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Management of Intellectual Property in Brazilian Universities

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Abstract

Originally established to incentivize individual inventors the patent system became broadly used by corporations, and has been increasingly used by universities worldwide. In Brazil, this is not different; especially in recent years when public policy has attempted to more directly foster innovation in the country. However, little is known as to the extent that universities in Brazil are able to coordinate patent-related activities and to facilitate knowledge transfer. On the basis of multiple case studies this paper explores how publicly-fundeduniversities in Brazil are equipping themselves to deal with intellectual property rights (IPR) as well as technology licensing. The studied cases suggest that despite significant amount of patents applications, Brazilian universities present many differences in the management of their intellectual property. In particular, universities' TTOs seem to play a central role in university productivity when it comes to patenting and knowledge transfer.

Keywords: innovation, intellectual property, patents, universities, TTOs

1. Introduction

Universities play a central role in national and regional innovation systems. They provide qualified personnel as well as new knowledge that can spillover to organizations (NELSON, 1993; ROSENBERG; NELSON, 1994). Thereby, the extent that new knowledge generated within universities should and could be transferred to organizations is not a novel concern (e.g. PETERS; ROBERTS, 1969). In fact, with the purpose of facilitating knowledge transfer between universities and firms the American Congress passed theBayh-Dole Act in the early 1980s. This enactment allowed American universities to take control of intellectual property derived from public funding. As a result, there was a 'boom' in patenting by American universities over the following decades (MOWERY et al., 2001). According to Etzkowitz et al. (2000), this regulatory change impacted on universities' posture and they have become more entrepreneurial. Thus, the explosion of technology transfer activities by American universities in the following years led to a praise for the Bayh-Dole Act that wasnot confined within American frontiers, and several countries have adopted similar orientation towards university patenting (BALDINI, 2009; LINDELOF, 2011).In Brazil, for example, the Law 10973 was enacted in 2004 (also known in Brazil as "innovation law") aiming at providing enough stimuli to the development of scientific and technological activities in the country. Among other things, this piece of legislation attempts to facilitate the engagement of universities with market-oriented research activities.Although university patenting is not a novel phenomenon in Brazil (PEREIRA; NOGUEIRA, 1989), Póvoa (2008) has noticed a positive impact of thislegal change on Brazilian universities' patenting activity.

However, many controversies surround the debate on patent protection by public universities. On the one hand, some arguethat universities should encourage the production of knowledge that generates patents, which would bring financial returns toinventors and their educational bodies. On the other hand,othersadvocate that public funded research should not be owned. By having property rights over the outcomes of that effort, public universities behave like profit-oriented organizations. As a result, research budget can be diverted towards more applied, short-term, endeavors that could be pursued by private funding (MAZZOLENI, 2006).In face of this debate universities have established technology transfer offices (TTOs) to ease the transfer of knowledge between universities and firms (PÓVOA, 2010). But the extent that TTOs are able to properly manage knowledge flows from university labs to the market is still disputed (SIEGEL et al., 2008).

While the recent surge in patenting by Brazilian universities is factual, little is known as to how universities have organized themselves to deal with the increasing interest of faculty on intellectual property rights (IPR). Thus, the purpose of this paper is to shed light on how government funded Brazilian universities are coping with this increasing pressure. Moreover, the paper explores the extent to which universities are equipping their TTOs and addresses potential implications of this behavior. In order to tackle these objectives amultiple case study was carried out encompassing four Brazilian public universities that have exceled in the volume of patent applications.

The paper is organized as follows: in section 2 a review of relevant literature is presented. In section 3 the methodology that was used to gather research data is detailed. Section 4 shows the data analysis for each university and a comparative analysis of the data. Finally, section 5 brings conclusions as well as indicatesboth limitations of this research and suggestions for future avenues of enquiry.

2. Intellectual Property Rights and Universities

According to Dosi (1990) innovation is related to the discovery of new products and forms of economic organization, which *ex-ante* the economic agents had only belief in unexplored opportunities and that *ex-post* are generally contrasted in product markets by competitive interactions. The adoption, diffusion, and production of novel goods and/or services have a key role in the economic and social development of nations. Actually, the development of new goods and/or new services is an essential

condition to the competitivenessof companies and nations, contributing to raise prosperity. So, policy makers are often keen on encouraging people to do things never done before, and that can change their quality of life as well as their consumption pattern (PAVITT, 1984; FREEMAN; SOETE, 2008).

However, gains from innovative effort will be discounted if the knowledge can easily be copied by third parties. Thus, the social benefits of innovation arise to the extent that a temporary monopoly can be achieved by knowledge generators (SCHUMPETER, 1982). Provisional monopoliesare legally assured by intellectual property rights (IPR), which area 'natural'[1] evolution from property rights on land, capital and labor (ANDERSEN, 2003). But IPRs are non-material rights that cover the human intellect. In general, the system of intellectual property comprises rights related to: (i) literary, artistic and scientific work; (ii) artistic interpretations and performances, phonograms, and radio diffusion; (iii) inventions in all fields of humane knowledge; (iv) scientific findings; (v) industrial design; (vi) brands, names and commercial denominations; (vii) protection against unlawful competition; and (viii) all others rights derived from intellectual activity in industrial, scientific, literary or artistic field (BOCCHINO et al., 2010). These rights are grouped into areas according to the primarily subject matter involved, and each category of IPRs is governed by a legal framework to assure property rights over the related subject matter upon fulfillment of certain criteria. Patents (or invention patents), for example, concern technology-based inventions – i.e. ideas that permit to solve, in a practical way, a technical problem (WIPO, 1997). Patents are issued upon application and enable their holders (so called patentees) to enforce, for a limited time (20 years, in general) and geographical area, exclusive rights over an invention. Thus, inventors not only own but also are able to enforce property rights over the knowledge embodied in their patent grant (CORNISH, 1999).For a patent to be granted an invention has to meet the criteria of novelty, inventive activity, and industrial applicability. Novelty means that an invention was not disclosed, published or known previously (i.e. by the date of filing a patent application at the Patent Office). Inventive activity means that the corresponding invention is not obvious to a skilled person on the subject. Industrial applicability refers to its possible use in some kind of industry - i.e.an invention must work (BRASIL, 1996).

Originally established to incentivize individual inventors the patent system became broadly used by corporations, and has been increasingly used by universities. To some extent this university behavior dates back to the period just after World War II when a great deal of support was designated to academic research in North American universities. In parallel, the American government stimulated the narrowing of the relationship between university and industry. The Bayh-Dole Act in the United States served as accelerant to this process in the early 1980s. This law permitted American universities to manage and commercialize its intellectual property. Before the approval of the Bayh-Dole Act about twenty universities in the US had a Technology Transfer Office (TTO); currently almost all universities have a TTO (MOWERY; ROSENBERG, 2005).

However, the effects of the Bayh-Dole Act on university behavior are disputed. Some argue that the enactment of the Bayh-Dole Act in the 1980s has led to the appearance of entrepreneur universities; that is, universities have moved from a static role to a dynamic role in the process of working with external actors for the commercialization of intellectual property rights (ETZKOWITZ et al., 2000; BERCOVITZ; FELDMANN, 2006). Others argue that the Bayh-Dole should be seen as "(...) initiating the latest, rather than the first, phase in the history of US university patenting" (MOWERY; SAMPAT, 2001b, p.797). This argument is based upon the evidence that most American universities were not engaged with the management of their patents before the 1970s; they used to rely on Research Corporation[2] to play that role. However, university budget constraints, the emergence of biomedical research and its potential application in industry as well as Research Corporation's growing operational costs led most universities to manage their patent portfolios directly, rather than contracting with a

[1] The evolution of the intellectual property concept, however, has followed a different trajectory from the concept of property. The former has its roots in deliberate interventions by political authorities whereas the latter emerged from a dialogue among jurists (BOUCKAERT, 1990).

[2] A nonprofit organization established to manage university patents;part of its revenues was allocatedto support scientific research (MOWERY; SAMPAT, 2001a).

specialized organization. As a result, university patenting had increased by 50% (in comparison to the prior two decades) even before the Bayh-Dole Act had passed in the US Congress (MOWERY; SAMPAT, 2001b).Mowery et al. (2001) also argue that the strengthening of the patent system in the US during the 1980s raised the economic value of patents and facilitated patent licensing. Thus, the Bayh-Dole Act was not the sole factor affecting university patenting. Nevertheless, the quality of university patents does not seem to have been negatively affected after the enactment of the Bayh-Dole Act, at least for those universities already used to patenting. Even for newcomers to patenting, the quality of their patents increased over the years. So, it is hard to claim thatthe Bayh-Dole has steered academic researchers and administrators to pursue patents of lower importance (MOWERY; ZIEDONIS, 2002).

Even if the impact of the Bayh-Dole Act is not conclusive, US universities behavior as to the commercialization of new technologies has spawned a growing interest of overseas universities, which have become more aware of IPR as well (BALDINI, 2009; LINDELOF, 2011). However, Geuna and Rossi (2011) argue that despite the general trend towards IPR ownership, university IPR regulations in Europe remain differentiated and do not perfectly mirror the US system. Brazilian universities have also become more aware of IPR over the years. Pereira and Nogueira (1989), for example, have detected that there was a growing trend of patenting among Brazilian universities during the 1967-1984 period. Latest studies have confirmed that trend and have shown that there has been a further increase of patent applications by universities in the 2000s. This recent surge in university patenting in Brazil is largely attributed to changes in the incentive system; that is, changes in public policy that have put innovation under the spotlight (PÓVOA, 2008; OLIVEIRA; VELHO, 2009). In particular, the Brazilian government enacted the Law 10973 in 2004 (also known in Brazil as 'Innovation Law') aiming at fostering innovation activities in the country.According to Vieira (2008), the Brazilian 'Innovation Law' aims at increasing the efficiency of the productive infrastructure as well as firms innovation capabilities that will ultimately promote the expansion of Brazilian exports. One of the underlying assumptions of this public policy is that governmental action is needed to promote the interaction between universities and firms, even if interactions do not happen solely at the institutional level; that is, personal contractual relationships with individual university researchers might be as important as institutional forms of interaction (BODAS-FREITAS et al., 2013). Actually, the 'Innovation Law' in Brazil seems to have encouraged the engagement of universities with market-oriented research activities (REZENDE et al., 2013).

The effort towards university-industry interaction has been accompanied by the perception that technology transfer does not happen merely by placing the outputs of publicly funded research in the public domain (BALDINI, 2009).In particular, the extent to which knowledge generating institutions engage in patenting and related activities, and hence facilitate knowledge transfer, depends on the organizational arrangements installed for that purpose (VAN LOOY et al., 2004). Thereby, it has been standard for universities to set up technology transfer offices (TTOs) which are, allegedly, units dedicated to the coordination of activities in support to technology transfer (GEUNA; MUSCIO, 2009). The 'Innovation Law' in Brazil, for instance, has foreseen the creation of Technological Innovation Centers (NITs)[3] in government-funded universities, which would be responsible for the management of public universities' intellectual property and relations with the productive sector (BRASIL, 2004). These universities' TTOs in Brazil are expected to assume full responsibility for matters relating to intellectual property, such as: i) the establishment, diffusion and encouragement of institutional policies relating to the protection of university-researchers' inventions; ii) licensing of innovations and other forms of technological transfers; iii) evaluation and assessment of the results arising from research activities and projects, by assessing the potential for innovation and economic feasibility of the research projects; iv) implementation of institutional marketing; v) promotion and availability of internal inventions and defining secrecy rules; vi) promotion and participation in knowledge transfer related meetings involving firms and universities; vii) negotiating and drafting

[3]In Portuguese: Núcleo de Inovação Tecnológica (NIT).

contracts of technology transfer, licensing and services; and viii) monitoring applications and maintenance of intellectual property rights (NUNES, 2010). Therefore, TTOs assist inventors with the process of patent application, and hence lower the costs of the faculty's engagement in this process (SIEGEL et al., 2003). TTOs are also instrumental in connecting university researchers and firms since they might not easily detect each other by other means (HELLMANN, 2005).

But the creation of TTOs may not beenough to stimulate knowledge transfer from universities to firms. Even if universities pursue and license patents, this is no guarantee of knowledge transfer. At best, this facilitates the generation of royalty income (COLYVAS et al., 2002; THURSBY et al., 2007). Even so, university scientists may bypassuniversity policies and transfer property rights to third parties (ARGYRES; LIEBESKIND, 1998).Actually, many inventions developed within universities have become the property of other agents (e.g.,BALCONI et al., 2003; MEYER, 2003; SARAGOSSI; VAN POTTELSBERGHE, 2003).Some authors claim that thewhole university environment needs to be supportive for knowledge transfer. So, in addition to TTOs, universities should further develop structures and processes, and these elements are more likely to emerge when universities promote the awareness of their potential contribution to economic development (DEBACKERE; VEUGELERS, 2005; KENNEY; GOE, 2004).Despite universities orientation towards IPR, and their effort to promote knowledge transfer, their TTOs are perceived (by firms) as inexperienced to handle technology-based contractual agreements, obsessed with unrealistic expectations on the value of their inventions, and lacking of managerial skills. Moreover,universities' TTOs lack authority to make a final commitment for the university (HERTZFELD et al., 2006). Collectively, these concerns amplify the limitations of TTOs, and hence university patenting may be restricting or delaying knowledge transfer. To the extent that this knowledge is an input to innovation in industry, the increase in university patenting may lead to a slowdown in the pace of technical progress (FABRIZIO, 2007). This runs contrary to the general expectation that property rights facilitate knowledge transfer and cumulative technological development.In this context it is relevant analyze the actions carried by the TTOs in the protection and dissemination of knowledge generated in Brazilian universities. This is particularly relevant because,among other things, Brazilian universities are younger than their counterparts in Latin America. Universities in Brazil date back to the beginning of the 19th century as a result of the reunion of isolated institutes and specific colleges; they were formed to satisfy the Brazilian economic/ political elites that used to seek further education in European universities by that time. Brazilian universities were established as a response to labor market needs forhighly qualified personnel, mainly in the areas of engineering, medicine and law.These aspects gave Brazilian universities a fragile and fragmented characteristic that has prolonged to date (STALLIVIERI, 2006; FÁVERO, 2006).According to Buarque (2012), despite being more autonomous nowadays, Brazilian universitiesare held hostage of theirown inner structures and simultaneously face the challenges of the contemporary world; that is, knowledge is not constrained by university walls and moves forward faster than universities can follow. Thus, in an era when IPR becomes of increasing concern in the academic circle the lack of appreciation of the infrastructure to support knowledge transfer from universities to society may lead to the development of misplaced public and university policies. Thereby, this paper aims at shedding light on how universities' TTOs have been equipped to promote initiatives toward academic patenting that are supposed to facilitate knowledge transfer.

3. Research Method

As the purpose of this piece of research is to address how public universities have installed infrastructures to help sustaining ownership over the outcomes of public-fundedresearch and to support the management of universities' patent portfolio, we have conducted multiple case studies of public Brazilian universities. Case studies provideprofoundunderstanding of contemporary phenomena (YIN, 2005), and hence are suitable to address the research question we are interested in.

Brazil has around 2300 higher education organizations, of which 11%arepublicly-funded and 8%are universities(INEP, 2010). One well established newspaper in Brazil (i.e., Folha de Sao Paulo)

has produced rankings of those universities according to four key attributes, namely: i) academic research (analysis of scientific production); ii) teaching quality; iii) market evaluation; and iv) innovativeness (on the basis of the number of patents filed in the Brazilian Patent Office). 'Folha' classified 232 Brazilian higher education institutions, namely: 41 colleges and alike and 191 universities (FOLHA, 2013a). It can be seen that the five top universities in the innovation ranking (Table 1) are the same shown in the general ranking (Appendix 1). Thus, we have selected four out of five most innovative universities to be our sample cases. We have concentrated on top rated institutions because they are supposed to be at the forefront of IPR management. Moreover, as two top rated universities (i.e., Unicamp and USP)are located in the same state, and are state funded (whereas the remaining are federal funded), we have prioritized one of them (according to the level of patenting). We have also cross-checkedFolha's information on university innovativeness (i.e., patenting) with the Brazilian Patent Office's dataset on patenting. So our final sample cases are: Unicamp, UFMG, UFRJ and UFRGS.

Our exploratory analysis is based on primary and secondary data derived from distinct sources of information; namely: archives and in-depth interviews. Archival data derived from our own search in academic repositories (papers and books), on the internet, on the websites of the four studied universities, and in the studied universities' management reports. Primary data was generated by semi-structured interviews grounded in an interview guide. Universities were contacted by e-mail, followed by phone calls to schedule the interview. Interviews were carried out online, and properly recorded. Then, transcriptions were run so as to categorize interviewees' statements according to common keywords (e.g., patents, personnel, faculty, and science), which were also grouped according to three major dimensions: i) infrastructure; ii) interaction with internal and external stakeholders; and iii) technology prospecting. Then, data analysis led to the description of each case individually after which a comparative analysis was carried out. TTO's infrastructure consists of experience (which can be measured by its running time), size, and qualification of the personnel as well as their competencies/ abilities. Interactions with internal and external stakeholders encompass the activities TTOs sponsor (or attend) as a way of publicizing their work (e.g., courses, workshops and lectures). Prospecting may be internal (which includes visits to laboratories and contact with researchers, as well as monitoring of projects that have potential for innovation) and external (which stresses the contact with companies to obtain licensing and cooperation agreements).

Table 1: Top 10 universities in the innovation ranking

Ranking 2012	University Name	State	Type	Innovation Indicator
1st	State University of Campinas (Unicamp)	SP	Public	5,00
2nd	São Paulo University (USP)	SP	Public	4,95
3rd	Federal University of Minas Gerais (UFMG)	MG	Public	4,89
4th	Federal University of Rio de Janeiro (UFRJ)	RJ	Public	4,84
5th	Federal University of Rio Grande do Sul (UFRGS)	RS	Public	4,79
6th	Federal University of Paraná (UFPR)	PR	Public	4,74
7th	State University Pta. Júlio de Mesquita Filho (Unesp)	SP	Public	4,68
8th	Federal University of Santa Catarina (UFSC)	SC	Public	4,63
9th	Pontifical Catholic University of Rio Grande do Sul	RS	Private	4,58
10th	Federal University of Viçosa (UFV)	MG	Public	4,53

Source: FOLHA DE SAO PAULO (2013a).

4. Results: Case Studies

State University of Campinas– Unicamp

Unicamp was established in 1966 and is a publichigher education organization; it has autonomy over educational policy but is subordinate to the Sao Paulo (SP) State Government with respect to its budget. So, the financial resources are mainly obtained from the Sao Paulo State Government and national and international funding institutions. It comprehends 22 teaching and research units and also holds a health complex, 23 interdisciplinary centers and nuclei, two technical schools and several support units in a universe where 50000individualsco-exist and develop innumerous research projects.

Unicamp often approaches foment agencies to support its research initiatives. Unicamp understands that scientific investigation serves not only as a basis forthe improvement of the quality of education but also as a source of revenue.Thereby, from its inception,Unicamphas dealt with industryin order to assure its fast insertion in the production process, and henceto foster technology transfer. As a result, Unicamp is regarded as one of the most successful Brazilian universities with respect to partnering for innovation. Unicamp holds hundreds of technology transfer and technical services contracts with firms, especially those firms located in the region of Campinas. Unicamp has attracted to its surroundings a number of technology-based firms, many of which as a result of the entrepreneurial effort of its former students (and/or faculty). Unicamp's ongoing effort has produced changes in the economic profile of the region over the years and Campinas, which is situated 90 kilometers from the city of Sao Paulo, has become a national reference when it comes to innovation.

Unicamp'sTTO(also known as'Inova') was created in 2003, with the objective of further establishing a network of university relationships with society to increase research activities, teaching and advancement of knowledge. 'Inova'has about 40 employees spread across four main areas: i) intellectual property management;ii) technology transfer;iii) local innovation system (Incamp, Inovasoft, Research and Inovation Center, Unicamp Ventures);and iv) training and cooperation.Inova's personnelis selected through a public tender process (i.e., public exams) that is carried out either by the university support foundation or by the university itself. There are also temporary employees hired on the basis of grants provided by funding agencies.

Unicamp also has three incubators and is working on the creation of the scientific park to foster research and the relationships with companies. The project to create the scientific park makes a prediction of the utilization of the public space in Unicamp by private companies through use permission. The park will provide accompaniment business services, assistance in the development of business models, lectures, and the creation of disciplines for undergraduate courses.

As for patenting, Unicamp's TTO composes 95% of its orders. Some of the processes are handled by a single person;that is, the same official who makes the screening on patents banks, drafts and seeks the transfer. Thus, a single person is responsible and is focused on a particular technology area.

Table shows the evolution of invention notices (sent from researchers to the university TTO), patenting, and technology transfer by Unicamp. It shows that patents filed and granted are growing as well as the number of notifications of invention that inventors forwarded to Inova. The more the university researchers are aware of the importance of depositing patents and the requirements for it, the greater the tendency towards an increase in notifications of invention. According to the manager of intellectual property, the figure on notifications of invention is due to the lecture series, which serves to inform and raise awareness about the importance of intellectual property protection. Prior to patent application there is no market analysis to identify what should or should not be patented. Inova files patent applications on all notifications of invention that meet the requirements of patentability (novelty, inventive activity and industrial application). When an invention does not meet patentability requirements it is refused the notification of invention, but researchers' inventions are still available for other purposes (e.g., licensing agreements not based on patents).

Table 2: Unicamp intellectual property in numbers

Intelectual Property and Technology Transfer	2007	2008	2009	2010	2011	2012
Patents filed in Brazil	50	52	52	51	67	73
Patents filed abroad	39	4	8	16	14	3
Patent granted	2	8	14	8	9	10
Communication of Invention	90	72	55	61	94	108
Licenced technology	10	4	4	7	10	15

Source: Inova/Unicamp.

Federal University of Minas Gerais– UFMG

According to its management report, UFMG stands out as an institution of national reference, forming critical and ethical individuals, with a strong scientific and humanistic base, committed with transforming interventions in society, and with the social-economic development at regional and national level (UFMG, 2011).

The creation of a university in the state of Minas Gerais was part of the political project of the "Inconfidência Mineira"[4].However, the idea came true only in 1927, with the founding of the University of Minas Gerais (UMG), a private institution, subsidized by the state, which arose from the four schools of higher education existing inthe region. In 1949 the UMG was federalized but its current name (i.e., UFMG) was only adopted in 1965. UFMG aims at the generation and dissemination of scientific, technological and cultural knowledge.

UFMG's TTO (also known as CTIT) was established in 1996, and is one of oldestformally structured officein the country dedicated to foster innovation from universities. The office operates in the management of scientific and technological knowledge, running, among other things, activities related to the dissemination of the culture of intellectual property, the confidentiality of sensitive information, the protection of knowledge and the commercialization of innovations produced at UFMG.CTIT materializes, therefore, as the connection between the market and the university and is responsible for promoting the information flow in both directions. Its performance favors and encourages the transformation of technologies generated within UFMG into products and processes useful to society.

The hiring can be made by public tender, by the supporting foundation and through grants from research funding agencies. Currently CTIT has 42 employees, divided in six functions: i) Board; ii) Advisory of Planning and Management; iii) Logistics Support and Infrastructure; iv) FinancialSection; v) Regularization of Intellectual Property Rights; vi)Technology Transfer and Intellectual Property; beyond the business incubator. Of the total staff only seven employees have tenure and ten are located in Inova - UFMG's business incubator (not Unicamp's TTO), which integrates CTIT. Beyond that, due to the possibility of hiring by the Foundation – Fundep, the patent area has an employee from each knowledge area of the university, with a total of 11 employees. With the presence of civil servants of different technical areas the drafting of patent applications can be made in UFMG's TTO.

With the purpose of increasing proximity with the general public and to facilitate dialogue with society, CTIT is located in a specific administrative unit. It has also recently inaugurated a service station in UFMG's service square, a place of mass circulation, located close to banking units, bookstores and restaurants. CTIT acts in three ways to make contact with companies potentially interested in licensing UFMG's protected technologies: i) the Technology Transfer and Intellectual Protection Section acts proactively to identify these companies; ii) the researcher indicates some institutions he knows to operate in certain areas; iii) the company seeks CTIT directly.

UFMG's researchers seem to be aware of the university TTO since they have directly sought CTIT. UFMG's TTO also use other forms of contact, which include visits to laboratories, promotion in the university newspaper as well as lectures and courses deployed to enhance IPR/ licensing

[4]'Infidelity of Minas Gerais' was an unsuccessful Brazilian independence movement in the late 18th century.

awareness.According to one patent editor from the function of Regularization of Intellectual Property Rights, for a TTO to succeed it is important to give visibility to its actions, informing researchers of its activities and services and showing the importance of patent protection. The informant also argued that the qualification of the personnel in all areas of knowledge is one of the factors that contribute most to guarantee the clarity and reliability of the patent draft. This is supposed to lead to a greater number of granted patents and an increasein the potential for technology licensing. UFMG's TTO also provides trainingfor its staff – through national and international courses – as well sends them to attend trade shows.Table shows the evolution of the number of UFMG's patent applications and patents granted between 2007 and 2012.

Table 3: UFMG intellectual property in numbers

Intelectual Property and Technology Transfer	2007	2008	2009	2010	2011	2012
Patents filed in Brazil	41	44	44	61	75	75
Patents granted	1	2	1	5	1	4
Licenced technology	0	9	22	7	18	9

Source: CTIT/UFMG.

Federal Universityof Rio de Janeiro – UFRJ

The Federal University of Rio de Janeiro (UFRJ) was established in 1920 under the name of University of Rio de Janeiro. It was renamed University of Brazil in 1937 and adopted its current name in 1965. Its emergence was a result of the unification of higher education organizations that already existed at that time; namely, the Faculty of Medicine, the Polytechnic School and the Law School.

UFRJ created the 'Coordination of Intellectual Property Activity' (CAPI) in 2001, under the Pro-Rectory of Equity and Finance. This early TTO was responsible for the managementof patent applications. In January 2004, CAPI was renamed to 'Division of Intellectual Property and Technology Transfer', being subject to the Pro-Rectory of Extension. At that time UFRJ's TTO started a series of lectures across various academic units of the university as an effort to promote theengagement of UFRJ's scientists with the patent system. Ultimately, this effort aimed at creating a pro-patent culture among UFRJ's researchers. In 2007, UFRJ took a step further in the development of its TTO by creating its 'Innovation Agency' – an initiative of the new Pro-Rectory for Graduate Studies and Research – with the mission of seeking the transfer of knowledge generated at the university to society. However, it was only in 2011 (Resolution 01/2011) that UFRJ formally recognized (with the approval by the Board of Education for Graduates) the new role of its TTO. The resolution emphasized the importance of the TTOalong the process of technological and social innovation through the cooperation of the university with other organizations.

Among itscurrent functions,UFRJ's TTO encompasses the management of intellectual property, technology transfer initiatives as well as entrepreneurship and social innovation activities. The protection of knowledge has become an important job of the TTO and apparently regarded as central in university research. Moreover, it is necessary that the knowledge developed at the university is channeled to society. In addition, the encouragement of entrepreneurial projects, their coordination,as well as the reassurance of cooperation among interested parties are key in the TTO operation. The area of social innovation articulates, organizes, collects, integrates and boosts socially innovative initiatives at UFRJ.

According to the assistant coordinator of the TTO, UFRJ has 297 families of filed patents, of which 161 have been applied after the creation of the agency in 2007. Among these, there are 12 patents granted in Brazil, 41 PCT applications, plus 11 filings in national phases in the United States, European Office, Japan, Canada, and Mexico (among others). UFRJ also holds 3 patents granted in the United States and 12 licensed patents.**Error! Reference source not found.**shows the evolution of the number of patent filings and granted (per year)by UFRJin Brazil and abroad, as well as the number of invention notices that the office received from UFRJ'sscientific community.

Table 4: UFRJ intellectual property in numbers

Intelectual Property and Technology Transfer	2007	2008	2009	2010	2011	2012
Patents filed in Brazil	31	33	21	31	20	25
Patents granted	0	0	0	1	1	5
Licenced technology	0	4	0	1	0	1

Source: UFRJ's TTO.

UFRJ's TTO has 17 staff members, hired by public tender (with the assistance of either UFRJ's support foundation oralternativefunding bodies). UFRJ'sTTO was once one of the largest TTOs in Brazil, but there is a tendency to off staff due to retirement as well as the end of research grants. Not surprisingly, the main complaint of the assistance coordinator regards staff turnover, which is generated by low wages. UFRJ's TTO has four technology transferagents who were supposed to visitlaboratories, to prospect technologies developed by university scientists, andto actively seek the licensing of university patents. However, due to the reduced amount of staff in the TTO these agents ended up involved in administrativework(e.g., the management of patent portfolios) and never developed the work they were originally hired for. Despite their engagement with the management of the university patent portfolio the drafting of patent applications is done by an external office, hired by UFRJ.

The assistant coordinator of the TTO indicates that due to the strict control of patent processes, the researchers have confidence in the TTO, and it provides safety when it comes the time to reveal their work for the drafting of the patent application. According to this informant, the success in patent applications is not only merit of the TTO but also a consequence of the scientific production in the university. He further points that the number of patents should not be as important to evaluate the success of a TTO, but rather the number of licenses since the latter means that the technology has been transferred to the market.

Federal University of Rio Grande do Sul – UFRGS

The roots of the Federal University of Rio Grande do Sul (UFRGS) dates back to 1895 whena college of pharmacy and chemistry was established in Porto Alegre. Actually, this marks the beginning of higher education in the state of Rio Grande do Sul. But it was only in the end of 1934 (November 28th) that the University of Porto Alegre was created. In 1950 it became a part of the administrative sphere of the Federal Government. Since then, UFRGS has taken center stage nationally as one of the most productive universities in the country. According to itsmanagement report, UFRGS is committed to the regional development and has responsibilities to society as a whole (UFRGS, 2011). UFRGS has witnessed an increase in the number of its civil servants in recent years after a long period without selecting new employees (UFRGS, 2012).

UFRGS's TTO (also known as The Office of Technology Development – SEDETEC) was created in 2000 with the objective of optimizing and coordinating efforts in the area of technological development, specifically with respect to the establishment of relations with the productive sector and providing tools for society for valuing and transfer of scientific and technological knowledge generated by the researchers at the institution. The office is linked directly to the university's central administration with the purpose of bringing more efficiency and agility to processes and operationalization of activities as well as greater visibility among internal and external communities. By 2005, there was on average 10 employees per year at UFRGS's TTO. After the opening of public tenders, the number of employees has recently increased to 16; namely, 01 professor, 01 legal advisor hired via support foundation, 04 members who depend on externally funded scholarships to keep their jobs at UFRGS's TTO, and 10 clerical staff – of which only two are located in the patents area.In addition to patents matters, those two civil servants also handle issues related to the registration of trademarks and software as well as issues within the scope of the plant variety rights. UFRGS's TTO has also opted for hiring professional services provider for the drafting of patent applications in an attempt to overcome the lack of personnel to handle patent issues. In particular, this is a result of the

'innovation law' which has incentivized the inclusion of patenting in academic researchers' career scoring system, and hence the demand for services on patenting has increase. Table shows the evolution in the number of patents applied and granted by UFRGS between 2007 and 2012.

Table 5: UFRGS intellectual property in numbers

Intelectual Property and Technology Transfer	2007	2008	2009	2010	2011	2012
Patents filed in Brazil	11	13	28	29	40	43
Patents filed abroad and PCT	3	3	1	5	5	7
Patents granted	0	0	1	1	1	2
Licenced technology	0	0	1	0	1	5

Source: SEDETEC/UFRGS.

4.1 Comparative Analysis and Discussion

Table 6 summarizes qualitative and quantitative information of the four universities studied regarding their infrastructure and orientation towards intellectual property during the period 2007-2012. It is intuitive that the amount of patent filings by universities is directly related to their size (proxied by the number of faculty members). However, our cases suggest that other factors may affect universities' productivity (with respect to patenting). Unicamp, for example, is the university with the largest number of patents in Brazil, but is not the largest university in the country (with respect to the size of its faculty).As one can notice from Table 6, Unicamp presents a ratio of 0.20 patent filing per faculty member while UFRJ, UFRGS, and UFMG have a ratio of 0.04, 0.06 and 0.08 patent application per faculty member, respectively. Thereby, despite being public universities, it is clear from the cases studied that universities in Brazil present differences not only with respect to their scope (i.e., number of courses) and size (i.e., number of students and faculties), but also with respect to the features of their TTOs. While it is clear that the formalization of universities' TTOs was prior to the 'Innovation Law' in 2004, their creation happened long after the beginning of universities' activities, and this might have influenced the performance of the university regarding the number of patents and technology transfer contracts.

Table 6: Qualitative and quantitative comparative analysis

		UNICAMP	UFMG	UFRJ	UFRGS
UNIVERSITY IN NUMBERS(1)	Year of foundation of the university	1966	1927	1920	1934
	# Undergraduate courses	66	75	175	98
	# Undergraduate students	17650	30957	41365	27595
	# Postgraduate courses	142	207	173	280
	# Postgraduate students	19718	14436	10948	15998
	# Technical administrative staff	7994	2743	10000	2553
	# Faculty members	1727	4323	4122	2541
TTO's STRUCTURE	Experience/Run time	9 years	16 years	5 years(2)	12 years
	Number of employees	40	42	17	16
	Qualification of personnel	Specific qualification	Specific qualification	Specific qualification	Generic qualification
	Competencies	Specific competencies	Specific competencies	Specific competencies	Acquired mainly within the TTO
INTERACTION WITH ACADEMIC AND EXTERNAL COMMUNITIES	Courses	Usual function	Usual function	Sporadic function	Sporadic function
	Workshops	Usual function	Usual function	Sporadic function	Sporadic function
	Presentation	Usual function	Usual function	Sporadic function	Sporadic function

			UNICAMP	UFMG	UFRJ	UFRGS
PROSPECTION	**Internal**	Visits to laboratories	Usual function	Usual function	Sporadic function	Rare function
		Contact with researchers	Usual function	Usual function	Sporadic function	Sporadic function
		Monitoring of projects with innovative potential	Usual function	Usual function	Sporadic function	Sporadic function
	External	Contacting companies for licensing and cooperation agreements	Usual function	Usual function	Rare function	Rare function
Number of patents filed in Brazil[3]			345	340	161	164
Number of patents filed abroad[3]			84	NA[4]	NA[4]	24
Number of patents granted[3]			51	14	7	5
Communication of invention[3]			480	NA[4]	NA[4]	NA[4]
Licensed technology[3]			50	65	6	7

Notes:
[1] Data relate to 2012.
[2] In this table it is assumed that UFRJ's TTO was formally structured as a university unit in 2007 when the 'Innovation Agency' was established. Prior to that a function called 'Coordination of Intellectual Property Activity' was in operation since 2001.
[3] Cumulative number from 2007 to 2012.
[4] NA = Not available

The four cases studied consider important to have a proper structure for the management of intellectual property and entrepreneurship, not only for the performance of the university but also for the country's technological development. Due to the reality of the Brazilian university system, in which 80% of researchers are working in public educational organizations, if there was no formally structuredTTO knowledge transfer would happen at a lower rate. However, having a TTO per se is not enough to assure that knowledge will be transferred. In fact, knowledge transfer seems to happen more often when TTOs adopt an active stance in relation to technology transfer and licensing. To some extent this behavior is a result of the size of the TTO. In fact, the larger the TTO, the more productive it is with respect to patenting (i.e. patent filings per faculty member). Thereby, inter-university differences as to the size of their TTO seem to be critical to explain differences in university patenting.

The TTOs of Unicamp and UFMG have similar structures with about 40 employees divided into various sectors in each TTO. Both TTOs have what they call innovation agents, who are responsible for conducting visits to laboratories to prospect new technologies and to inform researchers of the importance of protecting knowledge. These TTOs have staff from different areas of knowledge, which favors the skilled drafting of patent applications. Having people from different areas also assists in contacting researchers and companies, since the diversity of knowledge favors a greater familiarity in the particular language of the theme worked; that is, the larger the size of the TTO, the larger the scope of its technical knowledge. In turn, the TTOs of UFRJ and UFRGS have around 17 employees divided into various sectors as well. Due to staff shortages and the difficulty of hiring civil servants from technical areas, the TTOs in these universities cannot be so productive. The selection process also seems to constrain the studied universities' TTOs ability to provide more sophisticated services. To date public tenders have demanded a generic qualification of the employee to occupy administrative positions, and hence has hindered the hiring of more specialized personnel. Moreover, hired employees do not leave the office to visit laboratories to prospect clients and disseminate the implications and the process of patenting. A considerable portion of staff time is used with bureaucratic and administrative paperwork. The solution to remedy this deficiency in personnel was to hire outside professionals or offices to draft their patent applications.

As for interaction with academic and external communities there are significant differences between the cases studied. Unicamp and UFMG may be more successful in this regard as a result of a more focused orientation of these universities in projects or as a result of universities' effort to prioritize TTOs activities. UFRGS and UFRJ also create activities and interactions, but fewer in number and of lower intensity. UFRJ indicated that it has allocated 'innovation agents' to perform these activities, but UFRJ's TTO has few employees and usually they are involved with other tasks related to the management of patent portfolio and cannot devote much time to interaction activities.

As for prospecting, the situation is quite similar. Unicamp and UFMG are more active in seeking new partners to license-outtheir technologies. As the performance of TTOs is measured by the number of patent applications filed as well as the number of technology transfer contracts, prospecting for new technologies in laboratories and researchers become central in TTOs activities. Unicamp also shows that, due to its visibility with the external community, companies seek its TTO if they are interested in licensing-in or developing technologies with the university. UFRJ and UFRGS are more reactive to technology transfer since they tend to act (i.e. to seek opportunities to license-out) after new demands from the market emerge. All in all, these cases reveal that Unicamp and UFMG are better structured to spur technology transfer than are UFRJ and UFRGS. Even if these latter universities stand out in the Brazilian scenario, their infrastructure for technology transfer is still limited.

5. Conclusions

On the basis of four case studies this piece of research has examined how patent-active Brazilian universities have equipped their TTOs. The cases studied revealed that universities have followed distinct patterns of behavior as to the development of their TTOs. Case studies have shown, for example, that universities' TTOs vary in size and scope of their technical specialization. Thus, the emphasis to disseminate their activities and their role within university research departments also differ and hence dissimilar productive patterns have emerged.

The findingsof this study allowidentifying important elements when analyzing the management of intellectual property in higher education organizations. The study highlights three different issuesonuniversities' approaches to intellectual property. Firstly, at a philosophical and political level (which is not the focus of this study), one can realize that universities, even if public, possess different values when it comes to the management of their intellectual property. Secondly, at technical and procedural level, one can observe that each university has its own way of organizing its TTO. Finally, at the administrative and operational level, one can notice that universities' productivity with respect to patenting derives to some extent from their emphasis on the development of their TTO. For example, Unicamp and UFMG have a larger number of patent applications than UFRJ and UFRGS. Moreover, for the researchers to become aware to the importance of the registration of intellectual property, technology transfer contracts and know how, it is necessary to do lectures and other dissemination actions on these themes. However, UFRJ and UFRGS do not have enough staff in its TTO to increase this awareness. Another obstacle to the full development of these activities in these TTOs concerns a possible increase in the number of patent applications coming from a more intense process of prospecting, which could not be covered by their limited staff.

All in all, despite universities' concern with technology transfer, their ability to manage their intellectual propertyand to set up technology transfer contracts is rather limited to date. The implication of this finding is straightforward: As TTOs play a central role in the technology transfer process, their enlargement and specialization are needed for universities to become more active in knowledge transfer. Thus, the hiring of civil servants seems critical not only due to the excessive workload of the current staff but also due to the potential impact this hiring may have on the diffusion of TTOs' activities as well as on the number of patent applications and technology transfer contracts. This is even more critical in Brazil because public tenders for this type of work do not require previous experience, and hence demand some time for the new hiring to be proficient in the specific activity. Moreover, the expansion and specialization of TTOs' personnel is likely to allow universities to better

organize their portfolio of technologies to show companies that might have a potential interest in a particular technology. In addition, universities should make TTOs more active in dealing with university industry relationships. In this regard, the creation of tools that facilitate the exchange of information between business and universities could be useful. However, one observation is in order. To the extent that TTOs further develop their infrastructure and patenting becomes more actively pursued by universities' faculty, coordination costs will increase. As firms present better performance when their scope encompasses related activities, TTOs are expected to perform far from their efficiency frontier when too many technical areas are handled by the same organizational unit. Thereby, TTOs performance might not be as good as one foresees due to the difficulty in coordinating an array of dissimilar technological fields.

Our analysis is not free from limitation. By their nature, case studies are insightful but limited in their ability to generalize. Moreover, the purpose of this research was to provide an exploratory analysis of current conditions at selected universities. It has not provided robust evidence of causal relationship; for that purpose a quantitative approach could be useful. In addition, this paper has assumed that university patenting is a result of institutional interactions; TTOs may not simply substitute for personal relationships with individual university researchers, and this is a promising research avenue. By the same token, we have assumed that knowledge transfer is a result of institutional forms of interaction. A better understanding of the effects of interpersonal relationship between university researchers and managers/ entrepreneurs on knowledge transfer is in order. Last, this paper has focused on TTOs concern about prospecting university inventions useful to the market. A critical issue neglected in this research is the extent that university researchers bypass TTOs and universities' policies so as to out license their inventions. This is particularly critical in a weak institutional environment like the Brazilian judicial system, and hence deservers further consideration.

References

[1] Amadei, J. R. P. andTorkomian, A. L. 2009. As patentes nas universidades: análise dos depósitos das universidades públicas paulistas. Ciência da Informação. Brasília, v.38, n.2, May/Aug.

[2] Argyres, N.S. andLiebeskind, J.P. 1998.Privatizing the intellectual commons: universities and the commercialization of biotechnology. Journal of Economic Behavior and Organization, v.35, 427–454.

[3] Baldini, N. 2009. Implementing Bayh-Dole-like laws: Faculty problems and their impact on university patenting activity. Research Policy, v. 38, n. 8, p. 1217-1224.

[4] Bercovitz, J. andFeldmann, M. 2006. Entrepreneurial universities and technology transfer: a conceptual framework for understanding knowledge-based economic development. Journal of Technology Transfer,v.31, 175–188.

[5] Bocchino, L. O. [et al].2010.Publicações da Escola da AGU: propriedade intelectual – conceitos e procedimentos. Brasília: Advocacia-Geral da União.

[6] BRASIL. Lei nº 10.973, de 2 de Dezembro de 2004. Dispõe sobre incentivos à inovação e à pesquisa científica e tecnológica no ambiente produtivo e dá outras providências. Diário Oficial [da] República Federativa do Brasil, Brasília, DF.

[7] BRASIL. Lei nº 9.279, de 14 de Maio de 1996. Regula direitos e obrigações relativos à propriedade industrial. Diário Oficial [da] República Federativa do Brasil, Brasília, DF.

[8] Damasceno, A. O. P 2006. A inovação tecnológica e a propriedade industrial. Jornada de Iniciação Científica, 14, Rio de Janeiro, RJ. Anais. Rio de Janeiro: CETEM- Centro de Tecnologia Mineral.

[9] Dosi, G. 1990. Finance,innovation and industrial change. Journal of Economic Behavior and Organization,v.13, p.299-319, North-Holland.

[10] Drucker, P. 1986.Inovação e gestão: uma nova concepção de estratégia de empresa. Lisboa: Editorial Presença.

[11] Etzkowitz, H; Wester, C; Gebhardt, C; Terva, B 2000. The future of the university and the university of the future:evolution of the ivory tower to entrepreneurial paradigm. Research Policy, v.29, p.313–330.

[12] Fávero, M. L. A. 2006.Universidade no Brasil: das origens à Reforma Universitária de 1968.Educar, Curitiba: Editora UFPR. n.28, p.17-36.

[13] Feldman, M.; Feller, I.; Bercovitz, J.; Burton, R. 2002.Equity and the technology transfer strategies of American research universities.Management Science, v.48, n.1, p.105-121.

[14] Folha De São Paulo. 2013. Ranking universitário Folha: o ranking pela inovação. Available in: <http://ruf.folha.uol.com.br/rankings/pelainovacaonasuniversidades/>. Access in: jan 2013a.

[15] Folha De São Paulo. 2013. Ranking universitário Folha: o ranking geral das universidades. Available in: <http://ruf.folha.uol.com.br/rankings/rankingdeuniversidades/>. Accessin: jan 2013b.

[16] Freeman, C.; Soete, L 2008. A economia da inovação industrial. Tradutores: Andre Luis Sica de Campos e Janaina Oliveira Pamplona da Costa. Campinas: Editora Unicamp.

[17] Geuna, A., Muscio, A. 2009. The governance of university knowledge transfer: a critical review of the literature. Minerva, v. 47, n. 1, 93–114.

[18] Geuna, A., Rossi, F. 2011. Changes to university IPR regulations in Europe and the impact on academic patenting. Research Policy, v. 40, n. 8, 1068–1076.

[19] Haase, H.; Araújo, E.C.; Dias, J. 2005. Inovações vistas pelas patentes: exigências frente às novas funções das universidades. Revista Brasileira de Inovação, v.4, n.2 Jul/Dec.

[20] INEP – Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira; MEC – Ministério de Educação e Cultura. Resumo Técnico: Censo da Educação Superior 2009. Brasília, 2010.

[21] INPI – Instituto Nacional da Propriedade Intelectual. Conheça o INPI. Available in: <http://www.inpi.gov.br/portal/artigo/conheca_o_inpi>. Access in: jan 2013.

[22] Latini, S. A. 2003.Invenção e inovação tecnológica: uma receita de sucesso.Carta Mensal Rio de Janeiro, v.49, n.580, p.3-14.

[23] Lindelof, P. 2011. Formal institutional contexts as ownership of intellectual property rights and their implications for the organization of commercialization of innovations at universities: comparative data from Sweden and the United Kingdom. International Journal of Innovation Management, v.15, n.5, p.1069–1092.

[24] Malhotra, N. K. 2012. Pesquisa em Marketing: uma orientação aplicada. 6. ed. Porto Alegre: Bookman.

[25] Matei, A. P. 2009. A interação da universidade com empresas: a relação UFRGS – Petrobrás. UFRGS. Porto Alegre.

[26] Mazzoleni, R. 2006. The Effects of University Patenting and Licensing on Downstream R&D Investment and Social Welfare. Journal of Technology Transfer, v. 31, n. 4, p. 431-441.

[27] MEC – Ministério da Educação e Cultura. Qual é a diferença entre faculdades, centros universitários e universidades?Available in: <http://bit.ly/ZeXhjZ> Access jan 2013.

[28] Mowery, D. C. et al. 2001. The growth of patenting and licensing by U.S. universities: an assessment of the effects of the Bayh-Dole act of 1980. Research Policy, v. 30, n. 1, p. 99-119.

[29] Mowery, D. C.; Rosenberg, N. 2005. Trajetórias da inovação: a mudança tecnológica nos Estados Unidos da América no século XX. Campinas: Editora da UNICAMP.

[30] Mowery, D. C.; Sampat, B. N. 2001a. Patenting and Licensing University Inventions: Lessons from the History of the Research Corporation. Industrial & Corporate Change, v. 10, n. 2, p. 317-355.

[31] Mowery, D. C.; Sampat, B. N. 2001b. University Patents and Patent Policy Debates in the USA, 1925-1980. Industrial & Corporate Change, v. 10, n. 3, p. 781-814.

[32] Nelson, Richard. R. 1993.National innovation systems: a comparative analysis. New York: Oxford University Press.
[33] Nunes, A (2010). Mudanças promovidas pela lei da inovação nas funções e práticas de gestão dos intermediadores da cooperação universidade-empresa das universidades federais. Master's thesis. Curitiba.
[34] Pavitt, K. 1984. Sectoral patterns of technical change: Towards a taxonomy and a theory. ResearchPolicy, v.13, n. 6, p. 343-373.
[35] Pereira, M. G.; Nogueira, R. P. 1989. A universidade brasileira e o sistema de patentes. Revista de Administração da Universidade de São Paulo (RAUSP), v. 24, n. 2, p. 58-64.
[36] Povoa, L. M. C. 2008.Patentes de universidades e institutos publicos de pesquisa e a transferência de tecnologia para empresas no Brasil. Belo Horizonte: UFMG, 2008. Disponivel em: <http://www.cedeplar.ufmg.br/economia/teses/2008/Luciano_Povoa.pdf>. Acesso em: 10 ago. 2011.
[37] Povoa, L. M. C. 2010. A Universidade Deve Patentear Suas Invenções? Revista Brasileira de Inovação, v. 9, n. 2, p. 231-256.
[38] Pressman, D. 2011.Patent it yourself. 15 ed. Nolo.
[39] Schumpeter, J. A. 1961. Capitalismo, socialismo e democracia. Rio de Janeiro: Fundo de Cultura.
[40] Schumpeter, J. A. 1982. Teoria do desenvolvimento econômico. São Paulo: Abril Cultural.
[41] Severino, A. J. 2007. Metodologia do trabalho científico. 23 ed. São Paulo: Cortez Editora.
[42] Stallivieri, L. 2006.O sistema de ensino superior do Brasil: características, tendências e perspectivas. Assessoria de Relacões Interinstitucionais e Internacionais, UCS. Available in: <http://bit.ly/oVfGas> Access: jan 2013.
[43] UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL – UFRGS. 2012. Relatório de Gestão 2012. Available in: <http://www.ufrgs.br/prograd/news/prograd-divulga-relatorio-de-gestao-2008-2012>. Access in:jan 2013.
[44] UNIVERSIDADE FEDERAL DO RIO DE JANEIRO – UFRJ. 2012. Relatório de Gestão 2012. Available in: <http://www.pr3.ufrj.br/pr3/files/2012/Relatorio%20Gestão%202012%20ex%202011.pdf>Access in: jan 2013.
[45] UNIVERSIDADE FEDERAL DE MINAS GERAIS – UFMG. 2012. Relatório de Gestão 2012.Available in: <https://www2.ufmg.br/proplan/content/download/14516/106843/file/RELAT%C3%93RIO_DE_GEST%C3%83O_UFMG_2011.pdf>. Access in: jan2013.
[46] UNIVERSIDADE ESTADUAL DE CAMPINAS – UNICAMP. 2011. RelatórioInovaUnicamp 2011. Available in: <http://www.inova.unicamp.br/sobre/relatorio> Access in: jan 2013.
[47] Velazquez, V. H. T. 2007.Propriedade intelectual: setores emergentes e desenvolvimento. Piracicaba: Equilíbrio Editora.
[48] Vieira, C. P. 2008. Inovação tecnológica e desenvolvimento regional: as dimensões territoriais da lei de inovação tecnológica. Master'sthesis. Blumenau.
[49] Yin, R.K. 2005.Estudo de caso: planejamento e métodos. 3. ed. Porto Alegre: Bookman.