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**INNOVATION AND PUBLIC INCENTIVES: A Research about the Maturity Degree in Brazilian Companies**

**Benilton Medeiros Nunes**

*UFRN – Federal University from Rio Grande do Norte – Graduate Studies in Production Engineering  
Condomínio Residencial Bosque das Flores, Almeida dos Bosques n 795. Lote122 Parque do Jequi CEP  
59153155. PARNAMIRIM- RN*

**Jamerson Viegas Queiroz**

*UFRN – Federal University from Rio Grande do Norte – Graduate Studies in Production Engineering  
Rua Dom Pedro I 80, edifício cidade de Petrópolis apartamento 401, água verde Curitiba-PR cep 80620-130  
E-mail: [jvq@ufrnet.br](mailto:jvq@ufrnet.br)*

**Eduardo Lopes Marques (Corresponding Author)**

*Pontifical Catholic University of Paraná –PUC-PR – Graduate Studies in Business Administration  
[Programa de Pós- Graduação em Administração] (PPAD)  
Avenida Presidente Arthur da Silva Bernardes, 2108/Apto. 13 Bloco F – Portão –  
Curitiba – Paraná – Brasil – 80320-300  
E-mail: [eddumarques@uol.com.br](mailto:eddumarques@uol.com.br)*

**Fernanda Cristina Barbosa Pereira Queiroz**

*UFRN- Federal University of Rio Grande do Norte – Graduate Studies in Production Engineering  
Rua Dom Pedro I 80, edifício cidade de Petrópolis apartamento 401, água verde Curitiba-PR cep 80620-130  
E-mail: [fbp@ufrnet.br](mailto:fbp@ufrnet.br)*

**Christian Luiz da Silva**

*UTFPR – Federal Technological University of Paraná  
Rua Pedro Wobeto, 14 Boqueirão – Curitiba – Paraná – Brasil Cep: 81670310  
E-mail: [christiansilva@utfpr.edu.br](mailto:christiansilva@utfpr.edu.br)*

**Jamil Ramsi Farkat Diogenes**

*PhD Student in Industrial Engineering and Management  
Faculty of Engineering - University of Porto (FEUP)  
Rua Dr. Roberto Frias, s/n 4200-465 Porto PORTUGAL  
E-mail: [jamil.farkatt@fe.up.pt](mailto:jamil.farkatt@fe.up.pt)*

**Nilton Cesar Lima**

*Federal University of Uberlândia  
Rua Jornalista José Batista Coury, 535. Cep 38405-356. Uberlandia-MG.  
E-mail: [cesarlim@yahoo.com](mailto:cesarlim@yahoo.com)*

**Faimara do Rocio Strauhs**

*Federal Technological University of Paraná  
Avenida Sete de Setembro, 3165 - Curitiba - PR - CEP 80.230-901  
E-mail: [faimara@utfpr.edu.br](mailto:faimara@utfpr.edu.br)*

**Marciano Furukava**

*UFRN- Federal University of Rio Grande do Norte  
Rua Porto Mirim 9027 PONTA NEGRA, Natal-RN,  
E-mail: [furuka2010@yahoo.com.br](mailto:furuka2010@yahoo.com.br)*

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## ABSTRACT

*The present article aims to identify the influence of public incentives in innovation in the maturity degree of Brazilian companies. Thus, the study starts at the understanding of the innovation conceptive dimension over the Brazilian innovation system and interaction between university, company and government. Accordingly, it was performed a multi-method study with 43 companies attended by the project Pró-Inova/Nagi (2013), which promotes the innovation development in companies established in Federative Brazilian States. The obtained results provide reflections about the influence of public investments in innovation, by predictive qualitative variables associated to quantitative empiric test, explains which variables are significant in the maturity variation degree in companies' innovation.*

**Keywords:** *Innovation; Public investments; Maturity, Triple Helix; Brazil*

## 1-INTRODUCTION

The practice to apply knowledge in management have been highlighting the innovation as basic element of all the organizational dynamics, regarding technological advance in productive process, to the pursuit of new solutions for traditional problems, to interactions between companies of competitive gain and to more elevated degrees of management maturity (ESTERHUIZEN, SCHUTTE & DU TOIT, 2012; NASCIMENTO, VERAS & MILITO, 2013).

As Fiates et al. (2010) explained, the innovation is not seen anymore as competitive advantage and it became explicit in the organizations' survival – an organizational need. Probably, this occurred because, last decade, it had transformations of social, economic and cultural nature, globally, influenced, overall, by the globalization and technological advances, especially, in communication.

Regarding Brazil, there are significant problems of competitiveness that the companies have been through daily, due the hard access to know-how (standardization of productive process and specialized labor) and low competitive strength (costs, equipments and capital). Because of it, governmental programs are being developed to stimulate the creation and innovative skills in all the productive apparatus of companies and to promote the innovation by integrative relations between University, Company and Government (NUNES et al., 2010).

Accordingly, the present article has as goal to identify the influence of public investments and to promote the innovation in the maturity degree of Brazilian companies. For that, it is intended to assess the efficacy of public investments for innovation process at the model of Triple Helix (Academy – Industry – State), gauging up at innovation promotion relations and competitive gains for the investigated companies.

Beyond that, before the need to understand the effective use of public resources aiming the private sector, stimulating the generation of jobs and income (socially), the productive development (in the market) and the country money creation (economically), studies that contribute to assess the innovation efficacy in its strategic nature – being an inseparable element of everyday organization – are extremely relevant to the innovation advance by the functional bias, in other words, its practical applicability.

## 2 – Literature Review

### 2.1 - Innovation

It's assumed that "innovation" is a concept related to something new; recent and different of what already exists. Thus, is very common the mistake committed by many of understanding as identical the concepts "innovation" and "invention".

Certainly, the common etymology of the words contributes for this mistake. Assuming the concepts of Schumpeter (1988), this topic starts settling the difference between the words: (i) invention: it's a new idea created that has potential for commercial exploration; (ii) innovation: is the same idea when explored commercially in anyways. The author saw the innovation as a social specific activity (function), performed in the economic context and for commercial purposes, while the inventions, at first, can be performed in any place and without any commercialization intention. Despite the theme "innovation" be explored in a recurrent way by the organizations, academy, public power and media, there isn't yet a pacified conceptualization of it, which is fully accepted in these spheres.

Kline and Rosenberg (1986, p. 283), reported this issue and affirmed that “it’s a serious mistake to treat an innovation as a well defined, homogeneous thing, that could be identified its entrance in the economy on a specific date – or becoming available in a specific moment”.

Although there isn’t any consensus about innovation conceptualization, it fell to Manual de Oslo (OCDE; EUROSTAT; FINEP, 2005) to act as beacon element of the theme, establishing guidelines for data collection and interpretation about technologic innovation, aiming to guide and standardize concepts, methodologies and building of research statistics and indicators of R&D of industrialized countries.

According to Manual de Oslo (OCDE; EUROSTAT; FINEP, 2005, p. 55), the innovation is:

The implementation of a product (good or service) new or significantly improved, or a process, or a new marketing method, or a new organizational method in business practices, in workplace organization or external relations.

The innovation concept considered for this work is based on the definition above. This scenario, associated to the fast knowledge advance, has been changing the interpenetration and exchange ways in science, technology and innovation spheres and its expanding the complexity of the innovative process. So, there is the increasing need of integration and cooperation between the several agents bounded to the National Innovation Systems in the coordination of actions that result in policies that stimulate this collective effort.

Such environment, so obviously important, finds a restrictive factor: funding sources. Regardless of the origin source, public or private, the mechanisms destined to raise funds for investments in technological innovation are different from those destined to conventional funding, overall due the risks involved and the long period needed for returns, usually longer than the investments in modernization or expansion of productive capacity in technology conditions already consolidated. Under this aspect, Corder (2006), affirms that the increase of costs and risks are bounded to the new technologic trajectory that came with the development of new business strategies.

Thus, three moves in the international sphere are observed: i) increasing of alliances between companies and patent licensing; ii) financing of researches performed in universities and government laboratories by large companies as a way to outsource research and development (R&D) activities; and iii) performance of R&D activity, no longer restricted to large companies from the transformation industry, but also performed by companies of service sector and Small and Medium-sized Enterprises (SMEs), which expanded their participation in this activity.

In this context, the institutional arrangements develop an important role, with the purpose to favor the interdependence between researches and entrepreneurs, reducing the uncertainties and establishing reliability between the parties, enabling the generation and diffusion of innovations.

## 2.2 – National Innovation Systems

FINEP (Entity funding of Studies and Projects) is responsible to stimulate the innovation, aiming to increase the companies’ competitiveness in national and international market and to expand the capacity to export and to substitute imported products in the Country. FINEP covers three large action lines: Innovation support in companies; Support to Scientific and Technological Institutions (STIs); Support to cooperation between companies and STIs.

Other innovation national system is BNDES, a public federal company linked to the Ministry of Science, Technology and Innovation (MSTI). Its mission is to be an instrument for the economic and social development in the Country. For that, it acts as agent of change, with long-term perspective, having as goal the construction of a competitive economy that benefits the Brazilian population. The innovation support is a strategic priority to BNDES. The objective is to promote and support operations associated to training skills and development of innovative environments, intending to generate economic or social value and to improve the competitive position of the companies, contributing for the creation of better jobs, the increasing of productive efficiency, the environmental sustainability and the sustainable country growth.

The National Council of Scientific and Technological Development (CNPq) is a foundation linked to MSTI and considered one of the largest and most solid public structures of science, technology and innovation support of Latin America. Created in 1951, CNPq constituted an important milestone in the relations State-science, establishing, by the institutionalization of the State role being a direct sponsor of researches, new relationship

standard by which it assumes explicitly the condition and support to scientific production activity (ROMANI, 1982, p. 135-166). By its actions, CNPq stimulates the formation of human resources, with stock exchange concession, and encourages the research promotion, financing scientific, technologic and innovative projects. Beyond that, it supports the performance and participation of Brazilian researchers in scientific and technologic, national and international events.

### 2.3 – *Interaction: University ⇔ Company ⇔ Government*

The growing interaction between the segments university, government and company indicates the world's tendency to alliances and partnership as part of the society development process, which comprises information, knowledge, science, technology and innovation scenarios, among others. This relation seeks a solution for innovations generation promotion. The interaction between the agents university-company-government represents the triple helix model, due studies and propositions based in specific situations and characteristics of developed countries, and raises the university to the understanding of important factor in the innovative environment (DAGNINO, 2003).

To Etzkowitz (2003), the interaction between University ⇔ Company ⇔ Government, also entitled as triple helix, is essential for the development based in innovation, recognizing, clearly, three spaces: knowledge, which concretizes the creation of critical mass from the education, research and extension; agreement/disagreement, which different agents get closer, producing this way a synergy that boosts the development; and innovation, which generates the development from cooperation actions between university, company and government.

The University, the Company, the clusters, productive chains, the institutional arrangements, the governments and govern mechanisms of support and incentive, contextualizes in each segment, a bottom line for the interaction process of information demand and information system that covers the decision-making. In this model, the agents are interlaced and interact in the network, sharing responsibilities in the construction of the scientific and technological basis, not existing hierarchy, as well they work as autonomously, but interdependent, assuming distinct roles in each instant (SARTORI, 2011).

In this context, university is considered as a multiplier of innovation and change actions; governments as agents capable to create, improve and consolidate public policies; and, at last, the companies acting directly in the social responsibilities and in the development of projects that can describe well, and in a sustainable and lasting way, the model of system innovation. It means, “The interaction university – company – government, under a general aspect, is the key to improve the innovation conditions in a society based on the knowledge” (ETZKOWITZ, 2003). The author highlights yet that “the conflicts between the perceptions of a university as a space only for education or research should be transformed in convergence of ideas”.

These purposes bring the assumptions that is necessary to have a proximity to universities, being fundamental to provide incentives that interact: (government) and partnerships (companies), offering proper services' infrastructure, as well as, a efficient organizational structure, where each agent of a sphere keeps considerable autonomy, but simultaneously assumes new roles and a new understanding and conformation of the economic dynamics, in a organized, harmonic way, integrating the existent infrastructure so that it reach their business goals. These roles' expansion, according to this model, takes to a better possibility of innovative actions in several agents' actuation areas, with the insertion of researchers and students of the universities in a productive environment, because they create proactive attitudes, linked to the labor market (ETZKOWITZ e LEYDESDORFF, 2001).

### 2.4 *Local actions of innovation promotion*

Between the actions turned to innovation performed in the State of Rio Grande do Norte (RN), Brazil, three worth mentioning: (i) Innovation Notices from the Foundation of Research Support of RN (FAPERN); (ii) ALI Project from SEBRAE; and (iii) Innovation Notices from SENAI/SESI. These actions are responsible by the diffusion of the innovation in the state of RN.

The Notices from FAPERN, represented by the Program of Research Support in Companies (PAPPE) allowed the practice of the elaboration, implementation and management of the innovation projects for the companies of RN. This helpline registered in 2013 an available value in the order of R\$ 3,2 million, and were hired little more than R\$ 1,6 million, representing approximately 50% of the offered value.

The Local Agent of Innovation (ALI) project, which utilizes a methodology developed by the Brazilian Service of Support to Micro and Small Companies (SEBRAE) for national utilization, had in RN one of the pilot States in the development of this project. It attended about 400 companies in 2013, and has a forecast to attend more than 1,600 companies.

Lastly, the Innovation Notice of the Industry National Service jointly to Industry Social Service (SENAI/SESI), which in 2013 contemplated 30 innovation projects.

These examples considered as systems of innovation in the country, demonstrated the existence of the investments demand in innovation promotion. The results presented in this work, although having a scientific focus in evidencing the relation between the studied variables, simply reflects a notorious understanding: higher the investment in science and technology, higher the competitiveness of the attended companies.

### 3 – RESEARCH METHODOLOGY

The research proposed in this work will have a quantitative approach, which has as main characteristics: (i) to have a hypothesis, which can be wrong or right; (ii) seeks to describe meanings that are considered as inherent for the objective and acts; (iii) allows a focused, punctual and structured approach, utilizing the quantitative data; and (iv) the data collection is performed through structured answers (TANAKA & MELO, 2001).

The first factor that corroborates to this view would be the question of the study, to have a hypothesis, which during the research it will be considered if is true or not. Another characteristic in this research approach is the fact that it is also qualitative, through the reliability that the questionnaire offers to the study.

In relation to the objectives, this work can be classified as of descriptive character, given that the research will happen aiming to know better the investigated object, without the researcher's interference.

The research is characterized as bibliographic and data collection, through a survey. The bibliographic research was chosen aiming the theoretical basis about the theme, seeking to analyze from the better way possible, and to know the works published in the area, focusing in the study object, the RN. In this context, this work utilized the bibliographic research to fundament the procedures of the performed research, helping in the definition of the collection instrument and in the procedures of data analysis.

The sample quota utilized as object of research in this work is grounded in 43 companies that integrate *Pró-Inova* Project. With innovation projects structured from mobilization, capacity, consultancy and advice actions developed by the Center of Innovation Management Support at Rio Grande do Norte (NAGI-RN).

The target audience is industrial companies installed in RN state. From the total of the participant companies, 43 were researched, corresponding to approximately 60% of the total of companies, being settled as significant sample. The size of a sample is calculated from the equation:

$$n = \frac{Z_{1-\alpha/2}^2 \cdot p' \cdot (1 - p')}{\text{erro}^2}$$

#### Where:

- Z : value of normal distribution
- $\alpha$  : Reliability coefficient
- p': proportion obtained in the sample
- erro :  $1 - \alpha$

#### Considering:

- $\alpha = 90\%$  (acceptable value, according to literature, for researches of this nature)
- p' = 57, 3% (43companies interviewed of 75 subscribed)
- $Z_{\text{Tab}(95\%)} = 1,96$  (utilizing the normal standard distribution, once that the number of elements is high enough (n > 30))
- erro = 10%

It has:

$$n = \frac{1,645^2 \cdot 0,573 \cdot (1 - 0,573)}{0,1^2} = \frac{2,71 \cdot 0,573 \cdot 0,3}{0,01} = \frac{0,47}{0,01} = 46,58 \cong 47$$

For populations smaller than 2,000 elements, the literature recommends an adjustment in the sample size calculus, utilizing the equation below:

$$n_{adjusted} = \frac{n}{1 + \left(\frac{n}{N}\right)}$$

Where:

- n : calculated size = 47
- N : population size = 75

Soon, there is:

$$n_{adjusted} = \frac{47}{1 + \left(\frac{47}{75}\right)} = \frac{47}{1 + 0,63} = \frac{47}{1,63} = 28,83 \cong 29$$

Considering that it were applied questionnaires to 43 companies, the sample significance is evidenced. These companies are, in their majority, in productive colonies (Local Productive Adjustments – LPA’s, incubators, syndicates and associations) and belong to the following economic factors: Petroleum and Gas; Renewable Energies; Foods and Drinks; Civil Construction and Inputs; Textiles and Clothing; Agribusiness.

The strategy utilized to reach the objects of *Pró-Inova* Project is founded in the performance of a training program, composed by 13 modules, associated to *in loco* advice for implementation of knowledge passed in each module. The modules proposed were presented in board 01 below.

As a research instrument proposed for this work, it was considered from the bibliographic and documentary researches, the basis for the theoretical reference constitution. It was utilized the application of questionnaires as the data collection technique. It was performed by personal interview, conducted by an interviewer previously prepared and it corresponded to one of the activities from the training program *Pró-Inova* Project, which provided an initial diagnosis of innovation maturity of the participant companies. The interviewer team was formed by 20 researchers, and they were trained before the questionnaire application, intending to even the procedures of interviews and reduce possible biased behaviors during the instrument application.

**Board 1: Modules of Pró-Inova Project Training Program**

Modules of Training Program	
1.	Innovation Management
2.	Innovation strategic planning
3.	Human Resources Organization for innovation management
4.	Assessment methodologies and tools of product and process
5.	Methodologies and tools of new business development
6.	Methodologies and systems of competitive intelligence
7.	Organization of the learning process
8.	Innovative environments organization
9.	Organization of information system for innovation: public policies and innovation support programs
10.	Innovator Marketing System
11.	Technological Prospection and management actions of intellectual property
12.	Monitoring system and innovation assessment: development and implementation of indicators
13.	Information system about innovation funding (risk capital and credit lines for promotion, research and innovation)

Source: Authors.



The questionnaire was composed by 36 (thirty six) questions, divided in twelve dimensions that objectifies to identify the “Innovation Maturity Level” of the interviewed companies. The scale of value utilized was Three Point Likert (values = 01 pt; 03 pts and 05 pts); the scale measures the intensity of innovative practices in the company, where 01 pt, minimum on the scale, is indicated for situations that there isn't any register of the investigated practice, and the value 05 pts for situations that the innovative practice fully occurs. Between these both extremes, there is still an intermediate score, 03 pts, for situations that the company performs partially the innovative practice investigated.

It is important to highlight that the adoption of this scale “attends to the recommendation from the Oslo Manual, which establishes that the points of view of the companies is registered, or in binary base (important/not important), or with a narrow range of answers available (from very important until irrelevant)” (BACHMAN & DESTEFANI, 2008). The questionnaire also includes another part composed by 14 (fourteen) questions that the objective is to verify which actions are performed by the interviewed companies to effectively obtain an innovator environment in them. This part is represented by the dimension called “Innovative Ambience”. The dimensions utilized in the research instrument are detailed on Board 2 below.

This work, considering the objectives of the research and noting the importance of the right choice of the statistic method, utilized as techniques: the descriptive statistic and the regression analysis, in particular the simple regression analysis. It were utilized the statistic programs *R for Windows*® e *Action*®, and for electronic spread sheets Microsoft Excel 2010, responsible for data treatment.

**Board 2: Description of the Dimensions of the Research Instrument**

Dimension	Description
<b>Innovation Maturity Degree</b>	
Offer Dimension	This model dimension considers an innovative company the one who has a relevant part of their receipts associated to new products/services. For the calculus this variables were considered: (a) new markets; (b) new products; (c) boldness; (d) environment response; (e) design and (f) technological innovations.
Platform Dimension	This dimension assesses the company's ability to utilize the same infrastructure resources to offer different products/services, because it reflects higher innovative capacity of the company. It was considered the variables: (a) production system and (b) product versions.
Brand Dimension	The innovation in this dimension implies to use the brand to leverage other opportunities of business or to use other business to value the brand. Registered brand also indicates an innovative potential in the company. For the calculus, these variables were considered: (a) brand protection and (b) brand leverage.
Customers Dimension	Identifies the customers' needs, new markets and listens to customers' suggestions. The proper utilization of this information has an innovative differential for the companies in a competitive market. For the calculus these variables were considered: (a) needs identification, (b) market identification, (c) use of customer-process manifestations and (d) use of customer-results manifestations.
Solutions Dimension	This dimension is about the custom combination integrated of goods, services and information capable to solve the customer problem. Involve the offer of some complementary product/service to the public, creating new opportunities of receipt. For the calculus, these variables were considered: (a) complementary solutions and (b) resources integration.
Relationship Dimension	This dimension is about the easy access provided by the company to the customer For the calculus, these variables were considered: (a) facilities and amenities and (b) computerization.
Value Aggregation Dimension	This dimension reflects the adoption of new ways to generate receipts, from information analysis or customers, suppliers and partner's interaction. For the calculus, it was considered the variables: (a) use of existent resources and (b) use of the opportunities of interaction.

Dimension	Description
Processes Dimension	This dimension is about the utilization of modern management methods and instruments as certification, management practices or changes of procedures to generate higher efficiency, quality, flexibility, smaller production cycle or benefits for thirds. For the calculus, these variables were considered: (a) processes improvement; (b) management systems; (c) certifications; (d) management software's; (e) environment aspects; (f) residue management; (g) physical structure and (h) intern integration.
Organization Dimension	This dimension analyzes the way how the company is structured, the partnership that establishes and the reorganization of the responsibilities. For the calculus, these variables were considered: (a) reorganization; (b) partnerships; (c) external vision; and (d) competitive strategy.
Supply Chain Dimension	This dimension covers logistics aspects of the business, as transport, storage and delivery. For the calculus, this variable was considered: (a) supply chain.
Presence Dimension	This dimension is related to the distribution channels that the company utilizes to put their products/services in the market and also the places that these items can be acquired by the consumers. For the calculus, these variables were considered: (a) sales point and (b) new markets.
Network Dimension	This dimension is about the aspects related to the network that connects the company and their products/services to the customers. For the calculus, this variable was considered: (a) dialogue with customer.
<b>Innovative Ambience Degree</b>	
Innovative Ambience Dimension	This dimension is about which way the innovative practices are stimulated through the intern environment of the company. For the calculus, there variables were considered: (a) external knowledge resources I; (b) external knowledge resources II; (c) external knowledge resources III; (d) external knowledge resources IV; (e) intellectual property; (f) innovative boldness; (g) innovation financing; (h) ideas collection; (i) Agility; (j) Capacity; (k) Talents retention; (l) Recognition by innovation; (m) Lead for innovation; and (n) Technological Vigilance.

Source: Authors.

#### 4 – DATA ANALYSIS

Once postulated the research problem and defined the methodology to be utilized in this work, with the minimum enough theoretical foundation efficient to the research, the action to reach the proposed research object begins. Thus, it's done the approach and interpretation of the studied reality, i.e., from the collected data, it's sought to understand the effective relation of object influence of our research.

At first, it was done descriptive analyses of the results, with aid of the programs *R® for Windows e Action*, objectifying to diagnose some relevant aspects related to the sample.

These results that will be presented will follow the sequence proposed by the research instrument applied. This way, the following aspects are included:

- Size
- Economic sector
- Activity type

Regarding the size of the researched companies, it was considered that the methodology proposed by the National Industry Confederation (NIC), which recognizes the size of the companies due the number of employees that work on them. Thus, the companies can be classified according to the options below:

- **Industry:**
  - ✓ Micro: up to 19 employees;
  - ✓ Small: between 20 and 99 employees;
  - ✓ Medium: between 100 and 499 employees;
  - ✓ Large: more than 500 employees.
- **Commerce and Services**
  - ✓ Micro: up to 9 employees;
  - ✓ Small: between 10 and 49 employees;
  - ✓ Medium: between 50 to 99 employees;
  - ✓ Large: more than 100 employees.



Considering this criterion, it's possible to observe an interesting question. All the companies fit as micro or small size. The size that is most shown on the research is the small one. Data can be analyzed on Table 1:

**Table 1: Frequency Table (by size)**

Size	Frequency	Frequency (%)	Accumulated Frequency (%)
Micro	11	25,6	25,6
Small	32	74,4	100,0
Grand Total	43	100,0	

**Source:** Authors.

On the sequence it's possible to observe the distribution of the companies according to the economic sector of acting. The grouping was performed based on the National Register of Economic Activity (NREA), adapting the description of the activity to a more usual language, with fewer characters. Among the available options, the one that was showed with more frequency was the Textile – Clothing. Data can be better evaluated on Table 2:

**Table 2: Frequency Table (by economic sector of acting)**

Economic sector of acting	Frequency	Frequency (%)	Accumulated Frequency (%)
Textile Clothing	15	34,9	34,9
Food and Drink	10	23,3	58,1
Com. Services	8	18,6	76,7
Manuf. Equipment	4	9,3	86,0
Others	6	14,0	100,0
Grand Total	43	100	-

**Source:** Authors.

The option “others” gathered record of companies in sectors that registered only one occurrence, considering the code NREA. The sectors were:

**Board 3: Activities with only one occurrence in the sample**

20. 62-2-00	Manufacturing of cleaning and polish products
22. 12-9-00	Reform of pre-used tires
31. 02-1-00	Manufacturing of metal predominant furniture
71. 20-1-00	Technical tests and analyses
72. 20-7-00	Experimental research and development in social and human sciences

**Source:** Authors.

Lastly, it's seen the last description criterion of the population in study: Activity type. It was considered as variables the nature of the company activity: (i) industry; (ii) commerce; and (iii) service. The option most frequent was industry. Data can be analyzed on the following table:

**Table 3 – Frequency Table, by activity type**

Activity type	Frequency	Frequency (%)	Accumulated Frequency (%)
Industry	31	72,1	72,1
Service	6	14,0	86,0
Commerce	3	7,0	93,0
Others	3	7,0	100,0
Grand Total	43	100,0	-

**Source:** Authors with aid of the software Action.

To data treatment parameterization effects, it was considered as null hypothesis ( $H_0$ ) of the present work: variances are equal. In other words, they aren't dependent. The alternative hypothesis ( $H_1$ ), the one we want to prove, is the one that the innovation maturity degree influences directly in the innovative ambience.

$$H_0: \mu_1 = \mu_2$$

$$H_1: \mu_1 \neq \mu_2$$

Where:

$\mu_1$  = innovation maturity degree average

$\mu_2$  = innovative ambience degree average

- Significance Index and Variables Standardization

- ✓ Significance Index

( $\alpha$ ) = 0. 025

- ✓ Variables Standardization

- X => Maturity Degree

- Y => Innovative Ambience

After the definition of the research parameters, data treatment with the sample characterization started. Therefore, it was determined the average, standard deviation, minimum and maximum volume of the following characteristics of the researched companies:

- Innovation Maturity Degree;
- Innovative Ambience Degree.

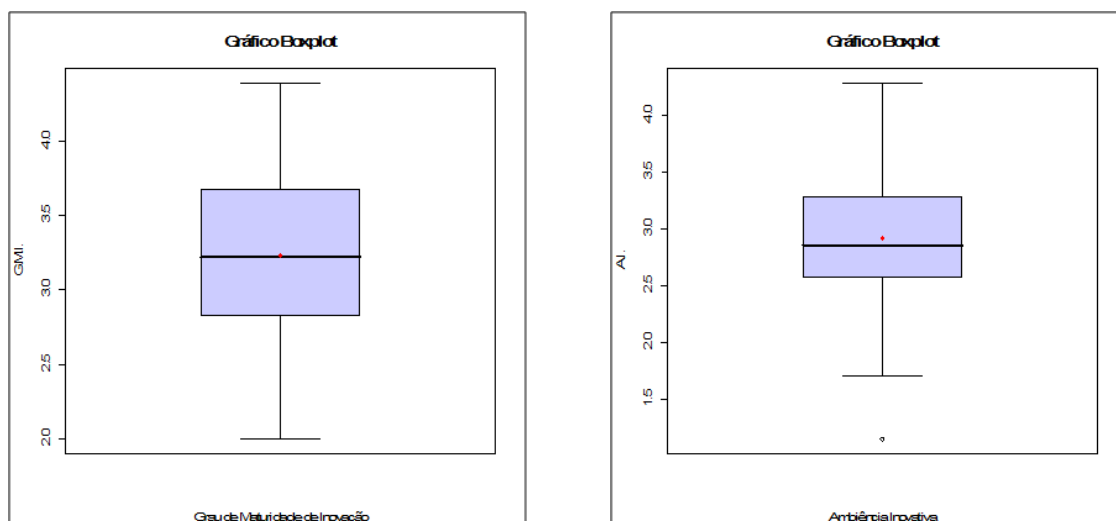
Firstly it was performed a descriptive analysis of the occurrence frequency of each one of the categories researched, being determined the average, standard deviation and the minimum and maximum values. Table 4, below, presents the results:

**Table 4: Descriptive analysis**

	Maturity Degree	Innovative Ambience
Average	3, 234899871	2, 898671096
Standard Deviation	0, 667614517	0, 736100975
Minimum	1, 628472222	1, 071428571
Maximum	4, 5	4, 285714286

**Source:** Authors.

Still, for each category was performed the graph, boxplot type, for analysis of the distribution and identification of eventual existent outliers. As observed in Graphic 1, below, there is occurrence of only 01 outlier in the sample related to the Innovative Ambience category.



**Graph 1. Studied categories boxplot**

**Source:** Authors, with Action software aid.

After the outlier analyses was performed, again was done the average and standard deviation, for each feedback category in each sample group, removing the data found as outliers. Considering Pestana and Gageiro (2005), which highlights that in the case of existing outliers, they should be reanalyzed, with or without outliers and then present the difference found in the results.

**Table 5: Descriptive Analysis (without outliers)**

	Maturity Degree	Innovative Ambience
<b>Average</b>	3, 251516667	2, 959833333
<b>Standard Deviation</b>	0, 601173383	0, 657120718
<b>Minimum</b>	2	1, 7143
<b>Maximum</b>	4, 3889	4, 2857

Source: Authors, with Action software aid.

**Table 6: Descriptive Comparative Analysis (with and without outliers)**

	Maturity Degree			Innovative Ambience		
	With Outliers	Without Outliers	Difference	With Outliers	Without outliers	Difference
<b>Average</b>	3, 234899871	3, 251516667	-0, 5%	2, 898671096	2, 959833333	-2, 1%
<b>Standard Deviation</b>	0, 667614517	0, 601173383	10, 0%	0, 736100975	0, 657120718	10, 7%
<b>Minimum</b>	1, 628472222	2	-22, 8%	1, 071428571	1, 7143	-60, 0%
<b>Maximum</b>	4, 5	4, 3889	2, 5%	4, 285714286	4, 2857	0, 0%

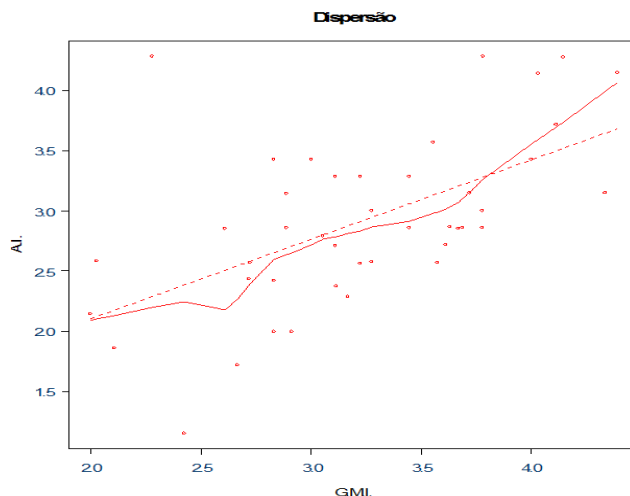
Source: Authors.

Considering that the comparative difference between the tables, with and without outliers, presented on Table 6, was significant, and still pondering Pestana and Gageiro (2005), it were considered, for effects of this work, the data without outliers.

In order to test the linear relation desired by the model, it's recommended to test the significance of the regression and, as consequence, the hypothesis of this study. Considering that the dependent variable (innovation ambience degree) is from quantitative nature, it was utilized the variance analysis to a factor (One Way Anova), since there is only one factor, i.e., an independent variable (MAROCO, 2003). As recommended by the author, before applying the F test of One Way Anova, their assumptions were previously verified:

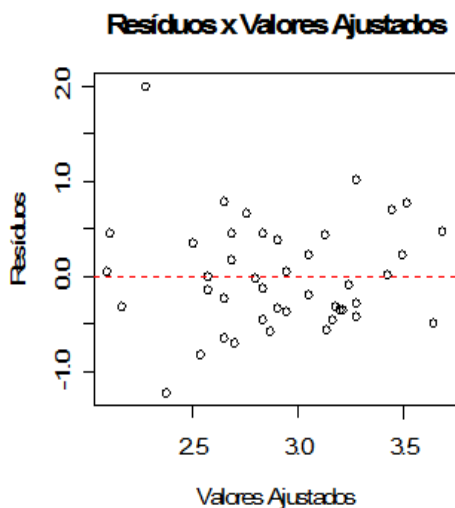
The observations inside each group have usual distribution: it was elaborated a dispersion graphic, confirming the usual data behavior, as can be observed in Graphic 2, below:

- The observations are independent of each other => the innovation maturity degree calculus utilizes data independent from the necessary to the innovative ambience degree calculus, characterizing the observation's independence.
- The variances of each group are equal between each other, i.e., it seeks to know if there is homocedasticity => if the points are randomly distributed around 0, without any behavior or tendency, there are evidences that the variance of the residue if homocedastic.



**Graphic 2. Variable dispersion**

Source: Authors, with Action software aid.



**Graphic 3. Residue graphic versus adjusted values**  
 Source: Authors, with Action software aid.

Test of regression significance:

The variance analysis to a factor (One Way Anova) is utilized for the test of regression significance, i.e., to verify the existence of linear relation between the quality characteristic *y* and a subgroup of control variables (MONTGOMERY, VINING & PECK, 2001).

The rejection of the null hypothesis  $H_0: \mu_1 = \mu_2 = \dots = \mu_k = 0$ , implies that at least one of the control variables is statistically significant for the model. The regression significance test is based on the decomposition of the total squares (TSS and ANOVA is presented on Board 4, below).

**Board 4: ANOVA – One Factor**

VF	Degrees of Freedom	Sum of Squares	Mean Squares	F <sub>0</sub>
Between Groups	$k - 1$	<i>SQA</i>	$QMA = \frac{SQA}{k-1}$	$F_0 = \frac{QMA}{QME}$
Within Groups	$N - k$	<i>SQE</i>	$QME = \frac{SQE}{N - k}$	
Total	$N - 1$	<i>SQT</i>		

Source: Authors.

The tests were done taking into account the significance index ( $\alpha$ ) = 0.025, as well as adopted X for Maturity Degree and Y for Innovative Ambience. The correlation was of 0.5341 for the variables: this value proves that there is significant and direct correlation between the variables. It's considered, then, that the innovative ambience depends directly on the Maturity Degree of a company.

**Table 7: Anova**

Factors	D.F	Sum of Squares	Mean Squares	F.ratio	p-value
M.D.I	1	6,776980271	6,776980271	19,68791269	6,71116E-05
Residual	41	14,1130345	0,344220354	-	-

Source: Authors with aid of Action software.

Observing the table above ANOVA's, it's possible to see that the p-value (6,71116E-05) is much smaller than  $\alpha$  (0, 025). According to Pestana and Gageiro (2005) there is, therefore, evidences to reject the null hypothesis ( $H_0$ ). In this case it would be significant to say that the variable Y suffers influence of the variable X.

Lastly, to guarantee that the outlier removal didn't influenced in the null hypothesis ( $H_0$ ) rejection, it was decided to do a not parametric verification test. It was performed the not-parametric test of Wilcoxon that, according to Maroco (2003), doesn't consider discrepant points.

**Table 8: Wilcoxon Test**

V	Statistic Test	p-value
702, 5	0, 025	0, 001715

**Source:** Authors.

An observation at the test allows us to verify that the p-value remains much smaller that the statistic test. Therefore, after the performance of a rebuttal by alternative method, it's possible to conclude that there are enough evidences to tell that the variable X influences on variable Y, with 97,5% of reliability. Before the results obtained by the tests presented above, it's concluded that:

**THERE IS RELATION BETWEEN THE STUDIED VARIABLES**

In other words, the innovative ambience degree interferes positively on the innovation maturity degree of the studied companies.

From the 12 proposed dimensions it's possible to assess several information about innovations, which won't be treated in this work but it may serve as basis for future studies. Nevertheless, considering the importance of the innovation degree for this study, it was judged interesting an analysis, even being superficial, of the innovation degree behavior from the researched population. Table 9 presents the necessary score for the innovation maturity level.

**Table 9: Necessary score for each innovation maturity level**

Classification	% in relation to the Maximum Innovation Degree (5 points)	Score
Innovative Company (IN)	Equal or higher than 80%	G. M. I. $\geq$ 4 points
Moderately Innovative Company (MIN)	Between 40% and 79%	2 $\geq$ G. M. I. $>$ 4 points
Little Innovative Company (PIN)	Lower than 40%	G. M. I. $<$ 2 points

**Source:** Adapted from Silva, Hartmann and Reis (2006).

Thus, considering the ranges established above, it's observed that the companies' majority is classified as moderately innovative (62,8%). Still according to data it's observed that 12 companies (27,9%) are classified as innovative and only 04 (9,3%) are little innovative. The detailed data are presented on Table 10, where is shown the Maximum Degree of Innovation (M.D.I.), presenting the respective activity type:

**Table 10: M.D.I. of the companies' integrants of Pró-Inova Project**

Activity type	Frequency	Frequency (%)	Accumulated Frequency (%)
Innovative (M.D.I. $\geq$ 4)	12	27, 9	27, 9
Moderately Innovative (2 $\leq$ M.D.I. $<$ 4)	27	62, 8	90, 7
Little Innovative (M.D.I. $<$ 2)	4	9, 3	100
<b>Grand Total</b>	<b>43</b>	<b>100</b>	

**Source:** Own elaboration, with aid of Action software.

## 5 – FINAL CONSIDERATIONS

From the assessment of innovation promotion actions influence in the index that measures the innovation maturity degree, it was sought to ratify or question the model of promotion actions in course.

One of the primordial questions in the formulation of Sciences and Technologies (S&T) policies is the need to have dominion over the environment to be interfered. It is necessary to map the insertion of S&T activities in the society development process so that is possible to do the right dimensioning of the most appropriated tools for each situation. Cavalcante and Aquino (2005) highlight that beyond the need of this knowledge about the environment, its necessary the monitoring of the adopted policies impacts. For those “the formulators of public policies have been seeking to systematize the main S&T indicators of the country, allowing analyses of temporal evolution, sector composition and interstate and international comparisons.”

Several government initiatives, as the creation of CNPq and CAPES at the 50's, allowed the appearance of an inexistent academic foundation in developing countries, that associated to the creation of companies of high technological intensity, lifted the country to worldwide levels of competitiveness in important sectors, as petroleum and gas (Petrobras), aeronautics (Embraer) and agricultural (Embrapa) (CRUZ, 2010). In a contradictory way, these initiatives are adjusted as “islands” of excellence, and as general rule the country is being highlighted internationally due the commercialization of primary products, with low aggregated value, considering the export tariffs where is concentrated, overall, iron ore, grains and soybean meal and sugar.

It is notable a mismatch between the govern initiatives in S&T and the effective return, in the form of competitiveness, to the country. Between the reasons of this mismatch, it's possible to highlight the fact that in Brazil the large concentration of scientists, technicians and engineers involved with innovation and technological development act, mainly, in university environments or govern research institutes, with only 23% acting in companies (CRUZ, 2010). In comparative terms, South Korea and USA – countries worldwide known due their competitiveness – have, respectively, in their companies 59% and 80% of scientists, technicians and engineers involved with innovation and technological development (CAVALCANTE & AQUINO, 2005).

At the business scope, also its notable an increase in the pursuit by results in S&T investments that grew significantly in the last decades, but do not presented return at the same proportion of the resources involved. Study of The Institute Innovation (2006, p.1) indicates that the studies made on USA and disclosed in a report of European Association of Research and Technology Organizations revealed that historically the achieved return over the investment if the order of 10 to 15%.

The pursuit of the competitiveness overly raised the investments in innovation making them each time higher, due the complexity and sophistication that the R&D actions started to require, becoming each time more necessary a better assessment of the investments in innovation return.

Interpreting the results that were obtained through analysis of correlation and ANOVA, it's possible to identify that the previous experience with innovation actions, by the studied companies, influenced, in the innovation maturity degree, corroborating with the standing hypothesis and answering the research question: THE INTERACTION UNIVERSITY ⇔ COMPANY ⇔ GOVERNMENT AFFECTS THE INNOVATION MATURITY DEGREE IN COMPANIES? These results take us to infer that the companies are being positively affected by the actions of innovation promotion, however, its considerable that more than 70% of the companies are moderately or little innovative, strengthening the need of investments in innovation promotion.

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