

## DIFFICULTIES TO BRIDGING THE PATH FROM INVENTION TO INNOVATION IN THE BRAZILIAN PUBLIC UNIVERSITIES ENVIRONMENT

**Carla Carvalho da Veiga** – [carlacveiga@gmail.com](mailto:carlacveiga@gmail.com)

*Program of Postgraduate in Production Engineering - Federal University of Rio de Janeiro*

**Virgílio José Martins Ferreira Filho** – [virgilio@ufrj.br](mailto:virgilio@ufrj.br)

*Program of Postgraduate in Production Engineering - Federal University of Rio de Janeiro*

**Fabício Molica de Mendonça** – [fabriciomolica@yahoo.com.br](mailto:fabriciomolica@yahoo.com.br)

*Program of Postgraduate in Intellectual Property and Technology Transfer for Innovation -  
Federal University of São João Del-Rei*

**Ricardo Coutinho** – [rcoutinhosa@yahoo.com](mailto:rcoutinhosa@yahoo.com)

*Program of Postgraduate in Marine Biotechnology -Admiral Paulo Moreira Institute of Sea Studies*

**Abstract**—Brazilian Government investments in science and technology were relevant in Brazil until the first half of the 2010 decade. These investments have generated both increases in researcher numbers and in the number of researches conducted, which could be demonstrated by the science, technology and innovation national indicators of that period. The indicators, as the Brazilian scientific publications, indicate that most research was rooted in public universities and most of this represents inventions and has the potential to become innovation. However, despite this seemingly promising scenario, the conversion rate of these inventions into innovation was very low, making a large part of these inventions fated to "die on laboratory stand". To address the problem, this paper aims to identify the main difficulties encountered by researchers in bridging the gap between invention and innovation in the innovation environment of Brazilian public universities. For that, it was through small-scale semi-structured interviews with individuals in key-positions of entities involved in innovation at the university and their boundaries. The findings demonstrated that culture is the most important aspect to be considered, followed by people's lack of knowledge about the laws, rules and policies that support the generation of innovation in those environments.

**Keywords**—innovation, invention, Brazilian public universities.

### 1 INTRODUCTION

Strong innovation is a frequency characteristic of regional economic expansion. This means that the increased competitiveness of countries is related to their capacity for innovation, which is only made possible through investments in science and technology. (ALMEIDA, 2008; RESENDE *et al.*, 2013).

In Brazil, the vast majority of research & development (R&D) originates in public science, technology and innovation institutions (primarily known by its acronym in Portuguese: ICTs), which encompass public universities and research institutes that operate thru Government grants (ANDRADE *et al.*, 2016). This scenario follows a world trend, in which governments usually support the riskiest research, whether applied or basic and indeed such support has often been the source of the most radical, path-breaking types of innovation (JUGEND *et al.*, 2018).

Contributes to this conjuncture a widespread feature of Brazilian companies that operate with incremental innovation, being more innovative in terms of processes innovation, designing adjustments and

product adequacy to local market conditions rather than new product development thru radical innovation (ROZENFELD *et al.*, 2006; JUGEND *et al.*, 2018).

Aiming an increase on innovation generation and consequently an increase on economic development, Brazilian government has been adapting its policies and legislation in the past years, in order to facilitate commercial agreements involving public universities and private companies. These type of agreements follow the concept of the triple helix, which defines chains formed by the government, university and private companies, with the purpose of producing new knowledge and innovations (more detail can be found in Etzkowitz and Leydesdorff, 1995). So, legal structure for innovation, amendment federal Constitution and regulating for innovation law have recently been sanctioned. In addition, until the first half of 2010, the National Innovation Policy created and granted innovation programs in order to foment the university-industry relationship (ANDRADE *et al.*, 2016).

But despite these legal adjustments and past grants, Brazil's position at Global Index Innovation has been decreasing from 47<sup>o</sup> position in 2011 to 69<sup>o</sup> position in 2017 (CORNELL UNIVERSITY; INSEAD and WIPO, 2017).

Through a quick research about science, technology and innovation national indicators, it is possible to verify the divergence between scientific publications and patent numbers. Between 2010 and 2014, Brazilian researches number increases 39.9%, which support the 63,126 scientific articles published in scientific journals indexed by Thomson/ISI and Scopus. On the other hand, in this same period, the National Institute of Industrial Property (acronym in Portuguese as INPI), which represents Brazilian patent office, has conceded 3,502 patents from Brazilian resident applications (MCTIC, 2018). Even considering that the average time for granting patents in Brazil is too long (seven years on average, according to QUERIDO *et al.*, 2011) and that not all published study is patentable, nevertheless those indicators emphasize that Brazil remain challenged to increase the conversion of science and technology into innovation (ANDRADE *et al.*, 2016).

Based on this reasoning, a gap between new technologies generated in the university environment and new products developed available to society emerges, pointing a lack of becoming inventions in innovations. These previous insights conducted us to the following question: which difficulties have been blocking the path to inventions from Brazilian public universities crossing the laboratory borders to society, bridging invention to innovation?

In this sense, this paper aims to identify the main difficulties encountered by researchers and innovation agents to transform an invention into innovation in the Brazilian public university environment.

Thereby, this paper is structured as follows. The next section presents the concepts applied to synthesize the literature on invention, innovation, innovation in Brazil and Brazilian public universities environment. Following this is the description of the methodology used to conduct the study. The results and analysis are then discussed and finally, final findings are presented, accompanied by a future research agenda.

## 2 CONCEPTUAL BACKGROUND

### 2.1 INVENTION AND INNOVATION

The invention is defined in literature by several previous works (e.g. Utterback, 1971) as an original solution generated from information about a need or want and information about the technical requested to meet referred need or want. Similarly, innovation is defined by different authors (e.g. Utterback, 1971; Dosi, 1988; Chesbrough, 2012) as the invention implemented and brought to market, in the case of a new product and first use in a production process, in the case of process innovation.

Following these definitions, there is a clear difference between both concepts in terms of development level, which corroborates on the perception of a pathway from invention to innovation.

To bridging the pathway between inventions to innovations Chesbrough (2012) argues for the use of so-called open innovation, in which innovation does not need to be conceived, developed and commercialized by the same agent, company or institution. At the same time, Almeida (2008) emphasizes that an innovation networking is the basis for generating an enabling environment for the development of innovations, since they are capable of providing the different capacities needed for the outlined objectives.

Thus, the section below presents the characteristics of innovation in Brazil, emphasizing the initiatives already undertaken with the aim of enabling and promoting the acting of different agents in the country's innovation network.

## 2.2 INNOVATION IN BRAZIL

In Brazil, as in “emerging” countries, basic, applied and experimental/developmental research is concentrated in public institutions, recognized in Brazil by the acronym ICTs (LAHORGUE, 2005; ALMEIDA, 2008; NETO *et al.*, 2013).

To support this reality and foment innovation, Brazilian laws and legal structure referred to innovation have been improved in the past years. This enhancing has started from Foundations Law (N. 8.958/1994), which deals with the relations between ICTs and foundations of support, aiming to establish contracts and agreements with other organizations, including the private sector. Next, the Industrial Property Law (N. 9.279/1996) has been drafted, providing and endorsing all rules to patent application and innovation protection. Following, the Innovation Law (N. 10.973/2004) was structured. The referred law explicit the differences between invention and innovation, define the terms “creation” as an invention and “innovation” as the introduction of novelty or improvement in the productive or social environment, and allow greater interactions between the university and industry. To complement the legal framework, the Law of Good (N. 11.196/2005) was approved, to ensure tax incentives for companies that were investing in innovation. Recently, the Government, through the Law N. 13.243/2016 and Decree N. 9.283/2018, sanctioned both structuring and regimentation for Innovation Law (BRAZIL, 1994; 1996; 2004; 2005; 2016; 2018).

In practical terms, Brazil has a National Science, Technology and Innovation System, which is composed by three levels of agents. Politicians' agents are in charge of define funds and grants value for the system operationalization. The funding agencies define the application, evaluate the rules and provide the grants to the third level agents. Finally, the ICTs, mainly public universities, are responsible for apply the grants in R&D and innovation generation activities (ANDRADE *et al.*, 2016).

Therefore, based on the national system and legal structure, the Brazilian innovation environment has undergone some modifications. Following the global trend of turning universities into more entrepreneurial institutions, by supporting and encouraging the generation of startups and spinoffs (CHAI *et al.*, 2018), technology parks and incubators were implemented. Moreover, universities have established organizational mechanisms to transfer knowledge and technology to industries (ALMEIDA, 2008), as the support foundations and Technology Transfer Offices (TTOs).

## 2.3 BRAZILIAN PUBLIC UNIVERSITIES ENVIRONMENT

Several agents form the innovation environment of Brazilian public universities, also called ICTs. These agents include students and teachers who conduct researches that contributes to science (basic research) and, in many cases, also generates inventions (applied research).

Other agent are the foundations. They aim to administer contracts and financial income mostly from research services providing and technology co-development between the university and private or public companies (LAHORGUE, 2005).

The technology parks, on the other hand, had been created to foster the creation of research spinoffs,

which could be turned into small businesses. Initial difficulties to establish these initiatives, as insufficient resources, the absence of venture capital and lack of academic leaders have forced a 15 years delay to reach their feasibility. Nowadays, technology parks embody small and big companies in shared environments, whose objective is to generate interaction between the university and the resident companies, as well as the interaction between the companies among themselves. However, there are few cases of success interaction (LAHORGUE, 2005; ABDI, 2007; ALMEIDA, 2008).

The agents called Incubators are bottom-up small structures developed to support startups and spinoffs generation. Despite the fact that most incubators have ties with universities, they could be found in other institutions, both public and private, not necessarily fostering the formation of technology-based companies (LAHORGUE, 2005; ALMEIDA, 2008).

The Brazilian TTOs are defined as Technological Innovation Nuclei (acronym in Portuguese as NIT) and are called by “agency”, “office” (LAHORGUE, 2005) or “center” (ALMEIDA, 2008). Their objectives are the management of university innovation policy. Therefore, they are in charge to monitor the development process from research to innovation and promoting partnerships between universities and companies. For that, the NITs should perform the following activities: protection of intellectual property; management of patent licensing and TT agreements; promotion of interaction between universities and companies and assistance to researches in fundraising for innovation (CHAIIS *et al.*, 2018).

Brazilian TTOs (or NITs) are small in terms of their full-time equivalent (FTE) staff and a significant proportion of the people working in TTOs are temporary staff – either students or professionals – who receive stipends and, as a result, cannot stay in the TTO for longer than two or three years (LAHORGUE, 2005).

So, despite the existence of these TTOs or NITs, the universities still have a portfolio of patents available to companies that seek to license for commercial use. In fact, the TT process is not established yet, it means, there is no clear and defined process and the valuation of new technologies stage does not have a valid methodology (CHAIIS *et al.*, 2018). Thus, in this research, we do not consider Brazilian NITs as real TTOs but as patent manager agencies.

In this scenario, the financial resources invested until the first half of 2010 decade was mostly used for the publication of papers in qualified journals. Some of those researches have been turned into technology patents (CHAIIS *et al.*, 2018). In these cases, universities are responsible for meeting the costs related to many granted patents, which are unable to reach the market (QUERIDO *et al.*, 2011) as they have not undergone a process of evaluating the feasibility of transfer to the market, not reaching the expected return (VEIGA, 2019).

Another fact to consider is that Government financial supporting does not always take place (CHAIIS *et al.*, 2018), just as it happens in the present moment, affecting directly all Brazilian public innovation environment.

### 3 METHODOLOGY

For the purposes of data collection, a plan of interviews was created to consult at least one agent of each party of the innovation network in the Federal University of Rio de Janeiro environment. Therefore, a semi-structured questionnaire was created seeking to understand the role of agents, the list of their activities and the form in which all activities are developed. The final and most important question was “In your opinion, which difficulties block the generation of innovation?”

#### 3.1 DATA COLLECTION

Firstly, a list of innovation network agents was generated. Due to physical and budgetary limitations, the individuals firstly selected were from the innovation environment of the Federal University of Rio de Janeiro. After that, the small-scale semi-structured interview form was developed. During the first



interviews, conducted in person, some interviewees suggested other individuals to be consulted, some from the outside of university. In fact, the interviewees suggested these few names considering that these individuals had the knowledge and/or experience in research and technology transfer topics, which may contribute to the results of the present research. For this reason, people from The Brazilian Agricultural Research Corporation (Embrapa), in Rio de Janeiro and Federal District, from University of São João Del Rei, in Minas Gerais and from private sector in Rio de Janeiro were also interviewed.

At same point, an interviewee suggested the inclusion of his business partner on the interviewed list, considering the huge experience of him in Jheronimus Academy in the Netherlands as Professor (MSc), Ph.D. student and senior member of an accelerator; and the huge experience in Brazil, as entrepreneur and investor. This last interview was conducted in Rio de Janeiro, during his visit to the city.

The list of respondents as shown in Table 1.

TABLE 1  
RESPONDENTS AND THEIR RESPECTIVE CHARACTERISTICS

Organization	People interviewed qualification	Quantity
Federal University of Rio de Janeiro	Business consultant at university technology transfer foundation	01
	University incubator coordinator	01
	Ph.D. student and inventor	02
	University patent manager agency coordinator	01
	University patent manager agency lawyer	01
	Startup entrepreneur of university technological park	09
	Corporate negotiations head of university technological park	01
	Entrepreneurship and social innovation head of university patent manager agency	01
Federal University of São João Del Rei	Professor	01
Jheronimus Academy – Netherlands	Professor (MSc), Entrepreneur, Ph.D. student, investor and senior member of an accelerator	01
Brazilian Agricultural Research Corporation – Embrapa	Business innovation research	01
	Technology transfer office head	01
	Technology transfer office research	01
Private sector	4 startups entrepreneur (Rio de Janeiro and São Paulo)	02
	MSc, senior technological multinational employee	01
	Business development director of an industry (South America)	01
Total		26

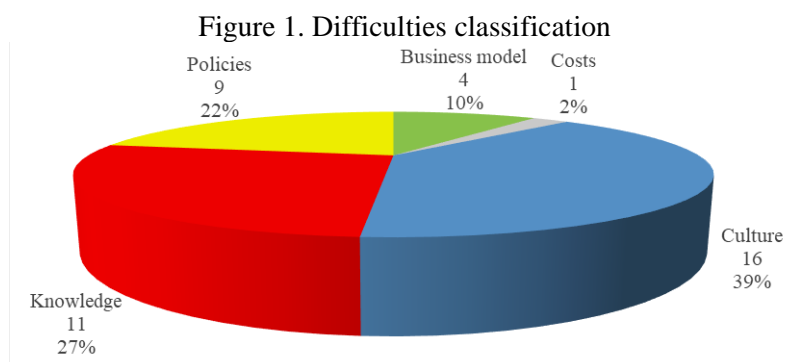
#### 4 RESULTS

Data generated from these interviews with four (4) senior managers, seven (7) senior professionals, two (2) Professors, eleven (11) startup entrepreneurs, as well as two (2) Ph.D. students-inventors were analyzed through a content analysis (more detail can be found in BARDIN, 2011), presented below.

#### 4.1. CONTENT ANALYSIS

After a content analysis of all respondents' answers, the difficulties pointed by the individuals interviewed were classified into five groups: culture, knowledge, policies, business model and costs, as shown in Figure 1.

Based on Figure 1, it is possible to observe that the group classified as "culture" has the largest number of problems raised, totalizing 16 difficulties, which represent 39% of the issues. The "knowledge" group has 11 difficulties or 27% of the total, while "policies" group has 9 difficulties (equivalent to 22%). "Business model" group represents 4 difficulties and "cost" group represents 1 (equivalent 10% and 2%) respectively.



**Erro! Autoreferência de indicador não válida.,**

TABLE 3, TABLE 4, TABLE 5, and TABLE 6 below present all the difficulties pointed out, grouped in a detailed way.

TABLE 2  
CULTURE GROUP OF DIFFICULTIES POINTED OUT BY INTERVIEWEES

Group	Difficulties pointed out by interviewees
Culture	<p>Academic protagonist and autonomy represent duplicate researches.</p> <p>Belief in the risk of a "public knowledge privatization" in partnerships between companies and universities.</p> <p>Brazilian companies do not absorb PhDs in their R&amp;D areas.</p> <p>Cultural differences between university and industry and between technical and business people still represent barriers.</p> <p>Difference between technology development and the market schedule is large.</p> <p>Large companies in Brazil are not concerned with R&amp;D; their focus is on product improvements; in many cases, they prefer to pay an assessment to a new solution risk.</p> <p>Researchers publish papers and finish the research.</p> <p>Researchers' evaluation prioritizes papers publication rather than technology transfer.</p> <p>The university focus is on technical feasibility, not on market demand.</p> <p>The university has no focus on product development; in many cases, it looks for basic rather than applied research.</p> <p>Few private companies support and recognize strict sense graduate courses.</p> <p>There is a lack of dialogue between agents in the innovation network. In some cases, there may be a rivalry.</p> <p>There is no bridge between small incubated or resident companies and research laboratories.</p>

Programs are discontinued, due to changes in Government.

Lack of searches for unprotected products in Brazil, which could be developed and commercialized through cooperation between small businesses and universities.

Analyzing, approving and releasing public resources to finance research in small companies is very time-consuming.

TABLE 3  
KNOWLEDGE GROUP OF DIFFICULTIES POINTED OUT BY INTERVIEWEES

Group	Difficulties pointed out by interviewees
Knowledge	<p>Difficulty in valuing technology and calculating return on investment.</p> <p>Lack of knowledge about laws and interaction possibilities between the university and private companies.</p> <p>Lack of knowledge about the grace period, which determines that the inventor has 1 year to the patent application, even if there's a paper published on the subject.</p> <p>Lack of knowledge regarding a licensed patent is worth more than published papers in national university evaluation.</p> <p>Lack of knowledge regarding the rules, rights and deadlines of Brazilian Patents Office (INPI).</p> <p>Large-scale production problems (scale up).</p> <p>Researchers sometimes negotiate their technologies on their own, without non-disclosure agreements.</p> <p>Researchers sometimes publish their inventions in academic publications, eliminating the chance to register patents.</p> <p>Some inventors apply for their patents in INPI without university patent manager agency (NIT) orientation.</p> <p>Some researchers are not interested in starting a business, learning or dedicating themselves to management a startup or spinoff.</p> <p>There is no regulation for Laws: no one knows how to operationalize the sanctioned Law, which creates legal insecurity and, consequently, inertia.</p>

TABLE 4  
POLICIES GROUP OF DIFFICULTIES POINTED OUT BY INTERVIEWEES

Group	Difficulties pointed out by interviewees
Policies	<p>Delay performance of NITs in manager contracts, due to the rotation of personnel and university policies.</p> <p>Delays in opening companies process; Difficulties related to tax policy;</p> <p>Lack of knowledge of NIT's professionals, both due to university policies, which imply personal rotation and allocation of university career professionals who are not specialized in the area.</p> <p>The long delay in obtaining patents (6 to 10 years).</p> <p>NITs do not have a sector or a team to identify potential market stakeholders to offer patent licensing, so there is no bridge to market.</p> <p>Small incubated and resident companies do not seek or receive support from NIT or technological parks.</p> <p>Startups and spin-offs have difficulties doing business with large companies, even those</p>

installed in technology parks, because they are very small; they cannot match demand and sometimes they even cannot apply as suppliers.

University spends a lot of time with legal aspects; all formalities must be submitted to the Prosecutor's Office.

Universities cannot license directly to a company; they need to make a public offer.

TABLE 5  
BUSINESS MODEL GROUP OF DIFFICULTIES POINTED OUT BY INTERVIEWEES

Group	Difficulties pointed out by interviewees
Business model	Researchers must carry out everything: seek partnerships; develop research, publish the paper, disseminate results, etc. and they have time limitations.
	Sales are the hardest part for a startup; the first sale can take too long; entrepreneurs may not be prepared for it.
	International companies from Brazilian technology parks develop technologies based on service contracts with university laboratories, but in those cases, those companies are the patent owners (it means that the university is not included as owner).
	In some cooperation for development agreements, intellectual property is divided between the university and the company, but without royalties' payments to university despite the commercial exploitation.

TABLE 6  
COSTS GROUP OF DIFFICULTIES POINTED OUT BY INTERVIEWEES

Group	Difficulties pointed out by interviewees
Costs	High cost to apply and maintain patents.

## 4.2. CONCLUSION

This study had the purpose to identify difficulties on the pathway between inventions to innovations in Brazilian public universities environment, though small-scale semi structured interviews with individuals in key-positions of entities involved in innovation network at the universities and their boundaries.

To achieve this objective, a list of difficulties pointed out by 26 professionals and students involved in innovation generation, including representative of public universities, national technology transfer entity, private sector and an agent of an international university was presented.

The findings have demonstrated that culture is the most important aspect to be considered. Such findings indicate a scenario with a barrier between universities and the private sector, which affects not only researchers and ICTs, who are responsible for the discoveries and inventions, but also the private companies and the society, whereas they have no access to innovative products that could improve people's lives, the planet's sustainability and the country's economic development.

Besides that, incubators, accelerators and their respective programs act firstly as evaluators, selecting the best startup companies or research groups, and secondly as instructors and mentors. In this scenario, only researchers who can already structure - minimally - a business plan and a pitch can participate of these programs. It turns out another gap. Researchers are highly qualified in their respective fields and have no qualifications to develop business and business plans. Also, the training and acting in business areas could takes them a precious time, which could be better utilized if they continue to generate new discoveries. Precisely for this reason, many researchers have no interest in developing and running businesses because they are interested in continuing their research in their own areas.



Another gap is the fact that business management trainings are interesting to gain knowledge related to the range of business needs, but it is naive to think that such short trainings are sufficient to develop good business plans.

In addition, the NITs mostly maintain a passive posture, remaining “patent showcases” and waiting possible interested partners appear to start a negotiation. Thereby, the universities absorb patent annuity costs for a period of 15 or 20 years, without any financial returns. In cases in which the NITs start a negotiation, cultural difficulties appear again, as university and private sector do not have the same language and in some cases encounter conflicts of interest, because the inventions could need to be needs further development to prove its economic viability.

On the other hand, Brazilian private companies have low interest in innovation, which is mostly produced in their headquarters, usually located outside Brazil. Brazilian operation is limited to import the parts and assemble. In many cases, the headquarters maintain part of the technology as confidential.

Finally, scale up is a very critical step, because the invention does not always present the same characteristics on laboratory and large scales. Thereby, scale up can require a set of equipment and resources, which is not always available to the developers.

Regarding limitations, the research was conducted mainly at the Federal University of Rio de Janeiro and data were collected directly from each interviewee, carrying with it a risk of bias.

Future studies could consult innovation agents from other Brazilian public universities and public universities of other “emergent” countries, which are also finding out difficulties to tread the path from invention to innovation. In addition, future studies could provide solutions to reduce or minimize the difficulties pointed out by the network agents, in order to inventions cross the laboratory border and reach to society.

## ACKNOWLEDGMENT

The authors expressed their gratitude to CNPq for their research support.

## REFERENCES

- ABDI. **Technology parks in Brazil**: study, analysis and propositions. Brasília, Brazil, 2007.
- ALMEIDA, M. Innovation and entrepreneurship in Brazilian universities. **International Journal of Technology Management and Sustainable Development**, 7(Number 1), p. 39–58, 2008.
- ANDRADE, J. *et al.* **Estratégia Nacional de Ciência, Tecnologia e Inovação**. Brasília, Brazil, 2016. <<http://www.mcti.gov.br/>> (Accessed online May 2016).
- BARDIN, L. **Content Analysis**. Edições 70, São Paulo, Brazil, 2011.
- BRAZIL. **Decreto N. 9.283/2018**. “Innovation law regimentation”, Brasília, Brazil, 2018.
- BRAZIL. **Lei N. 10.973/2004**. “Innovation Law”, Brasília, Brazil, 2004.
- BRAZIL. **Lei N. 11.196/2005**. “Law of Good”, Brasília, Brazil, 2005.
- BRAZIL. **Lei N. 13.243/2016**. “Legal structuring of science, technology and innovation”, Brasília, Brazil, 2016.
- BRAZIL. **Lei N. 8.958/1994**. “Foundations Law”, Brasília, Brazil, 1994.
- BRAZIL. **Lei N. 9.279/1996**. “Industrial Property Law”. Brasília, Brazil, 1996.

CHAI, C., GANZER, P., OLEA, P. Technology Transfer between universities and companies: Two cases of Brazilian universities. **Innovation and Management Review**, 15(1), pp. 20-40, 2018.

CHESBROUGH, H. **Inovação Aberta**: Como criar e lucrar com a tecnologia. Tradução: FARIA, L. C. Q. Porto Alegre: Bookman, p. 241, 2012.

CORNELL UNIVERSITY; INSEAD and WIPO. **The Global Innovation Index 2017**: Innovation Feeding the World. Ithaca, Fontainebleau and Geneva. 2017. <<https://www.globalinnovationindex.org/gii-2017-report>> (Accessed online Nov 2017).

DOSI, G. Sources, Procedures and Microeconomic Effects of Innovation. **Journal of Economic Literature**, vol. XXVI, September, p. 1120-1171, 1988.

ETZKOWITZ, H., LEYDESDORFF, L. The triple helix—university—industry—government relations: a laboratory for knowledge-based economic development. **EASST Review**, 14, 1, 14–19, 1995.

JUGEND, D. *et al.* Relationships among open innovation, innovative performance, government support and firm size: Comparing Brazilian firms embracing different levels of radicalism in innovation. **Technovation**, 74–75, 54–65. <https://doi.org/10.1016/j.technovation.2018.02.004>, 2018.

LAHORGUE, M. Managing relations with industry: The case of Brazilian universities. **Higher Education Management and Policy**, 17(2), 2005.

MCTIC. **Science, Technology and Innovation National Indicators**. Brasília, Brazil, 2017.

NETO, F. et al. Patterns of interaction between national and multinational corporations and Brazilian universities/public research institutes. **Science and Public Policy**, Volume 40, p. 281–292, 2013.

QUERIDO, A., LAGE, C., VASCONCELLOS, A. What is the Destiny of Patents of Brazilian Universities? **Journal of Technology Management & Innovation**, 6(1), 2011.

RESENDE, D., GIBSON, D., JARRETT, J. BTP - Best Transfer Practices. A tool for qualitative analysis of tech-transfer offices: A cross-cultural analysis. **Technovation**, 33, 2–12, 2013. <http://dx.doi.org/10.1016/j.technovation.2012.09.001>.

ROZENFELD, H. et al. **Product development management**: a reference for process improvement. Saraiva Publisher. São Paulo, Brazil, 2006.

UTTERBACK, J. The process of technological innovation within the firm. **Acad. Manag. J.** 14(1), 75–88, 1971.

VEIGA, C. **From Invention to Innovation**: A Sustainable Product Development Process to Marine Biotechnology. Ph.D. Thesis, Program of Production Engineering, COPPE, Universidade Federal do Rio de Janeiro, 2019.