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TRENDS AND STRATEGIES

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Semi-open Innovation: an Approach to the Innovation Typology

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ABSTRACT

Purpose: This study aims to contribute to the Innovation Models debate from a new perspective on the innovation process, more frequently discussed in a range from closed to open innovation model. Coming into to the discussion in the recent years, called semi open innovation, this modality of innovation has been referenced as one that uses external knowledge, however considers that this knowledge is not a crucial element for the development of innovation. In this present study, semi-open innovation is characterized when the innovation process meets specific conditions of particular set of technologies and companies bounded by the local conditions. Design/Methodology/Approach: it refers to a qualitative study, supported by case studies.

Findings: It was observed that the existence of a local Scientific and Technology Institute is a reason to define the location to produce, but did not find evidences of a large use of STI resources or with other local researchers for a product development. We could not clearly identify real open innovation model in practice. However, the proximity of a technological education and University of great national reputation, in addition to providing skilled labour, becomes a source of knowledge that should be used more frequently. Conclusions pointed out that there is a restricted support given by STI. The

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cases show that two firms practice an open innovation mode. In one case we concluded it refers to semi-open innovation practice.

KEY-WORDS: Innovation Typology. Closed Innovation. Open Innovation. Semi Open Innovation.

1 INTRODUCTION

The theoretical foundations about innovation offer a set of statements in continuous evolution. It could not be otherwise, given the changes in the technology patterns and economics and the expansion of scientific knowledge.

Although innovation, in the perspective of industry, has drawn attention in the past three centuries as a phenomenon that justifies, for example, the transition from handmade production model to for mass production, it is true that innovation is at the root of human development since at the dawn of human existence. It has been seen through the primitive artifacts and knowledge that evidenced the usage of a variety of sophisticated techniques that became important technologies with an impact on the field of agriculture and livestock for human consumption, according to Street (1969, p. 104).

According to Vega-González & Vega-Salinas (2014, pp. 117), the primitive man has developed techniques and procedures for the manufacture confection of clothes. Later, along with the domain of energy and the accumulated knowledge, the primitive man developed other more complex technologies, aiming to explore copper, bronze and iron, from about 4000 b. C to 1200 a. C.

It is inevitable to establish relationship among human needs, knowledge and the mastery of problem-solving techniques, even though a primitive feature, as a necessary condition for creating new technology. Having the domain of knowledge as a result of the observation, rationality, logics logic, summarized as intelligence, established as human skills, one can define as how elements of an essential equation of innovation. It means that technological innovation is equal to the sum of intelligence plus accumulated knowledge, added to the domain of problem solving techniques and prospecting and exploiting opportunities.

Nevertheless, it is necessary to consider the complexity of selecting, combining information and knowledge with techniques towards the generation of innovation which calls for resources of various natures, for example, financial capital; productive structure, networks and relationships, market knowledge, among other features. On the other hand, the evolutionary change

that culminates in innovation is recognized as the result of the biological and socio-cultural evolution (Vandervert, 2003).

Nobody can believe that innovation would be defined exclusively as a structured human intelligence phenomenon or as an action arising from a linear process, characterized by relations of cause-and-effect, which would make an oversimplified model (Kline, 1985). Without mentioning other more specific situations such as the lonely and persistent inventor, or project errors that end up being useful for other applications and even incidental events that generates new findings which results in new products or services.

If it is not a linear process, when examining innovation as a human interactive process we consider that the innovation process cannot be defined just in two poles, such as closed or open innovation, but by varying degrees within a defined range between the two poles.

Aiming to contribute to the innovation typology, in this article we present the results of a regional case study regarding a middle-term type of innovation: a semi-open innovation underpinned by the topography of the search space (Nelson & Winter, 1982).

This article is organized in five sections, including introduction as the first one. The second part describes the theoretical foundations to support the results analysis and discussion. The third part presents the methodology, the fourth section describes and discusses describe and discuss the results of the field research. In the last part, we present the conclusions and suggestions for futures studies related to the innovation typology.

2 THEORETICAL REVIEW

The seminal concepts of economics changes light up the direction to understand technological changes of a long-term cycle and their effects on the innovation patterns was firstly discussed by Kondratiev (1935) who observed that economic changes would come along technological changes, which would affect productivity in commodities production. The changes occur in a long-term cycle from 50 to 60 years, when the accumulated knowledge erupts in a new technology. Schumpeter (1939) considered Kondratiev´s cycle

as an assumption to the Theory of Economic Development, in which capitalism is responsible for an evolutionary economic process in which, entrepreneurs are the protagonists.

The power of the creative destruction, due to the continuous innovation process promoted by the Entrepreneur (Schumpeter, 1939), is a force in the economical evolution (Freeman, 2009; p. 126-144), culminating in new patterns of breakthrough innovation since technological knowledge achieves its edge. However, along the growth of the knowledge accumulation curve, a cluster of opportunities bubbles shows up what will possibly generate new products, gadgets or new applications (Perez, 2009). In this perspective, all these artifacts refer to incremental innovations. A breakthrough innovation related with the main discovery will take more time to be explored and delivered to the market.

At a time when new knowledge may be an incremental innovation generator, there is an emergence of enterprises that will explore the markets potential for trade in goods and services resulting from incremental innovation. The wealth accumulation in this cycle may finance new R&D now focused on product and process improvements and productivity, provided that there is, for example, some form of government support, such as purchase guarantee by the Government, as mentioned by Saxenian (1994), or with partnerships with large companies that will make the economic exploitation of the product.

It is observed in Brazil only a few small businesses (Sacramento & Teixeira, 2014), generated in technological incubators, can advance towards the second innovation for lack of specialized structure, to combine the P&D activity with the activities inherent in industrial production in large volumes (Gava, Garcia, Paula & Bastos, 2015, Tumelero, Santos & Kuniyoshi, 2016). This fact makes believe that shared knowledge in the technological incubators qualifies innovation held, but anyhow it enables the high technological inventor or entrepreneur.

The bulk of what we define as an innovation is, in fact, incremental improvement. The radical innovation thrives almost primarily on the basic research led in STI. Nevertheless, innovation requires, but differs from

novelty. "In the organization theory and strategy literatures the word novelty is generally used to refer to novel approaches or novel technologies", according to Carlile and Lakhani (2011, pp. 2) who proposed that

> The challenge of novelty is addressed by what we call the novelty-confirmation-transformation (N-C-T) cycle. For an individual then innovation is a cycle that requires both a capability to develop novel courses of action and a capability to confirm their value. This effort establishes a sweet spot for innovation where the identified consequences help an individual determine what knowledge to transform and what to keep the same to develop the next course of action to drive the innovation cycle. However, most innovation involves more than one person, often many individuals specialized in different domains.

It seems to be reasonable to assume that innovation is almost always results from a multidisciplinary and interactive action, as seen on Figure 1.

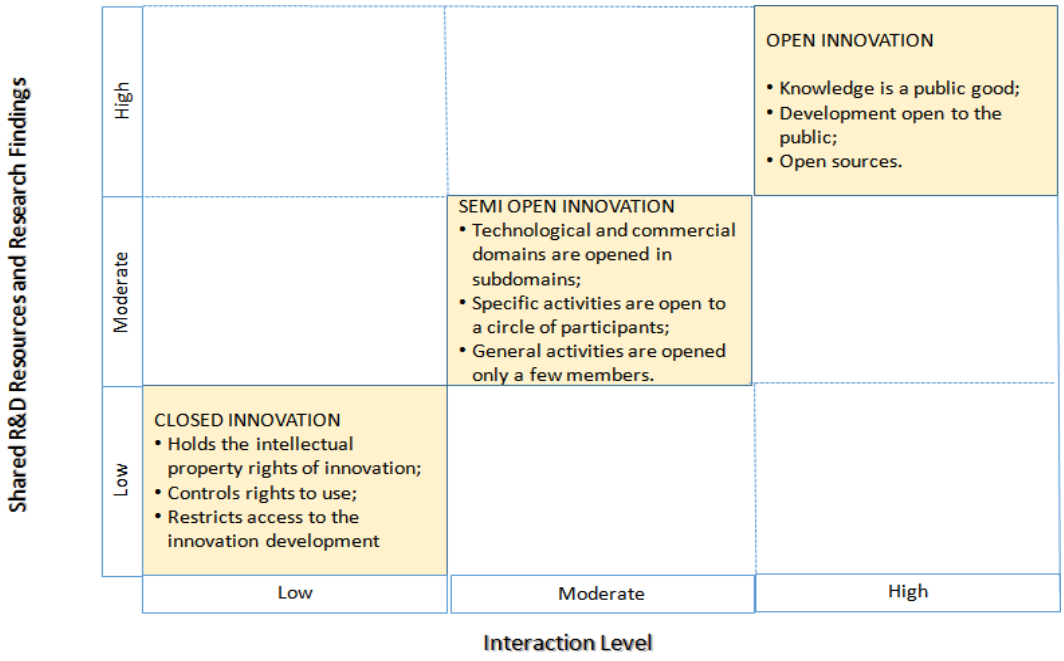

Figure 1 - Closed, semi open and open innovation framework
Source: Adapted from Hirsch-Kreinsen & Jacobson (2008, p. 56)

Therefore, to some degree it tends to be opened (Chesbrough, 2012). With rare exception, within the innovation framework in Military Technologies Critical calls, for which the behavior of the actors suggests , beyond the field of knowledge, a restricted level of interaction, and controlled, to the project members. However, regarding the artifacts production breaking discoveries end up being transferred to the industry. The following news represents this level of interaction:

> Missile systems employed in land, sea and air represent the ability of a country to master critical military technologies, which can only be achieved with a strong defence industrial base. Brazil has just joined the select group of Nations with such capability. Combining efforts of military and civilian research centers, and Brazilian companies Avibras, Mectron, Atech and Omnisys, in association with the European group MBDA, the Country has been producing engines, inertial guidance systems, explosive charges, fuselage and other missile components, whether they are for use in aircraft, ships or land-based launchers (Technology & Defense, 2012, n/p).

Apparently, even in usually closed sectors, cooperation refers to a form of behavior in research as open, though, partially open. Trajectories and patterns of technological change have tried to delineate the movements that, once combined, can synthesize the models of relationship among different domains of knowledge. Figure 2 shows that interaction:

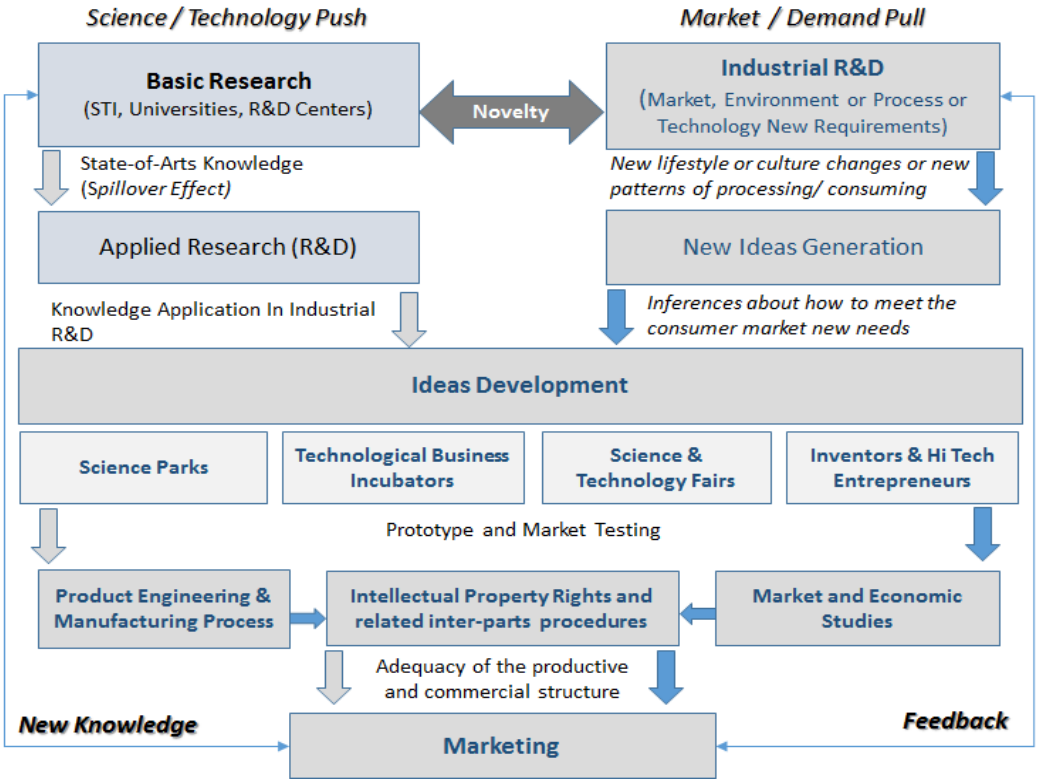

Figure 2 - Patterns of Revisited Technological Changes
Source: The authors

Dughe (2006) proposed a classification of the degree of novelty in innovation to the industry or sector, local market, world market, based on the criteria defined as "height of innovation".

Chesbrough (2012) highlights the insufficiency of a research-based innovation model and the Industrial Research and Development – IRD - to generate innovation apart. Chesbrough defines the open innovation model as the one that favors a greater number of actors creating value to the companies and market, given to the mobility of high skilled professionals who, when changing jobs, take with them the full collection of the hard knowledge developed through the research effort.

As the first premise to this research, we define:

a) Even in strategic and innovative product development, there is a certain level of interaction, except when referring to the lone inventor's innovative development.

2.1 INTERACTIVE LEARNING AND INNOVATION

"How can we (the company) involve strategic partners´ chain in the knowledge management cycle, guaranteeing, at the same time, the exclusiveness of the obtained advantages"? (Dos Santos & Amato Neto, 2009, p. 184). This secondary research problem, that guided the authors towards the investigation on sharing technological knowledge along the strategic supply chain, reflects a concern within the open innovation process.

Bogers (2011, p. 2) has raised up a similar question when discussing the intellectual property rights when innovating through an opening process, since it involves a multiple sourcing of a collaborative innovation development. Common interests may drive the open innovation. Meanwhile, the actors involved in this process may have defined specific objectives to reach during or after the developmental process that may not be shared. What part of the new findings developed within a shared process would be considered acceptable as an asset for the exclusive use of a single actor?

Barge-Gil (2010, p. 11) proposes semi-open innovation as a strategy to comprehend situations as in case of "the firms use external knowledge, but this knowledge is not crucial for their innovation." We consider semi-open innovation an intermediate type of innovation that meets specific conditions of particular technologies up to the knowledge created becomes a strategic

asset for each part. We also consider that regional factors, such as regional specialization, can contribute to the openness level in R&D innovation process.

The recent literature recognizes the existence of varying degrees of variation of the opening in the process of open innovation, according to the interest in crossing the boundaries of the organization to search or disseminate innovation (Bogers, 2011). Searching for innovation also refers to a learning process established by different individuals, in a seller-byer type of relationship, or professionals from a certain industry or interested in a specific technology, through a formally or informally type of network will exchange information, techniques and perception about how to improve technical functionalities or related materials or outcomes. This type of interaction is a necessary approach to develop new products or branches (Lundvall, 2010).

On the other hand, there are also geographical aspects related to environment in which innovation occurs, that extend or reduce levels of interaction for innovation. This fact can strengthen technological expertise, in more inaccessible areas, since geographically nucleated by science or technology institutes, scientific parks or universities, developing regional attractiveness in a product niche that may characterize that locality, region, or nation as a locus of innovation and production of a specific technology (Nelson and Winter, 1982; Saxenian, 1994).

Saxenian (1994) approached professional´s mobility within the local industries as a source of regional advantages of technological clusters. The results observed so far point out that semi-open innovation is a hybrid strategy to develop new knowledge and innovation, mainly developed by interactions.

However, the interaction leads to the knowledge sharing among the professionals of the industries, in a partnership, reflecting on how companies apply this knowledge and renew the production techniques and innovate products and their processes, making this shared knowledge a source of competitive advantage particular to that industry (Nelson, 2006).

Over time, innovation has been seen as a dynamic, systemic and an interactive phenomenon, and as evidenced by technological convergence, for instance, innovation is a set of multidisciplinary knowledge. Consequently, the more articulate is the network of relationships is, the more open the exchange

of expertise in the innovation process will be. At this point, we have as the second premise:

b) The openness of the open innovation model varies according to the intensity which collaborative relationship among different actors occurs, in a form of networks relationships.

2.2 NEW KNOWLEDGE GENERATION AND KNOWLEDGE TRANSFER MECHANISMS

In order to understand how social interaction would influence knowledge transfer Santos and Amato Neto (2009) identified a cluster of initiatives that accelerates knowledge capture through professional´s interaction that evolves from the individual to the team and to the organizational. Expatriation, benchmarking, international working teams, training are some of most effective practices to generate in-depth knowledge (Chai, 2000).

Other knowledge transfer mechanisms require business-to-business agreement, namely, technological transfer, joint venture; linkage with suppliers for internship program, linkage with universities, shared R&D activities, shared projects, license trade, technical assistance, among others (Luz & Santos, 2007).

Regarding the Reverse engineering, although it is a controversial subject, ideally, Luz and Santos (2007) characterize the knowledge as a common asset and must meet the society needs. The more advantages that its possession confers the one that has it, the more the open access to the knowledge must be respected. The authors affirm that

> The open access to knowledge not necessarily collides with the principle of intellectual property, but can restrict (the over protection). Therefore, the reverse engineering is a powerful tool for maintenance of the public good that, by its own characteristic of being public, of all people, should take precedence over other forms of law (Luz & Santos, 2007, pp.5)

One of the main advantages of reverse engineering in comparison with Direct Engineering is minimizing the technological risk, taking advantage of the lessons learned over technological development. Although there is no explicit social interaction in this, the so called, "innovation strategy", since innovation is within the technological artifact, it is important to note that the

reduction in development timeline may offer a considerable economy in terms of development teams (Luz & Santos, 2007). Anyhow, interacting seems to be the best way to reach the technology novelties. Figure 3 explores the technological competences creation process within the innovation strategy.

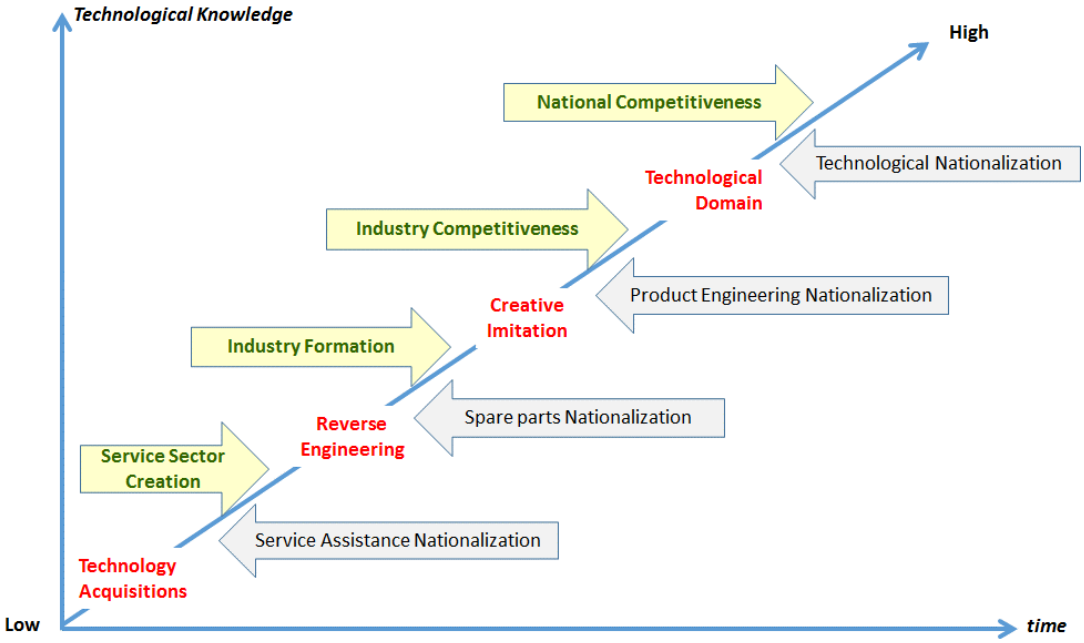

Figure 3 - Technological Competences Process
Source: Adapted from Santos & Luz (2007).

Figure 3 shows a scale of gradual knowledge growth towards the technological competencies development. Despite the ethical dilemma, however that it is important to consider him, it is noted that the countries that adopted the reverse engineering as a strategy of accelerating technological knowledge learning, as Japan and South Korea, especially, have achieved success in the construction national technological capabilities and progressed as a mature national innovation system.

Bunnell and Coe (2001) point out that contemporary research on innovative processes considers a range of scales, from global up to the regional or even local interactions to explain knowledge exchanged between different research centers and industrial R&D labs. Social network-based concepts brought up the non-territorially delimited dimension to the innovation studies, once the new Information, Communication and Virtual Reality Technologies have broken the notion of time and space geographically bounded (Santos & Rodrigues, 2007).

Innovation, in fact, can be developed for interaction among various actors, having their participation mediated by technology, since the partners have technological availability, interest on the subject and potential to contribute to the innovation development in a collaborative network. However, since the innovation ability results from the accumulation of knowledge in most cases, not necessarily a relationship of cause and effect, measured by the level of participation, it is important to emphasize the balance of trade promoted on the collaborative network. In addition, the application of the resulting knowledge among partners can be aimed at the achievement of different goals, with different levels of depth and intensity of participation. The exceptions to this case are the joint ventures, for the so-called technological artifacts co-create of mutual interest.

Thus, not only the community of researchers, but also localities, regions and Nations must offer educational, scientific and other attractions items – see The Global Competitiveness Report 2014-2015 Pillars (WEF, 2015) - that can sustain the technological specialization regional call. The innovative environment formed by science parks and incubators, when targeted to certain industry sectors, can characterize the local expertise and maintain regional governance on his research.

From this theoretical set we formalize the third premise that addressed this research:

c) The conditions of regional attractiveness factors may delimit the opening of open innovations .

According to Drucker (1993) and Utterback (1994), technological knowledge is progressive and mainly accumulative. This means that technological competences grow as long as the relationship with local scientific and industrial community reach regional and after then global scientific communities and global industrial partnership, as seen in the Figure 4:

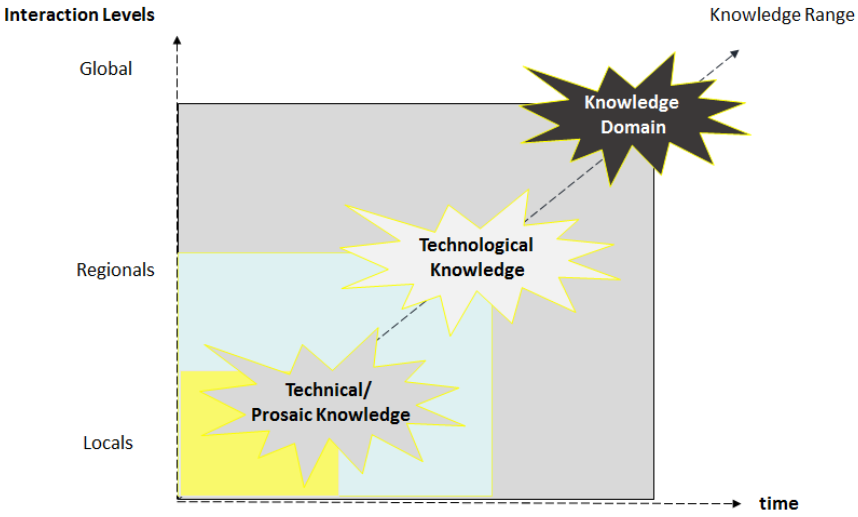

Figure 4 - Interaction and Knowledge Growth
Source: Drucker (1993), Utterback (1994)

The knowledge curve tendency is to grow towards the state-of-art knowledge as long as the relationship between production and Innovation Systems becomes more intense. However, following the firm's strategic positioning, it might decide at what point the curve of knowledge it should settle down. On the contraire, the knowledge accumulation will be progressive.

Solow (1957) was probably the first economist to consider the variable of technology progress "in the economic equation" in the mid-1950s. According to him, technology advances could respond about 90% of the economic growth in an industrialized country. However, from the very beginning of the neo-Keynesian thinking up to nowadays, at least, six models of innovation have been introduced, as such as summarized in the Figure 5. The level of interaction and diffusion of new knowledge can describe all of them.

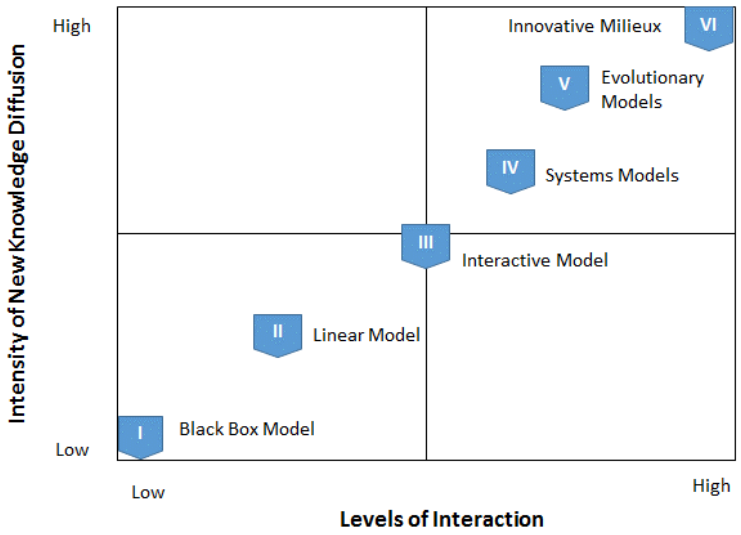

Figure 5 - Interaction and Intensity of New Knowledge Diffusion
Source: Solow (1957), Aydalot (1986, apud Benevides, Santos Junior, & Bresciani, 2012)

We explain each model as follows :

a) The Black Box Model

In the first model that arose in the 1950s to 1960s, innovation was not a high impacting factor for industrial economy, mostly because its findings, up to this time, more related to the basic research and Scientific Knowledge Creation. In the second model, in the mid-1960s to 1970s, the linear process captures attention from technology researchers who were more interested in opening the black box and learning about specific process of technology changes and the knowledge related to new technologies, from which new technological products and processes would be generated.

b) The Linear Model

Linear model consisted of researching from knowledge creation up to commercializing new products and services, following the flow presented in Figure 6.

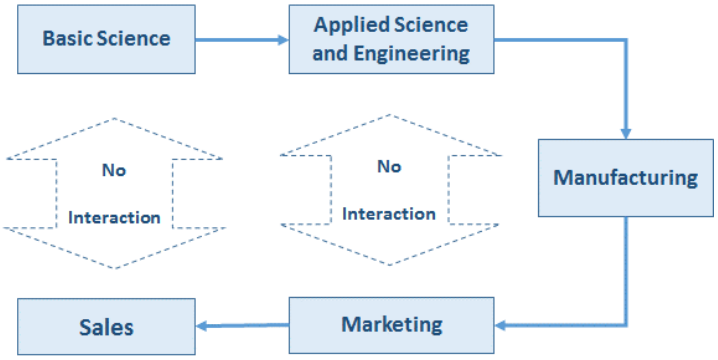

Figure 6 - Linear Model: linear interactions
Source: Marinova and Phillimore (2003)

Etzkowitz and Leydesdorff (2000) also described interactive model for innovation at different stages considering interactions. In the first mode, originally developed by scientists, in isolation, the frontier of the knowledge had not necessarily an industrial purpose. At this stage, the investments made by donors, helped the institutions to build up autonomy and an initial structure towards the research process organization. This stage the characteristic of Scientific Knowledge Creation was very similar to the Black Box Model.

On the other hand, the second model described by Etzkowitz and Leydesdorff (2000) is relational, i.e., it refers to the current relationship network aiming to generate innovation. In this case, scientific research occurs in articulated processes between the interests of the scientific community and industry in order to meet the society's demands, having the Government support. It should be compared to the Interactive Model. In both cases, one of the variables that designates the type of innovation is given according to the degree of interaction among different actors from different type of organizations and institutions.

c) The Interactive Model

The third model of innovation – Interactive Model - arose in the mid-1980s from the perception that the interaction is a key element for the development of new knowledge and new technological artifacts. This interaction should be performed through a complex net of communication, which involves inter, extra and intra organizational linkages, including a

broader scientific community and marketplace . Figure 7 shows the Interactive Model flow.

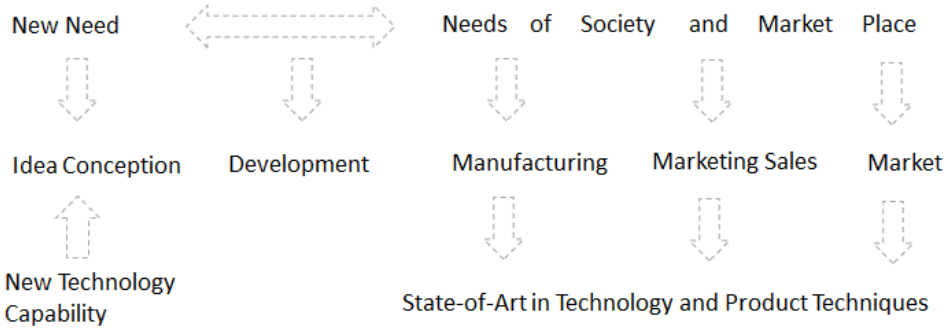

Figure 7- Interactive Model
Source: Marinova and Phillimore (2003, p. 47)

In the third model, seen above, the levels of interactions are underlined by the market needs and how state-of-art knowledge can respond to these needs through products and services development.

d) Systems Model

The strengths of the fourth model – Systems Models - relays on the large spectrum of agents that contributes to provide solutions to face the variety of knowledge and the vast requirements to reach the complexity that developing innovation become to be. Kline (1985, pp.41) explains these phenomena, saying that:

> Over the past two centuries, this knowledge cumulation about physical and biological nature has provided the human race with an increase of many orders of magnitude in insight into physical and biological natures. Furthermore, we have used this increased and increasing knowledge to vastly improve our stock of tools, instruments, machines and processes and to build increasingly powerful sociotechnical systems. The result is an accelerated increase in the capability of human sociotechnical systems that began about 1830, and is still in progress . This acceleration has been documented quantitatively by Lienhard (1979) and also by Kline (1977), using somewhat different methods. In many instances, this power of human systems has increased more than a million times during this period, and the process does not yet seem to have ended or to be slowing down in an overall sense.

Kline (1985), citing as an example the jet engine, points out that it would be unimaginable to develop such innovation without powerful articulated systems around scientific and productive requirements, such as knowledge, processes, sophisticated materials, skilled and talented and involved professionals working cooperatively. Thus, if the innovation process is not linear, as Kline says, I should say that, except for the inventor, innovation also cannot be a lonely adventure.

e) Evolutionary Model of Innovation

The fifth model, the so-called Evolutionary Model of Innovation, has as central elements, minimally, the variety of change and the speed at which they occur and redefine the capabilities with which organizations must make decisions about the innovations continuity and even on their strategy to attend, for instance, market breakthrough. Fast adaptation is a key factor.

Regarding the fifth innovation model characteristics, Chandi and Prabhu (2010, pp. 5) identify two key dimensions that, according to them, underpin all the various typologies mentioned in the literature. The first dimension considers attributes and the effect of an innovation; the second refers to the novelty degree that such innovation exhibits to the company that has adopted it and to the customer.

The dimensions given by Chandi and Prabhu (2010) refer to the issue of continuous monitoring that organizations need to have about applications, or of the attributes whose permeability; and potential needs, and possibly volatile, their consumers in order to make them indispensable for a certain time. The authors made a list of other class of innovation, such as:

- Product/service/process innovation,
- Technological breakthrough/platform innovation,
- Component innovation,
- Architectural/design innovation, and
- Business model innovation

This innovations highlight attributes which "novelty lies in the concept behind the innovation" (Chandy & Prabhu, 2010, pp. 5). Beyond all of this, they classify the novelty of innovation as such as:

- Organizational, administrative innovation and management innovation when emphasizes the innovation attributes to the firm;
- Drastic and revolutionary innovation: when emphasizes the effects of a given innovation or the concept behind the innovation;
- Discontinuous and disruptive innovation: when innovation emphasizes the novelty to the customer; emphasizes the?????
- Competence-destroying innovation: when innovation emphasizes the novelty to the company.

The related items refer to the variety possible in the set of innovations that a company must observe. Again, it emphasizes the need for a close and continuous interaction with universities, STI and poles of innovation so that a company, regardless of size, can establish a shared form of technology watch and best practices.

Productive infrastructure is one of the components of viability of reach marketing of new products. For this reason, although the relationships are not linear innovation, it is important to establish dialogue and partnership between science and manufacturing. About the interaction between science and business, Dodgson, Gann, Salter (2008), include a considerable evolution in the pattern of technological change that resulted from this approach between different sources of generation and application of innovation. According to the authors, we have been experiencing the fifth stage in the pattern of technological change.

f) Innovative Milieu

The sixth model, innovative milieu, comes from the mid-1970, the first debates when began to emerge regarding regional growth around the technological clusters. The vision of the territory from the relationships and the interactions around the technological knowledge, constituted a factor crucial to the understanding of technological development locally established. Thus forming the basis for studies on the innovative milieu, term coined by Aydalot (1986, apud Benevides, Santos Jr. & Bresciani, 2012).

The innovative milieu combines creative knowledge with problem-solving techniques and specific technological competences created in the surroundings of an agglomeration that focuses on knowledge and learning, for example, universities and research centers. These specific competences form

the basis of regional specialization that, as time passes by, will establish a technological profile and a regional mark of knowledge that characterizes the region and its human resources (Gava et al., 2015, Rocha & Vieira, 2016, Santos & Paula, 2012, Saxenian, 1994).

According to Camagni (1991, apud Marinova & Phillimore, 2003, p. 50) and Amato Neto (2009), a typical innovative milieu has the following components: a productive and innovative system; inter organizational interactions fostering innovations; local private and public institutions supporting innovation; dynamic local collective leaning process, among others.

About this innovation model, Etzkowitz and Leydesdorff (1995; 2000) built an articulation model among local Government, universities and companies, considering that these stakeholders would establish productive and innovative relations. The government's role is to support financially, through funding, the basic and applied research held in institutions of higher education, which, in their turn, should spillover the new knowledge to the local companies that would transform the knowledge into new products and services to consumers. In 2006, Eztkowitz and Zhou expanded the model inserting a new dimension to attend planetary demands related to sustainability.

Towards the consolidation the interactive models for innovation, some approaches on how to promote the participation of scientific and professional communities of interest of research and innovation, such as, among others:

- Crowd sourcing, which is a communitarian process for obtaining ideas or suggestions for a problem-solving from a large group of people through online tools; and
- Co-creation considered an economic strategy that brings different parties together aiming to produce a mutual value in the outcomes.

3 METHODOLOCIAL PROCEDURES

Due to the qualitative nature of this study, the adopted methodological strategy is based on an exploratory analysis considering some scientific

studies we have been dealing with along the last years, to support the development of this theoretical essay.

To carry out properly the discussion, we have defined a cluster of premises that will be discussed after presenting the research findings.

a) Even in strategic and innovative product development, there is a certain level of interaction, except when referring to the lone inventor's innovative development.

b) The openness of the open innovation model varies according to the intensity which collaborative relationship among different actors occurs, in a form of networks relationships.

c) The conditions of regional geographic attractiveness factors may delimit the opening of open innovation.

4 RESEARCH FINDINGS

Rocha & Vieira (2016) led a research aiming to identify innovation interactions in Santa Rita do Sapucaí which is known as Brazilian Electronic Valley.

The municipality is located at the South West of Minas Gerais State, in Brazil, where 40.435 inhabitants occupy an area near of 353 Km^2; Santa Rita do Sapucaí Human Development Index is about 0.721 .

The city is located at 826 meters above sea level, in a region that alternates mountains and valleys that form the Sapucaí Region Valley. Its economy is based mainly in the sectors of agriculture and industrial production. The agricultural production includes coffee, milk, and several seeds of rice, corn, among others, growing livestock and a considerable electronic industry are its main sources of income.

The region is known as the Brazilian Electronics Valley, and has as the main higher education institute, the National Institute of Telecommunications-INATEL, which is one of the best education and research institutions in its sector, in the country.

In the two last two decades, various industries in the sector of electronics, telecommunications and information technology have moved to the city, attracted by the skilled professionals available in the local labor market, as well as other attractive regional and local factors.

4.1 THE RESEARCH PARTICIPANTS´PROFILE

Aiming to guarantee confidentiality the firms were codified as A, B, C.

- Firm A was founded in 2003 and operates in the information technology field. In its portfolio, features 27 products that has been developed in-house and commercialized by the firm. It acknowledges owning one product innovation. The interview took place with the owner. This company takes opportunity when there is published a public call for projects regarding I T field towards the financial resources required to keep researching and producing.

- Firm B was founded in 2004 and has been established with the support of technology incubator of the National Institute of telecommunications, which is the main source of technological knowledge and generation of qualified human resources in the region. This company has expertise in the areas of electronics, telecommunications, information and administration.

- Firm C was founded in 1976. This firm exports technology to over fifteen countries and has several industrial plants in Brazil and Latin America countries. It produces and sells over 400 products regarding software, hardware and mechanics equipment for Security, telecommunications and net. This firm manages a partnership in R&D with one of the greatest Research Centers in Brazil and applies 5% of the incomes in R&D activities.

4.2 THE SOURCES OF LEARNING AND INNOVATING

Seen as a typical process, all the 3 companies use the most the mode of *learning by doing*, along the product development process, in order to accelerate the learning curve.

They also practice internal interaction, among firm principals, managers, project team and employees. Only firm B does not consider employees as a source of learning. So, we manage verifying that some degree of openness in open innovation type requires, somehow, different levels of interaction.

Besides, there are some practice external interactions for learning and innovating process from clients, suppliers, Universities, Technological Fairs, Training, Specific Courses. Only Firm A considers Congresses attendance as a knowledge source and innovation.

Other sources of new knowledge and innovation are based on bibliographical and documentary searching as the use of technical books, WEB, apps for searching, for the three firms.

New products are generated by reverse engineering by two firms and applying creative imitation to generate different products is the strategy chosen by one firm.

According to the premise a - even in strategic and innovative product development, there are a certain level of interaction, except when referring to the lone inventor's innovative development – we find out different levels of internal and external interaction. In the cases studied, we confirm innovation practice linked with interaction

Premise b - the openness of the open innovation model varies according to the intensity which collaborative relationship among different actors occurs, in a form of networks relationships, we have examined the level of interaction among different actors, but we could not perceive knowledge exchange from the companies to the participants.

4.2.1 The Dimensions and Levels of Learning

The three firms work with learning process at the individual, group and organizational based on feedback and feedforward. In this case, the learning process dimension considers specific attributes and the effect of an innovation in generating a new product as Chandy and Pabhu (2010) defines as a dimension of learning and innovating process.

4.2.2 Types of Innovation

Allegedly, firm B promotes incremental innovation, which is referred locally as continuous improvement. Considering the limited interaction with employees and the lack of R&D interactions, it is possible to affirm that incremental innovation calls for less knowledge sharing. In this case, we are comfortable to assume this case as a semi-open innovation practice.

Firm A (the smallest small one) and Firm C (the biggest participant) recognized they practice breakthrough innovation. They both manage a wide range of sourcing new knowledge and innovation.

None of them indicated the strategy they use to gather contributions, such as ideas, need or suggestions. In this case we are not able to confirm the third premise – related to the geographic factors as a source of selecting interactions, location to search innovation or generate new knowledge.

5 CONCLUSIONS

We took a modest sample aiming to contribute to the open innovation theory, while examining interactions and networks addressed to the innovation. Something that we noticed clearly is that there is no such thing as closed innovation when we are researching at the organizational and the institutional level. Interaction among parties presumes some degree of partnership, trust and confidence. On the other hand, based on the literature, open innovation mode seemed to be more applicable among scientific researchers located at Science and Technology Institutes – STI, when supported by a joint venture agreement.

In the studied cases, we observed that the existence of a local Scientific and Technology Institute is a reason to define the location to produce, but we have no evidences of a large use of STI resources or with other local researchers for a product development. We could not clearly identify open innovation model in practice. However, the proximity of a technological education and University of great national reputation, in addition to providing skilled labour, becomes a source of knowledge that maybe used frequently.

The existence of higher educational institution is considered a determining factor for the setting of regional economic activity, based on high technology, and for the construction of local brand as a pole of high technology in the field of engineering and telecommunications.

Since INATEL is considered the most important regional agent in supporting innovations, influencing the type of product that the local technological entrepreneurs develop and market, we strongly recommend enhancing other municipalities around INATEL in order to verify the type of interaction INATEL establishes with the Industrial Regional R&D activities.

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