



INNOVATION MANAGEMENT IN MICRO, SMALL AND MEDIUM-SIZED COMPANIES: A STUDY IN A BRAZILIAN ELECTRO-ELECTRONIC CLUSTER

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Submission: 27/04/2018

Accept: 08/05/2018

ABSTRACT

Innovation is an important way for corporations to increase their competitiveness. An analysis of the literature on innovation shows that almost all studies in that field keep focus on large companies. To overcome such gap, this paper focuses on the study of the Innovation Management in micro, small and medium-sized enterprise. The purpose of this study is to assess the most relevant factors related to Innovation Management of companies that compose the Electronic Valley, a cluster located in Brazil. The following dimensions regarding innovation will be herein analyzed: Strategy, Internal Processes, External Environment, Organization and Culture. Another indicator we considered is Innovative Performance, which was investigated based on data provided by the companies we analyzed.



The quantitative research approached 41 corporations, approximately 28% of the general population. The regression analysis showed that the five dimensions of Innovation Management are directly associated with Innovative Performance; Culture is the most relevant variable.

Keywords: Micro, Small and Medium-Sized Enterprises, Innovation Management, Innovative Performance, Culture

1. INTRODUCTION

Innovation is considered the driving force for organizations and nations to obtain and/or sustain competitive advantage (JONASH; SOMMERLATTE, 2001). Innovation allows companies to differentiate themselves from main competitors, while providing value to customers and partners, gaining new markets and even creating completely new ones (CHRISTENSEN, 1997).

According to Papaconstantinou (1997), not only innovative companies, but also the whole society benefits from innovation. As the developments achieved by innovation spreads, they contribute for productivity increase, competitiveness, employment and quality of life in the economy as a whole.

The competitive advantage generated through innovation, however, soon gets back to where it started, since one cannot stop competitors from imitating new technologies, products, services and/or business models (TIDD et al., 2008). There is, therefore, a constant need for organizations to renew themselves in order to maintain the competitive advantage, as Schumpeter in the beginning of the 20th century already emphasized.

According to Schumpeter, innovation covers all the process that starts with an idea, the subsequent development, the market reach and the impact on the economy. Two paths can lead a company to remain on the market: one of them implies that a company should improve things it already does, the other one suggests that companies have to do things in a different way. The challenge is to make a company follow both paths in a complementary way (TIDD et al., 2008).

In the context of emerging countries, such recommendations are particularly relevant when it comes to overcoming the gaps between different economies. One way to leverage competitiveness internationally or nationally can be through the

creation of clusters, which refer to geographical concentrations of business and interconnected institutions (PORTER, 1998).

According to the author, this condition promotes competitiveness while enhancing competitiveness among the cluster companies by stimulating the creation of new correlated businesses and providing a guidance towards innovation.

To turn the innovative process into an effective measure in individual firms, it is necessary to connect innovation with the entire organization. The integration of the different areas and the joint work are important factors that might influence the success of a management oriented to the development of innovation (CORAL et al., 2011). That way, if an adequate innovation is a matter of management, it is possible to analyze innovation by using different management dimensions in order to evaluate the effectiveness regarding this issue.

When it comes to small and medium sized enterprises, studies show they provide a strong contribution to innovation and technological development, especially in the context of innovation eco-systems such as the Silicon Valley (LOVE; ROPER, 2015). Still, there is a lot of controversy regarding the complex effect that organizational size has in the innovation process as a whole (FORÉS; CAMISÓN, 2016).

According to Berends et al. (2014), the literature on product innovation makes a mistake by prescribing large firm best practices to small firms, as small firms' innovation processes differ from those of large enterprises. While smaller firms have advantages in terms of rapid decision-making, willingness to take risks and flexibility in responding to new market opportunities; larger firms have advantages linked to scale and the availability of specialist resources. (LOVE; ROPER, 2015)

The focus of this study is to analyze the influence of innovation management on innovation performance in SME companies by proposing the following research question: "How does Innovation Management aspects affect Innovation Performance in micro, small and medium-sized enterprises?".

We intend to evaluate the ways in which efforts are complemented in order to generate results. To fulfil this goal, we accomplished a research at a local productive arrangement (LPA), known as Electronic Valley, located in a city called Santa Rita

do Sapucaí, a region that hosts several companies in the electronics, information technology and telecommunication segments.

2. THEORETICAL FRAMEWORK

2.1. Santa Rita do Sapucaí's LPA

In the 1980s the LPA known as Electronic Valley was institutionalized; this name is a reference to the Silicon Valley in the United States (DINIZ; LEMOS, 1998 apud BOTELHO; KAMASAKI, 2004). This LPA is constituted by over 140 companies that employ around ten thousand people; the LPA's revenue in 2009 was over R\$ 1.5 billion (DIAS, 2011).

The city has around six hundred students in technological schools in the fields of electronics and informatics and two thousand undergraduate students in the areas of informatics, telecommunications, computer engineering and business administration. It is important to emphasize that around 9% of the revenue is invested in research, development and innovation (GOVERNO DE MINAS, 2007, p. 6).

The Electronic Valley became a reference in Brazil as a technology center and it is recognized by the development and production of electronics. To support the constant development of this center, several research and educational institutions, business incubators and associations offer support and contribute to leverage success in the region (FIEMG; IEL MINAS; SINDIVEL, 2010).

2.2. Innovation management: theoretical frameworks

In this study, we tried to bring back conceptual models that handle innovation management as a process that involves the dimensions of the company in a complementary way to enable innovation.

2.3. Jonash and Sommerlatte's Model

According to Jonash and Sommerlatte (2001), the company must focus directly on innovation to survive in an environment characterized by very strong competition. For that, it is necessary to promote a full reorganization that includes strategies, processes and resources. The authors analyze innovation in a broader sense, involving the creation of new products, services and processes.



Innovation management must be present in the company as a whole; in other words, it contemplates every part of the value chain: suppliers, clients and strategical partners. This model of innovation management is defined as a more advanced generation or models of systems and networks (ROTHWELL, 1994).

This model has two main principles: the first one is to conduct innovation in the whole company in order to create value; the second is to leverage technologies and competencies to stimulate sustainable innovation and to create competitive advantage (JONASH; SOMMERLATTE, 2001). The purpose of model is to emphasize that relevant innovation does not occur singly; it is the result of the internal mobilization and of connected business networks. Figure 1 represents such model, which is formed by five dimensions: strategy, processes, resources, organization and learning.

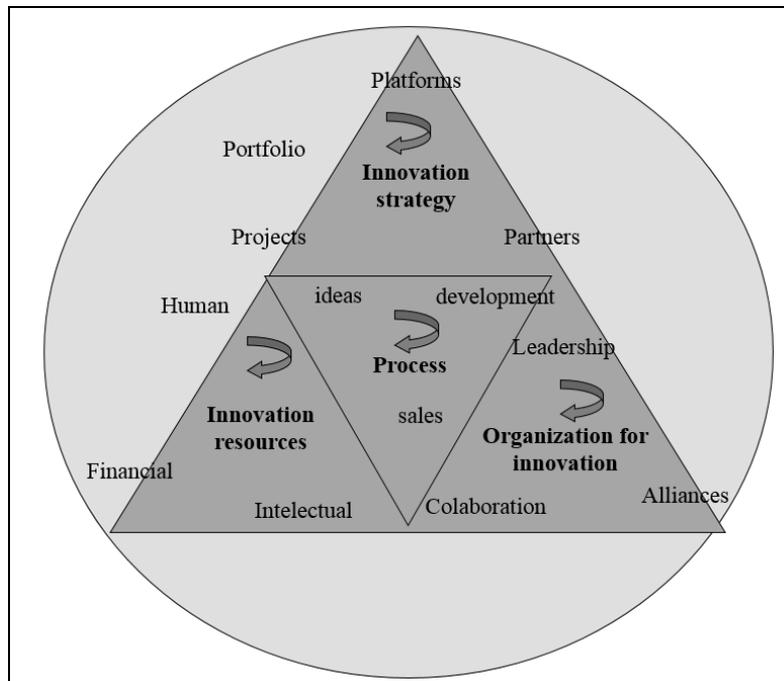


Figure 1: Structure of high-performance innovation

Source: Adapted from JONASH; SOMMERLATTE, 2001

The formulation of innovation strategies must be aligned with the corporative strategy and it is adjusted according to the needs of innovation and technology of the involved network. In order to make this formulation possible, it is necessary to use the concept of platforms, which originally only handled common structures that served as basis for the development of related products, giving more efficiency and speed for the launch to the market, e.g. vehicle chassis that can be used for different models.

The concept of platforms was extended to cover technologies, competencies or key abilities that can be useful in the development of products and services. When platforms are not enough to leverage innovation, the company must seek for partnerships with specialists (research institutes, consultants and even competitors).

In the center of Figure 1, one can see the path of the innovation process. In opposition to the linear model of the first generation, in which innovation would get started in the R&D department and would end up with launch of the product, the authors referred to the process as a complex system of feedbacks involving the creation of the idea, preparation of prototypes, detailed analysis and the launch to the market.

To reach the “most advanced generation” proposed, the company must: i) operate in networks in order to perceive new technological horizons, while monitoring the moves of the main competitors, ii) to integrate clients and suppliers in the process; iii) to expand the entry of innovation systems, giving a larger emphasis in initial phases as the creation of ideas and the development of concepts and the consequent screening; and iv) to share platforms – the purpose is to accelerate the speed of innovation.

Companies belonging to a more advanced stage are part of a system of dynamic learning based on the knowledge and commitment with sustainable and constant innovation. The system of knowledge management relates to the organization and availability of information for everyone. Companies must be organized in a way that they can be highly collaborative and connected to the network – when connecting partners, personal interactions and mutual growth are encouraged, stimulating innovation.

2.4. Tidd, Bessant and Pavitt's Model

Tidd et al. (2008) propose a process of innovation that covers three phases. For the company to survive and, ideally, to grow, innovation must be a fundamental activity. The process of innovation comprehends essentially the phases of search, selection and implementation, according to Figure 2. Over this cycle, the authors also present the dimension ‘learning’, which allows a feedback that makes the system more efficient.

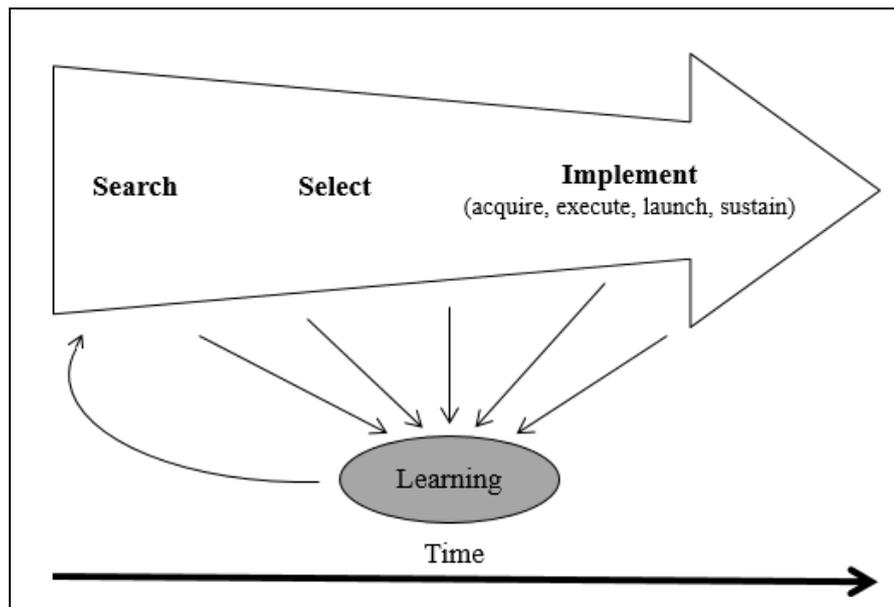


Figure 2: Simplified representation of the innovation process

Source: TID *et al.*, 2008, p. 88

In the search phase, the company appeals to the analysis of the internal and external scenario in order to look for threats and opportunities. The chance may come along as technological opportunities, conditions imposed by the market or, for instance, pressure from the competition. In the selection phase, the company must decide which opportunities will be prioritized taking into account the strategic vision.

The implementation phase regards the transformation of the potential of the initial idea into a product or service that can be launched or a process that can be adopted. Even though there are still general patterns in the process of innovation, each company has to identify what is effective and coherent in its own context.

These three phases provide feedback due to the learning gained along the way. This learning influences routines or behavior standards that, when effective, help the company to deal with innovation challenges. For this innovation management to be successful, it is not enough to handle with parts of the process; the company must be effective at all dimensions. The authors present four dimensions regarding innovation management: strategy, efficient external relationships, implementation mechanisms and supportive organizational context, according to Figure 3.

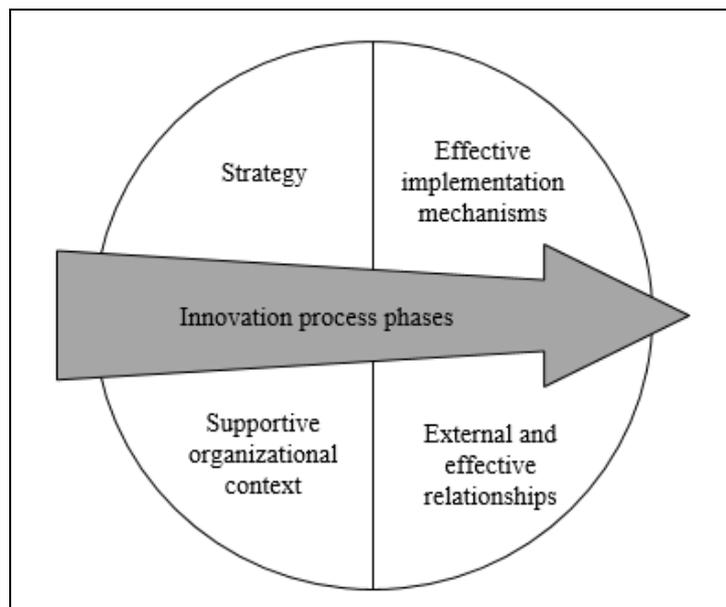


Figure 3: Behavior or routines for innovation

Source: TIDD *et al.*, 2008, p. 578

In the field of strategy, one can find three essential ingredients. The first one is the positioning of the company due to its products, processes, technologies and the context in which it operates. The second ingredient regards the technological trajectories that the company can follow, given the competencies gathered by the company. The last one refers to processes that integrate learning in all the sectors and levels of the company.

The efficient external relationships are a result of the approximation with the players involved in the company's activities. These players can be the market, strategic partners, suppliers, clients, and even competitors. The interaction with the external environment is an opportunity to learn.

Through the mechanisms of efficient implementation, ideas or opportunities are transformed into reality. In a structure where decision-making follows clear criteria, such mechanisms are useful to solve inevitable problems that might come along the execution of innovation projects. They help the company when it is necessary to focus on the development of a certain product or process, but they are also useful to indicate when it is necessary to stop.

Finally, the supportive organizational context is the one that allows ideas to be created and transformed into innovation. It is very important for innovation management that there is a culture geared towards creativity. The conditions for

creativity to occur are related with proper structures, work organization, training and development, recognition and reward systems, and internal communication.

2.5. Hansen and Birkinshaw's Model

Hansen and Birkinshaw (2007) propose a model that sees innovation as a value chain, characterized by three main phases: generation, conversion and diffusion of ideas. These three phases comprehend six critical activities: internal and external collaboration (as well as the collaboration among units); selection and development of ideas; and diffusion of developed ideas. Innovation is understood as an integrated flow – ideas act as inputs that can be implemented or adopted by the company, according to Figure 4. This model proves a general overview regarding the use of innovation efforts. That way, barriers can be overcome in this phase, which makes the value chain of innovation even more strengthened.

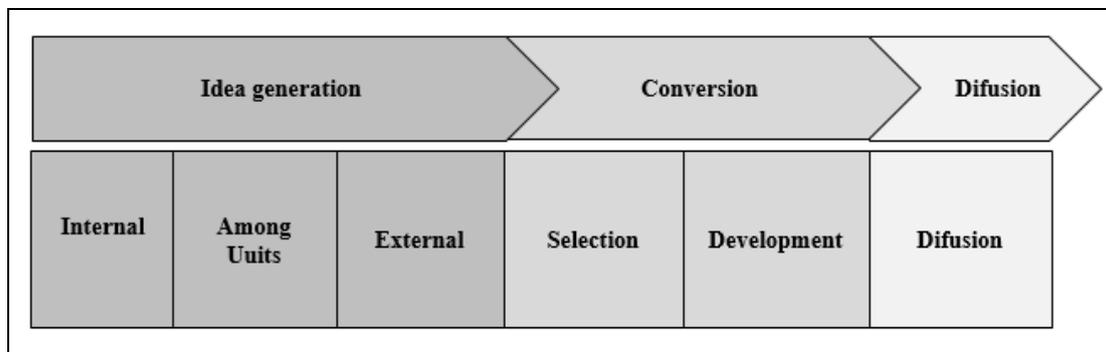


Figure 4: Innovation value chain

Source: adapted from HANSEN; BIRKINSHAW, 2007, p. 4

The approach that regards innovation as an integrated chain allows its links to be evaluated as weak or strong. According to the authors, its capacity to innovate is as good as the weakest link of its innovation value chain (HANSEN; BIRKINSHAW, 2007, p. 1). According to this evaluation, companies should provide the most adequate solutions for their reality instead of using solutions that have been developed for other organizations. In that case, there is the risk to adopt generic innovation practices that are no longer adequate, which can damage the performance through the innovation value chain.

The phase regarding the generation of ideas covers three activities: internal generation, generation among units and external generation. Initially, managers seek for better ideas inside their department – sometimes they realize, however, that great concepts can be generated by gathering pieces of ideas. In that sense, activities

regarding the generation of ideas among units and from external sources can enrich ideas generated internally.

The second phase of the innovation chain comprehends the processes of evaluation and selection of ideas and financing mechanisms of projects. If these processes are no longer adequate, there might be an interruption or a surplus of ideas. Regarding interruption, the consequence is the loss of opportunities to create innovation, besides discouragement. The surplus, on the other hand, can cause the waste of resources, focus and strategic alignment. The third phase consists of the diffusion and propagation of innovation. Besides the challenge of the diffusion of innovation to channels and clients, there are several times barriers inside the own organizations.

The research approach proposed by Hansen and Birkinshaw (2007) is useful because it understands that the capacity of a company to innovate is as good as the weakest link in the innovation value chain. Once that the barrier in the innovation flow is identified, the company must use its resources and efforts to solve problems. Once it is done, a new barrier might come along and, one more time, the company has to redirect its attention towards the new identified weak link. In a cumulative way, the process of generation, conversion and diffusion will become more effective.

2.6. Theoretical synthesis: Innovation integrated management

From the 1980s on, innovation stops being treated as a process essentially linear and compartmentalized. The consolidation of this process occurred in the next decade, in the 1990s, with the integration of organizations through networks and clients. The authors Neely and Hii (1998) emphasize the importance of networking and the geographical localization issue for innovative activities within the company.

In this period, studies have also been published regarding integrated models of innovation management. The studies accomplished by Jonash and Sommerlatte (2001) and Tidd et al. (2001) are references when it comes to the systemic approach of the innovation process. The study accomplished by Hansen and Birkinshaw (2007) strengthens the systematic character of innovation in organizations. Table 1 synthetizes the main characteristics of each one of the models in order to outline the dimensions explored in the field survey.

Table 1: Characteristics of innovation management models

Model	Authors	Characteristics	Dimensions, processes, phases
Most advanced generation	Jonash; Sommerlatte (2001)	The model is based on two principles: innovation has to be conducted in the whole organization (systemic approach); it has to leverage competencies and technologies (by means of platforms). It has four dimensions from which innovation may occur – there is also a fifth dimension, the capacity of the organization to learn.	Innovation strategy; innovation process; innovation resources; innovation organization; learning
Innovation Process Model	Tidd; Bessant; Pavitt (2001)	Innovation is a generic process (common for every company), associated with survival and growth and composed of three phases. An effective innovation management supposes a good performance towards four behaviors.	Innovation process: search, selection and implementation (permeated by learning); strategy; supportive organizational context; implementation mechanisms; external relationship
Innovation value chain	Hansen; Birkinshaw (2007)	Innovation as an integrated flow, which covers the generation of ideas towards the market. This approach allows companies to identify the barriers of the innovation process.	Innovation process: generation of ideas, conversion and diffusion

Source: Authors, 2016

From the theoretical framework presented herein, we can affirm that the models “most advanced generation” and “innovation process model” are very similar because they describe the context in which innovation management is expressed. In other words, both models regard dimensions (‘groups of behaviors’ according to TIDD et al. 2008 or ‘fundamental areas’ according to JONASH; SOMMERLATTE, 2001) that must occur in a harmonic way so that innovation happens.

Despite each model presents its own classification regarding dimensions and even though their limits are not the same, in a general way the dimensions overlap or complement one another: innovation strategy and strategy; process of innovation and implementation mechanisms; resources and organization of innovation with a supportive organizational context and external relationship; learning and supportive organizational context. In short, these two models have a systemic approach towards innovation.

The similarities between the ‘innovation process model’ and the ‘innovation value chain’ are in the procedural focus. Each approach agrees that the challenge to innovate is different in each company, even when they operate in the same sectors (HANSEN; BIRKINSHAW, 2007, p. 2; TIDD *et al.*, 2008, p.89). However, they also agree that there is an underlying sequence: search for or generation of ideas;



selection or conversion; implementation or diffusion. In short, these two models understand that the company has to develop innovation in a systematic way.

Even though there is successful innovation occasionally created (which is not sustainable over time), it is possible to affirm that the company manages innovation only when the results reached are the results of a systematic and systemic process. That way, the interest of this study is to evaluate the level of maturity of the management and the relationship with the obtained results. It is understood that five dimensions should be analyzed in the context regarding the LPA of the Electronic Valley according to Table 2.

Table 2: Dimensions of innovation management

Dimension	Characteristics
Strategy	Analyzes the company from the technological point of view and the alignment with the strategy of the business. Innovation has to be aligned with the strategy of the company.
Internal processes	Activities used to guide internal operations are configured. Innovation can be reached through the review of routines, in order to seek for greater efficiency, better productivity, greater quality in its products and less response time to the environment.
External environment	To deal with an environment in constant transformation, it is necessary to have a constant monitoring to identify opportunities and threats. The most innovative companies adopt a proactive posture regarding the environment in which they operate, they also operate in networks and have established partnerships with other agents.
Organization	To understand the way in which the company is organized. That includes an organizational structure (represented by the company's organization chart), but also approaches more subjective aspects, such as organizational climate and internal communication.
Culture	The creation of a culture focused on innovation, in smaller companies, is subject to the approval of the leader, founders or people related to them. The issue regarding knowledge, responsibility and autonomy of employees is approach, and also incentives for creativity and innovation.

Source: Authors, 2016

3. METHODOLOGY

The purpose of this study is to identify the relationship between six constructs analyzed in the framework. According to Vergara (2011), this research is classified as a field study, since it handles a survey accomplished where the phenomenon occurs through the application of questionnaires (primary data).

Based on the obtained data, we intend to verify which are the associations among the dimensions of innovation management and the innovative performance of companies. That way, we can define this research as a quantitative study. The conceptual model of Figure 5 synthesizes the theoretical review presented in the previous section.

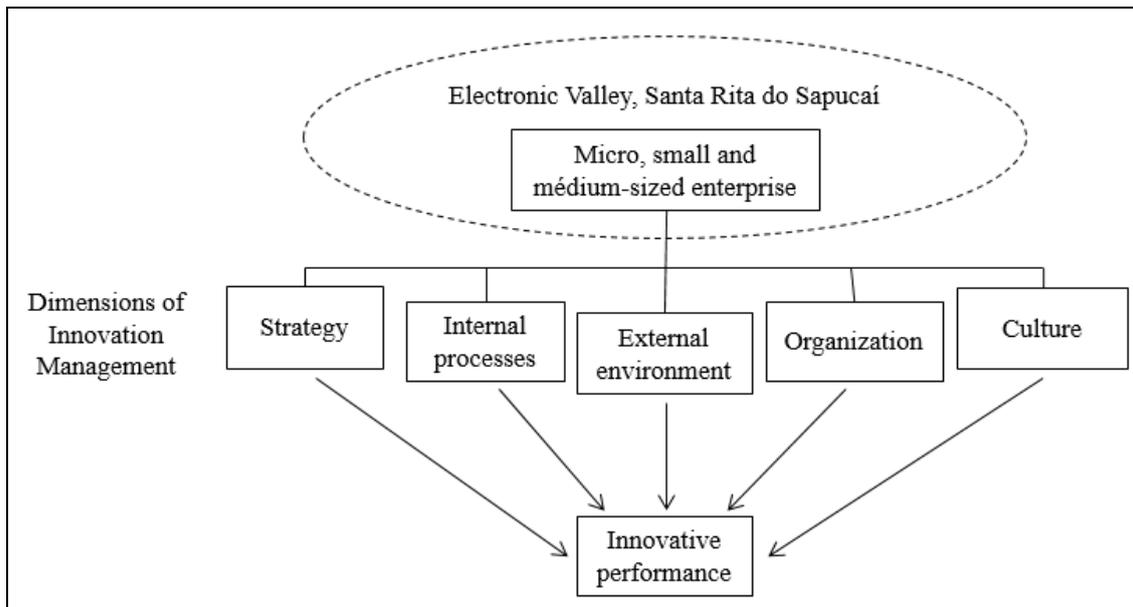


Figure 5: Conceptual model

Source: Authors, 2016

The data collection for the research occurred through the application of surveys, which were later transcribed into a database. Before applying the survey, we accomplished two pre-tests, carried out with specialists from these APL and with other companies that had characteristics similar to the research population (HAIR; BABIN; MONEY; SAMOUEL, 2005). The purpose of this stage was to increase the reliability of the search by ensuring that the questionnaire could measure what it stands for (MARTINS; THEÓPHILO, 2009).

The first analysis comprehends the descriptive statistics, which served as a first guide because it provides information about the quality of data and indicate tendencies, if they exist (BOTTER *et al.*, 1996). Next, we accomplished a linear regression analysis (HAIR *et al.*, 2005).

The use of such statistics technique is very relevant because the theory regarding innovation assumes that there is an association between innovative performance and innovation management. Besides, we only work with one dependent variable. The regression analysis can be used when one wants to create models that explain the impact produced by a group of variables regarding the behavior of another variable (FÁVERO, 2009; HAIR *et al.*, 2006).

The operationalization of this research measures six variables. To measure each variable, we used scales of multiple items. According to Hair *et al.* (2005), a scale of multiple items consists of individual affirmations (items or indicators) strictly

related whose answers are combined in a composite score used to measure a concept. Each dimension of innovation management and innovative performance was composed by four to six variables to measure the construct, each of them measure in a five point Likert scale.

4. RESULTS AND DISCUSSION

The final size of the sample embraces 41 companies and it was not necessary to exclude any questionnaire. The universe of the research, according to SINDVEL, corresponds to 142 companies. In agreement with the criteria of company size provided by the Brazilian Development Bank, 70.7% of them are microenterprises, 17.1% are small enterprises and 12.2% are medium-sized enterprises. The annual average revenue was R\$ 5.11 million; since there are several microenterprises involved, it is important to highlight the median measure of R\$ 1.24 million. The companies analyzed exist on an average of 11 years; 63.4% of them are less than ten years old. The main sector of activity is electronics, followed by security, factory automation and telecommunication (Figure 6).

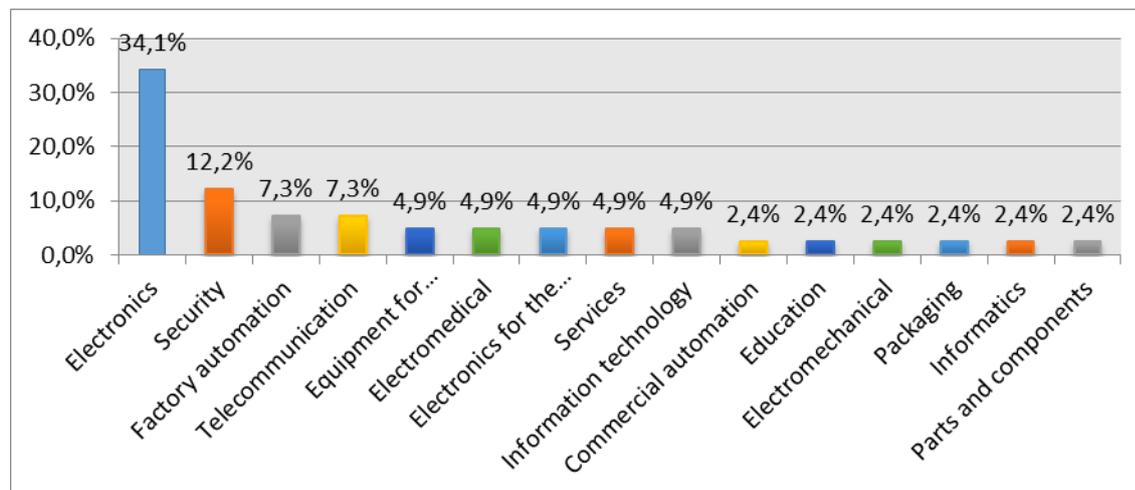


Figure 6. Sector of activities

Source: Authors, 2016

Regarding products launched by the companies three years before the accomplishment of the research, 51.2% of them affirmed that they launched new products in the national market; these products, however, already existed in the international market. Such occurrence indicates a strategy based on benchmarking of foreign markets to launch products in the domestic market. That way, the company can reach the status of innovative in Brazil (BOTELHO; KAMASAKI, 2004).

We conducted interviews with 160 employees representing the 41 companies. Regarding the functions that the employees have in their respective companies, most of them operate in Research, Development and Engineering (28.75%), followed by departments related to Administration (23.75%). Regarding the positions the employees have in the company, 40% of them are operators/analysts, 37.5% are managers/superintendents, 20% are the entrepreneurs themselves.

4.1. Regression analysis

The independent variables that compose the model presented a positive correlation placed between medium and high (HAIR *et al.*, 2005), which indicates a multicollinearity problem when accomplishing the linear multiple regression. This is the reason why we accomplished additionally a bivariate regression analysis for each pair of independent-dependent variables. The outcomes are presented in Table 3. The independent variable referring to each analysis was placed in the file "Model".

Table 3: Coefficients of the bivariate analysis

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Strat	1,113	0,045	0,973	24,582	0,000
Int Proc	1,266	0,055	0,969	22,928	0,000
Ext Env	1,128	0,048	0,970	23,416	0,000
Org	1,115	0,046	0,973	24,450	0,000
Cult	1,184	0,047	0,974	24,952	0,000

Source: Authors, 2016

The results indicate that the five dimensions that compose the model of Integrated Innovation Management (Strategy, Internal Processes, External Environment, Organization and Culture), singly, have a positive linear relationship with Innovative Performance.

The intention to accomplish the bivariate analysis while pulling off the multiple regression is due to the multicollinearity problem, where variables covariate. In other words, variables would basically work as a proxy of one another. For that reason, we had to recur to the structure provided by bivariate relationships.

In the linear multiple regression, when all independent variables are present, we used the forward method as a selection criterion. The tolerance rate complements the interpretation because it suits for the multicollinearity effect: the

smaller its value, the more the variable can be predicted by the other ones. The coefficients of the multiple regression analysis can be seen in Table 4.

Table 4. Multiple regression coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
Cult	1,184	0,047	0,974	24,952	0,000

Source: Authors, 2016

Due to the high correlation among independent variables, one could expect that only a small amount of them would be enough to explain the model. That way, the results indicate that only the dimension "Culture" contributes significantly to explain the integrated model of Innovation Management.

5. CONCLUSIONS

The purpose of this study was to identify how Innovation Management dimensions (Strategy, Internal Processes, External Environment, Organization and Culture) associate to affect the Innovative Performance and which are the predominant ones in the context of micro, small and medium-sized enterprises. The result of the model surprised us when showing that all constructs have a high correlation among themselves, since we expected the five dimensions to have a different behavior.

This is the reason why we had to deal with the multicollinearity problem, which led us to see that only one dimension of Innovation Management was enough to explain the Mode of Figure 5: culture for innovation. When analyzing them separately, however, we could determine that all five dimensions have a strong positive relationship with Innovative Performance.

The descriptive analysis of the dimensions indicated that the scores were around 3.8 (amplitude 1-5). As the companies of the sample belong to high added-value sectors, they face a very strong competition. In order to remain competitive in the market, it is necessary that they constantly launch new products while improving management practices. That way, the high scores in the five dimensions of innovation management support the commitment towards innovation.

The dimension Culture presented a medium score (3.82). Despite this fact, Culture is the only variable that was accepted in the multiple regression model,

presenting a $R^2 = 0.948$, the highest among the five variables. In fact, Tidd (2008) emphasizes the commitment with the development of people as one of the key-characteristics of innovative organizations. The author also mentions the adequate atmosphere for creativity and learning as core issues.

It was possible to conclude that there is a linear and direct relationship between the five dimensions of the Innovation Management Model and Innovative Performance, when the variables are analyzed separately. On the other hand, we could also conclude that when the five dimensions are analyzed together, the variable Culture is the only one necessary to explain the completely integrated model.

In accordance with Joanash and Sommerlatte (2001), Tidd et al. (2001), and Hansen and Birkinshaw (2007), however, to manage efficiently innovation is not about having success in one or two aspects, but in every area and levels within an organization, and also the interaction between the organization and the environment surrounding it. As further researches, we suggest to reduce the focus to each one of the dimensions while analyzing a new one, related to the learning process of organizations.

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