Patentometric analysis of the transfer of technology in Brazil between 2010 and 2018

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Abstract

This article aims to analyze the profile of technology-based companies, transferring technology and innovating their processes, presenting a mapping of companies and potential sectors, so that the participation of universities and companies in the intellectual property process can be made feasible. Conceptual discussions about technology-based and innovation-based companies were presented and used to justify the analyzes found in this study. Among the methodological aspects, the research is exploratory and descriptive, with qualitative and quantitative treatment. For the purposes of the research, the search for information was done through the National Institute of Intellectual Property (INPI), through technological prospecting and patentometry. There were found patent applications, of which 353 applications were selected for analysis from 2010 to 2018. In the search, the keywords were used: "company+base+ technology" and, later, the research was expanded with the keywords: "company+technology", "company and technology", to perceive changes in numerical terms and analysis within the validation criteria of a technology-based company. The results obtained were that although there are discussions about technology-based company concepts, innovation and technology transfer in the country , there is still a timid generation of innovations in the processes of technology-based companies. The technology-based companies resulting from this research with a higher incidence of innovation are those of manufacturing in general, noting that they do not have a clear understanding of what innovations they are capable of of developing to be able to transfer technology due to lack of: support to stimulate R & D, partnerships with the business sector and financial investments to seek innovation in their processes.

Keywords: technology-based companies; innovation; prospection; technology;

1. Introduction

Given the speed at which market trends change and product life cycles diminish, it becomes necesary for companies to engage in innovative activities in order to remain competitive and to achieve differentials to remain the Market (VARGAS et al, 2016).

In particular, technology-based companies usually have as a characteristic the generation of a high volume of innovations and the absorption of many knowledge related to technology (SPERAFICO et al, 2016).

The technology-based companies consist of organizations that have in the knowledge a strategic component for their competitiveness, making important technological efforts, concentrating a significant part of their dedication in the development and manufacture of products that systematically integrate new Technologies (WILLERDING et al, 2016).

The process of creating or launching a technology-based enterprise is complex because of its connection between basic research, the sectors or niche markets to which they are directed, as they have not reached full maturity and the concrete application of technology (VARGAS et al, 2016).

The results achieved by technology-based companies, through innovation, consist basically in the creation and use of new ideas that have been shown as the most effective ways of organizations to differentiate themselves from each other, since through this practice it is possible to perceive the inherent changes in the market and transform them into actions that generate better performance (SILVA e DACORSO, 2013).

Due to these characteristics, technology-based companies become, in the opinion of the aforementioned authors, a promising field of research in order to understand how resources, knowledge and applied technologies can leverage their results (GENUÍNO e MACHADO, 2016).

However, in the middle of discussions and concepts to define technology-based companies, the research problem that arises to be studied in this article is: which sectors of technology-based companies that most transfer technology?

As technology-based companies are the driving force behind the technology transfer process, this study becomes relevant in that it enables the perception of gaps that could be filled to optimize the research and development process, which results in appropriate direction in the identification of innovation, its characteristic aspects, its main focuses and trends.

Thus, it is proposed in this article, to analyze the profile of technology-based companies in transferring technology and innovating their processes, presenting a mapping of companies and potential sectors, so that the participation of universities and companies in the process of intellectual property can become viable.

The research can be characterized as exploratory and descriptive with a qualitative and quantitative approach (DALFOVO; LANA; SILVEIRA, 2008). In order to fulfill the objective of this study, a search of information was made using the technological prospection, more precisely, a patentometry, searching for granted patents or utility models (FAGUNDES, 2014). This research was used with a longitudinal character with a temporal cut from 2010 to 2018, and it is necessary to search with terms of the variations for a technology based company, so that it could generate qualitative and quantitative discussions, as explained in figure 1:

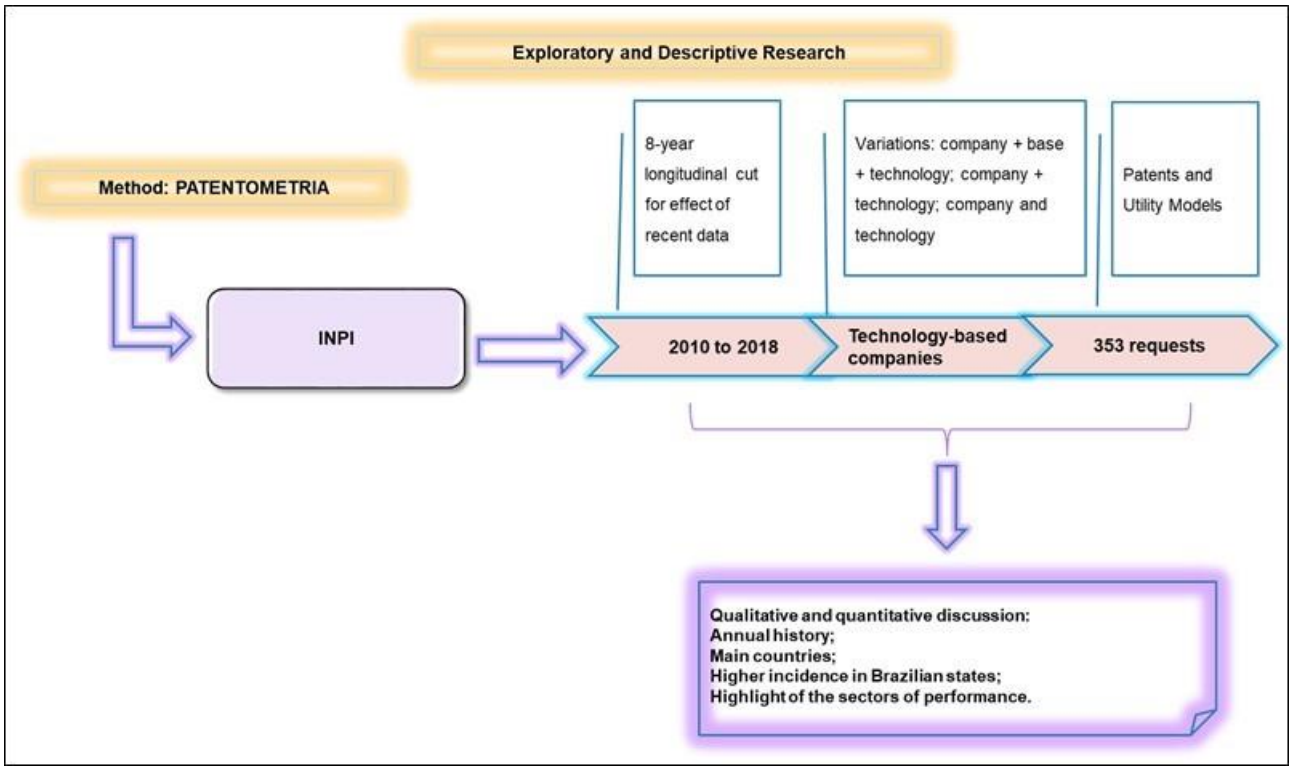

Figure 1: Methodological process
Source: Elaboration of authors (2019)

After the data were collected, 353 (three hundred and fifty three) processes granted. Of these 353, all the requests found (Patent of Invention and Utility Model) within the established period (2010 to 2018) were analyzed. The dimensions defined for analysis were: year of the processes, the main countries, the Brazilian states, and the main sectors that have processes of transfer of technology. All data found in the search for the terms established within the period from 2010 to 2018 were tabulated in Microsoft Excel 2010 spreadsheets for later construction of graphics.

2 Innovation and Technology Transfer: concepts and contributions for technology-based companies

The ability of companies to innovate, given their practices and attitudes, their ability to learn, adapt, improve strategic skills and organizational skills, becomes a key factor in the relationship with the market environment (SILVA e DACORSO, 2013).

The technology-based companies are for the country's development, since new technologies, products and / or services that are knowledge-intensive, innovative and can be considered as drivers of research and development, drawing the attention of academia to scientific research of several areas of knowledge (VARGAS, 2016; OSUNA e PÉREZ, 2016).

Its importance as a space for professional action has long been recognized by scientists, and perhaps for this reason academics were the first to focus on the specificities of such companies (WILLERDING et al, 2016), where the ability to innovate plays an essential role (TELLO e VELASCO, 2016).

The term innovation is based on the precepts of Chesbrough and their followers. Innovating means having a new idea or applying the idea of others in an original and effective way. But that is not all. It is a new idea allied to the successful implementation or exploitation of new ideas (DEMARCHI et al, 2016)

There is, in the theoretical field, a difficulty to conceptualize innovation, due to the clashes of thoughts about what is "new" for different authors (GENUÍNO e MACHADO, 2016).

So, that the term innovation is employed in at least three different contexts (DEMARCHI et al, 2016):

- synonym of invention: refers to a creative process in which two or more concepts are combined in a new way to produce an unknown configuration;
- a change: something, process and /or new procedure for the organization; and
- In the popular view, something practical or material artifact: something invented or seen as new independent of its adoption.

According to Innovation Law No. 10.793 of 2004, innovation is the design of a new product or process of manufacture, as well as the aggregation of new functionalities or characteristics to the product or process that imply incremental improvements and gain of quality or effective productivity, resulting in greater market competitiveness.

Other types of innovation may relate to new markets, new business models, new processes and organizational methods, new sources of supply, such as technological innovation.

Technological innovation is any innovation introduced by the productive sector, through research or investments, which increases the efficiency of the production process or implies a new or improved product. It is, therefore, product or process innovation (MANUAL DE OSLO, 2005).

Considering that technology-based companies are organizations that invest in technological innovation and adopt technologies in the development of new goods, services and processes, studies that address the influence of internal resources on innovation performance and the creation of competitive advantage are gaining ground in the literature, but this is not reflected in the empirical research, which makes the observation limited (SILVA et al, 2017).

Thus, in an attempt to deepen these studies, it is important to analyze the contribution of internal factors (Research & Development integration) and external factors (with the insertion of innovation) to technology-based companies.

Innovation is influenced by several internal (closed innovation) and external (open innovation) factors for the organization. In this way, it is possible to manage these influences to affect the results. In this sense, innovation management was created with the aim of making it feasible and based on the management of effective routines, which are considered tasks of organizational behavior involving technologies, procedures, formal strategies, informal habits and experiences that work (SPERAFICO et al, 2016).

Closed innovation was the standard adopted by companies until the early 2000s, where Research & Development (R & D) activities were carried out exclusively in their own laboratories. This model has been replaced by open innovation, in which companies, in addition to internal ideas, take advantage of the

inventive capacity of other sources, such as customers, suppliers, universities, research institutes or independent inventors, establishing partnerships (GENUÍNO e MACHADO, 2016). In this way, it is possible to obtain better innovations, cheaper and in less time, besides offering to the market the internal inventions that are not used, generating income. Among the most relevant aspects of this concept are the changes in business culture, business model and intellectual property (IP) management, which result in new ways of creating value and identifying external knowledge useful to the company (STAL et al, 2014).
The term open innovation opposes the concept of closed innovation, in which the process of innovation, from idea conception through development to marketing, occurs internally in the organization. One of the pillars of closed innovation is the profit generated by the price obtained through pioneering innovation in the Market (LOPES et al, 2017). The Schumpeterian view does not understand the innovation of the external environment and neglects the demand, that is, the external environment has no motivating power for the organization to develop products or services that meet a potential community. According to this author, the external environment is that it must conform to what the organization develops (GENUÍNO e MACHADO, 2016).
Open innovation is the paradigm that assumes that firms can and should use outside ideas in the same way that they use internal ideas and internal and external paths to the Market (STAL et al, 2014; SILVA e DACORSO, 2013; GENUÍNO e MACHADO, 2016; VARGAS, 2016; SPERAFICO et al, 2016).
Technological innovation, currently known as technology-based innovation, brings technological advances and uses technological know-how (DEMARCHI et al, 2016). It must be the result of an environment that produces state-of-the-art technology and, despite the Brazilian public universities, are centers of scientific excellence, it is possible to verify that the research of the academy does not have the due influence productive sector. This low incorporation of new technologies means that the services and products produced in the country are not competitive both in the domestic market and abroad (BERNI et al, 2015).
Therefore, in the light of the above, one can then establish the differences between the concepts of closed innovation, open innovation and technological innovation. However, in the concepts of the different types of innovation, one can mention the transfer of technology.
Technology Transfer corresponds to a process of transfer of specific knowledge and skills, developed from research, whose objective is to promote the technological qualification of the receiving companies. In more recent industrialized countries, the authors found that there was an effort to build a research and development infrastructure, while investing in rapid and intensive industrialization (SANTOS et al, 2016).
In the last decades, universities have become more relevant to the productive sector, since they contribute to the generation of new knowledge through research and development, as well as assisting in the innovation process in companies (BERNI et al, 2015). In this way, you will be able to transfer technology in these processes.
Technology Transfer as a process between two social entities, in which technological knowledge is acquired, developed, used and improved through the transfer of one or more technology components. The production method itself or part of it, with the intention of implementing a procedure, an element of a product, the product itself or a methodology. The process of technology transfer can also be understood as the set of steps that describes the formal transference of inventions resulting from scientific research to the productive

sector (SANTOS et al, 2016).

Therefore, the main contributions of the university to companies in relation to increasing competitiveness are: support for research and development, support for technological innovation capacity and partnerships for the formation of intellectual capital, to provide greater interaction with companies, identifying the need for that companies be more active in the process of cooperation with universities, seeking opportunities in research laboratories of educational institutions and proposing joint actions to improve processes that will generate cooperation between these entities (BERNI et al, 2015).

3 Results and Discussion

The search in the INPI database is carried out when there is a need to find already deposited technologies, as well as during the process of writing new patents. According to the analysis of the data presented in figure 2, the results presented 353 records of technology transfer between 2010 and 2018. The data show that the years 2010 and 2014 stand out with 70 and 65 requests, respectively. As for the number of requests, the year 2015 can also be highlighted with more than 50 requests filed in the same period.

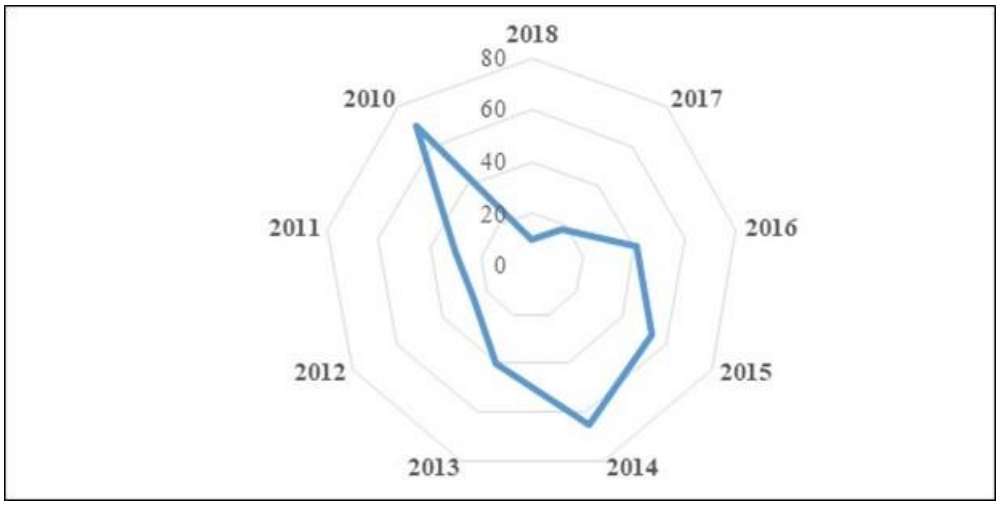

Figure 2: Technology Transfer Requests (2010 to 2018)
Source: Data Research - INPI (2019)

Technology transfer began in Brazil in the 1960s as a proposal to accelerate the process of industrialization of emerging economies such as Brazil, gaining momentum from the promulgation of the Innovation Law 10.973 / 2004, which encourages innovation and scientific and technological research in the productive environment (DIAS; SILVEIRA, 2013). The promulgation of the Law was important to stimulate and promote partnerships between universities and companies through the Nuclei of Innovation and Technology - NIT (CHAIS, 2013).

Figure 3 shows the main countries that carried out the largest transfer of technology in the period. The United States is the first with 104 cases, followed by Japan with 68 and Germany with 61. Countries such as France, Switzerland, the United Kingdom, Spain, Italy, Brazil, the Netherlands and Canada also appear, with an average of 15 cases. Emphasis on France (24) and Switzerland (22), respectively.

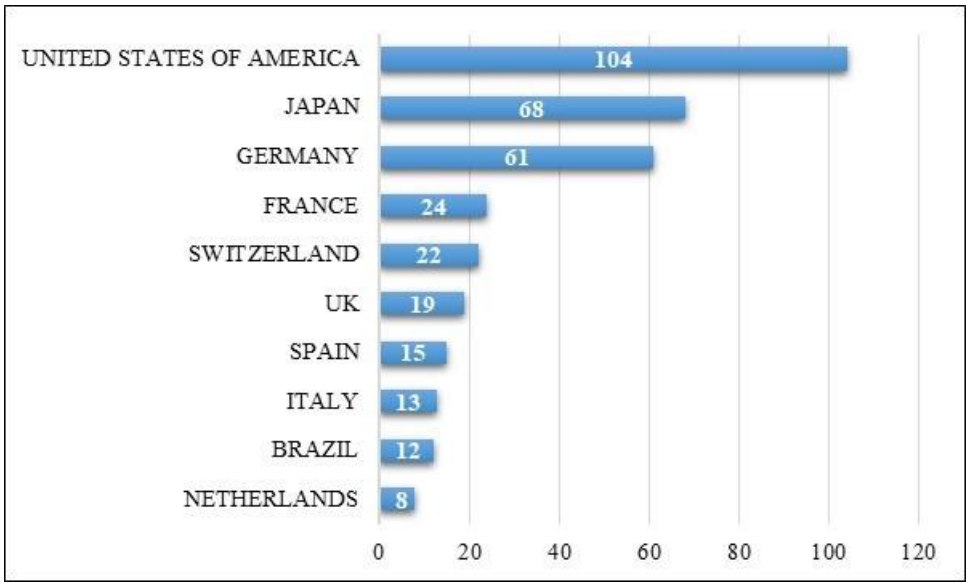

Figure 3: Main countries that have carried out the most technology transfer (2010 to 2018)
Source: Data Research - INPI (2019)

The United States is one of the major countries involved in research and development (R & D) activities. When it comes to, for example, the industrial sector, investments reach 75%. In the same way, it is also identified that for some the gains have been extended in the long term, with the highest performance in the industrial segments generating spillover effects for other sectors, leveraging the development of more sophisticated segments with positive effects on productivity country average. As a result, transnational corporations - usually based in developed countries and leading the process of international fragmentation of production - guarantee the control of brands, industrial secrets, knowledge, simultaneously the outsourcing of production steps and the consequent "technology loan". It consists of specifically making available the technology and / or knowledge used in the activity, highly protected and without the possibility of decoding and local rooting (CORRÊA et al, 2018).

Japan today is one of the leading countries in the development of science and technology. An interesting fact about this information is that the country has a median position in the development indexes analyzed, and this scenario is mainly related to its economic dynamism (MONTIEL, 2017). Analyzing the Brazilian reality, the stagnation of productivity levels is directly related to the inability to build a national development plan, using knowledge and innovation as fundamental factors for increasing national income. In Brazil, R & D spending equals 1,14% of GDP (2011), ranking thirty-fifth in the world ranking (BOCHI, 2017).

Universities are the main institutions that take care of the process of transfer of technology and the search of partners interested in licensing their products and processes developed by their researchers through NITs. In this sense, the patent is one of the main mechanisms for this process (PÓVOA, 2008). In this sense, the progress of some developing countries in their industrialization processes can be seen from the participation in this productive paradigm, however, there is a superficiality in this evolution due to the increased dependence on technology and knowledge of the developed countries (CORRÊA et al, 2018).

Figure 4 highlights the Brazilian states that are involved in the technology transfer processes. The state of São Paulo appears in prominence with 210 processes in the period of the research, with more than triple of the second state researched - Rio de Janeiro - 67 processes. The data also highlight the states of Paraná, Amazonas, Minas Gerais, Federal District, Rio Grande do Sul, Santa Catarina and Bahia with an arithmetic average of 15 processes during the period of the research (2010 to 2018). The other states appear with a minor amount (from 1 to 3 processes).

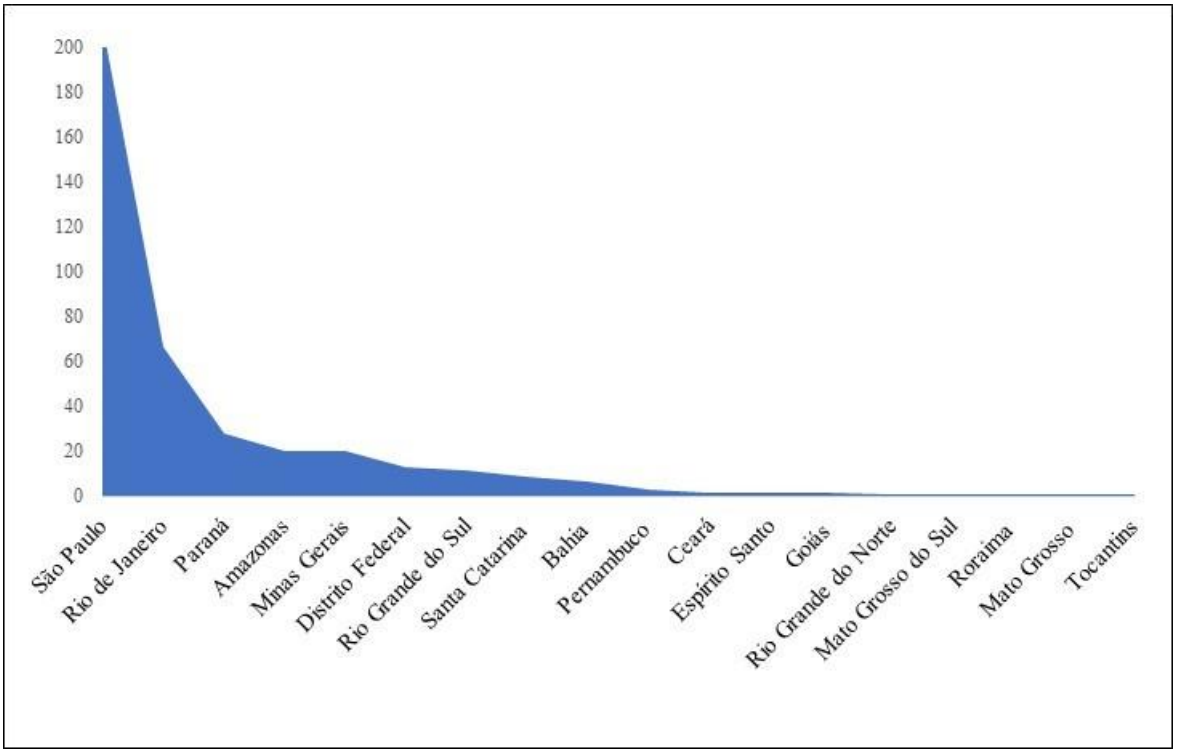

Figure 4: Relation of Brazilian States and Technology Transfer (2010 to 2018)
Source: Data Research - INPI (2019)

The state of São Paulo is one of the main states of the Brazilian Federation not because of its physical, demographic or political characteristics, but because it congregates in its surroundings the main institutions of Brazil such as: University of São Paulo (USP), Universidade Estadual Paulista (Unesp), State University of Campinas (Unicamp), Federal University of São Paulo (Unifesp) and Federal University of São Carlos (UFSCar). These institutions have intense research activity, generating technology and innovation. In a more specific way, the State of São Paulo has the Complementary Law 1.049 of 2008 that seeks to promote and develop innovation habitats, as well as the Paulista System of Technology Parks, promoting the strengthening of innovation mechanisms with public resources (GARNICA, et al, 2009).

The purpose of this study is not to analyze educational institutions regarding technology transfer processes, but what can be highlighted is that this process had as its starting point the creation of NIT's as presented previously. Unicamp, for example, is one of those institutions that has been involved in more intellectual property activities since the 1980s (DIAS; SILVEIRA, 2013).

The State of Rio de Janeiro presents policies for the promotion and development of science, technology and innovation in a much smaller proportion than the State of São Paulo. The State of Minas Gerais presents

a small part of the cases. What draws attention in the analysis of the data of the states of the Southeast region is that it holds more than 74% of the processes of technology transfer carried out in Brazil.
In the analysis of the search data, it was also possible to highlight the main sectors of the Concessionaire. What stands out most is manufacturing in general (spare parts and accessories, machinery and equipment, chemicals, cosmetics, packaging), corresponding to more than 75% found in the survey (353 processes). Second, with 55 processes, the construction and assembly sector appears, followed by mining (16) and commerce (14), as shown in figure 5.

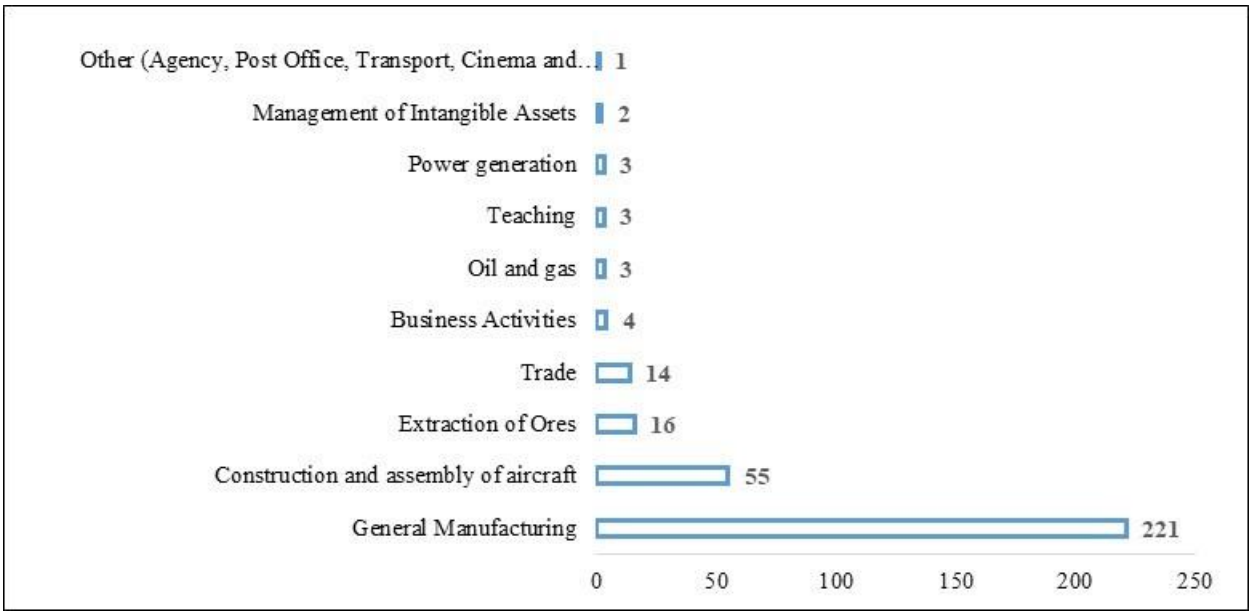

Figure 5: Main Sectors of Technology Transfer (2010 to 2018)
Source: Data Research - INPI (2019)

What happened is that in general manufacturing, as mentioned, there is the incidence of technology transfer to automotive parts and accessories, machines and equipment that are not specified (other types of automobiles) and manufacture of petroleum refining. The Pareto graph, shown in figure 6, has the objective of hierarchizing the segments, presenting the main sectors where there are requests granted with transfer of technology. Thus, it is clear that automotive manufacturing items have, within the scope of registration, innovative activities that classify this sector as a high technology transfer index. This is true when, for example, the automobile industry promotes open innovation (as was done by Fiat in the collaboration of customers for the production of Fiat Mio in 2010). On the other hand, Pareto also presents other sectors, such as: manufacture of glass containers, plastics and batteries, sectors that only have one (1) transfer of technology, but with a tendency to grow in the long term.

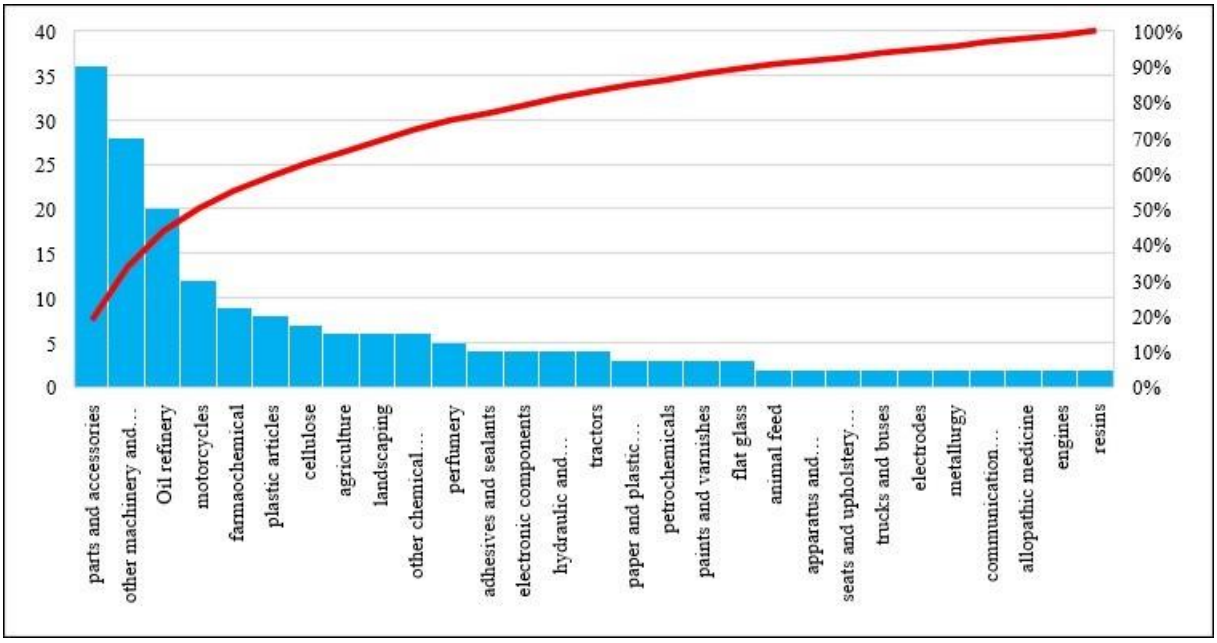

Figure 6: Pareto - general manufacturing sectors
Source: Data Research - INPI (2019)

Brazil is a country that suffers a high degree of internationalization of the economy, presenting low investments in Research and Development - R & D. In this sense, innovations have traditionally occurred in organizations. The whole research and development process was conceived, executed and monitored internally, which resulted in high financial expenses. Thus, only large companies held the R & D (GENUÍNO e MACHADO, 2016).

Investments for the promotion and development of technology and innovation are today the main competitive tools for companies and countries. Brazil is far from countries that have sought to dominate knowledge, because there are still deficiencies in the industrial sectors (which require investments in technology), and in other sectors that generate and transmit technical progress. For this reason, foreign firms have a large share of contribution with intellectual capital training, supplier partnerships and, more effectively, technology transfer (STAUB, 2010).

4 Final considerations

Technological prospecting is an important tool for companies that seek to develop market interaction strategies based on technology and innovation. This article aims to analyze the technology-based companies in the transfer of technology and innovation in their processes, considering for this, a mapping of these companies, and the potential sectors.

The research identified, after searching the INPI databases, that there are 353 processes, both of invention and utility model, involving the terms "technology-based company" in various forms of description.

Of the requests deposited and granted, most correspond to the stages of technology supply from other countries (the United States and Japan), that is, technology-based companies in Brazil, are still companies lacking the development of innovations capable of transferring technology, such as " laboratories "for large

multinational companies.

Although the universities of the Southeast represent a significant portion of attention in the country through NITs, there is still little. Even with the Innovation Law, implemented in 2004, there was no impulse in the research carried out to verify the applicability of this law in technology-based companies. Manufacturing companies in general (manufacturing and automotive accessories, petroleum refining) represent the majority of innovative practices, since there is a greater tendency in these segments for innovation in their processes, especially open innovation.

This research can be extended to other international patent databases such as WIPO and ESPACENET, for example, to develop a broader view on the subject, including benchmarking for alternative challenges.

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