

## Appropriation mechanisms of search results: A case study in a public university of Minas Gerais

André Siqueira Rennó<sup>a,b,\*</sup>, André Luiz Zambalde<sup>a</sup>, Ricardo Braga Veroneze<sup>a</sup>, Dalton de Sousa<sup>a,c</sup>

<sup>a</sup> Universidade Federal de Lavras (UFLA), Lavras, MG, Brazil

<sup>b</sup> Centro Universitário de Formiga (UNIFOR-MG), Formiga, MG, Brazil

<sup>c</sup> Universidade Federal do Mato Grosso do Sul (UFMS), Paranaíba, Brazil

Received 5 October 2015; accepted 17 May 2016

Available online 14 September 2016

### Abstract

The objective of the research was to investigate the appropriation mechanisms of research results at a public university in the state of Minas Gerais. Therefore, we conducted a descriptive and qualitative case study, based on interviews with semi-structured screenplay, literature and documentary research. It is remarkable the importance of universities in knowledge production and dissemination of research results that can lead to innovations, so this research is relevant to the universities context. The main practices identified in these institutions were the participation in networks, the presence of incubators of technology-based companies, partnerships or public cooperation, partnership between university and business, the presence of academic spin-offs, besides legal protections, such as patent applications, trademark and software registrations, plant variety log and protection, copyright and industry secret. This university is in a stage that the appropriateness culture implementation and there is a search for innovations developed within the university. However, this institution has yet to evolve in the technology transfer from academy to society, being necessary higher motivation for this practice.

© 2016 Departamento de Administração, Faculdade de Economia, Administração e Contabilidade da Universidade de São Paulo – FEA/USP. Published by Elsevier Editora Ltda. This is an open access article under the CC BY license (<http://creativecommons.org/licenses/by/4.0/>).

**Keywords:** Appropriation mechanisms; Research results; Technology transfer; Innovation; Public University

### Introduction

Brazilian universities faces the responsibility to provide the best return for the government and society about the public resources involved in the generation of technical and technological knowledge (Audy, Cunha, & Franco, 2002). These institutions have an important role in the fields of education, science and technology, especially in the generation of new

knowledge (Oslo, 2005). Moreover, they are directly responsible for cultural, technological and social changes (Clark, 2003). Therefore, they begin to be understood as spaces for creation of technologies with the responsibility to offer to society the elements to generate values in research and development through the commercialization of technologies (Bojesen-Trepka, 2009).

Santana and Porto (2009) identified, conducting a study in the medical sector companies, the need for companies, to be present in the cooperation process with the university, seeking opportunities in the research laboratories of educational institutions, and proposing joint actions to improve processes that can generate cooperation between those entities. Taking into account this interaction and considering that the scientific and technical knowledge is essential in generating innovation. In the context, the public university research groups play an important role in developing useful knowledge that, in cooperation with

\* Corresponding author.

E-mails: [andrerenn89@gmail.com](mailto:andrerenn89@gmail.com) (A.S. Rennó), [zamba@dcc.ufla.br](mailto:zamba@dcc.ufla.br) (A.L. Zambalde), [rbveroneze@gmail.com](mailto:rbveroneze@gmail.com) (R.B. Veroneze), [dalton.sousa@gmail.com](mailto:dalton.sousa@gmail.com) (D. de Sousa).

Peer Review under the responsibility of Departamento de Administração, Faculdade de Economia, Administração e Contabilidade da Universidade de São Paulo – FEA/USP.

companies, this knowledge can drive innovations in the market (Etzkowitz & Leydesdorff, 1996).

To meet this new reality, the challenge of these institutions is to change traditional structures and pursue new strategies that enable them to generate numerous technologies related to the creation of products and processes (De Benedicto, Carvalho, Bittencourt, & Zambalde, 2014). This way, the present study aims to broaden the discussion about the appropriation of research results in universities, using studies about the subject in the literature and seeking to achieve empirical evidence within a federal institution of higher education in the state of Minas Gerais.

Aiming to address this issue, this study sought to answer the following research problem: How do the appropriation mechanisms of search results occur in a federal institution of higher education? In this way, the main objective was to investigate the appropriation mechanisms of search results generated in a federal institution of higher education in the state of Minas Gerais.

Therefore, this work has five topics that will address the subject in focus. After this introduction, there is the theoretical framework, divided into four sub-topics, the methodology, analysis of results and discussion, and finally, the final considerations of the study.

### *Innovation context in Brazilian universities*

The world has experienced the emergence of a new model of development and competitiveness directly influenced by organizational innovations of products and processes. This new model, characterized as the knowledge economy, reaches educational institutions, as instigates actions and discussions involving the relationship between universities and companies (Gilde, 2007).

The creation and dissemination of knowledge have been the focus of the universities. The challenge is to notice how is possible to use this knowledge as an asset in order to provide value to the economy, the society and the university itself (IPO, 2011).

Markman, Gianiodis, Phan, and Balkin (2005) argued that the university–business technology transfer (TTUE) is an alternative for innovation in industries, taking advantage of the existing potential in universities. On the other hand, the author says that the technology transfer from university should not be the main and unique way of innovation. It should be seen as useful and complementary in order to take advantage of the research results in a way to create an ideal situation for generating innovation and internalization of Research and Development (R&D) in the own university and in the companies.

Branco and Vieira (2008) pointed out that the Intellectual Property Law enacted in 1996 (Brasil, 1996), in the Brazilian context, played an important role in the development of innovation and enhancement of Intellectual Property Rights (IPRs) protection. Andrade (2004) completes reporting other initiatives for the development of innovation policies implemented in Brazil from the 1990s, such as the creation of sector funds for research financial support and the relevance acquired by business incubators.

In 2004, it was approved the Federal Law No. 10.973 or “Innovation Law”, which exposes the incentives for innovation and scientific and technological research in the production environment and that boosted the establishment of technological innovation cores in the research centers in order to protect the scientific knowledge generated at the university. One of the goals of this law was to contribute to building an environment that could promote the technological development in the country (Chagas & Muniz, 2006).

Another important event about the innovation area in Brazil took place in early 2016, with the sanction of the Federal Law No. 13.243, also called “Legal Framework of Science, Technology and Innovation” (Brasil, 2016). This new law allows public universities and private companies to work more closely, allowing situations such as authorization for full-time basis teachers to develop research within companies and that university laboratories can be used by industry for the development of new technologies – in both cases, with payment. Other important points are the reducing bureaucracy of the bidding system, purchase and import of products intended for technological scientific research. This new law demonstrates an evolution of Brazil in the approach between universities and businesses and in the innovation fostering.

### *University–business cooperation*

The cooperation between universities and business is a way to spread knowledge, make it accessible to other actors outside the academic context. Botelho, Carrijo, and Kamasaki (2009) claimed that knowledge dissemination is important because it is the source for the development of the country. The authors also consider that the university–business cooperation is a good strategic choice for companies that face some kind of technological difficulty.

From the promulgation of the Technological Innovation Law (Brasil, 2004), it was regulated the practice of partnerships between research institutions, universities and business, seeking to strengthen their relations and encourage innovation, representing a government legal mechanism to increase the number of patent records in the country (Corrêa, 2007). The new Brazilian law has the object to increase the cooperation between universities and business (Brasil, 2016). Further analysis will be necessary about the impacts of this law in university–business cooperation in Brazil.

Gonçalo and Zanluchi (2011), and Iacono, Almeida, and Nagano (2011) stated that there are some motivations for university–business cooperation. For the universities the main motivations are: (A) access to government funds; (B) increase of the social prestige with practical results; (C) lack of equipment; (D) possibilities of gaining financial resources; (E) better training for postgraduate students; (F) the possibility of additional information on the research fields; (G) improvement of the university image and (H) access to the enterprise infrastructure.

De Pellegrin, Balestro, Junior, and Caulliraux (2007, p. 314) stated that “the cooperation for innovation takes a range of forms, from technology transfer agreements, agreements with

universities for development or joint exploitation of a patent, until the joint development of products to be sold in partnership”.

Dosi (1988) stated that the innovation process goes through all the stages of research, development and transfer until reaching the scrutiny of society, whether in the form of new products, new techniques, services and/or organizational and administrative processes. Most of these transfer forms contribute directly or indirectly to the improvement of innovations and technological advances.

#### *Limits of the university–company cooperation*

The technological innovation process takes on specific characteristics, depending on the region, the level of institutions located on it and the own process of coordination between the actors of innovation. These actors are companies, universities, research centers, science and technology agencies, incubators and start-up or spin-offs (Ribeiro, Andrade, & Zambalde, 2005).

In the technology transfer there are barriers which according to the study of Segatto-Mendes and Mendes (2006) are the following: university bureaucracy; very long-term project and differences in levels of knowledge among the people of the university and the company involved in cooperation.

Vieira, Van Bellen, and Fialho (2006) pointed out the organizational structure of universities as a barrier to technology transfer. The organizational structure, according to the authors, is a particularly critical point of the Brazilian federal universities. In the universities, the structures are extremely bureaucratized, processes are slow, divisional, both in administrative and academic procedures. Tonelli and Zambalde (2009) argued that anomalies arise when certain innovation processes do not find institutional actors able to absorb their needs.

#### *Appropriation mechanisms*

The theme “knowledge protection” is gaining more importance in the discussion agenda of organizations that have R&D activities as the basis of their business. This is because the protection may represent the guarantee of exclusive use of new knowledge. However, the financial return on R&D activities can be related not only to the protection of knowledge, but also with other strategies that allow their appropriation, it means, the capture of its value (Mattioli & Toma, 2009).

The Organisation for Economic (2005) defines the concept of appropriation as the ability that organizations have to appropriate the gains from research and development activities, which is an important factor and that effects innovation. Godinho, Pereira, and Mendonça (2008) stated that appropriation is the ability to get return on investments in knowledge. The effective appropriation of potential profits avoids that the knowledge generated by the organization overflow to others who did not contribute to the production of the same.

For Almeida (2013), the knowledge appropriation mechanisms are diverse and include patents, trademarks, industry

secrets and even the time of development and launch of a new product on the market (time-to-market). Results appropriation means the generation and retention of economic value (wealth) derived from new knowledge originating from a R&D project.

The appropriation mechanisms of intellectual assets include formal methods, such as patents and other intellectual property forms, and informal methods, such as secrecy, lead time, rapidly reducing the learning curve and sales and services efforts. Much of the research on appropriation has focused on activities of the companies about patents and trade secrets and other informal mechanisms, such as the speed for marketing, and the learning curve has received less explicit attention (Leiponen & Byma, 2009).

Contributing to the subject, Teece (1986) stated that the appropriation regime of a particular knowledge asset, can be identified as weak, moderate or strong, according to two criteria: (i) legal protection; and (ii) replication of knowledge, if tacit or encoded. The most important aspects of an appropriation system include the nature of technology and the mechanisms to protect intellectual property. So, it is reinforced the view that the appropriation and use of each instrument of legal protection vary according to the organization, the industry sector and the country.

De Benedicto, Bittencourt, Zambalde, and Silva Filho (2014) classified into two categories the appropriation mechanisms. The first are the mechanisms of direct appropriation, such as registration of patents, know-how transfer agreements, trademarks, copyrights, trade secrets, protection of plant varieties, software, computer programs, integrated circuit topography, geographical directions, breeders’ right, industrial designs, patent licensing, *sui generis* rights, among others.

The second category name is mechanisms of indirect appropriation, which includes partnerships between businesses and universities, strategic alliances formation, constant launch of new technologies, evaluation of market needs, changes in organizational structure, researchers hiring and training, negotiators hiring and training, strategic creation of academic spin-offs, strategic creation of technology incubators, development of combined technologies, complexity of product design, marketing strategies, among others.

De Benedicto et al. (2014) defined the indirect appropriation mechanisms and have the following description:

- Networks: regard to the integration of universities with other institutions that promote the intellectual property culture, such as RMPI – Rede Mineira de Propriedade Intelectual (Intellectual Property Network of Minas Gerais) and the RMI – Rede Mineira de Inovação (Innovation Network of Minas Gerais).
- Incubator of Technology-Based Companies: is a structure to coordinate entrepreneurial activities, offering support and guidance to the development of innovative companies.
- Technological Park: is a geographical concentration of companies, educational institutions, business incubators, research centers and laboratories that create a favorable environment to technological innovation.

- Expansion of the university structure: creation of new campuses with research structure, it is a method of indirect appropriation by the fact that enable the development of new research in new campuses.
- Partnerships or Public Cooperation: refers to the joint actions with the county, state (Secretaries, Fapemig) and/or federal government (Finep, CNPq or CAPES).
- University/companies Partnership: refers to existing cooperation agreements between universities and businesses through formal contracts.
- Negotiators hiring and training: it allows the university to present a better performance during the negotiations for the transfer of technology to companies. Better trading results on greater direct appropriation.
- Constant launch of new technologies: besides meeting the needs of the market, it also generates new demands and prints a leading university image.
- Participation in International Fairs: promotion of technologies developed by university in international events.
- Academic Spin-off: companies generated from university research's.

De Benedicto et al. (2014) also raised the economic and social benefits, that the appropriation mechanisms can cause, among them there is: the creation of jobs, the income increase, wealth creation, social development, cultural change and the local and regional technological subsidy.

Another important issue concerning the appropriation mechanisms of search results is the intellectual property (IP). The idea of “intellectual property” assumes that, as an individual may have ownership rights under a material good that he produces or acquires in the market, the resulting product of the ingenuity of the human mind must also be able to be appropriate by its creator. Thus, it is sought the private appropriation of economic results of the knowledge using that, by nature, is fleeting and temporary, as it is always being replaced by a new knowledge (Garnica, 2007; Pereira, 2008).

In the case of intellectual property, Kruglianskas and Matias-Pereira (2005) and Matias-Pereira (2011) argued that all research involving the development of knowledge with potential of technological application (products, processes, trademarks and software) can be object of IP protection. These mechanisms are legal instrument that fosters greater competition between individuals or companies and promotes competition and technological advances.

In Brazil, there is an increasing of the importance of intellectual property management and formalized technology transfer in the academic field, evidenced by the existence of Technological Innovation Centers (TIC), by university policies and rising performances (Closs, Ferreira, Sampaio, & Perin, 2012). For the expansion of university–business technology transfer it is necessary, however, a strong national policy to support the dissemination of intellectual property and promote the dialog between universities, government and the productive sector (Corrêa, 2007). Thus, joining efforts to overcome difficulties in this research results appropriation process in higher education institutions.

## Methodology

This research is an applied nature study, with descriptive objectives and qualitative approach (Jung, 2004). It was used the case study as the research method, understood here as an appropriate strategy when discussing about issues which involve contemporary phenomena inserted in the context of real life and that can be complemented by other exploratory research (Yin, 2010).

The Federal University of Lavras (UFLA-MG) was the object of analysis, with interviews conducted in 2014. To define the object of study, was necessary a survey with the Intellectual Property Network of Minas Gerais (RMPI), however this source had only available information until 2011. This way, according to the available data at the moment of definition of the object, UFLA was chosen because it is one of the three universities of Minas Gerais with more intellectual property registration until 2011 (RMPI, 2011).

This institution is a Brazilian public university located in the city of Lavras, in Minas Gerais, 240 km far from Belo Horizonte, which is the state capital. According to the General Index of Courses (IGC) of the Brazilian higher education institutions, published by the National Institute of Educational Studies and Research Anísio Teixeira (INEP), UFLA has the 10th highest rate of Brazil and the 3rd of Minas Gerais among public and private universities (INEP, 2016). The IGC is a quality indicator, which evaluates higher education institutions. One of the criteria for defining the IGC is the average of the assessment concepts of *stricto sensu* postgraduate programs awarded by CAPES (Commission of Higher Level Personnel Improvement). This fact has relation to the level of quality of research carried out in these institutions and consequently the generation of search results with relevance in the academic field. UFLA has featured in the areas of Forestry Engineering, Agricultural Engineering, Veterinary Medicine and Agronomy, besides having well-respected postgraduate programs in Soil Science, Plant Science and Management.

By allowing further deepening of the case study, the chosen data collection method was semi-structured interviews with the various institutional actors directly involved in the innovation context in the educational institution. The interviewed actors had the follow identification: Pro-Rector for Research (E1); the Technological Innovation Center Coordinator (E2); two members of the Technological Innovation Core (E3 and E4), they were responsible for the protection processes of the research results of the university; and one Researcher (E5), whose had its technology transferred from university to the market and transformed into innovation for society.

The interviews intended to extract elements for reflection such as the appropriation strategies, constraints and faced challenges and the alternative practices of appropriation. It was important for the study a documentary research seeking to complement the data and information collected during interviews. The research prospected written documents, such as internal resolutions of the university, disclosure folders of TICs, internal regulations, internal procedures manuals, laws about innovation and intellectual property. Moreover, it was used research on the

internet pages as the website of the Center for Technological Innovation of UFLA (NINTEC), the site of the Federal University of Lavras, the site of Innovation Network of Minas Gerais and the site of Intellectual Property Network of Minas Gerais. It was also prospected documents about indicators of intellectual property of UFLA.

Regarding to the data analysis, we used the content analysis technique to interpret the meanings of the words of the subjects, according to Bardin (2011). For the process of content analysis, there was the preparation phase, in which the interviews transcription occurred according to the semi-structured questions. It is emphasized that this phase not only encompassed interviews, but also the set of observations obtained at the process. After the transcript of the recording, a reinterpretation of the material took place and the organization of the reports had in a certain order, with the objective to start a classification and organization of data.

The categorization phase involved repeated reading of interviews (floating reading) and made possible the seizure of the relevant structures of the social actors and the central ideas transmitted. Categorization happened by the time the material was coded on two main criteria, repetition and relevance, and has the primary objective of producing a representation of the data (Bardin, 2011; Turato, 2003). Considering these methods of data analyses and according to De Benedicto et al. (2014), the research achieved two main classifications discussed in the results: Direct Appropriation mechanisms in UFLA and Indirect Appropriation mechanisms in UFLA.

In order to facilitate the understanding of the adopted methodological procedures and show the flow of the research, the main steps are in Fig. 1.

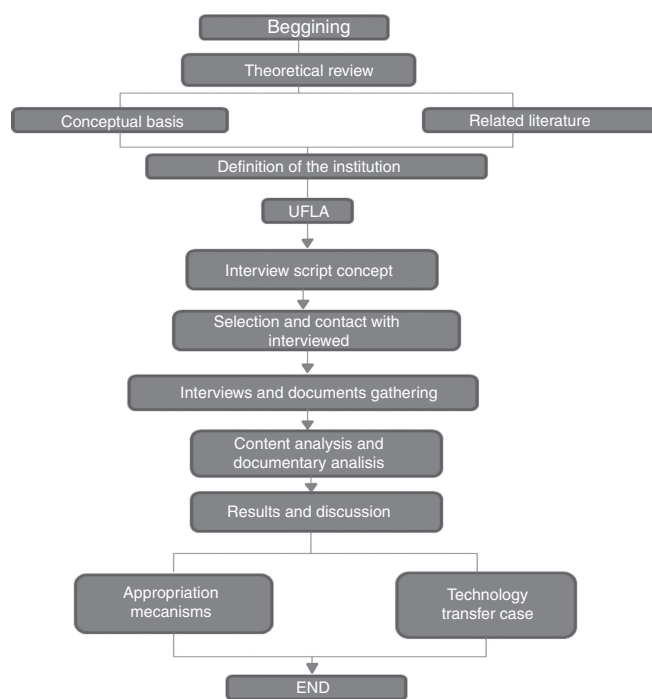


Fig. 1. Research structure diagram.

Source: created by the authors.

In addition to the proposal of investigating how do occur the appropriation mechanisms of search results from that Higher Education Institution, the research aimed to describe a success case of technology transfer that culminated in an innovation for society. This case discussion will occur in the next section.

## Discussion and results analysis

This section will discuss the case of UFLA, contextualizing all the appropriation process of search results of the institution. First, it will be discussed the existing appropriation mechanisms in UFLA and then deepening on the mechanisms of direct and indirect appropriation from that institution and the description of a success story of technology transfer occurred in this university.

### Appropriation mechanisms in UFLA

The Technological Innovation Center of UFLA is responsible for managing the process of generating innovation, technology transfer and the intellectual property within this institution. This center, linked to the Dean of Research, aims to create and manage the policy of encouraging innovation and scientific and technological research, as well as the viability of strategies and actions related to intellectual property in the internal and external fields of university.

De Benedicto et al. (2014) argued research in UFLA evolved substantially from 2004 primarily, due to: (i) greater awareness of the need for better balance between teaching, research and extension; (ii) teacher training plan; (iii) expansion and replacement of teaching staff; (iv) consolidation of graduate programs; (v) expansion and improvement of infrastructure, and; (vi) the new national model of financing and management of S & T. Another important year for the evolution of appropriation process in this institution, was 2007, when the creation Technological Innovation Center of UFLA occurred, there was a huge growth of requests for protection of intellectual property of UFLA researchers.

Seeking to support and stimulate the appropriation mechanisms in UFLA, NINTEC develops promotional activities to the protection of new technologies developed in the institution; participation in the negotiation of technology involving researchers from institutions and interested companies; moreover, the mapping of research in UFLA, subject to patent protection, computer programs, copyright, trademark and others.

Fig. 2 shows the appropriation mechanisms used at the university.

An important finding is that, at first, the appropriation mechanisms (patents, trademarks, licensing, organizational arrangements, etc.) are benefits generators (material, physical, financial, human resources, etc.) and, second, may generate domain of new technologies, new operational arrangements, performance improvement, new research agenda, new market strategies, creating a virtuous cycle.

However, the mechanisms of appropriation and the benefits only occur in a dynamic context that involves the external environment (policies, laws, public and private funding of research, technological needs of the market, competitors and users of

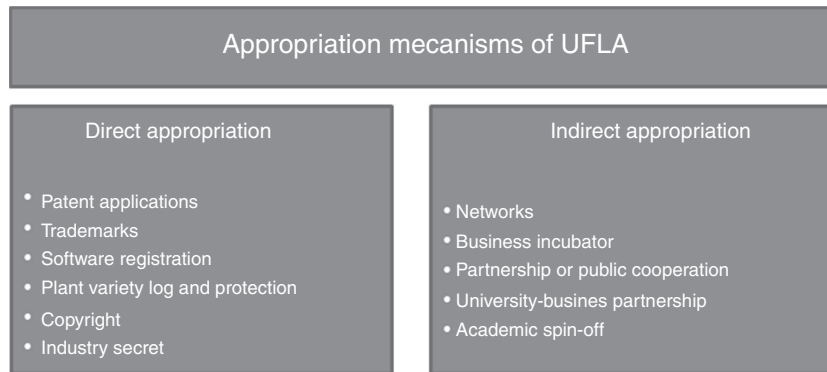


Fig. 2. Appropriation mechanisms.

Source: created by the authors based on the research data.

technologies, societal expectations) and internal (strategic planning, administrative model, technological and market vision, regulation, culture, human resources, R&D structure, various resources).

In addition to the existing mechanisms of direct appropriation in this institution, other appropriation mechanisms are very important in this process. The indirect appropriation mechanisms complement and strengthen the protection of research results in universities. They are considered indirect because do not directly formalize the protection of research results in an institution, but assist in this process. Besides seeking to foster the protection of research results, it also aims to transfer technologies to the market that can turn into innovations to society.

#### Direct appropriation mechanisms in UFLA

According to De Benedicto et al. (2014), the protections derived from intellectual property are formal protections, so mechanisms of direct appropriation. From this perspective, it is discussed in this session the mechanisms of direct appropriation of UFLA and therefore its intellectual property.

UFLA has a close relationship with Fapemig, which is a funding agency for research in the province of Minas Gerais and funds numerous research carried out within the university. Because of this funding, licensing and technology transfer agreements take Fapemig as co-author. What makes it a crucial relationship for the development of research in this institution, some of them subject to appropriation by UFLA.

Regarding the ownership of patents, UFLA is the license holder and Fapemig is co-holder. Thus, the obligations inherent in the patent application are responsibilities of UFLA and Fapemig. In case of technology transfer or licensing, the royalties and down payments definition occurs by contracts that stipulate each case what would be the shares of Fapemig and UFLA. Regarding the share that benefits UFLA, 1/3 is for the institution, 1/3 for the Department and 1/3 for the researcher. The fate of the raised funds is mandatorily on research.

Fapemig is co-holder in 84 of the 606 patents applied in Minas Gerais, being UFLA one of the Science and Technology

Institutions (ICT) with the highest number of patents that has the participation of funding agency, with 34 applications (Júnior & Guimarães, 2012).

The research found some specific data about the intellectual property elements in UFLA, according to information of NINTEC database, and show the following picture presented in Fig. 3.

The university has a total of 80 patent applications, 15 plants varieties records, 19 software registrations and 13 trademarks, besides to a copyright and an industry secret. The research findings did not captured other forms of intellectual property in the context of the investigated sources. Other relevant point related this finding is that a big part of the 80 Patents Applications were develop without the concern to markets necessity, and probably will not reach society to become innovations.

According to De Benedicto et al. (2014), UFLA took some actions to leverage the Technology Transfer numbers. Some of these measures were the integration of UFLA to the Intellectual Property Network of Minas Gerais – RMPI, the creation of the Technological Incubator of UFLA and the Lavras Technological Park, that had UFLA scientific and technological support, another important step was the participation in the Innovation Incentive Program – IIP. All these measures, according to this research, are Indirect Appropriation mechanisms, which the discussion will occur in the next topic.

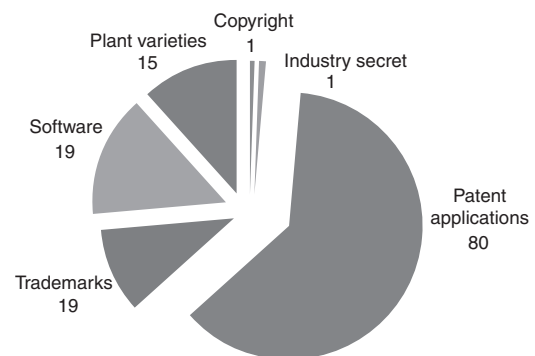


Fig. 3. Accumulated of intellectual property registration of UFLA.

Source: NINTEC (2014).

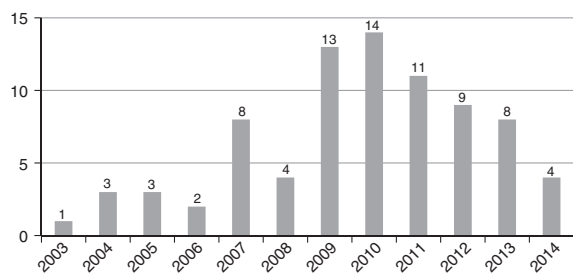


Fig. 4. Patents applications in UFLA.

Source: NINTEC (2014).

It is possible to illustrate the evolution of the patents registration over the years through the information provided by NINTEC (Fig. 4).

The largest number of deposits (14) occurred in 2010 and the year with fewer deposits (1) was 2003. This high number of patent deposits of the institution endorses the findings of González-Alvarez & Nieto-Antolin, (2007), which said that deposit is one of the available mechanisms for organizations to take possession of the results of their innovative activities. When asked about the largest number of deposits in 2010, members of TIC said:

The patent application deposits are made according to demand. There is not a specific reason to justify a larger or smaller number of deposits in a given year. What I can clarify is that we work to spread the culture of protection at the university. This certainly reflects the number of protections, but is not the only cause. (E3)

Dalmarco (2011) warned that Brazilian universities seem to be more concerned about protecting the knowledge of what to establish partnerships with companies. Consequently, instead of providing technology for businesses, universities are keeping knowledge internally in the form of patents.

UFLA protection numbers contrast with the University of São Paulo (USP), a national reference in the question patent applications, but USP still rather have problems in transferring their technology to society. A study realized by Dias and Porto (2014) reinforced the Dalmarco et al. (2011) warn by the following statistics: by the beginning of 2011, USP owned 601 deposits of patent applications, mainly in the machinery & equipment and health & personal cares. Of these, 95 patents were granted and only 36 technologies were licensed, representing an average rate of 6% licensing. The other technologies generate only registration and maintenance costs.

Concerning to the registration of trademarks (Fig. 5), in recent years this practice has not happened. The last record was in 2011. The largest number of trademark registrations, in one year, was three records in 2006 and 2009.

One of the survey respondents explained the reason why in the last three years the registration of trademarks was null:

The trademark registration, as well as the vast majority of procedures performed by NINTEC, happens according to demand. The longest interval was only in the records where the ownership belongs to the university, and these are even

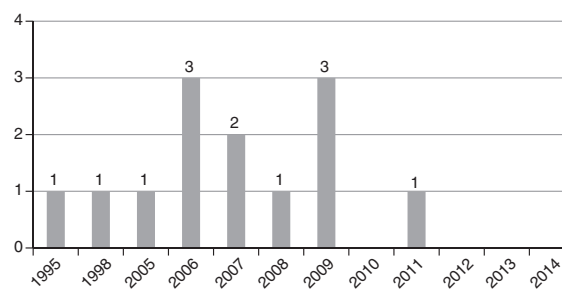


Fig. 5. Trademark registrations in UFLA.

Source: NINTEC (2014).

more specific; since the major brands of the institution are already protected. (E4)

About software records (Fig. 6), the University has 19 registered software programs, and most of them are free software, that is, allows adaptations or modifications to its code without needing to request permission to the owner to reprogram it. Note that in recent years, there is a higher software registration flow by NINTEC, and the apex of these records was in 2011, with five software registration and in 2014, until the date of the survey data, presented the registering of three applications.

The low level of software registration compared to patent deposits are justified by the National Institute of Intellectual property (INPI, 2016), which affirmed the statistics are bleak. The requests for software registration compared to the number of patents are insignificant. Per example, in 2000, were deposited 20,783 patents in the national territory (by residents and non-residents) against 663 software's registration. The number of requests for records from 2008 has grown considerably, reaching 1282 requests for records, but is still small when compared to deposits patent applications.

This research shows that UFLA did not change this paradigm yet and there is still a low level of software registration in this institution compared to patent deposits. Considering UFLA has the Computer Science and Information Systems courses, this indicator could be higher. A major effort is necessary to promote the generation and registration of new software's by the university, never taking aside the society necessities and market desires to complete the technology transfer process.

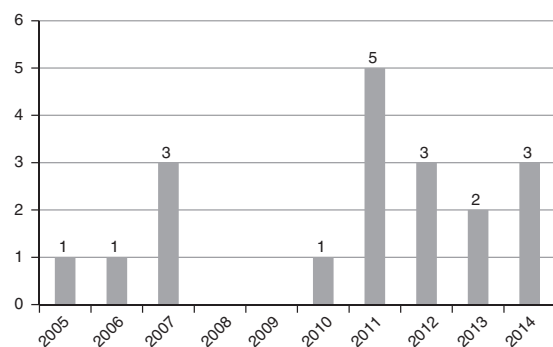


Fig. 6. Software registration in UFLA.

Source: NINTEC (2014).

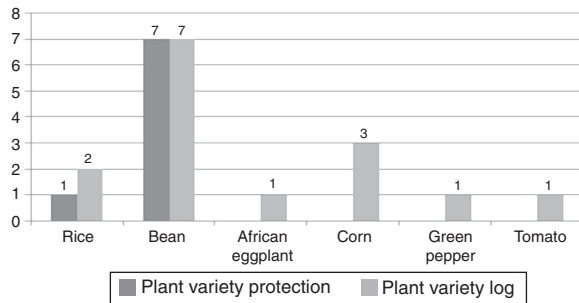


Fig. 7. Plant varieties protections and logs at UFLA.

Source: NINTEC (2014).

Regarding plants variety (Fig. 7), the university has one protection of a rice plant variety and seven protections of beans. In relation to this type of protection, that institution has 15 records in crops such as rice, beans, African eggplant, corn, green peppers and tomatoes.

According to Interviewed 1 (E1), UFLA supposed to have more protections and logs in Plant Varieties, but some of this IPRs were not registered under UFLA's protection but to other research institution that works together with this university like the Brazilian Agricultural Research Corporation (EMBRAPA).

The understanding of intellectual property protection is crucial to the success of the institution. According to Baldini, Grimaldi, and Sobrero (2007), this helps to promote a cultural change and to legitimize this activity. One respondent also states that:

UFLA has had its Incentive Program Innovation (IIP), with the State Office for Science, Technology and Innovation, with SEBRAE and the University (. . .). UFLA will launch a new program, and it already has prior support of SEBRAE itself and the promised support from the State Office. (. . .) This program, the main task is to shake the university and see where innovation is and where it is not. (E1)

According to Baldini et al. (2007), the funding to the intellectual property protection helps to promote a cultural change and to legitimize this activity. In a more recent context, the aspect of knowledge protection is more frequent in universities, even because the tools for their management have become more widespread. Furthermore, universities are structuring for the most appropriate management of intellectual property for the challenges of technology transfer (Garnica & Torkomian, 2009).

The results in this section show that, contrary to what Macho-Stadler and Pérez-Castrillo (2010) affirmed about the technology transfer opportunities between universities and industry are only between licensing agreements and the creation of spin-offs, there are other ways, which may be considered, such as software, plant varieties and trademarks.

#### *Indirect appropriation mechanisms in UFLA*

Related to the data about indirect appropriation, there are the following mechanisms: Networks, Business Incubator,

Partnership or Public Cooperation, university–business partnerships and academic spin-offs.

Networks that UFLA participates are the Intellectual Property Network of Minas Gerais – RMPI, which is a non-profit association made up of the Scientific and Technological Institutions (ICTs) in the state of Minas Gerais. Besides the RMPI, UFLA also participates in the Innovation Network of Minas Gerais – RMI. Since its inception in 1997, RMI maintains its main objective to integrate research, technology and innovation so that, together, they can propitiate competitive business and, consequently, the strengthening of its members. The Network welcomes today 24 incubators, 3 technology parks, a non-profit applied research center and an institution of the private sector.

Another important structure to promote innovation in UFLA is the Incubator of technology-based companies (Inbatec/UFLA) which works with companies operating in agribusiness, biotechnology, environmental management and information technology.

UFLA through partnership or public cooperation developed the Innovation Incentive Program in partnership with the SEBRAE-MG, the State Office of Science, Technology and Higher Education (SECTES) and Lavras City Hall. This program aimed to transform projects of applied research in technological innovations.

The university–business partnerships of UFLA have the participation of large companies in the fields of paper and cellulose, mining, agricultural inputs, seeds, pesticides and fertilizers. Companies like Vale, Syngenta, Foliare, Fibria Celulose, Souza Cruz, are strategic partners of the university. This University has a reference role in these segments. These companies often invest in research developed in UFLA in an exchange for new knowledge, technologies, access to the university infrastructure and skilled labor researchers. On the other hand, the university receives investments in research and laboratories and reaches prestige in the academic and industrial fields.

Through the development of research within UFLA, two academic spin-offs creation happened by teachers of this institution; the first was the MDA Research and the second was Biotech. UFLA does not have a regulation on the creation of spin-off generated from research's developed at the university. As Dias and Porto (2014) stated, USP also has fragilities in the technology transfer process. According to the author, there was no regulation on the spin-off companies' creation either which may compromise the innovation process.

According to De Benedicto et al. (2014) the promotion of events that aims the dissemination of intellectual property culture, direct service to staff and researchers in addition to advice on contracts should be pursued more and more. Besides the faculty, this strategy should also include graduate students and technicians of laboratories in developing projects. It should work for the formation of entrepreneurs. The author emphasize the need for major advances in activities to encourage knowledge protection and dissemination of the institutional advice to teachers.

A step further to the appropriation process itself there is the technology transfer process. In American universities, for example, the faculty members are often involved in the



commercialization phase as it often well placed to identify potential companies interested in licensing and because due to their expertise become important partners for companies that wish absorb the technology (Siegel, Wadman, & Link, 2003).

According to this perspective, besides describing how do occur the appropriation mechanisms of search results in this university, the research proposed to demonstrate a technology transfer case occurred in UFLA. Aiming to demonstrate this process within a High Education Institution and raise the importance of the protection of research results for organizations with knowledge intensive capital.

#### *Case of technology transfer: cachaça leaven*

The technology transfer case had as developed product, one kind of leaven that has the property to increase the quality of cachaça. The Department of Biology developed this product called “Leaven LNF CA-11”. It is possible to use this innovation in the fermentation for the production of cachaça and quality ethane. It provides speed in the fermentation, product standardization, production stability and a 30% increase in productivity. More than 100 factories and distilleries in Brazil and South America tasted this innovation.

The fact that Brazilian law does not allow the patenting of leaven caused that the industry secret was the direct appropriation mechanism used in this technology. The Down Payment received on signing the technology transfer was R\$45,000.00, value that was reinvested in research. Regarding to the royalties returns of this innovation: 10% of net revenues from the sale of the product goes to the University and 5% to the Department to fund new research.

This technology transfer generated some interesting results for those involved in the case studied, such as the innovation of the concept, unprecedented know-how, pioneering in the segment, satisfaction of the technology receiving company, positive image of the university in academic field and the society, and development of complementary technologies.

It was also highlighted some difficulties faced by researchers in the process of knowledge production and innovation. The difficulty of reconciling the time between research, patenting process and teaching, was an obstacle for one of the interviewees. Santana and Porto (2009) confirm it in they researches.

It's complicated (the incentive of UFLA for research development), because UFLA has some positive actions, such as technological innovation scholarship, but here my workload is very high, here in the Department [...] (E5)

In that direction, Caldera and Debande (2010) observed that rules are important to deal with such conflicts of interest. The difficulty pointed demonstrates the reality of academic life of researchers/teachers who accumulate various functions and the research is only one of them. This situation shows that the academic structure in this institution has failures and often an activity has priority in relation to others. The teacher as well as teaching classes, needs to have a high scientific production, participate in stalls, participate in departmental function and to engage in research and technology generation.

#### **Final considerations**

It is remarkable the importance of universities in knowledge production and dissemination of research results that can generate innovation, making it a key player in the economic development of the country. However, much can still be searched in innovation fields and mainly in relation to appropriation mechanisms of research results in universities.

This study achieved its goal of investigating the appropriation mechanisms of results generated in a federal institution of higher education. In this sense, the studied institution is in an intermediate stage of development. Given that, this university transferred few developed technologies to the society, a practice that should be encouraged to have the appropriation of results that generate economic and social benefits.

By analyzing the behavior of American institutions, the Association of University Technology Managers (Association Of University Technology Managers, 2010) found that they reported total revenues of \$ 2.4 billion from licensing technologies in fiscal year 2010. Sweden and Germany also pass by a process of intensification of investments in infrastructure for Technology Transfer in its universities. (Sellenthin, 2009) and among emerging countries, such as China, the entrepreneurial attitude of the university is a reality that has interfered with the process of economic development (Eun, Lee, & Wu, 2006).

Within universities, little matters investing in research, develop new technologies and not be able to transfer these technologies to society. This seems to be the stage where this university has more difficulties, mainly because many researches development happen without thinking about its economic viability or the potential for solving a problem for society.

UFLA still needs to advance in the culture about appropriation and encourage the technology transfer. The university has highlight in software records, plants varieties registration and patent applications, but still has few technology transfers.

It is important to note that although the management model of technology transfer from that institution has deficiencies, there is a whole effort by the TICs to support the demand increase for services. Harman (2010) points out; many of the problems experienced by technology transfer managers can be caused by the lack of support from upper levels of the university. Thus, the improvement of the transfer conditions has direct relation to the adoption of a strategy of incentive and enhancement of this process and, hence the incorporation of organizational processes that allow its implementation.

An important limitation of this paper was the investigation of only one university reality. However, it also points to opportunities for future studies on the topic of appropriation in other public and/or private Brazilian universities. It would be interesting, in this direction, to compare the performance of public and private institutions and outline the overall picture of the subject in Brazil.

#### **Conflicts of interest**

The authors declare no conflicts of interest.

## References

- Association Of University Technology Managers. (2010). AUTM U.S. licensing activity survey highlights: FY2010. Available in: [http://www.autm.net/AM/Template.cfm?Section=FY\\_2010.Licensing.Survey&Template=/CM/ContentDisplay.cfm&ContentID=6874](http://www.autm.net/AM/Template.cfm?Section=FY_2010.Licensing.Survey&Template=/CM/ContentDisplay.cfm&ContentID=6874) Accessed in: 03.11.16.
- Almeida, M. F. L., Barreto Júnior, J. T., & Frota, M. N. (2013). Apropriação econômica de resultados de P&D: o caso de uma empresa concessionária de energia elétrica no Brasil. In *XV Congresso Latino-iberoamericano de Gestão de Tecnologia*, 15. ALTEC.
- Andrade, T. D. (2004). Inovação Tecnológica e meio ambiente: A construção de novos enfoques. *Scientific Electronic Library Online*, 7.
- Audy, J. L. N., Cunha, N., & Franco, P. R. G. (2002). *TECNOPEC: Uma Proposta de Habitat de Inovação para Porto Alegre*. Seminário ANPROTEC.
- Baldini, N., Grimaldi, R., & Sobrero, M. (2007). To patent or no to patent: A survey of Italian inventors on motivations, incentives and obstacles to university patenting. *Scientometrics*, Amsterdam, 70(2), 333–354.
- Bardin, L. (2011). . pp. 280. *Análise de conteúdo* (Vol. 70) São Paulo: Edições.
- Bojesen-Trepka, M. H. (2009). Industrial firm technology transfer: the role of marketing. 447 p. *Doctor of Philosophy Thesis*. Hamilton: University of Waikato. Hamilton, New Zealand.
- Botelho, M. R. A., Carrijo, M. de C., & Kamasaki, G. Y. (2009). Inovações, pequenas empresas e interações com instituições de ensino/pesquisa em arranjos produtivos locais de setores de tecnologia avançada. *Revista Brasileira de Inovação, Rio de Janeiro*, 6(2), 331–371.
- Branco, R. C., & Vieira, A. (2008). Patentes e Biotecnologia aceleram o crescimento da agricultura brasileira. Ministério da Agricultura, Parcerias Estratégicas: 33–99.
- Brasil. (1996). Lei n° 9.279, de 14 de maio de 1996. Regula direitos e obrigações relativos à Propriedade Industrial. Brasília. Accessed in 10.11.2013, from [http://www.planalto.gov.br/ccivil\\_03/leis/l9279.htm](http://www.planalto.gov.br/ccivil_03/leis/l9279.htm)
- Brasil. (2004). Lei n° 10.973, de 2 de dezembro de 2004. Dispõe sobre incentivos à Inovação e à Pesquisa Científica e Tecnológica no ambiente produtivo e de outras providências. Brasília. Accessed in 10.11.13, from [http://www.planalto.gov.br/ccivil\\_03/\\_ato2004-2006/2004/lei/l10.973.htm](http://www.planalto.gov.br/ccivil_03/_ato2004-2006/2004/lei/l10.973.htm)
- Brasil. (2016). Lei n° 13.243, de 11 de janeiro de 2016. Dispõe sobre estímulos ao desenvolvimento científico, à pesquisa, à capacitação científica e tecnológica e à inovação. Accessed in 01.03.16 from [http://www.planalto.gov.br/ccivil\\_03/\\_Ato2015-2018/2016/Lei/L13243.htm](http://www.planalto.gov.br/ccivil_03/_Ato2015-2018/2016/Lei/L13243.htm)
- Caldera, A., & Debande, O. (2010). Performance of Spanish universities in technology transfer: An empirical analysis. *Research Policy*, 39(9), 1160–1173.
- Clark, B. R. (2003). Sustaining change in universities: Continuities in case studies and concepts. *Tertiary Education and Management, New York*, 9(2), 99–116.
- Closs, L., Ferreira, G., Sampaio, C., & Perin, M. (2012). Intervenientes na transferência de tecnologia universidade-empresa: o caso PUCRS. *Revista de Administração Contemporânea*, 16(1), 59–78.
- Chagas, E. N., & Muniz, J. N. (2006). *Propriedade Intelectual e pesquisa nas instituições públicas de ensino superior*. pp. 139. Viçosa, MG: UFV.
- Corrêa, F. A. (2007). Patente na universidade: Contexto e perspectivas de uma política de geração de patentes na Universidade Federal Fluminense. Dissertação de mestrado. Universidade Federal Fluminense, Niterói, RJ, Brasil.
- De Benedicto, S. C., Bittencourt, J. J., Zambalde, A. L., & Silva Filho, C. F. D. (2014). *Apropriação da Inovação em Agrotecnologias: Estudo Multicaso em Universidades Brasileiras-Revista Organizações em Contexto-online*, 10(19), 181–212.
- De Pellegrin, I., Balestro, M. V., Junior, J. A. V. A., & Caulliraux, H. M. (2007). Redes de inovação: Construção e gestão da cooperação pró-inovação. *Revista de Administração da Universidade de São Paulo*, 42(3).
- Dalmarco, G., Dewes, M. D. F., Zawislak, P. A., & Padula, A. D. (2011). Universities' intellectual property: Path for innovation or patent competition? *Journal of Technology and Management Innovation*, 6, 159–170.
- Dias, A. A., & Porto, G. S. (2014). *Como a USP transfere tecnologia?* pp. 489–507. *Organizações & Sociedade* (21) Salvador.
- Dosi, G. (1988). Sources, procedures and microeconomics effects of innovation. *Journal of Economic Literature, Pittsburg*, 26(3), 1120–1171.
- Eun, J. H., Lee, K., & Wu, G. (2006). Explaining the “University-run enterprises” in China: A theoretical framework for university–industry relationship in developing countries and its application to China. *Research Policy*, 35, 1329–1346.
- Etzkowitz, H., & Leydesdorff, L. (1996). A triple helix of academic–industry–government relations: Development models beyond ‘capitalism versus socialism’. *Current Science*, 70(8), 690–693.
- Garnica, L. A. (2007). Transferência de tecnologia e gestão da propriedade intelectual em universidades públicas no estado de São Paulo. 206 p. Dissertação (Mestrado em Engenharia de Produção) – Universidade Federal de São Carlos, São Carlos.
- Garnica, L. A., & Torkomian, A. L. V. (2009). Gestão de tecnologia em universidades: Uma análise do patenteamento e dos fatores de dificuldade e de apoio à transferência de tecnologia no Estado de São Paulo. *Gestão & Produção*, 16(4), 624–638.
- Gilde, C. (2007). *Higher education: Open for business*. pp. 196. Lanham: Lexington Book.
- Godinho, M., Pereira, T., & Mendonça, S. (2008). *Propriedade intelectual: Uma temática na ordem do dia*. Lisboa: UAL.
- Gonçalo, C. R., & Zanluchi, J. (2011). Relacionamento entre empresa e universidade: Uma análise das características de cooperação em um setor intensivo em conhecimento. *BASE - Revista de Administração e Contabilidade da Unisinos, São Leopoldo*, 8(3), 261–272.
- González-Alvarez, N., & Nieto-Antolin, M. (2007). Appropriability of innovation results: An empirical study in Spanish manufacturing firms. *Technovation, Essex*, 27(5), 280–295.
- Harman, G. (2010). Australian university research commercialization: Perceptions of technology transfer specialists and science and technology academics. *Journal of Higher Education Policy and Management, Oxford*, 32(1), 69–83.
- Iacono, A., de Almeida, C. A. D. S., & Nagano, M. S. (2011). Interação e cooperação de empresas incubadas de base tecnológica: Uma análise diante do novo paradigma de inovação. *Revista de Administração Pública*, 45(5), 1485–1516.
- Instituto Nacional de Estudos e Pesquisas Educacionais Anísio Teixeira. (2015). Censo da educação superior 2014. Brasília. Recuperado em 10 fevereiro, 2016, de <http://portal.inep.gov.br/educacao-superior/indicadores/indice-geral-de-cursos-igc>
- Instituto Nacional de Propriedade Industrial. (INPI). Available in: <http://www.inpi.gov.br/>. Accessed in: 03.05.16.
- Intellectual Property Office. (2011). *Intellectual asset management for universities*. Accessed in 10.04.16, from <http://www.ipo.gov.uk/ipasset-management.pdf>
- Jung, C. F. (2004). *Metodologia para pesquisa e desenvolvimento: Aplicada a novas tecnologias, produtos e processos*. pp. 312. Rio de Janeiro: Axcel Books.
- Júnior, C., & Guimarães, M. B. (2012). Gestão da Propriedade Intelectual Nas Instituições De Ciência e Tecnologia: o papel da Fapemig no fomento à inovação. *Revista Perspectivas em Políticas Públicas*, 5(9).
- Kruglianskas, I., & Matias-Pereira, J. (2005). Um enfoque sobre a Lei de Inovação Tecnológica do Brasil. *Revista de Administração Pública, Rio de Janeiro*, 39(5), 1011–1029.
- Leiponen, A., & Byma, J. (2009). If you cannot block, you better run: Small firms, cooperative innovation, and appropriation strategies. *Research Policy*, 38(9), 1478–1488.
- Macho-Stadler, I., & Pérez-Castrillo, D. (2010). Incentives in university technology transfers. *International Journal of Industrial Organization*, 28(4), 362–367.
- Markman, G., Gianiodis, P., Phan, P., & Balkin, D. (2005). *Innovation speed: transferring university technology to market*. pp. 1058–1075. *Research Policy* (34) Amsterdam.
- Matias-Pereira, J. (2011). A gestão do sistema de proteção à propriedade intelectual no Brasil é consistente? *Revista de Administração Pública, Rio de Janeiro*, 45(3), 567–590.
- Mattioli, M., & Toma, E. (2009). *Proteção, apropriação e gestão de ativos intelectuais*. pp. 16. Belo Horizonte: Instituto Inovação.
- Núcleo de Inovação Tecnológica da Ufla. (2013). Sobre o Nintec. Lavras. Accessed in 01.12.14 from <http://www.prpuffa.br/nintec/sobre.html>

- Organisation for Economic Co-Operation and Development. (2005). *Oslo manual: Guidelines for collecting and interpreting innovation data* (3rd ed., pp. 92). Oslo: European Commission.
- Pereira, V. (2008). Análise da gestão de propriedade intelectual e de transferência de tecnologia nas universidades do Rio de Janeiro. 2008. 125 f. Dissertação (Mestrado em Engenharia de Produção) – Universidade Federal Fluminense, Rio de Janeiro.
- Rede Mineira de Propriedade Intelectual. (2011). *Quem somos..* Accessed in 10.12.14 from <http://www.redemineirapi.com/novo>
- Ribeiro, S. A., Andrade, R. M. G. D., & Zambalde, A. L. (2005). Incubadoras de empresas, inovação tecnológica e ação governamental: o caso de Santa Rita do Sapucaí (MG). *Cadernos EBAPE. BR*, 3(SPE), 01-14.
- Sellenthin, M. O. (2009). Technology transfer offices and university patenting in Sweden and Germany. *The Journal of Technology Transfer*, 34, 603–620.
- Santana, E., & Porto, G. (2009). E agora, o que fazer com essa tecnologia? Um estudo multicaso sobre as possibilidades de transferência de tecnologia na USP-RP. *Revista de Administração Contemporânea, Curitiba*, 13(3), 410–429.
- Segatto-Mendes, A. P. & Mendes, N. (2006). Cooperação tecnológica universidade-empresa para eficiência energética: Um estudo de caso. *Revista de Administração Contemporânea, Curitiba*, p. 53–75. Edição especial.
- Siegel, D., 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, 27–48.
- Teece, D. J. (1986). Profiting from technological innovation. *Research Policy, Amsterdam*, 15(6), 285–305.
- Tonelli, D. F., & Zambalde, A. L. (2009). Fatores de sucesso de uma inovação no contexto universitário: Estudo de caso no setor pecuário. *Ciência e Agrotecnologia, Lavras*, 33(4), 1118–1124.
- Turato, E. R. (2003). *Tratado da metodologia da pesquisa clínico-qualitativa: Construção teórico-epistemológica, discussão comparada e aplicação nas áreas da saúde e humanas*. pp. 688. Petrópolis: Vozes.
- Vieira, E. M. F., Van Bellen, H. M., & Fialho, F.A. P. (2006). Universidade em tempo de mudança. *Caderno EBAPE. BR*, 01-07.
- Yin, R. K. (2010). *Estudo de caso: Planejamento e métodos* (4th ed., pp. 212). Porto Alegre: Bookman.