basis for new corporate initiatives aimed at implementing regular and systematic innovation capability. The characterization of innovation function also adds new elements to existing knowledge on how companies can build and maintain innovation capability. For future research, some of the proposed paths are: deepening the comprehension on the assignments of innovation function and identifying the ways by which innovation function can be legitimized in organizations.

Key words: Innovation Management; Organizational Functions; Industrial Companies; Systematic Innovation.

INTRODUCTION

In last decades, innovation has been gradually recognized as one of the main pillars of companies' competitiveness. Organizational skills and factors relating to operational excellence that improved the competitiveness of large organizations in the past are no longer enough to ensure performance or even the survival of organizations in future (Gibson, 2010b; Teece, 2007). In the literature, there exists numerous contributions in the field of innovation management, but such contributions are fairly spread. Sears and Baba (2011) declare that, despite a significant amount of research, literature in innovation subjects is characterized by its fragmentation, lack of transversality and little synthesis of the advances over the multiple levels of analysis. As stated by O'Connor (2012), much of what has been studied in the academic community represents small pieces of an organizational phenomenon that can raise richer insights if analyzed in a systemic perspective.

The management of innovation in organizations is a complex process, which exhibits strong interdisciplinary characteristics, whose practice pervades several emphases and functional activities (Baregheh et al., 2009; McDermott and O'Connor, 2002; Tatikonda and Montoya-Weiss, 2001). Thus, the proposition of organizational management practices with the intent to make innovation occur systematically in companies is a great challenge. These challenges exist both for academics as well as practitioners in organizations, since traditional formulas like high investments in R&D activities or even the adoption of best practices of innovative organizations do not provide complete solutions (Hansen and Birkinshaw, 2007; Jaruzelski et al., 2005; Jensen et al., 2007). Thus, it is important to understand that the management of technological innovation is a more complex phenomenon, which involves the effective integration of people, organizational processes and planning activities (Roberts, 1988).

According to Kelley (2009), literature has several recommendations on how to carry on with innovation efforts in organizations. However, the authors note that, typically, these initiatives do not hold up over time and such efforts are often decelerated or even canceled by short-term emergencies. O'Connor et al. (2008) attest that even organizations that feature emblematic cases of innovation projects may do so in an infrequent, irregular and unpredictable ways. Such prospects reinforce the need to broaden a debate on the establishment of a systemic model, that can be integrated into the routine activities of the companies and assume the mission of making innovation a continuing one (Gibson, 2010b), not dependent on special budgets or on the will of specific leaders at any given moment of an organization (O'Connor et al., 2008).

Researchers at Rensselaer Polytechnic Institute (RPI), in partnership with Industrial Research Institute (IRI) of United States conducted a longitudinal study in 12 large corporations, all them immersed in the effort of systematizing innovation (Kelley, 2009; O'Connor and DeMartino, 2006; O'Connor et al., 2008). One of the main conclusions that emerged from their research is that innovation has evolved over a period of time to become a new organizational function in those companies. According to O'Connor et al. (2008) an organizational function is defined by the existence of a recognized and identifiable team that holds - and is measured by - a specific mission pertaining to that organization.

In this context, the central questions posed in the present work arise: taking innovation as an organizational function, how can it be characterized and what are its characteristics? The study was carried on large industrial companies in Brazil, engaged in systematizing innovation efforts. The

following sections are organized as follows: theoretical basis is presented in four sections - first, concepts of innovation are presented, followed by a discussion on innovation processes. Then, some contributions from literature regarding the challenge of systematizing innovation precede the last theoretical section that summarizes the studies presenting innovation as an emergent organizational function. The next section presents multiple case studies as the methodological approach, which was performed in 15 companies. The findings are divided in six perspectives, representing how innovation function (IF) is characterized and then, its characteristics, as identified from research data, are discussed. Finally, the main constraints of the study and its implications are presented. Suggestions for further investigations are proposed, taking the innovation function a central object of analysis.

CONCEPTS OF INNOVATION

The lack of understanding about what innovation is leads companies to problems on how to manage it (O'Connor et al., 2008). These authors observed in several of their discussions and interactions with companies a series of disagreements on what is (or is not) innovation. Such problems were linked to misunderstandings among work teams, slowness and even ruin of various efforts to implement innovative capacity in organizations.

This work takes the concept proposed by Innovation Report (DTI, 2003), which defines innovation as the exploration of new ideas successfully. In the context of industrial organizations, this comprises new technologies or technological applications, better products and services, new production processes or even more efficient and cleaner processes and new business models. However, there is a need for additional considerations for a more complete understanding of the implications of the innovation concept, mainly regarding managerial processes and their subjacent elements.

Baregheh et al. (2009) identified and analyzed innovation concepts as presented in 60 academic studies, from many different areas of knowledge. The authors synthesize their analysis in the following concept:

"Innovation is the multi-stage process whereby organizations transform ideas into new/improved products, service or processes, in order to advance, compete and differentiate themselves successfully in their marketplace" (Baregheh et al., 2009).

Schumpeter (1934) was the one who first put technological innovation at the center of the debate about economic development. The author argues that innovations can be grouped in: new organizational arrangements, new sources of energy and raw materials, R&D, imitation, experimentation and adaptation of processes and products. In their turn, Tidd et al. (2009) consider that innovations are divided in product, process, position (context of product introduction) or paradigm. Sawhney et al. (2006) state that the companies that identify and dominate a larger number of dimensions of innovation may cause significant changes in the bases of competition. Their study deploys innovation in four dimensions, viz, i) what is offered; ii) which customers are served; iii) the processes used to serve customers; and iv) the places where company offers its products. Between each pair of these four major anchors there are eight other dimensions of the business system, completing 12 dimensions or types of innovation.

Several authors classify innovations according to some degrees of intensity, such as incremental or radical and/or other possible intermediate levels. At this point, regardless of the criteria that may be

taken to define the "degree" or intensity of an innovation, several studies claim that different management approaches are necessary to deal with incremental or radical innovations (Chang et al., 2012; Gassmann et al., 2012; Kauppila, 2010; O'Connor and DeMartino, 2006; O'Reilly and Tushman, 2004). So, it is reasonable to assume that the constitution of specific management models aimed at consolidating systematic innovation in organizational environments is something which is driven by a need to carry out radical innovations. This was taken as an assumption in the field study of this work.

INNOVATION AS A MANAGEMENT PROCESS

Utterback (1970) argues that the process of generating, developing and introducing technological innovation is central to the industrial firm. Tidd et al. (2009) argue that the understanding of innovation as a process shapes the way in which companies experience and manage it. Although there exists a considerable diversity among many existing innovation process models (Silva et al., 2014), Tidd et al. (2009) argue that there is some convergence around a basic structure for the process.

The Cooper's (1993) Stage Gates is known as one of the most influential innovation models. Its key characteristic is on the understanding of technological innovation as a process centered on new product development (NPD). In the background of this model, there is a place for some organizational elements as the multidisciplinary of the activities in each phase, the connection with the market and different levels of decision-making. Some studies like Khurana and Rosenthal's (1998) complement this perspective by adding previous activities as: formulation and communication of product strategy; opportunity identification and analysis; idea generation; product definition; project planning and executive review.

Clark and Wheelwright (1992) contribute with their classic funnel model. This model is effective in communicating that, among various opportunities and ideas, few will actually reach space in the current portfolio of an organization. Funnel models can both describe the development of technologies or products and are also used to illustrate the logic behind open innovation systems, as proposed by Chesborough (2003).

Some models of innovation shed more light on the managerial issues that underlie the sequence of steps. Hansen and Birkinshaw (2007) propose the "innovation value chain," that is composed of three main phases: idea generation, conversion (which includes New Product Development as it is commonly known) and diffusion. The authors link each step of their model to a specific capability to be built in organizations. So, firms should concentrate their efforts in filling the gaps relating to the capabilities needed. In turn, Goffin and Mitchell (2010) propose a model that integrates procedural (generation of ideas; prioritization and selection; and implementation) and environmental (innovation strategy, people and organization) elements of innovation.

O'Connor et al. (2008) propose the DNA model to deal with the challenge of organizing and managing radical innovation. The proposal also extrapolates the NPD-centric view once it aims at creation of new business platforms. The model consists of three macro phases: Discovery, iNcubation (to isolate the discoveries from daily pressures until they gain enough potential) and Acceleration (when the discovery acquires the status of a new business). Each phase is also associated with a specific capability to be built in the organization and there is a need for balance among the various capabilities and skills demanded from the organization at each stage. The DNA is established under a set of organizational elements, considered necessary for a sustainable

innovation management: (i) mandate and responsibilities; (ii) structure and processes; (iii) resources and skills; (iv) leadership and governance; and (v) metrics and rewards.

Generally, the first models intended to support innovation management focuses on NPD, loosely considering the underlying activities (but no less important) that enable the main process to work (Salerno et al., 2015; Tidd et al., 2009). In addition, organizational aspects and the intrinsic characteristics of the firm are poorly discussed (Salerno et al., 2015). In this sense, it is emphasized that an effective innovation management demands a better understanding of the organizational structures and managerial behaviors that best fit the business contingencies (Goffin and Mitchell, 2010; Salerno et al., 2015; Tidd et al., 2009). So, it can be concluded that, to the extent that innovation models reinforce the importance of managerial elements and take a perspective based on capabilities, more relevant is the idea that a repeated occurrence of radical innovation is more strongly linked to organizational arrangements than a specific sequence of activities.

SYSTEMATIC INNOVATION

O'Connor et al. (2008) state that a company aimed at a systematic generation of innovations, in addition to the use of a process, must formulate a system. Such a system must be as immune as possible to the organization's internal and external elements that could decrease the innovation capability. According to Gibson:

(...) if would-be innovators can only succeed in an organization despite the system – if they have to fight their way heroically through a minefield to push their ideas forward – then by definition, innovation is not a systemic capability in that organization, nor is it a core value that is deeply ingrained in the corporate culture. (Gibson, 2010b)

The study of Chang et al. (2012) found some organizational capabilities are positively associated with the performance of companies in innovating: (i) openness – capability of seeking external sources of radical innovation; (ii) integration – capability of integrating and aligning internal connections and the ambidextrous integration of radical innovation with core business operations; (iii) autonomy – capability of encouraging and tolerating the risks, ambiguity and failures associated with radical innovation and new ideas; (iv) experimentation – capability of testing and marketing new ideas and radical concepts. Teece (2007) argues that companies with strong dynamic capabilities are intensely entrepreneurial, since they not only adapt themselves to foreign ecosystems, but also transform such ecosystems through innovation and collaboration with other organizations, entities and institutions. However, Lee and Kelley (2008) affirm that the literature of dynamic capabilities poorly explains what such capabilities are made of.

Tao et al. (2010) argues for the need of business management approaches that support the innovation process. However, Gibson (2010b) notes that, in most organizations, innovation is forced to be disconnected from the rest of the company and often assume the form of isolated departments of R&D or NPD, Skunk Works, incubation of companies or specific divisions for new businesses. Chang et al. (2012) argue that the main challenges come from inappropriate structures and systems, limitations of research activities, insufficient planning structure and assessment methods, rigid organizational routines and culture and a great reluctance to conduct experiments into unknown territories. Several elements can be identified in the literature as potential constituent parts of an appropriate framework to systematic innovation. Some of them are highlighted below:

External networks: according to Chiaroni et al. (2011), engaging in an innovation strategy demands the establishment of relationships with a variety of partners, in particular, universities, research institutions, suppliers and users. The authors state that open innovation requires management skills to cope with different networks and each kind of network is adherent to different purposes. In this context, practitioners of open innovation should increase both the quantity of partners as the deep of each relationship performed.

Portfolio: the main purpose of an innovation program is to stimulate and manage an innovation project portfolio (Kelley et al., 2009). Essentially, this management must define which ideas/projects the company should work in. Goffin and Mitchell (2010) summarize the mission of portfolio management in two main aspects: how to assess the portfolio and how to achieve balance. But, according to Paulson et al. (2007), there are few tools for an appropriate portfolio assessment to deal with projects that present high levels of uncertainty, ambiguity and long lifecycles - typically those associated with radical innovations.

People, individual skills and internal networks: O'Connor et al. (2008) state that the participation in innovation projects must be tied to better returns, career paths and/or other types of incentives. The authors claim that there is a great challenge in motivating people to generate, articulate and pursue opportunities that do not have real importance among top company decisions. Hamel (1999) reinforces the relationship between incentive mechanisms to entrepreneurship and motivation of employees. In turn, Kelley et al. (2009) advocate the importance of networking among people, especially in environments of high uncertainty, complexity and dynamism. Innovation projects require diverse sources of knowledge and it is unlikely that individuals hold themselves the necessary know-how. Chiaroni et al. (2011) advocate for organizational structures devoted to the analysis and integration of the knowledge acquired by the company throughout the innovation process.

Organizational structures for innovation management: O'Connor and DeMartino (2006) analyzed organizational structures adopted by 12 companies that participated IRI's Radical Innovation Program and conclude that innovation does not depend on an element in particular, but on a system focused in learning, experimentation and in delineating multiple paths to market. However, the study of O'Connor and DeMartino (2006) admit the existence of many forms by which each company draw the organization and define the governance of innovation activities. So, these authors do not propose a typology of organizational structures based on convergences among the cases they observed. An example of this kind of structure is shown in figure 1.

Many academics and practitioners of innovation management have designed models aimed at organizing and integrating organizational elements required for the generation of radical innovations in organizations. Some examples of models designed for this purpose can be found in Skarzynski and Gibson (2008), Leis et al. (2010), Terra et al. (2012) and TIM Foundation (2013). In general, managerial elements most commonly considered are: leadership; culture and social values; people and skills; processes and tools; strategy; organizational structure; innovation process; funding; external networks; knowledge management and performance indicators. As advocated in this article, the integration of such elements can be carried out through the establishment of an organizational function devoted to this aim. This should allow, not only the integration of these elements, but also a greater level of expertise in themes necessary to manage radical and systematic innovation.

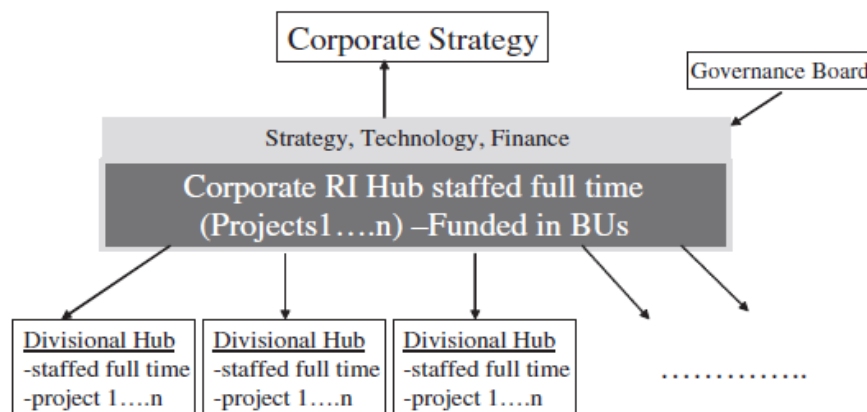


Figure 1 - Self-similar model. Source: O'Connor and DeMartino (2006)

INNOVATION AS A NEW ORGANIZATIONAL FUNCTION

O'Connor (2012) defines "organizational function" as the existence of an identifiable team that has the responsibility to lead a specific mission of the company. The author points out that, few decades ago, companies did not have their marketing departments neither such a function was well defined in organizations. However, marketing has become a sophisticated function, incorporating different processes to meet different mandates. O'Connor et al. (2008) conclude that innovation is an emerging function in organizations, as marketing or quality functions were in the past. As an implication, innovation function should have its own leadership, metrics, vocabulary, career paths and permanent power in organizations. Another example of the gradual emergence of new organizational functions can be seen in the study of Olson and Chervany (1980), who mentioned the "information services function", while Ein-Dor and Segev (1982) explicitly entitled their work as "Information Systems: emergence of a new organizational function".

O'Connor et al. (2008) argue that someone or a group should be responsible for innovation in established companies. Its main role would be to orchestrate the interface between innovation function (IF) and other parts of the organization. The authors justify such proposition under the following grounds: (i) organizational capability building is not simple, especially when confronted with operational efficiency-oriented processes; (ii) the accumulation of experiences demands consistency and continuity of the people involved; (iii) the existence of a group responsible for the occurrence of innovation and which is measured by its performance in pursuing this mission motivates the whole company to reflect on the real progress of these activities and the possible reconfigurations necessary to improve them and; (iv) it is necessary to develop appropriate skills to innovate radically. Teece (2007) proposes that the management of organizational functions requires a continuous redesign of the organization as new challenges emerge. The author states that innovation is often "badly served" of this kind of approach.

O'Connor et al. (2008) and Kelley et al. (2011) highlight the need to ensure adequate people and budget to support the activities related to the IF. O'Connor et al. (2008) argue that a group aimed at consolidating innovation as a permanent function of the organization would have these main tasks: to stimulate the generation of ideas; involve senior leadership in clarifying the strategy; seed funded projects; support innovation project teams; scan the external environment to capture trends; invest in small businesses; interact with other organizational functions; help to develop governance over

innovation efforts, support decision-making and facilitate portfolio reviews and; monitor innovation capability.

To strengthen IF legitimacy, O'Connor et al. (2008) also highlight the importance of establishing relationships with other functions of the company, although it is noted that such relationships tend to change frequently as the company develops its innovation capability. Tolbert and Zucker (1999) state that the establishment of a new function, to a greater or lesser degree, necessarily causes changes in other functions, as changes in parts of an organization require adaptive changes in others.

The tensions found between innovation team and the main operations of a company are identified by Govindarajan and Trimble (2010) as a major threat for innovation efforts. So, it is also important to define an organizational perimeter for IF. In other words, it must be established - with more or less accuracy - what is part of IF role (expertise, activities and/or responsibilities) and what is not. It aims at avoiding conflicts triggered by overlaps with other functions (beyond possible internal oppositions to IF in its central mission). According to the cited authors, minimizing these tensions requires special attention to three points: a) the correct division of work; b) constitution of a team dedicated to innovation –what determines new working relationships and; c) conflict mitigation, in which the legitimization of innovation efforts through direct senior management support plays a special role. Gibson (2010a) argues that innovation, previously understood as something intangible and occasional and should become part of the company in its very constitution. This author deals with innovation as something to be "institutionalized" in the organizations and compares this challenge to the efforts previously undertaken by companies in Total Quality Management (TQM) approach.

METHODOLOGY

This work aims at the characterization of innovation as a new organizational function and the methodological strategy adopted is the multiple case studies. In this context, according to Eisenhardt (1989), the use of an appropriate sample is necessary to avoid strange variations to the object of analysis. This also helps to define the boundaries of generalization of the results. So, two fundamental criteria were considered for case selection: (i) the existence of an identifiable group of people with the central responsibility of conducting innovation efforts (what confirms that the company has the Innovation Function at some level of maturation) and; (ii) the adequacy in terms of the selected context of research (large industrial companies operating in Brazil). The study applies inductive logic and theory building is performed from (a) the categorization of data collected in cases (enabling adequate comparisons) and; (b) identification of convergences/ divergences/ complementarities among cases in the sample.

Table 1 lists the companies involved in the research and the central missions addressed to their innovation teams. Such teams are the basic units for investigation. The study was conducted with 15 companies: 13 of them meet the basic requirement of having identifiable innovation function. However, two exceptions were intentionally included in the sample (companies Chem-2 and Transp-4), as detailed later. The companies were given fictitious names that make reference to their sectors of activity: *Telec* (equipment, software and services for IT and telecommunications), *Chem* (companies based on chemical production processes), *Transp* (development and assembly of equipment, products and sub-systems for transport applications), *Elect* (development and assembly

of electrical and electronic equipments), Min (extraction) and Metal (metallurgy/steel). Table 1 also informs the location of each headquarters and the respondents' positions in the structure.

Table 1 – Cases studied

Company	HQ	Interviewed person	Innovation team's core mission
Telec-1	Brazil	Manager of innovation Committee	Systematization and organization of processes associated to radical innovation development. There is a perception that daily routine processes deal well with incremental innovations.
Chem-1	Brazil	Corporate Innovation Director	- Standardization of innovation practices throughout the organization. - Idea generation and development until bench tests. - Agglutination of managerial competences related to innovation.
Transp-1	Brazil	Manager of Innovation and knowledge management	- "To take care" of innovation within the company: corporate policies, processes for innovation, organizational environment for innovation and knowledge management. - To create indicators related to innovation performance.
Chem-2	Overseas	Innovation Manager- industrial market	To develop innovative products and new business opportunities.
Chem-3	Brazil	Resource Coordinator for systems and technology	- To relieve researchers from "administrative burden" in technological innovation projects, once these demands tends to grow and generate "noise" to technical activities. - Synergistic competence gains in supporting activities that are not research itself, but vital for research efficiency."
Chem-4	Brazil	Manager of networks and partnerships for innovation	Governance of the innovation process, network building for C&T, product development and management of issues related to consumer safety.
Elect-1	Overseas	Director of technology and innovation	- Conduction of underlying activities related to innovation in a more synergic way in order to generate value for several BU's. - To serve as formal input channel for opportunities that come from external partners and/or when these opportunities require distinct skills, located in different parts of the company.
Elect-2	Brazil	Manager of innovation core	Formulation and acceleration of business plans of high added value, attraction of financial resources and partners for R&D.
Elect-3	Overseas	Innovation area (several respondents)	- To ensure sustainability in innovation and enhance financial returns from innovation. To define local innovation strategy; - To manage the innovation process, defining and managing innovation targets for other teams in the company that work with innovation issues; - To catalyze people engagement in innovation activities; - To generate, lead and manage the various innovation in the company.
Elect-4	Brazil	Institutional Relations Manager- R&D/ Innovation	To perform the technological plan and to monitor the innovation funnel.
Min-1	Brazil	Innovation Manager	To promote adequate environment for technological innovation in the company through planning science oriented activities, open innovation partnerships and funding for strategic projects.
Transp-2	Overseas	Manager of strategic planning and Innovation	To systematize innovation and maintain a balance between operational efficiency and innovativeness. The Innovation Group is responsible for innovation management, encouraging innovation in the company, but is not responsible for idea generation.
Transp-3	Overseas	Innovation Program Manager	To capture innovation opportunities for new products, with strong bias in partnership consolidation with universities and attraction of public funding.
Transp-4	Overseas	Research and Development Manager- innovation	To get closer of universities and to lever opportunities related to new products, new markets and new processes. Part of the team is focused on new opportunities regarding information technology, but has also initiatives related to innovation culture and partnership consolidation.
Metal-1	Brazil	Innovation team - board of directors	To "orchestrate" technological innovation efforts regarding products and processes (before the institutionalization of innovation team, these efforts used to occur in a decentralized manner) and to integrate these efforts to the routine of other areas of the company.

Four out the 15 companies represent special cases: Chem-2, Transp.-3, Transp.-4 and Metal-1. Special cases were considered to provide richer insights and comparisons.

Chem-2: This company is very renowned for its systematized practices of innovation, but has no identifiable group to which you can assign specific responsibility for innovation efforts.

Transp-3: This case was given a longitudinal approach and was followed for 5 years. Qualitative data was collected from three different coordinators of innovation team that succeeded one another over this period. In addition, secondary data was collected from many other sources, such as internal reports, presentations, etc.

Transp-4: At the time of the field study, the company was still on the verge of establishing a formalized innovation team.

Metal-1: This case represents an example of strong retrogression of IF despite a high level of dedicated structure and respective formalization. The case was observed in two different moments: (i) at the apex of IF, in mid-2011, when a large number of initiatives were in progress, there were many people dedicated on a fulltime basis to the functional activities and a higher strategic importance was being gradually achieved and; (ii) in the end of 2013, after a period of crisis and strategic redirection which has strongly mined the efforts.

An interview protocol was established following Voss et al. (2002) recommendations. This was intended to allow comparisons throughout the cases that could reveal the IF characteristics to be further discussed and the adequate categories to contain them. Based on literature, twelve elements were considered relevant to raise potential characteristics for an organizational function and were articulated among the questions of the protocol: (a) mission or output of the innovation team; (b) activities undertaken to achieve the mission; (c) organizational form (department, transversal program, etc.); (d) budget allocation; (e) mechanisms to control and evaluate functional performance; (f) leadership and its coordination mechanisms; (g) people involved in the function and their profile; (h) career paths; (i) skills and competencies required to perform the function; (j) relations with other functions in the organization; (k) the forms by which function's role is communicated to the rest of the organization; (l) formal and informal links established with agents of the external environments.

After conducting all interviews, a pre-analysis led to six categories of the data: (i) general purpose of IF; (ii) origins (context of function creation); (iii) legitimacy (the level in which IF is acknowledged for its role and the perimeter of action); (iv) People (leadership, team profile and careers); (v) assignments (core mission and the underlying tasks that are seen as function's intrinsic responsibilities and part of its expertise); and (vi) future projections (medium and long term).

After categorization and data reduction, conceptual frames were built for each company, which combined primary (interviews) and secondary data. Then, these frames were returned to each company to be adjusted and/or validated. At this stage information was checked by individuals other than the first respondents, but also directly involved in IF. This was done in order to check errors relating to the interpretation of data, personal biases and to fill some data gaps. After these steps, information was considered definitive for final analysis and the elaboration of conclusions.

FINDINGS: CHARACTERIZATION OF INNOVATION FUNCTION

This section presents the main conclusions and analyses of the cases studied in the research. The subtopics are organized according to the categories presented in the methodology and present the main observed convergences.

Innovation Function's general purposes

IF catalyses innovations – and is not project executor

Essentially, company's innovation does not happen inside IF, neither is IF the company's place where "innovators" meet. In all the cases observed, the total innovation effort in a given organization is always greater than the specific work done within IF. Additionally, it is quite possible that companies innovate without institutionalizing a specific organizational function for that (e.g. Chem-2). However, when this function is present, it assumes the role of innovation catalyst or facilitator. In some particular cases, innovation projects can be conducted in IF's work context, but, in general, IF is a staff function, and not a line one.

IF is focused on "new to the company" instead of new to the market or to the world

Oslo manual (OECD/Eurostat, 2005) discerns innovation at three levels: (i) new to the company, (ii) new to the market, and (iii) new to the world. IF, however, is centered in what is new to the company (being or not new to the market or to the world). IF catalyzes the occurrence of innovations in so far it assumes responsibilities that are not attributable to other processes and/or existing functions. Regarding these other functions, IF seeks to manage horizontal connections to integrate complementary skills, necessary for the success of innovation efforts. Thus, IF fills gaps found between problems that the core organization is designed to deal with efficiently and predictably, and the typical demands concerning innovation generation. The more innovative (from a company's perspective) are the projects and their underlying activities, the more respondent IF is expected to be in order to fill the gaps.

Institutionalizing IF is different from doing R&D or setting up technological centers

R&D-related activities may, or may not be among IF main attributions. However, IF-R&D connections are always relevant. The cases reveal that IF and R&D can live together in three different ways:

- i. IF under R&D. IF is part of R&D (or NPD) structure and performs direct support to this instance. This form was observed in Chem-3, Elect-3, Elect-4, Transp.-2 and the last configuration of Transp.-3.
- ii. IF over R&D. IF contains R&D and assumes greater strategic role. This form was observed in Chem-1, where IF was created to promote businesses' "descommoditization" and in Metal-1, in which the technology center responded to Innovation Directory.
- iii. IF besides R&D. IF is not contained, nor contains R&D. This form was observed in Telec-1, Transp.-1, Chem-4, Elect-1, Elect-2 Min-1 and was in the initial form of Transp-3. In these cases, the scope is more focused on doing actions for innovation culture, new business development, innovation spillovers with other functions, etc.

Origins of Innovation Function

Why companies create an organizational function to catalyze innovation efforts?

Below are the most cited reasons for creating such a function. Normally, a case is not explained by just one reason, but by a combination of them.

- i. Previous innovation initiatives and/or innovation projects. In Chem-1, a new product with a special environmental appeal leveraged the competition in a new market with greater added value than the commodities so far offered by the company. Transp-3 had just develop innovative product with new features before the decision that led to IF creation. By turn, Telec-1 developed a high-tech product for the public sector, but has failed due to misalignments with end customers' expectations. In many cases, success of projects (despite the absence of ideal environment) or even failures (attributable to the lack of such conditions) motivated reflections that seeded IF institutionalization. In other cases, spread innovation efforts in small groups preceded IF creation. Examples: Chem-3 (belonged to a bigger corporation that already hold IF), Chem-4 (typical IF's assignments were conducted by small and not connected groups in the company) and Elect-4 (IF had been evolving for over 10 years, but it was subordinated along time from an area to another).
- ii. Political-economic context and technological environment. This point is given by the potential of local market, public policy, local opportunities for innovation funding and C&T infrastructure. Elect-1 experienced an increasing demand for capital goods, whereas Elect-4 identified opportunities in a niche of more sophisticated products. Chem-1 institutionalized IF after a normative requirement regarding minimum investments in technological innovation. Other companies like Elect-1 and Transp-4 identified opportunities in economic sectors linked to the priorities of industrial policy. Chem-4 has focused on the competences of local universities to justify IF creation, whereas Transp-2 and Transp-4 have triggered IF after an effort to map the skills in Brazilian Universities.
- iii. Market defense. In Chem-1 and Chem-3, commoditization was the main threat to the future when companies decided for IF creation. Metal-1 had been threatened even in markets previously considered as captive. In more dynamic sectors, avoidance of obsolescence proved to be a big trigger, as observed in Transp-1 and Telec-3, both threatened by local implementation of concepts already disseminated abroad.
- iv. Business diversification. IF comes to leverage new business, most commonly by taking advantage of existing technological skills. For Transp-1, which already had well consolidated structures for R&D and NPD, this was the main trigger for IF creation. Elect-1 and Elect-2 bet on IF to accelerate the opening of entirely new business units.
- v. Establishment of a brand associated to innovation. IF can motivate important institutional relationships. This may expose the company to new markets and relieve some social pressures. In Chem-4, Min-1, Transp-2, Transp-3 and Transp-4, an image of innovative company was associated with several business opportunities and new partners.
- vi. Follower reaction. There is a tendency, even if subjective, to create IF after seeing other companies involved in innovation efforts. Consulting firms also help to propagate this "need" when diffusing success cases, what make some environment disturbance.

IF it is still recent, has embryonic characteristics and undergoes constant changes

Most companies studied is still shaping IF in its structural form and operation. The average time of IF creation was five years and ten of the companies led such efforts for five years or less. Some initiatives cannot be considered as "stable" as expected and others presented moments of effort retraction (temporary or not) as noted mainly in Elect-1, Elect-2 Min-1, Transp-3 and Metal-1. On other hand, some level of oscillation is considered normal to recalibrate IF's strategic focus, reallocate resources and promote changes in internal organization and processes.

Innovation Function legitimacy and guidance

What legitimizes or, at least, what is done to legitimize IF in companies?

First of all, it is important to emphasize that a deeper discussion about the elements related to the legitimization of a phenomenon still considered embryonic, is something very challenging. Ideally, it would require additional data and a longer period of investigation. However, the data available raises the following points as potential issues linked to IF legitimization.

- i. Short-term results. By assumption, IF should be aimed at long-term goals. However, some short-term outcome can help minimize internal attacks. The demand for some "quick" projects was crucial in Transp-3 for the maintenance of innovation team and marked the use of suggestion systems in Min-1.
- ii. External links. Project partnerships and support from financing agencies can bring an "outer anchorage" for IF in so far as they involve the company's image in external environment. On Elect-2, the search for partnerships was commonly done before an internal "sale" of innovation opportunities in order to associate the idea with a greater backing. In Chem-1, Telec-1 and Elect-2, the direct involvement of corporate clients in B2B opportunities aimed both at raising support for the IF and at reducing market uncertainty.
- iii. Clear assignments. Instead of open scopes, the cases highlighted the importance of establishing clear missions and assignments for IF, that be associated with the whole strategic plan and recognized throughout the organization. In Min-1, projects not aligned with strategic priorities caused constant relocations and little support for it in the organization. In Chem-1 a clear role in the company's strategy was crucial for IF's stability.
- iv. Regulatory demands. In some sectors, regulatory pressure for innovation or local technological content is a very relevant element, which can strongly support IF in an organizational environment. The most prominent examples are Chem-1, Elect-1, Transp.-2, in addition to preliminary work done in Transp-4.
- v. Internal communication. Several cases showed a kind of internal marketing around IF. These efforts aimed at diffusing to the rest of the Organization IF's initiatives and achievements, via newsletters, events, etc.

In addition to these points, IF seems to suffer from absence of precise metrics for performance evaluation (exceptions are Chem-1, Chem-2 and Elect-3, which had IF institutionalized for more time). Once the most expected results from IF come in long term, it is not easy to define strong metrics related to intermediary victories or other advances in the general efforts.

Other important issue regards hierarchy: the closer were the IF leader to a company's top level, more support and higher strategic importance were perceived for IF. This question was more prominent in Elect-1 and first phase of IF in Metal-1. When IF was subordinate to other functions, most often these instances served as scope limiters and so, IF tended to have lower influence in an organization (as in the cases in which IF was allocated under R&D function).

People and organizational design

Three instances linked to a small core team delineate IF organizational design

Normally, few people work in the core of IF (less than 10, in almost all cases observed). This core team is recognized as the main responsible for the operation of IF assignments. Nevertheless, three other organizational instances directly support and complement the function, which are: (i) strategic committees, (ii) focal points, and (iii) project teams (figure 2).

Strategic committees (usually composed of senior managers) formulate guidelines for IF as goals, main projects or activities and get involved in decisions of higher impact. Focal points are people formally allocated in other functions or even business units that work as local extensions of IF which facilitate horizontal communication and internal networking and competence building. Project teams are temporary structures to conduct innovation projects.

Engineering specialties (linked to the technological basis of current businesses), Design, Business and Management and Economics are the most common university educations among people who work in the core team of the IF. However, diversified experiences (especially in other agents of National Innovation System) and tacit skills as creativity, initiative, no risk aversion, among others, are equally or more valued than formal education. This was strongly evidenced in Transp-1 and Elect-1, that presented well structured efforts to attract talents to IF.

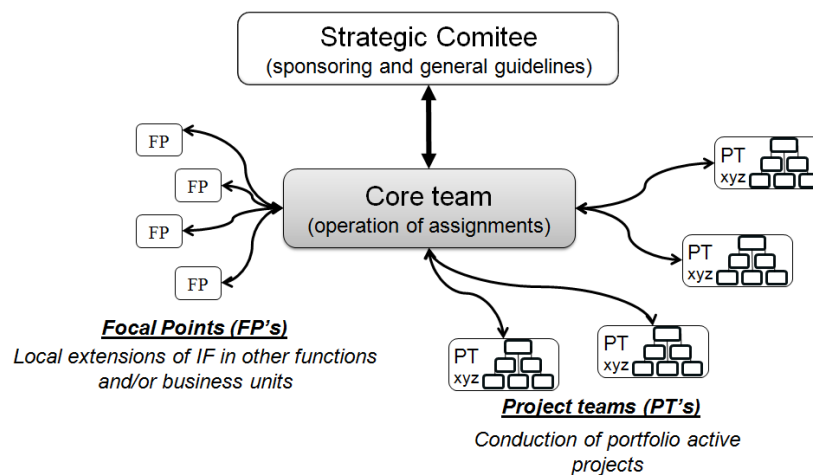


Figure 2 - Organizational instances associated with Innovation Function.

Career path is not the only attraction element for people to get involved in IF

From the perspective of talent attraction, four main elements were observed: (a) the potential of career path in IF (more evidenced in Chem-1 and Chem-4, in that IF leader enjoyed a greater position in hierarchy); (b) personal affinity with innovation (as noted in Telec-1, where volunteers claimed for participation in IF and Elect-4 in that IF had particular preference in requests for job rotation, since IF

had no declared roots in existent functions); (c) escape option: IF appears as an option for people with blocked careers (more evidenced in Transp-3 and Elect-2); and (d) initial career leverage: working in IF promotes exposure to other areas, once there are intense horizontal interaction (e.g. Elect-1 had special trainee program in that people were transferred to other functions after a programmed period in IF).

Assignments of Innovation Function

IF can be associated with twelve different assignments

The assignments are probably the strongest elements to characterize an organizational function. Along the field work in collecting and revising information about the assignments related to IF, the respondents were asked to evaluate, according to their subjective view, the degree of relative importance of each assignment in IF routines. Thus, the twelve identified assignments are presented below according the summed score, from largest to smallest. This does not aim at establishing a correct or recommended level of efforts for IF, but is a picture of the studied sample.

- i. Capture of funding and tax incentives: Funding and tax incentives: search for resources, calls, project elaboration (or translation) to dispute calls of funding agencies, capture of tax benefits, among other tasks.
- ii. Establishment of partnerships with Science and Technology Institutes (STIs). Leverage and manage partnerships with universities, public or private, local or foreign and/or other kinds of research centers.
- iii. Management of innovation portfolio and projects. Portfolio management can be done in several levels: (i) just the control, balance and establishment of indicators; (ii) new project planning and initial scope/resource definition (attraction of partners, definition of project team, tailor made indicators, etc.); (iii) management (and maybe execution) of innovation projects from the start to diffusion.
- iv. Other partnerships. Partnerships with industry associations, clients, suppliers, government, etc. What differs this assignment from partnerships with STIs are the formal and informal ways of establishing such partnerships (such as technical language, contracts and the specific goals) and, in many cases, the short-medium term that characterize the actions taken.
- v. Management of intellectual property (IP). Management of intellectual property (IP). Delineation of IP policies, patent management, patent mining, analysis of other forms of knowledge protection, licensing, support on contract elaboration for network relations, etc.
- vi. Dissemination of innovation culture. Actions for promoting a work environment conducive to innovation: events, communication, people involvement channels, etc.
- vii. R&D. There is a strong relationship between IF and R&D, which can be a direct assignment of IF or, on other extreme, has IF as its support function, usually for methodological purposes.
- viii. Strategic, technological or market prospection. Studies of future scenarios to support the innovation strategy and project selection. This assignment is usually associated with the application of specific methods and techniques such as Technology Roadmapping.

- ix. Competence building. Training and other more elaborated actions to increase capabilities in innovation management and technological skills that aims at enabling future strategies. Associated with STI partnerships, there are actions for high degree of employee education such as masters programs and participation in research teams.
- x. Idea management. Capture innovation ideas from employees, via suggestion systems in their many possible configurations and/or intrapreneurship programs.
- xi. Knowledge management. It hosts activities such as use of communities of practice; blogs for discussions on innovation topics; dissemination efforts of tacit knowledge; diffusion strategies of trainings and events; etc.
- xii. Leverage of new businesses and incursions in venture capital. These include inorganic ways to compete through innovation such as new business development and spin-off; investment and/or acquisition of startups; etc.

It should be noted that the institutionalization of IF does not require the internalization of all assignments nor carrying out of the assignments with the same level of effort or importance. Furthermore, assignments may arise over time to the extent that IF consolidates in organizational environment and get its borders and scope clearer.

IF assignments reserve a great field of opportunities for future research to deepen in the understanding of their nature and of the contingencies that shape it. Examples of new research questions are the role of public policies in shaping IF assignments, the dynamics regarding the emergence of assignments along time and how IF establish connections to the rest of the organization through exercising its assignments. However, in the scope of this study, it is important to reinforce that IF is not defined, in essence, by the existence of efforts related to one or more of the listed assignments in organizational environment. For example, a company may conduct activities in knowledge management or some partnership with universities without having identifiable IF. In fact, the presence of an IF is given by the existence of an identifiable team that hosts the primary mission to catalyze the innovation occurrence in the company. Within this scope, the agglutination of different specialties and activities in an organizational function makes sense so that this mission may be accomplished more efficiently and/or more effectively.

Future perspectives for Innovation Function

In all interviews conducted, the respondents were asked to share their future prospects for IF. There were some important and convergent points among these views, which are described below.

- i. IF strengthens focus on diffusing innovation culture all around the company, expanding the traditional product/process innovation perspective. Elect-3, Min-1 and Transp-3 are examples of teams that have started their activities with a more prominent approach in acculturation for innovation, but then turned back to a greater technological bias. Chem-2 is an example of innovation culture fully entrenched in the routine of the entire company.
- ii. IF core teams remain small. There is no signal that IF core team should become significantly larger (e.g. turning into a big department), because it does not tend to accumulate new tasks in so far as the innovation is catalyzed in the company - but the activities conducted in IF tend to be nobler. In some cases, it is stated that the IF should gradually abandon methods

and/or tasks that come to be systematized in other areas by turning its attention just in picking up new trends. However, this view is balanced by other that fears the loss of synergy and a possibility of reverting to the older ways of dealing with innovation.

- iii. IF intensifies focus on long term and gets greater strategic importance. Rather than only deploying the company's strategy, IF gradually turns into a key influencer of the strategy. Also, IF increasingly build competence in dealing with high risk/uncertainty projects. An ideal definition for IF that summarizes the various perspectives collected about the future is: small boards with high influence in strategic thinking and a great interaction with other areas in regard to the innovation dynamics of the whole company.
- iv. IF establishes more complex networks. Public universities are still central targets to do open innovation in Brazil. However, cases like Transp-1, Chem-2 and Transp-2 are examples of more structured actions to suppliers' involvement in innovation efforts whereas Elect-1 is prominent in networking with various agents other than universities. More diversified opportunities and less bureaucratic barriers are some points that motivate this tendency.

CONCLUSION

This work aimed at characterizing innovation as an organizational function. Taking the concept of organizational function as the existence of an identifiable team that is responsible for a specific mission in the company, fifteen teams specifically created to drive innovation in different large industrial companies operating in Brazil were analyzed. The identified characteristics were organized into six different perspectives, viz, (i) general purposes; (ii) origins; (iii) legitimacy; (iv) people; (v) assignments and (vi) future perspectives. The work took multiple case studies as methodological strategy and had analysis and conclusions predominantly based in inductive logic.

It is important to consider the observation that emerges from this study that, to some extent, particular characteristics of Brazilian industrial environment act as shapers of organizational forms. So, generalizations and convergences for other contexts must be discussed with care. Furthermore, the emergence and consolidation of a new organizational function is certainly a dynamic phenomenon. It depends on a larger set of external and internal variables. Thus, greater research effort is recommended to better understand this new function, their respective characteristics and the forms it may assume in each industrial environment.

As stated, the general purpose of IF is to catalyze the occurrence of innovations in the organizations. To do this, this function comprises a set of specialties to interact with the rest of the organization. However, it is necessary to note that the constitution of an organizational function dedicated to innovation cannot be asserted as the only way by which companies seek for systematic innovation and the case of Chem-2 reinforces such a consideration. Moreover, the creation of a formal department to deal with innovation is not a sufficient shield against the internal attacks in organizations. Metal-1 illustrates how a moment of crisis or changes in strategic vision can cause the retraction of efforts. Nevertheless, this study highlights that the constitution of IF is an important alternative to integrate efforts to systematize radical innovation in organizations.

As a contribution to practice, the characteristics of IF can serve as initial prescriptions for new organizational efforts to systematize radical innovation. In respect of innovation management theory, the study helps to consolidate IF as a new unit of analysis, providing a framework for newer

studies to deepen the understanding of IF assignments or even otherwise, of its revealed characteristics.

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