INNOVATION MODEL FOR BRAZILIAN SMALL AND MEDIUM TECHNOLOGY-BASED ENTERPRISES

Fabiana Matos da Silva[1]
Edson Aparecida de Araujo Querido Oliveira[2]
Marcela Barbosa de Moraes[3]
Monica Franchi Carniello[4]

Abstract

This paper aims to propose an innovation model for Brazilian small and medium technology-based enterprises. The methodological approach used was the qualitative multiple case study. The data collection instrument used was the semi-structured interviews with entrepreneurs and analysis occurred for each case and then making a comparison between the cases in search of similarities and differences leading to the formation of valid results. Seven Brazilian companies located in Metropolitan Region of Paraíba Valley and North Coast – São Paulo

[1] Mestre em Gestão e Desenvolvimento Regional pela Universidade de Taubaté. Graduada em Engenharia de

Produção Mecânica pela Universidade de Taubaté, Taubaté – SP, Brasil. E-mail: fabianamatos.ali@gmail.com

[2] Doutor em Engenharia Aeronáutica e Mecânica - Área de Organização Industrial pelo Instituto Tecnológico de Aeronáutica. Professor da Universidade de Taubaté, Taubaté – SP, Brasil. E-mail: edson.oliveira@unitau.com.br

[3] Doutora em Administração pela Universidade Nove de Julho (UNINOVE). Professora do Mestrado Acadêmico em Planejamento e Desenvolvimento Regional e do Mestrado Profissional em Gestão e Desenvolvimento Regional da UNITAU. Taubaté – SP, Brasil. E-mail: marcelabmoraes@gmail.com

[4] Doutora em Comunicação e Semiótica pela PUC SP. Professora do Mestrado Acadêmico em Planejamento e Desenvolvimento Regional e do Mestrado Profissional em Gestão e Desenvolvimento Regional da UNITAU. Taubaté – SP, Brasil. E-mail: monicafcarniello@gmail.com

State, Brazil, composed the sample. With the results, it can be said that Brazilian small and medium technology-based enterprises do not innovate alone, but in the context of networking system with university, research centers and several companies. Thereby, technological innovation is an ongoing collaborative process involving the activities of management, coordination, learning and negotiation, research about customer needs, skills acquisition and new product development management. Finally, it was possible to draw up an integrative innovation model that explain how occurs the process of innovation in the companies that composed the sample. The model consists of four main phases that are the generation and dissemination of ideas; the viability of the idea; development, prototyping, production scale and marketing; and learning.

Keywords: Management. Development. Innovation. SMES. Innovation Model.

MODELO DE INOVAÇÃO PARA EMPRESAS BASE TECNOLÓGICAS DE PEQUENAS E MÉDIAS BRASILEIRAS

Resumo

Este artigo pretende propor um modelo de inovação para empresas brasileiras de pequena e média tecnologia. A abordagem metodológica utilizada foi o estudo de caso múltiplo qualitativo. O instrumento de coleta de dados utilizado foi as entrevistas semi-estruturadas com empresários e a análise ocorreu para cada caso e, em seguida, fez uma comparação entre os casos em busca de semelhanças e diferenças que levaram à formação de resultados válidos. Sete empresas brasileiras localizadas na Região Metropolitana do Vale do Paraíba e Costa Norte - São Paulo, Brasil, compuseram a amostra. Com os resultados, pode-se dizer que as empresas brasileiras de pequena e média tecnologia não inovam sozinhas, mas no contexto do sistema de rede com universidades, centros de pesquisa e várias empresas. Assim, a inovação tecnológica é um processo colaborativo contínuo que envolve as

atividades de gerenciamento, coordenação, aprendizagem e negociação, pesquisa sobre necessidades do cliente, aquisição de habilidades e gerenciamento de desenvolvimento de novos produtos. Finalmente, foi possível elaborar um modelo de inovação integrador que explique como ocorre o processo de inovação nas empresas que compuseram a amostra. O modelo consiste em quatro fases principais que são a geração e disseminação de ideias; a viabilidade da ideia; desenvolvimento, prototipagem, escala de produção e comercialização; e aprendendo.

Palavras-chave: Gestão. Desenvolvimento. Inovação. PESSOAS. Modelo de inovação.

Introduction

Innovation processes are fundamental to give competitive strength to companies. Entrepreneurial intentions often motivated the innovations to meet new market demands, adding value to goods and services already offered to the market or to offer something new to the market. Thereby, these processes reflect organizational skills that renew the competitive vigor and contribute to the longevity of the company (FREEMAN; SOETE, 1997; LEIPONEN; HELFAT, 2010).

For innovation occur and conceive results in a company, it is necessary to develop management and knowledge exploration of the people systems that give rise to that innovation have been properly applied to the use of organizational resources. Hence, make possible the improvement of products and processes already available to the market or even the creation of something new (LEIPONE; HELFAT, 2010; MUSIOLIK, MARKARD; HEKKERT, 2012).

To explain the occurrence of innovation, some authors have developed phases in which knowledge is managed (KLINE, 1985; ROTHWELL, 1994; BARBIERI, 2003; VIOTTI; MACEDO, 2003). One of the advantages of working with these models is the possibility of detailed understanding of the origins of knowledge used as the basis for innovation, such as applied research, scientific research and market needs (VIOTTI; MACEDO, 2003; LOBOSCO, MORAES; MACCARI, 2011).

Innovation Processes may vary from company to company and are influenced by sector of activity and the size of the company (CONDE; ARAÚJO-JORGE, 2003). It is in relation to these contingent factors that define the focus of interest of the presented study, which comes to the specifics of the innovation process in small and medium technology-based enterprises.

Given the relevance of the topic, this paper is justified by its potential to generate new knowledge and it has the objective to answer the following question:

How occurs the innovation process in small technology-based enterprises located in Metropolitan Region of Paraíba Valley and North Cost - Brazil?

To facilitate the development of answer to this question, the authors explored the concept of innovation and six available innovation models in the literature.

The evolution of innovation models

The evolution of innovation is characterized by a high complexity requiring unorthodox thinking and in result social acceptance (KOTSEMIR; MEISSNER, 2013).Hence the term innovation includes new technological; economic; organizational and social solutions which are not necessarily marketable in an economic sense with direct monetary impact but are applicable and are being used.

Some authors like Nobelius (2004), Ortt and Van Der Duin (2008) and Kotsemir and Meissner (2013) describe the processes of innovation in six generations of different models, as shown in Table 1. These models vary in the number and format of stages of the innovation process, however, in general, three main steps can be distinguished:

- Idea (or invention) of "something new (product, service or process (organizational or technological));
- Development (production, "doing") of "something new";
- Commercialization (diffusion, "selling") of "something new".

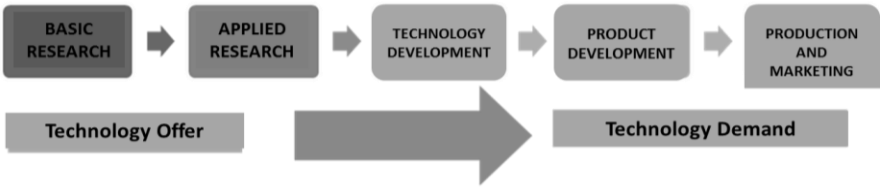
Table 1: Innovation Models Evolution in historical Perspective, Source: Kotsemir and Meissner (2013)

Generation	Period	Authorsof Fundamental Ideas	InnovationModel	EssenceoftheModel
1	1950-s – late 1960-s	Usher (1954, 1955)	Technology Push	Linear Process
2	Late 1960-s – first half of 1970-s	Myers andMarquis (1969)	Market [Need] Pull	R&D on customer wishes
3	Second half of 1970-er – end of 1980-s	RothwellandZegveld (1985)	CouplingModel	Interactionof diferente functions
4	End of 1980-s – early 1990-s	Kline and Rosenberg (1986)	IntegratedModel	Simultaneous process with feedback loops; "Chain-linked" Model.
5	1990-s	Rothwell (1992)	Networking Model	System integration and networks (SIN)
6	2000-s	Chesbrough (2003)	Open Innovation	Innovation collaboration and multiple exploitation paths.

The oldest model between the models of innovation is the *Technology Push Model*, which was dominant in 1950s, is a simple linear process where the scientific and technological advances push a new product into the market (GALANAKIS, 2006). In this model, development, production and commercialization of new technologies are seen as a well-defined time sequence, which originates in research

activities, involved in the development phase of the product and leads to the production and marketing (GALANAKIS, 2006). This model is exemplified in Figure 1.

Figure 1: Technology Push Model, Source: Viotti & Macedo, 2003



The model presented in Figure 1is taken as a linear process and it is supposed that is the intensive scientific investments produce significant innovations. The challenge for managers is to invest more in research and development, which, in this model, operates in isolation.

The second model is the *Market Pull Model* or *Demand Pull Model*, which was dominant in 1960s is also a linear process where the markets needs pull a new product into the market (GALANAKIS, 2006). Figure 2 shows the steps in this model.

Figure 2: Market Pull Model, Source: Barbieri (2003)

The Market Pull Model was born with the investigation needs in the market, going to the responsible department for research and development (R&D) which studies, analyses, and begins the process of generating ideas and then to the development those.

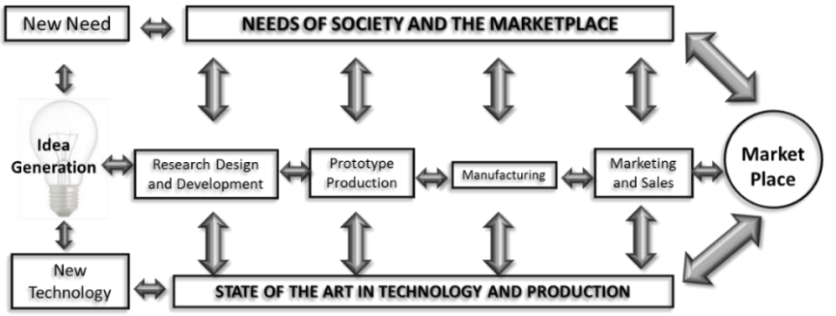
Mowery and Rosenberg (1979) argue that the market demand acts in dominant mode in the innovation process, "stimulating" innovation in market economies. In these studies, it is evident that the market demand is associated with successful innovations than the sources of external knowledge which originated in basic research. They also say that the demand pull approach ignores the operation of a complex and diverse set of secondary mechanisms of supply and demand which are continuously changing the structure of production

costs (as well as introducing completely new products) and are then fundamental to explaining the process of innovation.

What attracts attention is the importance of the factor of market demand about that process, which equals not ignore the influence of factors such as the scientific basis and external and internal technological conditions for firm's innovation. In Market Pull Model or Demand Pull Model, technical progress in a matter of supply or demand, absent questions about other determinants of technological change. In this approach, the challenge of managers becomes the marketing investment, given that the market demand is the initiator of the process.

The third generation of innovation process is known as *Coupling Innovation Process Theory*. This model was dominant during the 1970s and early 1980s and recognized that a push-pull theory comes closer to reality (ROTHWELL, 1994; GALANAKIS, 2006). Figure 3 shows the steps in this model.

Figure 3: Coupling Innovation Process Model, Source: Rothwell and Zegveld (1985)



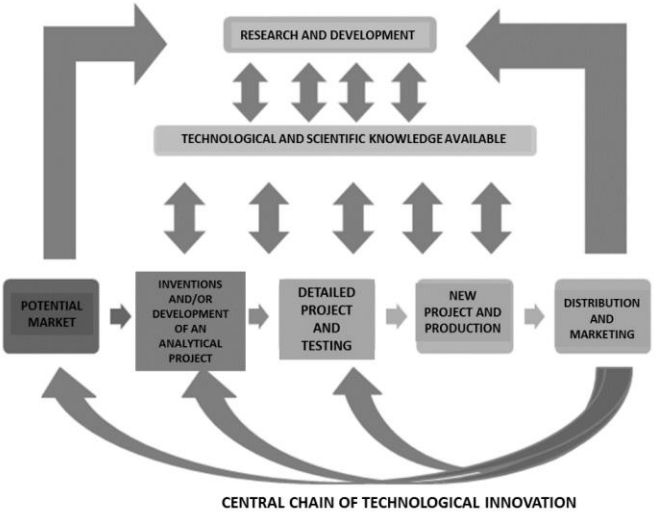
According to Rothwell and Zegveld (1985), the Coupling Innovation Process is sequential but not necessarily continuous. The innovation process can be divided into a series of interdependent stages and feedbacks to the previous stage. The intra-organizational and external connections and influences create a complex net, linking together the different functions of the firm, the technological and scientific community and the marketplace.

The fourth model is been developed by Kline (1985) and it is known as Functional Integration Innovation Process Model. This model is characterized by a logical sequence, but not necessarily continuous and linearly in which the processes necessary to always turn earlier or

later stage, can be divided in functional series with interdependent and interactive steps (KLINE; ROSENBERG, 1986). The model provides a reassessment of the importance of science and research in the innovation process, giving companies a central position in this process.

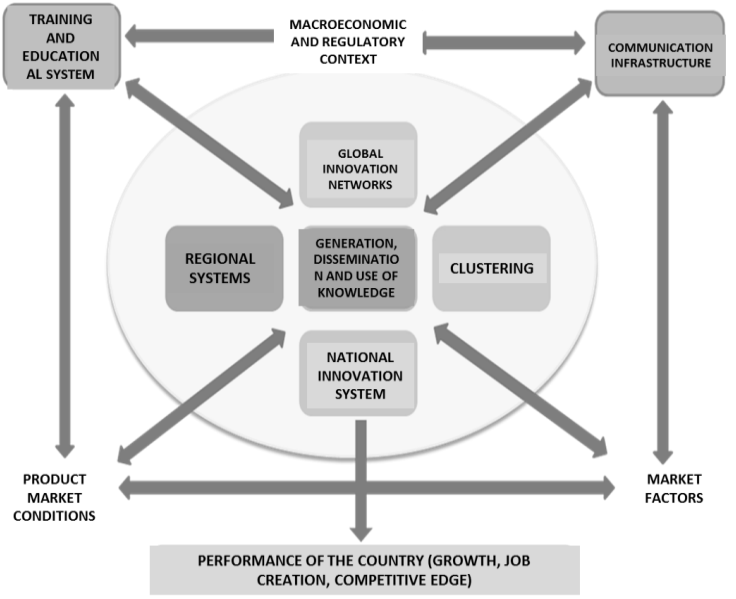
This model emphasizes the effects of feedback between phases of the linear model described above, as well as the numerous interactions that each stage of the innovation process are established between innovative companies and other companies (competitors and suppliers), or between the first and industrial users, the end users (VON HIPPEL, 1988) and organizations from the education system and scientific and technological system. This model is exemplified in Figure 4.

Figure 4: The Functional Integration Innovation Process Model, Source: Kline (1985)



The fifth model is System Integration and Networking Innovation Process defined by Viotti and Macedo (2003), which back the idea that firms do not innovate in an isolated manner, but is inserted into a context of networked system of relationships with other companies (directly or indirectly) with the infrastructure of public and private research (universities and research institutes) and the national and international economy. This model, illustrated in Figure 5, is contrary to the models already presented, because they consider technological innovation as a set of steps (and these are sequential or not).

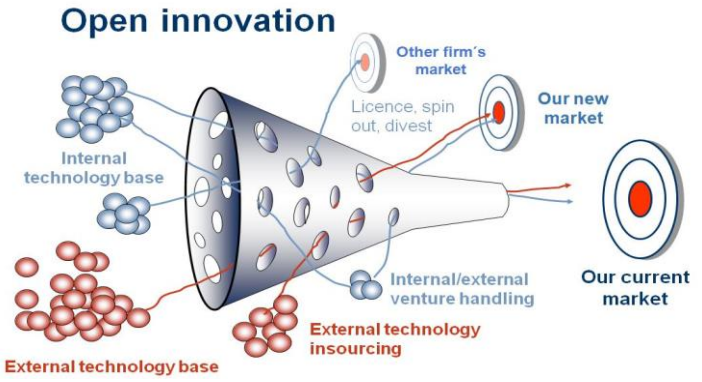
Figure 5: The System Integration and Networking Innovation Process Model, Source: Viotti and Macedo (2003)



The central point of this model is within the company focusing on the relationships between elements in the system as drivers of technological innovation process that considered several factors that have influence within the process, such as macroeconomic conditions, market conditions and communications infrastructure, as well to consider impacts on the process performance of the country, such as economic growth, job creation and competitive edge (VIOTTI; MACEDO, 2003).

The sixth and last generation, developed by Chesbrough (2003), is the open innovation model that means a change in the traditional format innovation. Chesbrough (2003, 2006) shows that this open format model that focuses on the use of external expertise to help and accelerate internal innovation process, as shown in Figure 6.

Figure 6: Open Innovation Model, Source: Chesbrough (2003)



Rahman and Ramos (2010) explain that in terms of process, open innovation covers the management and the accumulation of ideas, knowledge, licenses, intellectual property, patents and inventions. The authors add that in terms of innovation, it can be considered user-innovation, marketing innovation, cumulative innovation and distributed innovation. Therefore, open innovation theory corresponds to a number of innovative approaches whose basic element is made innovation beyond the research and development departments of the organization.

In other words, open innovation incorporates joint efforts of internal initiatives to the organization and possible outsourcing or combination of multiple inputs coming from the external environment during the process of design and product development.

Noticeably, you see the transition from a closed system of innovation to open innovation system. In the closed system, the development of the idea rarely goes beyond the walls of companies; these seek to obtain competitive advantages, especially from the internal capabilities, and the R & D prominent place. The open system presents a model that not only allows other companies to internalize the knowledge and new technologies developed, creating new opportunities and new challenges, but also values the knowledge, experience and external creativity to the firm, giving rise to new business models.

To sum it up, the six generations of the development process of innovation indicate that linked innovative approach to research and development (R & D) is changing and adapting to the context of major organizational changes (NOBELIUS, 2004). We show that these models

are an important source of competitive advantage for companies both large as medium and small sized.

Methodology

We chose to use a qualitative, exploratory, descriptive research to analyze the technological innovation process in technology-based SMEs located in Metropolitan Region of Paraíba Valley and North Coast – Brazil. In this paper, we used the multiple case study methodology, following the recommendations of Eisenhardt (1989). The proposed method was selected to generate a descriptive and explanatory understanding of the phenomenon in question in a predominantly inductive manner, from multi-case qualitative research.

According to Eisenhardt (1989), case study can be applied to highlight or to comprehend the dynamics of parallel events, primarily contemporary ones. The author also points out that case studies may combine various techniques of data collection and analysis – such as studies of historical data and archives, questionnaires, interviews, and observations – and can take on quantitative, qualitative, or quantitative/qualitative perspectives. In addition, the author states that the choice of cases is a very important aspect because it defines the characteristics of the study design. In our multi-case study, cases were intentionally chosen based on the contributions they could deliver to the study – i.e. the study sample is characterized as theoretical and intentional (LIMA, 2010). A sample of SMEs studied is presented in Table 2.

Table 2: Sample of SMEs

NAME OF SMES	ECONOMIC ACTIVITY	NUMBER OF EMPLOYEES	YEAR OF FOUNDATION
PROSHOCK	Their operation is associated to the cycling industry in Brazil. Manufactures bicycles and wheelchairs.	38	1993
SAT	Their operation is associated to the aeronautical industry in Brazil. They carry out maintenance and repair of aircraft, except maintenance on track. Maintenance and mechanical repair of motor vehicles	20	2000
TIQ	Manufacture of chemical products for textile industry.	55	1991
TROYA	Production of aircraft structures and tools.	45	2005
ALLTEC	Development and manufacture of products and high performance structures in composite materials.	200	1995
EMPREENDIMENTOS AERONÁUTICOS (Fictitious Name)	Medium-sized enterprise specializing in the development of landing gear solutions. The company also designs and manufactures civil and military aircraft.	128	1998
AERO BRASIL (Fictitious Name)	Small company specializing in development of multi-function displays for aero navigationin special applications. Also specializes in developing command solutions, control and intelligencebased on unmanned aerial vehicles (UAV).	31	2005

For data collection, we adopted a semi-structured, in-depth individual interview. This qualitative technique allowed exploring the subject through seeking information, experiences, and perceptions of respondents to analyze and present them in a structured form. It should be noted that the semi-structured, in-depth individual interview is a methodology that, based on theories and assumptions defined by the researcher, collects responses from the experience of a source selected for possessing the information required.

To build the guidelines for the interviews was used as the basis he model of value chain of innovation developed by Hansen and Birkinshaw (2007). This model seeks to examine innovation as an integrated process, from idea generation to the diffusion of innovation among other areas of the organization.

Hansen and Birkinshaw (2007) divide the innovation chain in three phases(generation, conversion and diffusion of idea) and six connective tasks (internal and external collaboration between units, selection and development of ideas and dissemination of selected ideas). The priorities of each of these three phases are summarized in Table 2.

Table 3: Stages of Value Chain of Innovation, Source: Hansen and Birkinshaw (2007)

GENERATION OF IDEA			CONVERSION		DIFFUSION
Creation of idea within a unit.	Collaboration between units	Collaboration with actors from outside the company	Selection, screening and initial funding	Development and movement of the idea for a first result	Propagation and dissemination throughout the organization

The data collected in the interviews were analyses in two stages: intra-and cross case. Intra-case analysis describes, explains, and generates understanding of what happens in a unique and limited context – i.e. in one case (MILES; HUBERMAN, 1994). This type of analysis that takes each case separately places greater emphasis on conceptual content, which is more important for describing and explaining a given phenomenon (LIMA, 2010). Conversely, cross-case analysis describes and explains conceptual contents, processes, and outcomes of a particular phenomenon by comparative analysis of different cases to identify regularities and differences between them regarding data on the phenomenon in question (MILES; HUBERMAN, 1994).

From this perspective, the data were analyzed using Atlas.ti qualitative analysis software. According to Muhr (1995) and Lima (2010), this tool developed to meet the challenge of managing the large amount of data that is typical in qualitative research, and facilitate data coding and classification.

Results

Franco and Haase (2010) point out some of the main obstacles faced by SMEs in the competitive environment:

- difficult access to finance;
- unfavorable market conditions, already that compete with large companies;
- poor professional qualifications of the labor that employ;
- lack of institutional support, cooperation and networking, given that isolated activities shown a restrictive aspect for the survival of these companies;
- few business vision by managers;
- low-level manager of education;
- fragile social capital; and
- incapacity to recognize the problems faced by the company and performance of multiple roles by professionals who participate in them.

With this vision, Robertson, Casali and Jacobson (2012) state that the creation of an integrated dynamic and innovative environment for SMEs depends on the inclusion of practices that allow these companies to innovate competitively.

The relations established in the proposed model in this study intended to circumvent these difficulties exposed by Franco and Haase (2010) and the creation of innovative environment mentioned by Robertson, Casali and Jacobson (2012). Therefore, the analysis of intra- and cross case allowed construction the innovation model for Brazilian small and medium technology-based enterprises. We will show and explain this model in the next session.

Proposal for an Innovation Model for Brazilian SMEs

The model we proposed, Figure 7, is interactive and shows an intense communication within and outside the company. It interacts directly with the environment in which it is inserted and all the actors who make it up. It is important to highlight that this model is based on the theory developed by Hansen and Birkinshaw (2007) that divide the innovation chain in three phases (generation, conversion and diffusion of idea) and six connective tasks (internal and external collaboration between units, selection and development of ideas and dissemination of selected ideas).

Thereby, the first stage shown in Figure 7 is the link of generation of idea. This stage has three phases: a) generation of ideas; b) selection of the idea; and c) research and development. If this stage did not get the expected performance, there is opportunity to develop it with some actions.

In the first phase, the generation of idea is through the internal research and / or needs market and demand market.

To promote the internal development it can create focused teams on developing new ideas and projects. These teams work in the selection of ideas and research and development. To help them may be the creation of communication networks, internal or external, as well as information networks with players outside the organization, such as: education institutions, regulatory agencies, consumer association, business centers, institute of science and technology and funding institute for science, technology and innovation. We propose that to optimize the selection process of idea, this is important to involve customers, suppliers, and a multi-functional internal staff. In this way, this makes it easier the previous analysis of the possibility of an idea become a successful product.

The second stage is the conversion of ideas that it is divided into three phases: the technical-economic viability; prototype and tests; and the formalization through patents and models. No matter how good it is the screening of ideas, and its cost, it still needs to turn the concept into products, services, and processes that generate revenue. Followed by the selection of ideas there is the stage of feasibility study of implementing that idea. It is a phase in which it is carried out a detailed survey of the funding, the finance sources, possible economic subvention in addition to the technical feasibility study for project execution.

The technical viability is important because at this stage you can view the business partners that can be signed for execution of project, and raise all customer needs and issues related to its standardization.

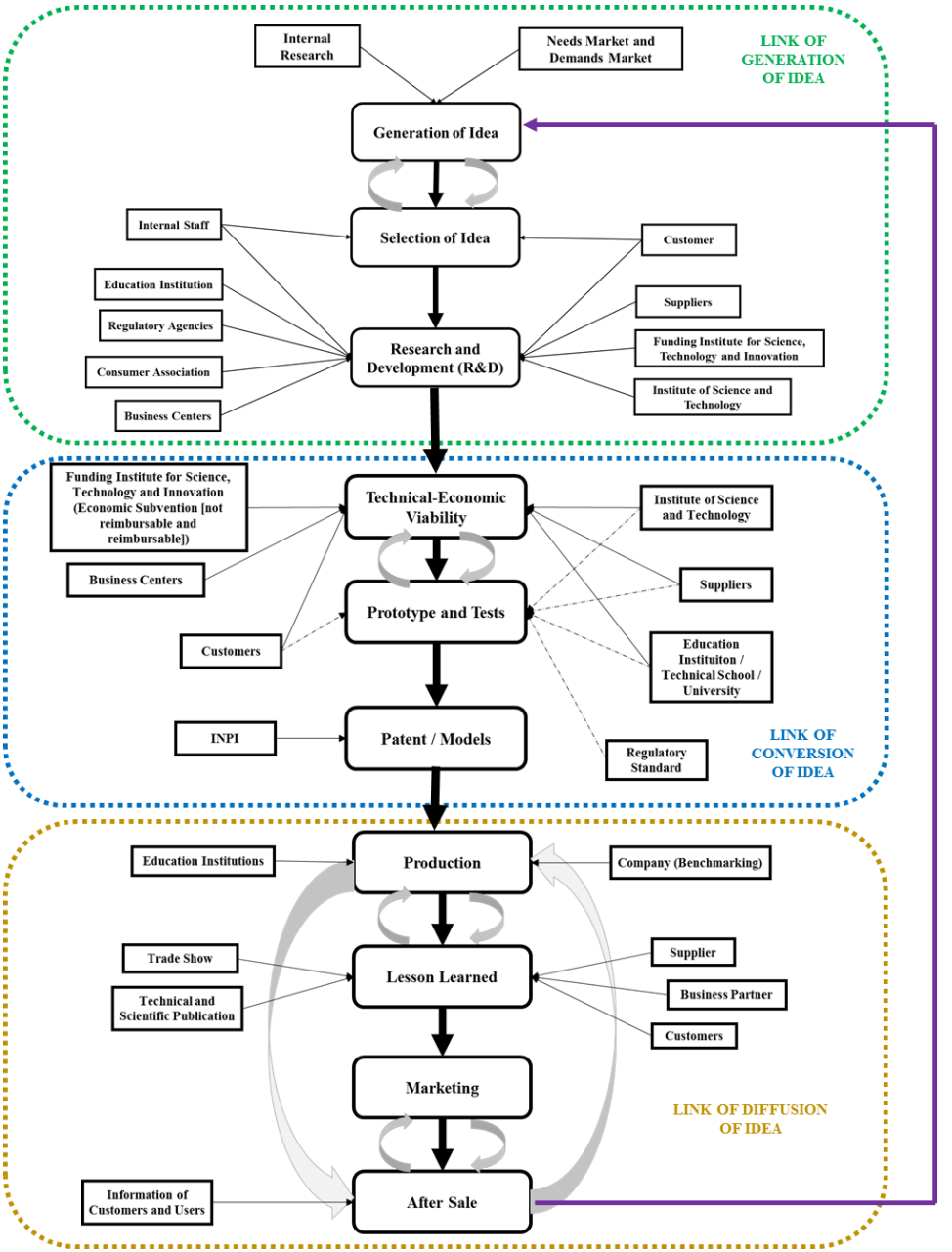
After the idea be located, evaluated, financed and developed, the concept has yet to be endorsed by customers, suppliers and partners. The company needs to convince relevant managers of the organization to support and disseminate the news (a product, a business, a practice) in places, canals, and desirable customer groups.

The prototype and tests phase is often needed or even mandatory. The interesting of the business partner in this phase is able to share the costs and responsibilities for implementation. After the prototype and tests follows the formalization through of patents and utility models. That stage is not mandatory, but the patent should be seen as a competitive instrument. It is noteworthy that the utility model is a patent modality that is designed to protect innovations with less inventive load, usually resulting from the worker or artisan activity.

The stage of development of patents and utility models has been participating in the Nacional Institute of Industrial Property (INPI –

Portuguese: *Instituto Nacional da Propriedade Intelectual*), whose main purpose carry out at the national level, the rules governing industrial property, with a view to its social, economic, legal and technical .This institution is responsible for the registration and granting of trademarks, patents, industrial design, and technology transfer and among others.

Figure 7: Innovation Model for Brazilian SMEs



The stage of the diffusion of ideas begins with the production when there are partnerships established with education institutions for training and benchmarking with business partner.

The development of a new product or business is rarely documented in a systematic way, with all changes and relevant information. This history of relevant information is very rich, but it runs into the culture of the companies that see it as a gap to be filled, in which it was inserted into a phase denominated 'Lessons Learned'.

These lessons should be used for every and any activity that generates positive results for the organization. Must make the lessons learned a live record of all activities of development of innovation, and its use should be encouraged in all departments and also involves customers, business partners, and suppliers. The development of a clear thinking about what can be create in a lesson learned necessarily involves considering aspects already present in any process that is inserted in a project. Thenceforth, it starts to become possible to think of something about that can really have some utility.

The after sale is a good opportunity for the company to identify the needs of its customers, improve to your products, or even seek new target markets, therefore is an important partto be executed.

It is important to highlight that the model considers the balance and union between the three phases, as described above. The model also enhances communication between the stages and the actors involved. All fundamental interactions and feedbacks to the interactive innovation process happens, observed at all stages, make the processes are fed and fed back, whenever necessary.

SMEs have difficulties to remain in the market and achieve internal competencies to innovate for that reason these companies have an innovative format that is characterized by informal practices, focused on the search for quality and daily feedback on the activities of the company.

The proposal for this model aims to disseminate innovation in these enterprises, demonstrating that it is possible to meet their internal deficiencies by external expertise, and enable greater competitive power in the market in order to help the small and medium enterprises survive.

Discussion and conclusion

This section intended to introduce the discussion of the results and conclusion of this research, considering the work of authors who are

part of its theoretical basis. Therefore, confront each theoretical content presented with the results obtained in intra- and cross-case analysis.

The competitive advantage created by innovation, defended by Tidd, Bessant and Pavitt (2008), is visible in the companies surveyed. Regardless of the segment, each search them "to do something that no one else does, or do it better," focusing on its processes, for example, TIQ and SAT, or products lined up with the company's strategy like ProShock, Troya, Aero Brasil, Empreendimentos Aeronáuticos and Alltec.

The development of innovation is not the same in every company; it is influenced, among other things, by sector of activity and by size (CONDE; ARAÚJO-JORGE, 2003). You can see that the companies in the aeronautical industry the development of innovation occurs mainly because of the requirements of customers, while the other sectors search meet new markets as a way of survival. According to Iacono et al. (2011), the technology can be considered endogenous character; a complex and multidimensional phenomenon that takes into account the participation of various stakeholders, and take the relationship between science and technological and economic development from an interactive view.

The perspective of interactive model of innovation is to consider interactions and joint actions, key elements for multidisciplinary learning and the development of new products and new technologies.

Tidd, Bessant and Pavitt (2008) state that innovation is driven by the ability to build relationships, identify opportunities and take advantage of them, and that it was really observed in the companies surveyed. All of these external relationships established in different degrees and for different purposes. As for the types of relationships, we observe the association, cooperation, and information.

Cassiolato and Lastres (2005) report that innovation processes of companies are usually supported by their relationships with other companies and organizations. Relations of competition and conflict or trust and partnership on different levels can represent these forms of interaction of local stakeholders with external actors. The authors add that the type of interaction also requires information on the number and types of stakeholders involved; motivations and objectives; frequency; intensity and duration; problems and difficulties of the interactions.

The main sources of cooperation and information are customers, suppliers, universities and research centers. The relationship with institute of science and technology and universities are at various levels in the companies surveyed. In the case of linked to the aeronautical market this proximity is by nature of the business itself (aeronautical

industry) and physical proximity to the Aerospace Technology and Science Department (Portuguese: *Departamento de Ciência e Tecnologia Aerospacial* - DCTA) and Technological Institute of Aeronautics (Portuguese: *Instituto Tecnológico de Aeronáutica* – ITA).

Innovation in SMEs confront biggest obstacles than in large companies, especially concerning resources to promote innovation that occurs in a multidisciplinary approach and with the involvement of various sectors and business professionals.

The proposed model has similarities with the Hansen and Birkinshaw (2007), which presents the innovation chain also in three stages: generation, conversion, and dissemination of ideas.It also presents six cognitive tasks: internal collaboration, external and between units; selection and development of ideas; and dissemination of selected ideas. The two proposals are very close to our innovation model.

Hansen and Birkinshaw (2007) emphasize the importance of the role of communication at any stage of this process, demystifying the idea that innovation occurs in isolation way. Innovation should not be seen as unique effort but as a built event with varied support, either internally or externally. The generation of ideas, authors like Hansen and Birkinshaw (2007) highlight the importance of communication in the three stages that belong to that phase, as discussed in the previous section.

The results obtained many actors play more of a role in the process and even if they have certain linearity is no greater iteration between those involved. In the field, the process was more dynamic, and often-checked steps are not so clear and structured. In addition, there is not a fully defined boundary between these steps, being able to have some overlap and iteration between them. Ideas come and turn a project in development when various opinions are integrated, but they often arise from unstructured way or observation of market needs. Even unintentionally, companies build relationships of external networks and involve their employees in multidisciplinary groups.

The institutional environment where companies interact is also important because it affects the innovation (ALBAGLI; MACIEL, 2004). If there is no integration between the technical, marketing, R & D, and others area involved in the innovation process, groups promoted internally will generate countless ideas that will be evaluated in isolation after a long process, instead of being immediately vetoed at the beginning.

Hamel (1999) shows how models of temporary participation in projects can contribute to the exchange of knowledge and generation of ideas, and to Cross et al. (2007) innovations are created through

networks and groups of people working together. This aspect was noticed in the number of ideas and projects generated by companies and how employee participation is active mainly in the stages of generation and development of ideas.

Another important point concerns the interaction between stages of the model. This topic was not addressed in Hansen and Birkinshaw's article (2007), but it was found in this study that the diffusion stage can feed back into the product development stage.

The companies analyzed have the functional integration innovation process model presented by Kline and Rosenberg (1986), which is characterized by the sharing of information throughout the process, confirming once again the importance of communication between all stages of the process.

The purpose of this model comes close to meeting the needs of the market or consumer satisfaction. All companies surveyed have this sharing of information, and the main goal is to meet customer needs. For are companies of various economic activities, the way in which this need is perceived, the interaction with the customer, and the customer engagement level in the development process vary, but always occur.

The conversion of idea stage involves a credible, transparent and rational assessment of improvement suggestions. In parallel, a financial support mechanism to the ideas must be defined, as well as the criteria for resource allocation. In respect to financial resources, there is the economic subsidy option until the moment of production. The subsidy can be defined as the sharing of costs and risks of research and development (R & D) between business and State. This option is not widely used because of the complexity of access to these resources, mainly by SMEs.

Regarding the issue related to patents, Ferreira et al. (2009) point out those Brazilian companies not yet paid attention to the importance of using patents as a competitive tool, and did not understand the importance of exploitation of patents as source of technological information.

The diffusion of ideas can make the product to reach an industrial scale. In this phase may or may not be collected information to feed back into the development of ideas.

Finally, the authors concluded that innovation in SMEs is a very particular way and adapts according to the company's own characteristics and its leaders. The relationships established in this process are different from established in large companies and it is necessary to understand them, since their importance is mainly recognized with regard to the benefits brought to the region, for

example, the generation of qualified jobs, generation new technologies and participation in the local economy.

References

ALBAGLI, S.; MACIEL, M. L. Informação e conhecimento na inovação e no desenvolvimento local. *Ciência da Informação*, *33*(3), 9-16, 2004.

BARBIERI, J. C. *Organizações inovadoras*: estudos e casos brasileiros. FGV Editora, 2003.

CASSIOLATO, J.; LASTRES, H. Sistemas da Inovação: Políticas e perspectivas. *Parceriasestratégicas*, n.8, maio, 2005.

CHESBROUGH, H. The logic of open innovation: managing intellectual property. *California Management Review*, *45*(3), 33-58, 2003.

CHESBROUGH, H. W. The era of open innovation. *Managing innovation and change*, *127*(3), 34-41, 2006.

CONDE, M. V. F.; ARAÚJO-JORGE, T. C. Modelos e concepções de inovação: a transição de paradigmas, a reforma da C&T brasileira e as concepções de gestores de uma instituição pública de pesquisa em saúde. *Ciência&saúdecoletiva*, 8(3), 727-741, 2003.

CROSS, R., HARGADON, A., PARISE, S.; THOMAS, R. J. Together we innovate-how can companies come up with new ideas? By getting employees working with one another. *MIT Sloan Management Review*, 2007. Disponível em: <http://sloanreview.mit.edu/wsj/insight/innovation/2007/09/> Acesso em: 05 fev. 2015

EISENHARDT, K. M. Building theories from case study research. *Academyof Management Review*, 14(4), 532-550, 1989.

FERREIRA, A. A., GUIMARÃES, E. R.; CONTADOR, J. C. Patente como instrumento competitivo e como fonte de informação tecnológica. *Gest Prod*,*16*(2), 209-21, 2009.

FRANCO, M.; HAASE, H. Failure factors in small and medium-sized enterprises: qualitative study from an attributional perspective. *International Entrepreneurship and Management Journal*, *6*(4), 503-521, 2010.

FREEMAN, C.; SOETE, L. (Eds.). *The economics of industrial innovation*. Psychology Press, 1997.

GALANAKIS, K. Innovation process. Make sense using systems thinking. *Technovation*, 26(11), 1222-1232, 2006.

HAMEL, G. Bringing Silicon Valley Inside. *Harvard Business Review*, 75 (5), Sep-Oct., 1999.

HANSEN, M. T.; BIRKINSHAW, J. The innovation value chain. *Harvard business review*, 85(6), 121, 2007.

IACONO, A., DE ALMEIDA, C. A. D. S.; NAGANO, M. S. Interação e cooperação de empresas incubadas de base tecnológica: uma análise diante do novo paradigma de inovação. *Revista de AdministraçãoPública*, *45*(5), 1485-1516, 2011.

KLINE, S. J. Innovation is not a linear process. *Research management*, 28(4), 36-45, 1985.

KLINE S.J.; ROSENBERG N. An overview of innovation. In: Landau, R. & Rosenberg, N. *The Positive Sum strategy: Harnessing Technology for Economic Growth*. National Academy Press, Washington, 1986.

KOTSEMIR, M. N.; MEISSNER, D. Conceptualizing the innovation process–trends and outlook. *Higher School of Economics Research Paper No. WP BPR*, *10, 2013*.

LEIPONEN, A.; HELFAT, C. E. Innovation objectives, knowledge sources, and the benefits of breadth. *Strategic Management Journal*, 31(2), 224-236, 2010.

LIMA, E. Teorizando a partir de Dados Qualitativos em Administração. *Revista Pretexto*, 11(1), 2010.

LOBOSCO, A., MORAES, M. B.; MACCARI, E. A. Inovação: uma análise do papel da agência USP de inovação na geração de propriedade intelectual e nos depósitos de patentes da Universidade de São Paulo. *Revista de Administração* da UFSM, 4(3), 406-424, 2011.

MILES, M. B.; HUBERMAN, A. M. *Qualitative data analysis*: An expanded sourcebook. Sage, 1994.

MOWERY, D.; ROSENBERG, N. The influence of market demand upon innovation: a critical review of some recent empirical studies. Research policy, 8(2), 102-153, 1079.

MUSIOLIK, J., MARKARD, J.; HEKKERT, M. Networks and network resources in technological innovation systems: Towards a conceptual framework for system building. *Technological Forecasting and Social Change*, 79(6), 1032-1048, 2012.

MÜHR, T. Atlas/ti, Release 1.1 E. In: WEITZMAN, E. A.; MILES, M. B. *Computer Programs for Qualitative Data Analysis*. Thousand Oaks: Sage, 217-229, 1995.

NOBELIUS, D. Towards the sixth generation of R&D management. *International Journal of Project Management*, 22(5), 369-375, 2004.

ORTT, J. R.; VAN DER DUIN, P. A. The evolution of innovation management towards contextual innovation. *EuropeanJournalofInnovation Management*, 11(4), 522-538, 2008.

RAHMAN, H., & RAMOS, I. Open Innovation in SMEs: From closed boundaries to networked paradigm. *Issues in Informing Science and Information Technology*, 7(4), 471-487, 2010.

ROBERTSON, P. L., CASALI, G. L.; JACOBSON, D. Managing open incremental process innovation: absorptive capacity and distributed learning.*Research policy*, *41*(5), 822-832, 2012.

ROTHWELL, R. Towards the fifth-generation innovation process. *International Marketing Review*, 11(1), 7-31, 1994.

ROTHWELL, R, ZEGVELD, W. *Reindustrialization and technology*. ME Sharpe, 1985.

TIDD, J.; BESSANT, J.; PAVITT, K. *Gestão da inovação*. Bookman, 2008.

VIOTTI, E. B.; MACEDO, M. D. M. *Indicadores de ciência, tecnologia e inovação no Brasil*. Unicamp, 2003.

VON HIPPEL, E. *The Sources of Innovation*. Oxford, Oxford University Press, 1988.