Patent Negotiation and Valuation Process of Universities

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Abstract

Transfer of technology is one of the ways in which the knowledge developed by universities can be passed on to companies, and vice-versa, licensing being its traditional form, since universities have increasingly protected their inventions. A very important part of this process is the establishment of a licensing value but universities usually do not have methodologies to do so. For that reason, based on a qualitative study, developed with the technique of multiple case studies with Brazilian universities that stand out in the production of patents, it is sought to answer which are the factors that influence the valuation of a technology developed by the university.

Keywords: valuation, technology, patent, technology transfer, university.

1. Introduction

Companies are becoming aware that knowledge is not something produced only internally. The level of creation of a new knowledge is not only related to the degree to which companies and institutions are capable of generating new knowledge, but also to the ability to acquire new knowledge from other companies (Ramadani et al, 2017). The focus of the relations between industry and academia has shifted from a one-way model of "research marketing" to a bidirectional model of "academic engagement" where universities, industries and other actors are co-creators of research (Sengupta and Ray, 2017).

However, as the firms place the products and services in the market, they are responsible for the innovation, because according to Schumpeter (1961) the creation of economic values only occurs from the moment the inventions are transacted in the market, and hence, they can be called innovation. Universities cannot negotiate their inventions directly in the market; they must do so through firms.

The transfer of technology is one of the ways in which the knowledge generated by the Institutions of Science and Technology (known in Brazil as ICTs) can be passed on to companies, and vice-versa. Licensing has traditionally been the most popular form of technology transfer both in North American universities (Thursby and Kemp, 2002), English (Chapple et al., 2005) and Brazilian universities (Fujino and Stal, 2007). As it was modeled in Thursby and Thursby (2001), this process has three sequential stages (creation, patenting and licensing), which involve multiple entries in each step.

A crucial part of this process is how to stipulate a value for the technologies. These technologies, in turn, to a large extent are in the embryonic stage and, as they are new, do not have similar products so that comparisons can be made. In addition, the cost of development encompasses many factors, including: raw material cost, researchers' working hours, research and development (R & D) cost, etc. Most of the time they are projects of years of study,

financed by public agencies of development, using resources of diverse laboratories and equipment.

Despite all the complexity, universities do not have methodologies or procedures to make this assessment accurately. Thursby and Kemp (2002) point out that the reasons for the technical inefficiency of universities include, among other things, the inability to take advantage of all the commercially viable protected technologies. The lack of methodology to analyze the market, evaluate and value the technology and offer the same to interested companies is a factor that negatively influences the licensing process (Thursby and Kemp, 2002).

Therefore, licensing is largely at the initiative of companies looking for universities or of teachers who interact with companies (Pojo and Zawislak, 2015). The universities then accept the values offered by the companies in the negotiations.

Based on this, the question that guides this article arises: how do universities value their technologies? To answer this question, the objective of the present project is to analyze the licensing process in the commercialization of university innovations. The central argument is that the value of a technology ends up being given by the market considering the potential of return generated by the use of it, whether in the form of revenue increase, cost reduction, productivity increase, radical change of technology used, etc.

2. Theoretical Framework

2.1. Technology Transfer and Licensing

The exchange of information between universities and society takes place through a wide variety of mechanisms, some of which are formally and easily controlled such as publications, patents, licenses; and others that are more difficult to control, such as teacher counseling and student engagement (Mowery et al., 2001; Thursby et al., 2009; Zawislak and Dalmarco, 2011). The transfer of technology is one of the ways that the knowledge generated by universities can reach companies, and vice-versa, and licensing is one of its most popular forms (Thursby and Kemp, 2002; Chapple et al., 2005; Fujino and Stal, 2007). The marketing of university technologies to firms has been described as a "contact sport," in which exchange of tacit information among staff is essential (Mowery and Ziedonis, 2015).

A large part of patents are developed from basic research only by the researchers without interactions with companies. These technologies can be licensed to companies that are interested in continuing the development and production of the technology to be placed on the market.

Some are developed through relationships with companies, which may have been part of development, hired the service of development of a particular technology, or even funded research or important equipment. In these cases, university and company may appear as co-owners of the protection application (Fugino and Stal, 2007).

In public universities, the discussion about licensing is more complex, due to legal and cultural issues. The innovation law has made this process a bit easier, abolishing the need to bid for all types of licenses, while retaining only the exclusive licenses. However, in addition to the favorable legal framework, the participation of researchers in the different stages of development and commercialization is fundamental for the effective transfer of technology.

Researchers are often involved in the marketing phase because they are in a good position to identify licensors and because they have the technical knowledge to partner with the firms that wish to license them (Siegel et al., 2003a; Thursby and Thursby, 2007). According to Thursby and Thursby (2007), it is necessary the participation of the researchers due to the embryonic stage of technologies when they are licensed and in need of development.

According to Thursby and Kemp (2002), the university patent licensing process can be characterized as follows: 1) Research (basic or applied) are conducted by professors without

necessarily aiming to market; 2) These researches may or may not be sponsored by companies; 3) Those that have commercial potential are informed to the office; 4) The office conducts the analysis of patentability and market potential, and then makes patent applications of what they consider relevant; 5) The office is looking for companies that may be interested in the technology to do the licensing.
For commercialization to occur, an estimate of value is required. Value can be defined as "the degree of utility or convenience of something." As the actors in the transfer process between the university and the company have great differences of objectives, the knowledge will also have different values for each of them. Therefore, any valuation method needs to take into account this subjective nature, deliberately choosing the appropriate "value pattern" (value for whom?) And "value premise" (value under what circumstances?) (Baycan and Stough, 2013).

2.2. Technology Assessment and Valuation

The evaluation of technologies is a first approximation with the result of a research, which may still be an idea or even a product already in development. The goal is to make an initial survey of its market potential.
In the case of universities, an evaluation of a research in its initial stage may be interesting to analyze what is already being developed in the area, direct research projects to meet market needs or to assess the state of the art. For more advanced technologies, the evaluation aims to calculate the risks of progressing to the next stages of development, to consider the possibilities of protection, and to analyze the potential of success for future commercialization.
The evaluation process seeks to identify possible technological problems, as well as to estimate the potential of the technology. Comparing complementing and competing technological solutions that address similar needs are part of the process. In this way it is possible to have an idea of the position of the technology in relation to available alternatives in the market and, if possible, to alternatives still at the development stage.
In order to evaluate a patent, researchers have suggested some indicators: (i) nature of the technology, and (ii) the nature of the applicant, (depositor and/or inventor); (iii) nature of the industry (type of industry, field of knowledge); (iv) stage of development; (v) age of the patent; (vi) size of the patent family; (vii) number of claims in a patent is an evidence of its scope, and therefore of its value; (viii) number of references cited in a patent; (ix) amount of "citations received" is proof of the importance that other inventors grant the patent; (x) "generality", which is means of calculating the dispersion of citations received through different classes of patents, which may be a measure of the amplitude of the patent; (xi) "originality", which is a mean of calculating the dispersion of quotations made in different classes of patents; (xii) number of different International Patents Classifications (IPCs) may be indicative of the amplitude and originality of an invention.

The Figure 1 shows the indicator generally used in technology evaluation. An interesting point to note is that of the possible indicators of evaluation of a technology, almost all of them are controllable by depositors or inventors, or at least are easily recognized by them (Allison et al, 2003). Only two - the patent age and citations received - are previously unknown by the applicant.
According to Allison et al (2003) patent evaluation, then, it is not only something that researchers can identify after the fact but something that patent owners themselves can anticipate in advance. If a technology does not meet the criteria set out in the evaluation, no effort is needed to evaluate.

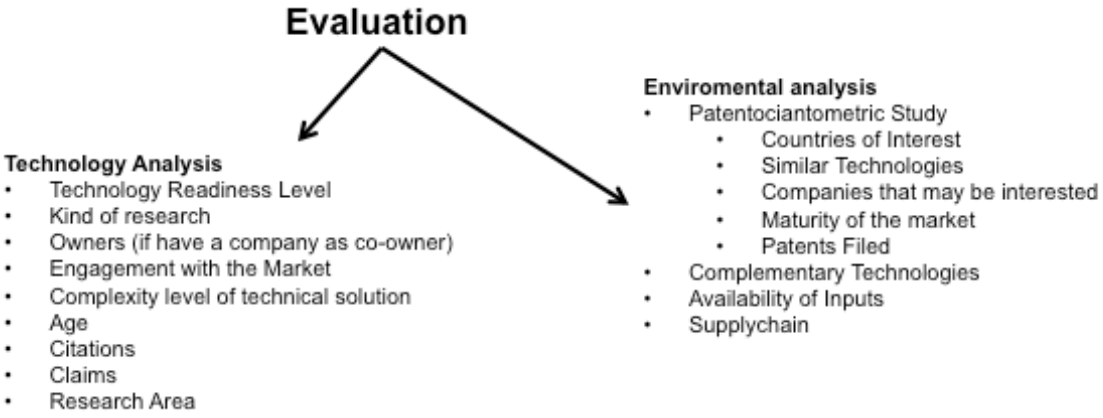

Figure 1: Indicators used in technology evaluation

Generally, valuing a technology means assigning it a value that should be fair to the company that is licensing and also to the university that is offering the technology. According to Grönqvist (2009) patent value may differ by the nature of the technology, inventor nationality, patent protection country, patent type, type of owner, and patent family. Allison et al (2003) adds that the nature of the industry to which the technology applies can also be a factor influencing its value.

According to Santos and Santiago (2008b), the purpose of valuation is not to predict exactly the value of technology at the time of its commercialization, but to provide, given all the uncertainties that characterize the process of technological innovation, an expected value that seizes the risks and uncertainties inherent in this process. Besides this, another objective of this analysis is the definition of reference values for a possible negotiation.
If the value is very high, companies will not be interested in technology, preferring similar ones in the market. If it is valued below its real value, the university will be giving up revenue, which, for example, for public universities is illegal.

Traditional pricing techniques based on economic concepts such as demand curve and marginal analysis are often not applicable to intangible assets, due to the novelty of the product, the lack of assets for comparison, among other aspects.

To estimate the value of patents or technologies, several approaches have been used in terms of future cash flow projections generated by patents: patent indicator regression models, net present value, valuation based on development cost, valuation by multiples and the valuation based on Discounted Cash Flow (DCF), among others (Santos and Santiago, 2008a, Gambardella et al, 2006, Sohn et al, 2013). In addition to these, more recently, the Real Options Theory has emerged as an alternative to traditional methods. However, Sohn et al (2013) state that these techniques do not apply to all areas of knowledge.

3. Methodological Procedures

In order to meet the general objective of this article, and to understand the factors that influence the process of valuation of technologies developed by the university, it is necessary to analyze the best practices of valuation of technology in Brazilian universities, to understand how valuation is done, to observe the criteria/factors/variables that are used and the understanding that universities believe should be used to do so.

In view of the mentioned objectives, it was necessary to use a qualitative research method, adopting the multiple case study strategy. The intention is to present a more detailed picture of the field of research (Eisenhardt, 1989; Yin, 2005). Exploratory analysis was based on primary and secondary data derived from distinct sources of information; specifically: archives and in-

depth interviews. Archive data derived from research in academic repositories (articles and books), on the Internet, on the websites of the selected universities and in the management reports of the universities. The primary data were generated by semi-structured interviews based on an interview script. In each University, the managers of the Technological Innovation Centers (known in Brazil as NITs) or analysts who work in the area of intellectual property were interviewed.

Folha de São Paulo, a well-established newspaper in Brazil, produces rankings of these universities according to four fundamental attributes, namely: i) academic research (analysis of scientific production); ii) quality of teaching; (iii) market assessment; and iv) innovation (based on the number of patents filed at the Brazilian Patent Office). Thus, the most innovative universities were selected to be examples of cases: UFMG, Unicamp, USP, UFPR and UFRGS. Unicamp however did not respond to the research and was withdrawn from the study. This choice is justified as higher education institutions should be at the forefront of intellectual property management and thus have successful licensing.

4. Presentation and Analysis of Results

4.1. Federal University of Minas Gerais (UFMG)

The creation of a university in the state of Minas Gerais (MG) was part of the political project of Inconfidência Mineira (A pro-independence movement against the Portuguese domination). In 1927, it was founded the University of Minas Gerais (UMG), a private institution, subsidized by the state, which emerged from the four higher education schools in the region. In 1949, the UMG was federalized, but the current name was only adopted in 1965.

The institution aims to generate and disseminate scientific, technological and cultural knowledge, standing out as a national reference, in the formation of critical and ethical individuals, founded on the solid scientific and humanistic basis (UFMG, 2016).

The NIT (Technological Innovation Center) is called CTIT, created in 1996; it was one of the first established organizations to promote innovation in the country. The office operates in the management of scientific and technological knowledge, including activities related to the dissemination of intellectual property culture, confidentiality of sensitive information, protection of knowledge and commercialization of innovations produced at UFMG.

The hiring of employees can be done by public tender, by the support foundation and through donations from research funding agencies. Due to the possibility of hiring by the support foundation, the patent section has a staff member from each area of knowledge of the university, with a total of 11 employees, who has the skills to do the writing of patent applications. The prospection of new protectable technologies is done through contact with researchers, visits to laboratories, lectures and courses and the inclusion of information in the university's newspaper.

CTIT acts in three ways to contact companies potentially interested in licensing UFMG's protected technologies: i) the Technology Transfer and Intellectual Protection Section proactively works to identify these companies; ii) the researcher indicates some institutions that he knows how to operate in certain areas; iii) the company directly contacts the CTIT.

The Valuation Unit is part of the CTIT/UFMG Technology Partnerships and Transfer Sector, responsible for the valuation process, which uses a methodology to determine the value of an invention developed at UFMG to be licensed to third parties interested in its commercial exploitation.

The valuation of technologies was introduced in the CTIT in the year 2012 with the creation of the Nucleus of Market Intelligence, currently called Valuation Nucleus, according to the NIT Coordinator. A specific methodology is used that will provide a basis for estimating the values that compose the commercial proposal to be sent to the company interested in the

licensing. The process covers technical, economic, marketing and financial viability studies together with the application of the Net Present Value (NPV) method and Discounted Cash Flow to estimate the value of the technology. The values found for the NPVs make it possible to verify the feasibility of commercial application of the technology in the market and contribute to an estimation of the values of access rate and royalties to be negotiated.

4.2. University of Sao Paulo (USP)

The University of São Paulo (USP) is a public university, maintained by the State of São Paulo and linked to the Secretariat of Economic Development, Science, Technology and Innovation (SDECTI). USP is considered an advanced center of teaching, research and outreach services to the community. There are 11 campuses in total, four in São Paulo, two in São Carlos, one in Bauru, Piracicaba, Pirassununga, Lorena and Ribeirão Preto. There are 249 undergraduate courses and 239 postgraduate programs.

The NIT, called the USP Innovation Agency, is responsible for managing the innovation policy to promote the use of scientific, technological and cultural knowledge produced in the university, in favor of the sustainable socioeconomic development of the State of São Paulo and the country. Through business incubators, technology parks and specific training, it promotes entrepreneurship, offering technical support, management and complementary training to the entrepreneur. It also works on the transfer of technologies, aiming making them available to society.

The Technological Transfer sector is responsible for the development of innovation activities and elaboration of Technical, Social and Economic Viability Studies, selecting the assets with greater transfer potential and identifying partners for the exploitation of the technologies; promotion of business rounds with USP technologies; stimulation of cooperation initiatives with companies aiming at innovation; identifying potential investors and supporting the creation of spin-outs. According to the head of the technology transfer sector, they use as reference the average royalty rates of some international sources and the characteristics of technology and the market. A simplified survey of key stakeholders and competing products is done. The depth of this survey depends very much on the information available on the specific market.

4.3. Federal University of Paraná (UFPR)

The Federal University of Paraná is the oldest university in Brazil. It was created in December 1912, began operating in 1913 as a private institution, in 1950, it was renamed the Federal University of Paraná, a public and free institution. It adopts the Tripod Teaching, Research and Extension, to guide the activities of the university towards the development of the community. At the Federal University of Paraná, the innovative capacity happens transversely through Teaching, Research and Extension. The UFPR academic community makes knowledge available to society as one of its main institutional objectives, through its continuous scientific production.

The NIT of the university is called Innovation Agency which has as one of its objectives: to support the internal community in the demands of knowledge protection; guide the procedures, in conjunction with other administrative units, on technology transfer; define capacity building plans and events for entrepreneurship and innovative business generation projects. The Agency has three supervisions: Intellectual Property; Technology transfer; Entrepreneurship and Business Incubation.

According to the Agency coordinator, the valuation is not accurately done, but uses as reference the average royalty rates of some international sources and the characteristics of technology and the market. The formulation of the royalties' percentage is based on the impact of the technology on the final product and the stage of development. Usually the analysis is done by

the company and by the technical staff of inventors. The agency verifies whether the technology is an aggregate or final product and whether the technology requires investment in development (very common case). They also consider the size of the company, the economic potential, the risk of technology and the history of royalties (when it comes to the same technology or similar).

4.4. Federal University of Rio Grande do Sul (UFRGS)

The Federal University of Rio Grande do Sul, inaugurated in 1895, marks the beginning of higher education in the state of Rio Grande do Sul. But only on November 28, 1934 was created the University of Porto Alegre. In 1950, it became part of the administrative sphere of the Federal Government, becoming, therefore, a Federal University.

According to the Management Report (UFRGS, 2016), the mission of the institution is "higher education and the production of philosophical, scientific, artistic and technological knowledge integrated with teaching, research and extension". The university professors and staff are selected by public competition. In the process of career progression, the pedagogical profile and good teaching practices, as well as the activities of production and intellectual extension, management and continuous training are evaluated.

The NIT is called the Technological Development Secretariat (SEDETEC), created in 2000 with the objective of optimizing and coordinating efforts in the area of technological development, specifically to establishing relations with the productive sector and providing tools for society for valorization and transfer of scientific and technological knowledge. The office is directly linked to the university's central administration, which brings more efficiency and agility to the processes and operation of activities, as well as greater visibility among internal and external communities.

The office currently has 16 employees, with 10 technical administrative staff - of whom only two are located in the patent area - one teacher, one legal advisor hired through a support foundation and four interns.

According to the head of the intellectual property sector, there is no valuation formula; a quick analysis of the scenario and usually the negotiation begins with the company's proposal. This proposal is evaluated by the NIT and the researchers and then submitted for approval by the attorney's office of the university.

	University			NIT		
	Faculty Members	**Employees**	**Students**	**Employees**	**Total of Patents Filed in Brazil**	**Total of Signed Agreements**
UFMG	3045	4315	48.202	42	834	89
USP	5844	14866	96364	29	1299	51
UFPR	2567	6343	35252	14	416	15
UFRGS	2701	2654	14572	16	384	13

Table 1: Universities in Numbers

Table 1 shows universities numbers of faculty members, employee and students, as well as, the numbers of Universities' NIT employees, patents filed and signed agreements. With this data, it is possible to observe the size and performance of universities in the innovation issue. USP is the largest university in the country, but the one that obtains better results is the UFMG, with

more patents filed and more license agreements signed. Until the end of this article none of the universities studied had published the management report with 2017 data.

5. Final Considerations

Patent protection by universities is a controversial subject, since the mission of a university is the creation and dissemination of knowledge (Thursby and Thursby, 2007). The intellectual property system is also based on two incentives: the incentive to invent and the incentive to reveal the invention, that is, to spread knowledge.

So the university patents are justified as they are marketed and result in financial gains for the owner and external benefits for the neighboring communities, since the new technology-based companies are seen as an important source of creation of new jobs (Chapple et al, 2005). Arguments in favor of university patents are found in providing incentives to companies to market and develop university inventions that are often embryonic in nature (Thursby andThursby, 2007).

It is then realized that it is fundamental for the university to fulfill its mission, that its technologies are licensed to companies that can put the products on the market. An extremely important factor in this licensing process is the valuation of technology. In order to answer the survey question, it can be observed that there are several factors that influence the analysis and valuation of a patent, among them are: the nature of the technology, type of holder, stage of development, age of the patent (Schankerman, 1998; Allison et al, 2003; Gambardella et al, 2006; Thursby et al, 2009; Thursby and Thursby, 2007; Deste and Patel, 2007). In addition, in order to have a precise value, it is important to know the size of the market, production costs, development costs, research time involved, research time required to place the object of the patent in the market, need and availability of complementary assets, etc.

From this point, it is possible to confirm the central argument that the value of a technology of the university ends up being given by the market, since the companies dominate many of the factors that need to be taken into account when valuing a technology. Many universities do not have a clear methodology for valuing their patents, and for public universities this is an even more delicate theme. Of the four universities analyzed, only one university has a clear and objective methodology for valuation, one has a subjective methodology and the other two are based on the value offered by companies. The patents of public universities are public goods, and therefore, much more rigor is necessary in their commercialization.

The dominant perspective in the literature (Baek et al, 2007; Schankerman, 1998; Grönqvist, 2009; Gambardella et al, 2006; Sohn et al, 2013; Allison et al., 2003) addresses the valuation from companies' perspective. However, when it comes to university technologies other aspects need to be analyzed, and some knowledge the university does not hold, because they are based on the result of the relationship of companies in the market.

References

Allison, J. R., Lemley, M. A., Moore, K. A., & Trunkey, R. D. (2003). Valuable patents. Geo. Lj, 92, 435.

Baycan, T., & Stough, R. R. (2013). Bridging knowledge to commercialization: the good, the bad, and the challenging. The Annals of Regional Science, 50(2), 367-405.

Chapple, W., Lockett, A., Siegel, D., & Wright, M. (2005). Assessing the relative performance of UK university technology transfer offices: parametric and non-parametric evidence. Research Policy, 34(3), 369-384.

D’Este, P., & Patel, P. (2007). University–industry linkages in the UK: What are the factors underlying the variety of interactions with industry?. Research policy, 36(9), 1295-1313.

Eisenhardt, K. M. (1989). Building theories from case study research. Academy of management review, 14(4), 532-550.

Fujino, A., & Stal, E. (2007). Gestão da propriedade intelectual na universidade pública brasileira: diretrizes para licenciamento e comercialização. Revista de Negócios, 12(1), 104-120

Gambardella, A., Harhoff, D., & Verspagen, B. (2008). The value of European patents. European Management Review, 5(2), 69-84.

Grönqvist, C. (2009). The private value of patents by patent characteristics: evidence from Finland. The Journal of Technology Transfer, 34(2), 159-168.

Mowery, D. C., & Ziedonis, A. A. (2015). Markets versus spillovers in outflows of university research. Research Policy, 44(1), 50-66.

Pojo, S. R.; Zawislak, P.A.. Proteção e Licenciamento de Patentes da Universidade. XVI Congresso Latino-Iberoamericano de Gestão da Tecnologia. Porto Alegre-Brasil. 19-22 de outubro de 2015

Ramadani, V., Abazi-Alili, H., Dana, L. P., Rexhepi, G., & Ibraimi, S. (2017). The impact of knowledge spillovers and innovation on firm-performance: findings from the Balkans countries. International Entrepreneurship and Management Journal, 13(1), 299-325.

Santos, D. T. E., & Santiago, L. P. (2008). Métodos de valoração de tecnologias. Belo Horizonte: Laboratório de Apoio à Decisão e Confiabilidade, Departamento de Engenharia de Produção, UFMG.

Santos, D., & Santiago, L. (2008). Avaliar x valorar novas tecnologias: desmistificando conceitos. Belo Horizonte: Laboratório de Apoio à Decisão e Confiabilidade, Departamento de Engenharia de Produção, Universidade Federal de Minas Gerais, 2008a.

Schankerman, M. (1998). How valuable is patent protection? Estimates by technology field. the RAND Journal of Economics, 77-107.

Schumpeter, J. A. (2017). Capitalismo, socialismo e democracia. SciELO-Editora UNESP.

Sengupta, A., & Ray, A. S. (2017). University research and knowledge transfer: A dynamic view of ambidexterity in british universities. Research Policy, 46(5), 881-897.

Siegel, D. S., Waldman, D., & Link, A. (2003). Assessing the impact of organizational practices on the relative productivity of university technology transfer offices: an exploratory study. Research policy, 32(1), 27-48.

Sohn, S. Y., Lee, W. S., & Ju, Y. H. (2013). Valuing academic patents and intellectual properties: Different perspectives of willingness to pay and sell. Technovation, 33(1), 13-24.

Thursby, J. G., & Kemp, S. (2002). Growth and productive efficiency of university intellectual property licensing. Research policy, 31(1), 109-124.

Thursby, J. G., & Thursby, M. C. (2002). Who is selling the ivory tower? Sources of growth in university licensing. Management science, 48(1), 90-104.

Thursby, J. G., & Thursby, M. C. (2007). University licensing. Oxford Review of Economic Policy, 23(4), 620-639.

Thursby, J., Fuller, A. W., & Thursby, M. (2009). US faculty patenting: Inside and outside the university. Research Policy, 38(1), 14-25.

Yin, R. K. (2015). Estudo de Caso-: Planejamento e Métodos. Bookman editora.