

Obstacles to implementation of innovations in Brazil: how different companies perceive their importance

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ABSTRACT

The objective of this study is to see how different companies perceive the importance of obstacles in the implementation of innovations. This is a descriptive research, developed through statistical analysis (factorial regression and ANOVA), based on secondary data, covering a sample of nearly 23,000 companies. The companies were organized into different groups. The results indicate a slightly higher perception on the part of small businesses, especially in the case of industrial companies. They also indicate that barriers related to economic issues are perceived to have greater importance than the others. It is concluded that different companies have different perceptions on most obstacles listed. Few differences were found between groups with respect to centralization of innovation activity in other units and many differences were found in the lack of qualified personnel. The lack of information about technology and the lack of qualified personnel have been identified as factors that contribute the most to whether or not companies innovate.

Keywords: Innovation; obstacles; PINTEC.

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1 INTRODUCTION

Currently, companies are under several pressures, such as competitive intensity, legal requirements and requirements of stakeholders, amongst others. "They constantly find innovative solutions to the pressures that they suffer from competitors, consumers and regulators." (PORTER; van der LINDE, 1995, p. 120). "It is widely recognized that technological change and innovation are the main drivers of economic growth and are at the heart of the competitive process." (CAINELLI; EVANGELISTA; SAVONA, 2005, p. 435). That was championed by Schumpeter (1997), in the early 20th century. Thus, "innovation is critical for sustained growth and the prosperity of organizations" (GOMIS *et al.*, 2011, p. 3), as a means of gaining competitive advantage, in that the economic focus is the center of activities. (DAROIT; BIRTH, 2004, p.1).

Therefore, innovation is an alternative for seeking to achieve or maintain competitive advantage, either by reducing costs or by the expansion of its market or, ultimately, just to survive. "The gains in competitiveness that innovation can bring are important stimuli for the implementation of products and/or new or substantially improved processes by the company." (IBGE, 2007, p. 50).

Implementing innovations is a challenge that demands study, time and resources, and its route also requires that managers confront and overcome the obstacles. These obstacles have different origins, but the principal ones are: economical (costs, risks, funding, etc.), organizational (rigidity, centralization, etc.), informational (market information, technology, etc.), technical (qualified personnel, technical services, etc.) and other (co-operation, consumers, rules and regulations, etc.) without, however, disregarding the others. Therefore, the first step towards seeking alternatives for companies to solve or overcome their obstacles is to identify and evaluate them. The IBGE (2007, p. 58) has emphasized in Technological Innovation Research (PINTEC) that:

The reasons why companies do not innovate and the obstacles they encounter in the development of their innovative activities provide valuable information for the formulation and evaluation of policies aimed at increasing the technological performance and competitiveness of firms.

The IBGE has already developed surveys, in PINTEC, about some obstacles faced by companies in the innovation processes that have contributed to the companies not

implementing innovations at certain periods. However, the obstacles are only identified and are measured fairly superficially, not being explored in more depth.

In order to broaden the depth of the study begun in PINTEC and to better understand the barriers to innovation that are perceived by companies, the problem that will guide this study is expressed with the following research question: **How do companies perceive the importance of obstacles in the implementation of innovations?**

The list of obstacles can be extensive, depending on the context, so it was decided to limit the focus to the obstacles listed in PINTEC, because this list is based on the Oslo Manual (OECD, 2005) and similar to others used throughout the world. The types of companies are also diverse, so they will be classified according to the classifications contained in PINTEC.

The importance of the study is rooted in its own explanation of the IBGE (2007, p. 58 – authors' emphasis) that the information obtained from the study of obstacles to innovative processes "[...] provide valuable information for the formulation and evaluation of policies aimed at increasing the technological performance and competitiveness of firms." The importance of obstacles in the innovation process was also highlighted by Mohr (1969, p. 114 – authors' emphasis), when he said that "innovation is directly related to the motivation to innovate, inversely related to the strength of the obstacles to innovation, and directly related to the availability of resources to overcome such obstacles." Added to this is the need for every company to have a diagnosis of their obstacles, an assessment of them and measures that are, or will be, taken to overcome them.

In an effort to answer the research question, statistical procedures such as exploratory factor analysis and Logistic Regression, and the Analysis of Variance (ANOVA) were used, as well as the t-test to identify the differences in averages between some groups. The results indicated a slightly different perception among small businesses and others that obstacles related to economic issues have greater importance, according to the average, than the others and that different companies have different perceptions about most obstacles included in the study. The high cost of innovation was the obstacle with the highest average importance attributed in most groups of companies considered. Lack of information on technology and lack of qualified personnel contribute greatly for the companies to implement innovations.

In addition to this introduction, this study is structured in four sections: one that addresses the main theoretical topics relevant to the study; one that deals with the

methodological aspects used; the following, which brings the data analysis; and the last, in which final remarks are made.

2 THEORETICAL FRAMEWORK

The theme of innovation has attracted many researchers from various academic disciplines, including research in fields such as product development, project management, general management, organizational theory, economics and psychology (TANG, 1998, p. 297), but "despite the numerous studies on the subject of innovation, there is still a lack of consensus on a single definition" (WAN; ONG; LEE, 2005, p. 262). Perhaps because "the concept of 'innovation' is seen in different manners in the literature" (WONGLIMPIYARAT, 2004, p. 229).

Innovation is not a new concept. "Innovations had already drawn the attention of many scholars since the most ancient times, [...]" (BARBIERI, 2007, p. 85). By the early 20th century, more precisely in the 20s, Innovation Theory emerges in the early work of Schumpeter, "about the positive effects of innovation in firms and countries, positioning it as a 'springboard' for economic growth." (SANTOS, 2009, p 30). "[...] It has been common to consider the work of the Austrian economist Joseph Schumpeter, at the beginning of the last century, as a major milestone for his study on the economic outlook and business" (BARBIERI, 2007, p. 85).

The definition of innovation given by Schumpeter (1997) is considered by Nuchera, Serrano and Morote (2002, p. 55) as the most classical of definitions. The OECD (2005, p. 56), much quoted today, follows the line of Schumpeter, defining innovation, briefly, as the implementation of something new or significantly improved, both a product (or service), as a process, a marketing method or organizational method. The OECD (2005, p. 69) also identifies that innovations must present a degree of novelty for the company, for the market or for the world.

But innovation is not just about technology in transition and is not limited to technological changes. Innovation involves technological changes (products and services, processes, training), but also changes in the business model (value proposition, supply chain, customer target). According to Burgelman, Christensen and Wheelwright (2004, p. 2), technological innovation can be understood as a combination of activities that lead to new products or services and/or new process and distribution systems. The dimension of non-technological innovation covers "all innovation activities that are excluded from technological

innovation. This means that it normally includes all the innovation activities of companies related to organizational and managerial issues. "(SCHVARZ SOBRINHO, 2009, p. 34).

Currently, "innovation is a key requirement for business enterprises". Kay (1993, apud BROWN; MAYLOR, 2005, p. 308) argues that innovation is one of the key factors needed to achieve competitive success" (BROWN & MAYLOR, 2005, p. 308).

In the management process, there are problems and difficulties to be faced and obstacles to overcome. "The innovation activity may be hampered by several factors." (OECD, 2005, p. 128). These factors may be those that affect the innovation process or impact negatively on the expected outcome of innovation (OECD, 2005, p. 128) or those that restrict innovation activity (CSO, 2009).

Various barriers could be listed that arise before, during and after the implementation of innovation; for example, market conditions, cultural barriers (internal and external) and technological barriers (access, cost, skills, knowledge, etc.).

Several lists of obstacles could also be used, like those used by Sirilli and Evangelista (1998), Hauknes (1998), Howells and Tether (2004), EUROSTAT (2004), OECD (2005), CSO (2009), among others. However, it was decided to use only the list of obstacles used in PINTEC (IBGE, 2007, p. 25), which uses as conceptual and methodological reference the Oslo Manual and the *Community Innovation Survey (CIS)* conducted by EUROSTAT in Europe. (IBGE, 2007, p. 14).

On the list appear factors of an economic nature (costs, risks, appropriate sources of financing), problems internal to the company (organizational rigidity), faults (lack of adequate external technical services, lack of qualified staff), information problems (lack of information on technology and markets), problems with the national innovation system (few opportunities for cooperation with other companies/institutions), and regulatory problems (difficulty to comply with the standards, rules and regulations) (IBGE, 2007, p. 25).

Table 1 lists these obstacles. The nature of the factors was classified, for the purposes of this study, as can be seen in the quote above, but with the inclusion of a variable of internal problems in the group, not included in the quote, but included in the obstacles studied considered in PINTEC (IBGE, 2007).

Table 1 - Barriers to Innovation Processes

NATURE OF FACTORS	DESCRIPTION OF OBSTACLES	VARIABLE
Economic Nature	1 - High costs of innovation	Cost
	2 - Excessive economic risks	Risk
	3 - Shortage of appropriate sources of funding	Financial
Technical Deficiencies	4 - Lack of qualified personnel	Personal
	5 - Shortage of adequate external technical services	Services
Information	6 - Lack of information on technology	Technology
	7 - Lack of market information	Market
National System of Innovation	8 - Shortage of possibilities for cooperation	Cooperation
	9 - Weak consumer response to new products	Consumers
Internal Problems	10 - Organizational rigidity	Rigidity
	11 - Centralization of activity in another unit of the group	Centralization
Regulation	12 - Difficulty to meet the standards, rules and regulations	Standards

Source: Data for the survey, based on data from PINTEC (IBGE, 2007).

Immediately following, there is a rapid presentation of each in order to identify its importance, but not intended to define them.

With respect to the high costs of innovation, Burgelman, Maidique, and Wheelwright (2001, p. 551) state that high-tech companies invest 5% to 10% of their sales on research and development. Nimgade and Thomke (2001, p. 308) mention that pharmaceutical companies invest approximately 16% of their sales in research and development. That is, the investment required to implement that innovation is high, much more if the company is involved in high-technology markets, as in the examples cited, or companies involved in the process of radical innovation. Therefore, the high costs of innovation can be an obstacle, since most companies do not have sufficient resources for them and, in many cases, actual spending is higher than predicted, and there is no guarantee of return on the investment, requiring companies to seek cost minimization.

The economic risks are high, due to the high costs spent in the innovation process. They can be amplified if the innovation process redefines the company's products to a market

unknown to it or if a new standard for the product is entered in the market by the competition. Economic risks are also associated with the time it takes for an innovation to be implemented, from its initial idea. As there are no guarantees of return on the investment, economic risks associated with the process may be obstacles, mainly the greater time required for the development of the innovation process. In many cases of radical innovations, the risk is the extreme factor, since there is no possibility of turning back.

The risk is in the group of economic obstacles, but their perception is determined by individual characteristics, depending on the propensity for or aversion to risk. In this way, the economic risk is an obstacle, but the individual characteristics are what determine the degree to which this obstacle will be perceived.

The lack of appropriate sources of funding is a problem. The main source of funding is the results generated by the organization itself, but in its absence or the need for more resources, it must resort to external sources, in which case, the scarcity of funding sources, both in quantity and in availability, becomes an obstacle.

The lack of qualified personnel is a recurring complaint among Brazilian companies; however, in the context of innovation, the need is greater in relation to innovative capacity than to the qualification. Mussi and Spuldaro (2008, p. 45) stress that "other obstacles to innovation, [...] refer to the problem of the lack of skilled labor and the difficulty of immediately absorbing and adapting to innovations in the method of work." The obstacle in this case may be focused on the lack of personnel with innovative capacity or the lack of qualified personnel to handle innovations, besides the need to know how to deal with new technologies.

The lack of adequate external technical services is similar to the lack of qualified staff, but focuses on the environment external to the organization. The innovative capabilities, knowing how to deal with innovations and new technologies, are also pressing this case.

Information about technology helps to educate companies about possible threats and opportunities that these technologies are creating. (COTEC, 1999, p. 20). "Among the main advantages of using external sources of technological information, may be cited the creation of new opportunities, effective and faster results, lower costs of innovation, greater ease in establishing priorities and stimulating internal innovation." (MASON ; BELTRAMO; PAUL, 2004 cited in GOMES; KRUGLIANSKAS, 2009, p. 3). Therefore, the lack of information technology can create obstacles in the implementation of innovations, since, currently, most

of the innovations are based on some technology and in some cases state-of-the-art technologies.

Market information is intended to assist in the analysis of the market and, in particular, the behavior and needs of customers, which can provide valuable information with which to feed the innovation process. In addition, market analysis is useful for identifying new opportunities. (COTEC, 1999, p. 10). The lack of this information becomes problematic for the innovation processes.

"Companies can obtain inspiration and guidance for their innovation projects from a variety of sources of information [...], and their ability to innovate is certainly influenced by their ability to absorb and combine such information." (IBGE, 2007, p. 23). Therefore, "the innovative activities of a firm depend in part on the variety and structure of their interactions with the sources of information [...]" (OECD, 2005, p. 87). Therefore, "it is clear that information is a key input in the innovation process, at the beginning of a project (in terms of knowledge creation) or the end (in terms of knowledge dissemination)." (EUROSTAT, 2004, p. 23). Thus, the lack of information on technology or the market, is an obstacle to innovation.

Johannessen and Olsen (2010, p. 503) believe that new structures of cooperation are one of the mechanisms that initiate, sustain or enhance the process of social change and also improve innovation. Nidumolu, Prahalad and Rangaswami (2009, p. 8) also state that few innovations can be developed in the world today without companies joining with other companies or organizations. Likewise, for Mello, *et al.* (2008, p. 60) and Márquez and Pérez (2007, p. 2), the relationship with other organizations is one of the factors of organizational capacity. Moreover, difficulties in developing, maintaining and utilizing relationships with partners become an obstacle because the innovations are somehow related to customers, suppliers, partners and even competitors, amongst others.

Howells and Tether (2004, p. 80) include attention to customer needs as one of the factors for successful innovation. Rothwell (1992, p. 74) considered this as a factor for successful innovation. Earlier, Mohr (1969, p. 63) already considered this to be one of the predictors of innovation. Consumers are recognized in theory and practice as external resources. Many studies have shown that the involvement of consumers in the innovation process has a positive influence on its success (GASSMANN; WECHT, acesso em 27 jan. 2010). Therefore, difficulties in achieving consumer response become an obstacle in the process of innovation because, among other reasons, it might be linked to difficulties in relationships with those consumers.

According to Wan, Ong and Lee (2005, p. 262), the concentration of power by centralization is supposedly the main obstacle to the adoption of innovations. Adaptability, flexibility and organizational agility are factors that contribute to the success of the innovation processes (MAIDIQUE; HAYES, 2001, p. 25-26). Decentralization was also considered by Mohr (1969) as one of the predictors of innovation at the collective level, and organizational structure and organizational flexibility were considered important factors for successful innovation by Howells and Tether (2004, p. 80).

Some companies are struggling in their fields, because they are governed by standards, rules and/or regulations, usually of government order (laws, for example). That is, the innovations must meet certain standards, rules and/or regulations, and the company is struggling to meet them. This process is thus being an obstacle in the process of innovation. In some cases, their own rules and/or regulations require that innovations be implemented, for example, the laws currently related to environmental issues.

Therefore, the successful implementation of innovation presupposes the need to circumvent or overcome these obstacles, so much so that Howells and Tether (2004), Wan, Ong and Lee (2005), Tether and Massini (2007) and Mansury and Love (2008) describe some deciding factors of successful innovation that can be considered counterpoints to some of the obstacles listed above, as highlighted below:

- Compliance with standards and norms (HOWELLS; TETHER, 2004) as opposed to the difficulty of adapting to rules and regulations;
- Decentralized and informal structure (WAN; NGOs; LEE, 2005) as opposed to centralization and organizational rigidity;
- Organizational Resources (WAN; NGOs; LEE, 2005) as opposed to the lack of funding sources and costs of innovation;
- Willingness to take risks (WAN; NGOs; LEE, 2005) as opposed to economic risks;
- Qualified workforce (MANSURY; LOVE, 2008) as opposed to the lack of qualified staff and lack of external technical services;
- Sources of information (TETHER, MASSINI, 2007) as opposed to lack of information about the market and technology.

Therefore, the decisions companies need to make to circumvent or overcome these obstacles come from the knowledge of these obstacles and their evaluation, as well as identifying the best possible alternatives. The successful implementation of innovations involves factors that are opposite to those obstacles. And this is one of the contributions of this study: to provide information about some of the obstacles and the perceived importance of each by Brazilian companies. Future studies may, from now on, seek to verify what companies can do to overcome these obstacles.

3 METHODOLOGICAL ASPECTS

This is a descriptive research, which according to Collis and Hussey (2005, p. 24), "is used to identify and obtain information on the characteristics of a particular problem or issue." The issue at hand is the verification of how companies realize the importance of obstacles in the implementation of innovations. To answer this question, it was decided to carry out a descriptive study, using secondary data, collected through a survey by IBGE (2007).

The objectivist hypothetico-deductive analysis of the data was founded in the exploratory factor analysis, the logistic regression and analysis of comparisons of averages (t-test and analysis of variance), by using the Statistical Package for the Social Sciences (SPSS®).

Data from PINTEC/2005 (IBGE, 2007) was used, because the PINTEC/2008 was just released on 10/29/2010, after the completion of the tabulation and calculations and analyses of this study. The choice of PINTEC is justified from the following argument:

The adoption of an internationally accepted and applied methodology, and operational procedures more advanced than those used in most countries, aimed to ensure the quality of the information and its comparability with international data. (IBGE, 2007, p. 14).

The information which formed the basis for this study is contained in spreadsheets disclosed in PINTEC (IBGE, 2007, p. 112-123) and spreadsheets available on the IBGE site (<http://www.pintec.ibge.gov.br/>). The data do not present the detail needed to perform the analyses, requiring its tabulation. This tabulation has generated a matrix containing 22,955 lines, each corresponding to the view of a company, and 16 columns, 12 referring to the obstacles and the other 4 referring to data necessary to the analysis. The following tabulation is contained in spreadsheets, so there is no identification of the companies nor the relationship with these data, i.e. the data are not matched, precluding analyses that require this feature (e.g., regressions and correlations).

In addition to this tabulation, since the data are not matched, precluding logistic regression, it was necessary to make a new tabulation. Thus, companies were grouped by segment, according to the segments included in PINTEC, resulting in a sample of 36 segments, for which the average was calculated from the perception of companies regarding the degree of importance of each obstacle (variable) in each segment, separating them into two groups (those that have and have not implemented innovation), with 36 segments in each group.

The sample included in PINTEC is divided into extractive industrial companies in manufacturing industries and some service providers, along the lines of the National Classification of Economic Activities (NACE). The table refers to the divisions and aggregations of enterprises in the PINTEC (IBGE, 2007, p. 17), with the detailing of activities and exceptions (inclusions and exclusions) for some of them.

The survey of the perception of the importance of the variables is first divided into two groups of companies: those that implemented innovations and those that have not implemented in the period from 2003 to 2005. In the latter group, the market conditions are the main reason for companies not to implement innovations, representing approximately 70% of the companies in this group, with approximately 11% of them even claiming that they did not innovate because they had completed previous innovations. The remaining 19% (11,404 companies) said they did not innovate due to other factors. These other factors, as identified in Table 1, are the factors also included in the questionnaire for companies that innovated (11,551 companies). Future studies may seek to exploit market constraints as an obstacle to innovation.

4 DATA ANALYSIS

The first step was to verify the reliability of the scale. The measurement of obstacles (variables) is made by PINTEC by a three-point interval scale, and assessment options were "high importance", "medium importance" and "low importance or not relevant," being assigned to them the weights 3, 2 and 1, respectively. The reliability of the scale was made from the Cronbach's alpha for the 12 variables, considering the total enterprises. The result was 0.966, indicating the reliability of the scale. According to Field (2009, p. 594), "a value of 0.7-0.8 is acceptable for Cronbach's α and substantially lower values indicate an unreliable scale." The result presented by SPSS ® suggests that the variable Centralization could be removed, increasing the result of Cronbach's alpha, but it was chosen to keep it, at least initially, because the gain in the value of Cronbach's alpha would be small.

Further, there was the normality of data from Kolmogorov-Smirnov and Shapiro-Wilk, which revealed that there is no deviation from normality according to both ($p < 0.001$).

The first part of the analysis starts with the verification that took into account the existence of statistically significant differences in perceptions between some of the possible groupings. In this way, a check was made for the existence of statistically significant differences in the average importance attributed to each variable for groups of companies that have or have not implemented innovations in the period, according to the t-Student test, at the 0.05 level. "The t-Student test is used to test whether the averages of two populations are significantly different or not" (MAROCO, 2003, p. 122). The result indicated that the perception of the two groups is statistically different, so the analyses should not be made jointly.

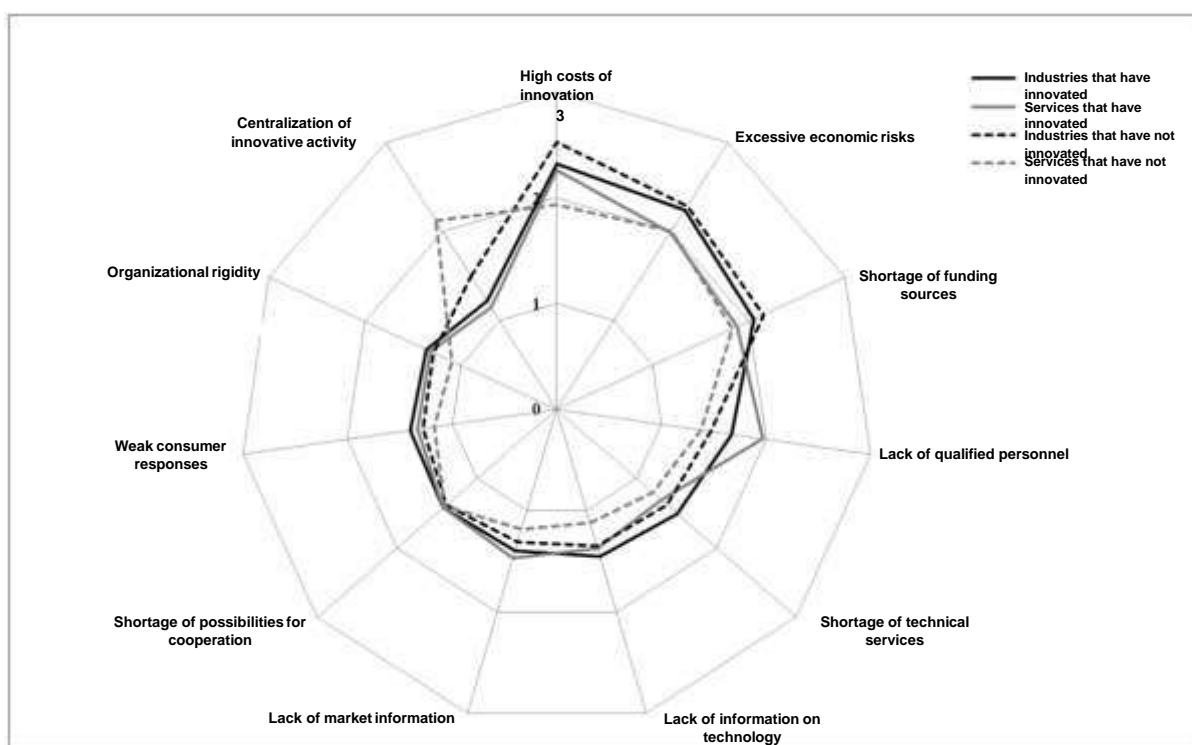
Likewise, it was found that there is a difference between the average perception of the importance attached by the industries and service providers. The result indicated that industries and service providers differ significantly. The test indicated no difference in three variables, but the fact is confirmed in the graph analysis (*Error Bar*), which is a second opinion if the difference between the averages is relatively small. Thus, the perception between these two groups is also statistically different.

Furthermore, the analysis was done in a segmented manner: industries that have or have not implemented innovations and service providers that have or have not implemented innovations, by analysis of variance (ANOVA One-Way) for the four groups. To test the significance of the results, the 0.05 level was chosen. The Tukey test was also used, as this is considered "[...] one of the most robust to measure deviations from normality and homogeneity of variances [...] for large samples, [...]" (MAROCO, 2003, p. 133). In just three points, the graphical analysis showed a difference in relation to the test.

The detailed analysis and discussion of the relations of convergence or divergence in each variable from the results could ultimately extend for several pages; however this study did not, leaving this exercise for future researchers. However, some aspects are interesting. All groups differed in the variables: Personnel; Services; Market; and Consumers. For those industries that have innovated and that did not innovate, different average importances were presented for the variable Cooperation, and the average given by the industries that innovated was superior to the others. For the remaining variables, just two groups did not diverge from each other.

From the results obtained, it is not possible to establish a pattern, i.e., the average amounts, awarded by industries and by service providers that do or do not innovate, change for most variables. The discrepancy can be observed in the four variables in the four groups that have perceptions of average importance statistically distinct.

Graph 1 helps to visualize the differences between these four groups; it is clear that the convergence of the sums allocated to the variable Cooperation and the spacing in the variable Personnel. Additionally, it can be seen that the trend of the variables related to Economic Nature possess averages higher than the others.



Graph 1 - Comparison of the averages

Source: Prepared by the authors.

The next step was to segment the sample further, now also in terms of size according to the number of persons employed. Thus, companies were separated into groups, with the first group containing industries that innovated, with 10 to 29 people employed; the second, industries that innovated, with 30 to 49 people employed; and so on, until the last group, which contains service providers that did not innovate, with more than 500 people employed, this group being excluded from the analysis because it contained only one company. There then remained 23 groups of companies.

To verify whether there are statistically significant differences between the importance attributed to each variable for each of the 23 company groups, ANOVA was used. To better

visualize and analyze the results, they were structured into 12 matrices with 23 rows x 23 columns. Each matrix corresponds to a variable, and the rows and columns correspond to groups of companies. Each variable was analyzed individually; however, due to space restrictions, the analyses are not reproduced here, but a summary of the conclusions drawn from the set of matrices is reported below.

It is important to note that, in this analysis, clusters of statistically significant divergences were considered and not the relationship between paired groups, i.e., the agglomeration of the greatest amount of difference between the groups was considered. Therefore, differences between the groups refer, in most cases, to the majority of groups and not the totality, because there was no consensus on any variable.

The variable Personnel was the obstacle where statistically significant divergences in the importance awarded by the groups occurred most. Cooperation was the variable that had the least statistically significant divergence between groups, while Consumers was the variable where divergence of a group occurred with almost all the other groups. Centralization was another case where differences occurred almost unanimously. Among the groups, the industry groups with less than 49 people that did not innovate, and service providers with 10 to 29 people that did not innovate, diverged more from the other groups.

In summary, there were no variables in which the differences between groups were constant, or nearly constant. Moreover, the variables were few in a group of companies that diverged from most other groups. This implies that the average importance assigned to each variable, for the most part, is similar, i.e., they have similar importance, regardless of whether or not the company has promoted innovation, the type of company (industry or service provider) and its size; unlike the individualized analyses (industry and services, innovative and non-innovative) since, considering only the industries and service providers groups and companies that did and did not innovate, statistically significant differences were observed.

Table 1 shows that most companies assign greater importance to economic factors (Cost, Risk, Finance). The other factors were below average, indicating that the importance of these is considered to be low to medium. Economic factors showed average levels of medium to high importance.

Table 1 - Averages of importance allocated to obstacles

		OBSTACLES												
		1	2	3	4	5	6	7	8	9	10	11	12	
		HAVE INNOVATED	INDUSTRY	A	2.33	2.26	2.15	1.73	1.57	1.47	1.42	1.47	1.45	1.40
B	2.40			2.28	1.97	1.63	1.53	1.58	1.45	1.33	1.29	1.26	1.13	1.63
C	2.34			2.20	1.93	1.58	1.38	1.39	1.37	1.39	1.32	1.30	1.22	1.43
D	2.27			2.18	2.01	1.59	1.43	1.36	1.36	1.33	1.35	1.39	1.15	1.46
E	2.16			2.20	1.75	1.48	1.31	1.31	1.35	1.27	1.28	1.23	1.14	1.35
F	2.14			2.05	1.71	1.52	1.29	1.34	1.31	1.31	1.34	1.36	1.20	1.35
SERVICES	A		2.30	2.02	1.81	2.04	1.30	1.47	1.51	1.43	1.30	1.29	1.22	1.33
	B		2.13	1.98	1.98	1.81	1.33	1.18	1.42	1.41	1.47	1.13	1.00	1.45
	C		2.01	2.01	2.53	2.07	1.46	1.31	1.66	1.57	1.28	1.62	1.14	1.60
	D		2.40	1.83	1.86	1.81	1.32	1.11	1.17	1.46	1.32	1.29	1.04	1.29
	E		2.21	2.07	1.79	1.96	1.39	1.29	1.46	1.36	1.25	1.75	1.09	1.36
	F		2.34	1.80	1.75	1.75	1.20	1.16	1.25	1.23	1.36	1.66	1.15	1.64
HAVE NOT INNOVATED	INDUSTRY	A	2.55	2.27	2.21	1.49	1.44	1.39	1.34	1.41	1.27	1.28	2.01	1.47
		B	2.49	2.28	1.99	1.47	1.25	1.30	1.26	1.36	1.29	1.33	1.74	1.46
		C	2.48	2.32	2.03	1.35	1.18	1.20	1.24	1.25	1.30	1.19	1.26	1.36
		D	2.39	2.26	1.94	1.42	1.25	1.17	1.23	1.34	1.33	1.22	1.28	1.27
		E	2.51	2.42	2.02	1.36	1.47	1.19	1.13	1.40	1.33	1.41	1.10	1.27
		F	2.29	2.04	2.00	1.24	1.16	1.16	1.22	1.35	1.22	1.31	1.08	1.29
	SERVICES	A	1.94	2.02	1.86	1.42	1.19	1.12	1.19	1.42	1.13	1.05	2.20	1.36
		B	1.97	1.94	1.44	1.12	1.06	1.12	1.25	1.12	1.12	1.59	1.80	1.28
		C	2.16	1.68	2.16	1.11	1.63	1.00	1.00	1.42	2.05	1.32	1.00	1.74
		D	1.86	1.71	1.14	1.00	1.00	1.14	1.00	1.57	1.43	1.14	2.00	1.57
		E	1.33	1.67	1.33	1.00	1.33	1.33	1.00	1.00	1.00	1.00	3.00*	1.00
		F	2.00*	3.00*	3.00*	1.00*	2.00*	1.00*	2.00*	1.00*	1.00*	1.00*	**	2.00*

A - Companies with 10 to 29 employees

B - Companies with 30 to 49 employees

C - Companies with 50 to 99 employees

D - Companies with 100 to 249 employees

E - Companies with 250 to 499 employees

F - Companies with more than 500 employees

* Value corresponding to only one company

values not reported **

Source: Authors.

In Table 1, some interesting points are highlighted, such as assigning higher average importance to economic obstacles for smaller industrial companies. This is possibly due to the greater economic and financial difficulties faced by these companies.

Also with respect to the variables of an economic nature, it is clear that industrial companies that have not innovated assign greater average importance to them than industrial companies that have innovated. Perhaps this discrepancy has its origin in the decision to innovate or not to innovate. This assumption will become more evident in the part where the Logistic Regression results are found.

Many other aspects could be highlighted; however the purpose of Table 2 is only to show that the average importance given by different types of businesses, classified by sector, innovation and size, is different and is statistically different in most variables, as had already been highlighted previously, according to ANOVA. That is, the perception of companies in relation to the variables listed in PINTEC and included in this study differs between different groups of companies.

Differences with respect to innovation depending on the size of the companies have already been identified; as in Kruglianskas and Gomes (2009). Differences in orientation of innovation among industrial companies and service providers have also been highlighted; as in Howells and Tether (2004) and Tether (2005). These differences, therefore, contribute to the fact that the perception and the real importance of the obstacles are different.

After the initial analysis to identify the differences in perception between different clusters of companies, it was moved to the Exploratory Factor Analysis (EFA) and Logistic Regression (LR).

The first step in EFA is the Kaiser-Mayer-Olkin test (KMO), which resulted in 0.940. Kaiser (1974 cited in FIELD, 2009, p. 579) emphasizes "that values between 0.5 and 0.7 are mediocre, values between 0.7 and 0.8 are good, values between 0.8 and 0.9 are great and values above 0.9 are excellent." That is, "we should be confident that the factor analysis is appropriate for these data." (FIELD, 2009, p. 579).

The EFA resulted in only three groups: one with the variable Centralization, one containing the first three variables (Risk, Cost and Financing) and the third with the others. Therefore, only the first group identified in Table 1 was confirmed by the EFA. The result is quite close to the grouping shown in EUROSTAT (2004), that combined 9 factors into 3 groups (economic, internal, and others). However, the scale reliability of each group

generated by the EFA, was below acceptable, which dismisses the possibility of analysis considering the three factors. If the group that contains only Centralization is deleted, the scale becomes reliable and the importance attached to the two remaining groups can be analyzed; however, only one group, with the variables of economic nature, presents theoretical coherence to the grouping. Future studies may attempt to confirm the groupings found in the literature via Confirmatory Factor Analysis.

Considering then the Economy factor (variables 1-3) and Other factor (variables 4-11), obtained from the EFA, it was sought to determine, through the RL, which of them had more contribution for companies to innovate, according to the perception of the importance attributed by the companies. For this part of the analysis, the tabulation by sector presented in the previous section was used; keeping in mind that using the data, tabulated initially according to company, makes it impossible to use this method.

Initially, it was attempted to verify the existence of multi co-linearity of variables. In this case, it was found that co-linearity exists; however, according to Blanchard (1998 cited in GUJARATI, 2006, p. 293), this is essentially a problem in the data and "sometimes we have no choice as to the available data for the empirical analysis." That is, despite being a problem, the analysis can still be done with caution, especially if the goal is to forecast or predict (GUJARATI, 2006, p. 297).

For the realization of RL, the dependent variable is whether or not the innovation was implemented in the period (1 - innovated; 0 - not innovated), i.e., a categorical variable. Obstacles are the explanatory variables. Data normality was also verified, according to Kolmogorov-Smirnov and Shapiro-Wilk, again being confirmed.

With the results of the RL (SPSS report), it was found that the two factors are significant variables in predicting the implementation of innovation, as both had $p < 0.05$. The overall adhesion of the model is determined by the likelihood-log, this being significant ($p < 0.05$), according to tests in Steps of Model Coefficients. Also in this sense, the Hosmer and Lemeshow test indicated the adherence of the model (Chi-Square = 8.134; $df = 8$; $p = 0.421$). The overall accuracy of classification, shown in the Classification Table is 73.6%. However, the explanatory power of the model is relatively low, since the R^2 of Cox and Snell was 0.270, and the R^2 of Nagelkerke was 0.360. Furthermore, the level of significance of the constant in the equation was higher than recommended.

The variables in the equation can be seen in Table 2.

Table 2 - Variables in the equation

	B	S.E.	Wald	df	Sig.	Exp(B)
Constant	-3,878	3,743	1,073	1	0,300	0,021
Economic	-3,825	1,452	6,935	1	0,008	0,022
Others	8,878	2,567	11,966	1	0,001	7175,255

Source: Authors, based on the results presented by SPSS.

Thus, companies have less awareness about the importance of the Economic Factor, but have greater awareness about the importance of Other Factors. It is also noticed that the implementation of innovation has a negative association with the Economic Factor and positive with Other Factors. The weight of the composition of Other Factors in the equation is well above the weight of the Economic Factor.

In this case, it is concluded that the chances of a company that implemented innovations to realize the importance of the issues (Economic and Others) is approximately 155 times higher than a company that did not implement innovations in the period. Virtually all of this proportion is represented by the factor Others.

It was then decided to conduct the RL using the variables listed in Table 1, except Centralization. Analyzing the significance of them, it was found that only the variables Costs, Personnel and Technology could be included in the model. The results indicated that all three variables are significant in predicting the implementation of innovation, since they had

$p < 0.05$. The overall adherence of the model, determined by the likelihood-log, is significant ($p < 0.05$); the tests in Steps of Model Coefficients and the Hosmer and Lemeshow test indicated the adherence of the model (Chi-Square = 10.395; $df = 8$; $p = 0.238$). The overall accuracy of classification shown in the Classification Table is 68.1%. Again, the explanatory power of the model is relatively low, since the R^2 of Cox and Snell stood at 0.278 and R^2 of Nagelkerke was 0.371. Again, the level of significance of the Constant in the equation was higher than recommended, as can be seen in Table 3, as well as the variable Cost, slightly above the limit.

Table 3 - Variables in the equation

	B	S.E.	Wald	Df	Sig.	Exp(B)
Constant	-3.542	3.201	1.224	1	0.269	0.029
Cost	-2.143	1.110	3.728	1	0.053	0.117
Personnel	2.274	1.098	4.293	1	0.038	9.719
Technology	3.803	1.665	5.219	1	0.022	44.845

Source: Authors, based on the results presented by SPSS.

In this case, it is clear that companies have a lower perception about Cost than about the other two, and that the greater perception is in the importance of Technology. It is emphasized that the implementation of innovation has a negative association with Cost and is positive with Personnel and Technology. This association follows the logic shown in the previous equation with respect to the Economic and Others factors. The weight of the variable Technology in the composition of the equation is greater than the weight of the variable Personnel and the variable Cost.

In this case, it was concluded that the chances of a company that implemented innovations to realize the importance of the High Cost of Innovation, the Lack of Qualified Personnel and the Lack of Information Technology is about 51 times greater than a company that did not implement innovations in the period . Nearly 2/3 of this can be attributed to Lack of Information Technology and 1/3 to Lack of Qualified Personnel. The High Cost of Innovation has a very small share of participation; so much so that the significance of the equation was less than recommended.

It is important to note that, comparisons and analyses conducted here must be considered with caution. It is also important to note that the considerations are woven according to the results and these are limited to the research sample. Therefore, any inference should take into account the characteristics inherent to this study.

5 FINAL CONSIDERATIONS

Companies face many obstacles in their day to day lives, and it's no different in the implementation of innovations. The PINTEC lists twelve obstacles and an evaluation of their importance, according to a sample of Brazilian companies. From this data and using statistical calculations, more accurately comparing the averages by t-test for analysis of variance, it was possible to compare the perceptions of companies. For this review, it appears that the perception that companies have of obstacles changes only in the degree of importance attached to each of them. However it was not possible to identify a pattern, except for a few

obstacles in which this pattern was almost confirmed, as was the case for centralization of activity in another unit to which most business groups gave similar importance, or in the case of a lack of qualified personnel, which included the most differences between groups.

In addition, the analyses showed that small companies attach greater importance to the obstacles than larger companies and the obstacles that directly involve the economic and financial aspects received even greater importance. This is especially interesting when industrial companies are viewed, with averages higher than those of service companies in most groups. Perhaps the greater need for resources by industrial companies justifies this result.

By means of the RL it was also possible to identify obstacles which contribute most to the implementation or not of innovations. Despite the higher importance attributed to obstacles relating to economic and financial issues, these, grouped into a single factor, do not constitute the major factor for the implementation of innovations; this characteristic being linked to other obstacles.

Analyzing the obstacles individually by means of RL, it was found that the main obstacles related to the implementation or not of innovation are the Lack of Qualified Personnel and the Lack of Information Technology.

An interesting finding is that the Lack of Qualified Personnel appears in most analyses. This finding, to some extent, corroborates the claim of Spuldaro and Mussi (2008), according to whom this factor is considered an obstacle to implementing innovation, but is also associated with difficulty to absorb and adapt to innovation in the work process. This finding leads to questions related to education and vocational training.

Thus, the study goal of verifying how different companies perceive the importance of obstacles in implementing innovation is achieved. Through quantitative data analysis, it is clear that the importance attributed to obstacles by companies differ due to having or not having implemented innovation, whether it is in the industrial sector or not and according to its size. However, the divergences are not homogeneous among these groups, especially with respect to size. Therefore, the conclusion is that different companies perceive and attach importance to different obstacles to innovation.

These considerations must be analyzed carefully, because there are some limitations in the study. The first is the discrepancy in the data obtained in PINTEC. Another limitation in PINTEC is the form of data presentation, which impedes some statistical treatments. The use

of a three-point scale, which conceals much of the variability in the amounts assigned, is another limitation.

As to contributions of the study, there is confirmation by factor analysis of the groupings in relation to those presented by EUROSTAT (2004), confirmation of statistically significant differences between the perceptions of industries and service providers, between small and larger companies, and the importance given to the lack of qualified personnel. Future studies may broaden the understanding on these points, as well as some points made in the development of the text.

Another important contribution of this study is the attempt to extend the depth of analysis of the data collected and presented in PINTEC, providing insights for future studies in the academic realm, and providing relevant insights about the obstacles to the evaluation and formulation of incentives for innovation in the scope of public policies.

Comparisons with studies such as EUROSTAT (2004), Howells and Tether (2004), and CSO (2009), among others, are not possible because the approach used by them, although similar to that used in PINTEC, is substantially different from that used in this study.

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