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Article

Intellectual Property Management in Public Higher Education Institutions in Minas Gerais

A gestão da propriedade intelectual nas instituições públicas de ensino superior mineiras

Gestión de la propiedad intelectual en las instituciones públicas de enseñanza superior de Minas Gerais

Allynson Takehiro Fujita – Universidade do Estado de Minas Gerais | Frutal | Minas Gerais | Brasil. E-mail: allynson.fujita@uemg.br | Orcid: https://orcid.org/0000-0002-9848-8299

Jhansley Ferreira da Mata – Universidade do Estado de Minas Gerais | Frutal | Minas Gerais | Brasil. E-mail: jhansley.mata@uemg.br | Orcid: https://orcid.org/0000-0001-8452-7368

Larissa Campos Sousa – Universidade do Estado de Minas Gerais | Frutal | Minas Gerais | Brasil. E-mail: laricamp97@gmail.com | Orcid: https://orcid.org/0000-0002-3474-2999

Abstract: The study addresses patent granting in public higher education institutions in Minas Gerais, focusing on deposits made by Technology Innovation Centers (TICs). The aim is to analyze patent applications, including grants, rejections, and the presence of frugal innovation in technologies. The research employs operational logic, deductive methods, and a qualitative approach to gather institution-related information and conduct the analysis. The primary goal is to examine patent application submissions made by these institutions in the state, regardless of the final patent grant outcome. Furthermore, it was possible to detect that the State University of Minas Gerais has 1218 patents filed with the INPI, being ahead of other public institutions in Minas Gerais regarding patents granted. UFLA had the higher number of patent applications rejected, and the UFSJ's TIC had the higher number of patents filed with a bias towards frugal innovation.

Keywords: frugal innovation; patents; universities.

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Resumo: O estudo aborda a concessão de patentes em instituições públicas de ensino superior em Minas Gerais, focando nos depósitos feitos pelos Núcleos de Inovações Tecnológicas (NITs). O objetivo é analisar os pedidos de patentes, incluindo concessões, rejeições e a presença de inovação frugal nas tecnologias. O objetivo central é examinar os depósitos de pedidos de patentes feitos por estas instituições no estado, independentemente da concessão final das patentes. A pesquisa utiliza lógica operacional, método dedutivo e abordagem qualitativa para coletar informações das instituições e realizar a análise. Além disso, foi possível perceber que a Universidade do Estado de Minas Gerais possui 1218 patentes depositadas junto ao INPI, estando à frente das demais instituições públicas mineiras quanto as patentes concedidas. Já a UFLA teve o maior número de pedidos de patentes indeferidas. O NIT da UFSJ foi o que apresentou o maior número de patentes com viés em inovação frugal depositadas.

Palavras-chave: inovação frugal; patentes; universidades.

Resumen: Este estudio examina la concesión de patentes en las instituciones públicas de enseñanza superior de Minas Gerais, centrándose en las solicitudes presentadas por los Centros de Innovación Tecnológica (NIT). El objetivo es analizar las solicitudes de patentes, incluyendo las concesiones, los rechazos y la presencia de innovación frugal en las tecnologías. El objetivo central es analizar las solicitudes de patentes presentadas por estas instituciones en el Estado, independientemente de la concesión final de las patentes. La investigación utiliza la lógica operacional, el método deductivo y un enfoque cualitativo para recoger información de las instituciones y llevar a cabo el análisis. Además, fue posible constatar que la Universidad Estadual de Minas Gerais posee 1218 patentes depositadas en el INPI, y está a la cabeza de las demás instituciones públicas de Minas Gerais en términos de patentes concedidas. La UFLA, por otro lado, tuvo el mayor número de solicitudes de patentes rechazadas. El NIT de la UFSJ tuvo el mayor número de patentes presentadas con un sesgo de innovación frugal.

Palavras clave: innovación frugal; patentes; universidades.

1 Introduction

Innovation has become a goal for different types of organizations according to their reality, considering aspects to encourage their development and eliminating barriers that hinder their advancement. Its concept is a complex construct with different perceptions, conveying theoretical approaches in various fields of knowledge, branches of activity, and industrial sectors (Faria; Fonseca, 2014).

According to Plonski (2017), innovation has two paradigms: creation and process. When demonstrating creation, it is explicit that it is both the process and the result, considering that it makes concrete what did not exist, while when understood as a process, it is seen as exclusivity, being analyzed as a structured set of actions and operations seeking a result.

Given this, not long ago, innovation was predominantly associated with the secondary sector of the economy, especially linked to the launch of industrialized products, rich in technology and optimizations in manufacturing procedures (Plonski, 2017).

Given technological advances, the intellectual property and innovation are increasingly taking on a prominent role in global wealth (Castro; Souza, 2012). With this, a large part of this growth derives from the development of new products or services that require protection, whose innovations are characterized by the introduction of new combinations, whether productive or in production functions (Roczanski; Tosta; Melo, 2017).

From this perception, there is a behavior seeking to accompany innovation and technology through the management of intellectual property assets in universities and public institutes. The Innovation Law, number 10,973, enacted in 2004, established that universities and public institutes should create and structure an organization to manage innovation policy, called the Technological Innovation Center – TIC, now

constituted by one or more Science and Technology Institutions (Machado; Sartori; Crubellate, 2017).

Therefore, according to Moura *et al.* (2019), universities have as their perspective the production of technologies in their research that presupposes the ability to solve technical problems to return them to the entire country. In recent years, some actions have been developed to produce goods and services of high technological value, being able to share the construction of new developments with technology-based incubators or even companies from partnerships.

According to Pakes *et al.* (2018), the use of knowledge from universities is a rich source of information and training for the development of new technologies, consequently resulting in the transfer of technologies between universities and companies and between public universities or even universities and society, highlighting the licensing of patents.

Given the development resulting from technological advances, with the spontaneous and constant growth in the number of patent application filings by universities, there is a need to demonstrate what a patent is according to its legislative concept.

Article 6 of Law 9.279/96 (Industrial Property Law) explains that the author of the invention or utility model has the right to obtain a patent on his creation. In Article 9, an object of practical use, or part thereof, capable of industrial application, which presents a new form or arrangement involving an inventive act that results in a functional improvement in its use or manufacture, is patentable as a utility model.

The patent is a temporary property title, being a model of utility or invention, granted by the State to inventors, authors, and natural or legal individuals retaining the rights inherent to creation, possessing the right to exclude third parties from the use of knowledge object of the patent, unless licensed by the owner.

That said, it was decided to analyze the patents filed by the Technological Innovation Centers (TICs), adhering to the concept of frugal innovation in universities in the state of Minas Gerais to contribute to the knowledge generated by this study to increase the possibilities of demonstrating the innovative perspectives that can be provided with technological advances celebrated within this sector.

There is still a need to understand the technologies that explore the concept of frugal innovation, considering that there is also a need for protection given this "win-win" environment, which will lead to increased business profits and a positive impact on reducing inequality or poverty (Zanandrea *et al.,* 2015).

Therefore, this article aims to analyze patents that benefit from the concept of frugal innovation, developed by public higher education institutions in Minas Gerais, Brazil, managed by innovation and technology centers, and deposited at the Brazilian National Institute of Industrial Property, the competent authority for granting patent protection in the country.

2 Development

2.1 Intellectual Property

The protection of intellectual property is relevant since it encourages the development of new technologies and stimulates creators to boost technological development and innovation. The granting of this right could provide significant economic advantages and recognition for the effort and dedication towards new creations and improvement of existing techniques (Oliveira, 2016).

According to the World Intellectual Property Organization (WIPO), intellectual property aims to protect knowledge generated through intellectual activity or human skill, including:

> literary, artistic, and scientific works; the interpretations of the performing artists and the executions of the performing artists, the phonograms and radio broadcasts; inventions in all domains of human activity; scientific discoveries; industrial designs and models; industrial, commercial, and service brands, as well as commercial names and commercial names; protection against unfair competition and all other rights inherent to intellectual activity in the industrial, scientific, literary, and artistic domains (WIPO, 2016, p. 5).

In addition to guaranteeing the privilege of exclusive exploration, intellectual property stimulates technological development, as it promotes the dissemination of protected knowledge and creates security conditions to encourage investment in new technological research (Cota Júnior, 2012).

Intellectual property is subdivided into three types: copyright, sui generis protection, and industrial property. Given this overview, it is necessary to limit the direction of this study to industrial property, a branch of intellectual property defined by the Paris Union Convention of 1883, as demonstrated by Barbosa (2010, p. 11):

> A set of rights comprising invention patents, utility models, industrial designs or models, factory or trademarks, service marks, commercial names and indications of provenance or designations of origin, as well as repression of unfair competition.

That is, industrial property constitutes one of the types of intellectual property, covering intangible assets used in industrial activities. It implies considering not only creations in this domain but in a broader sense, comprising agricultural and extractive sectors and manufactured and natural products (Barbosa, 2010).

The 1988 Brazilian Federal Constitution also imposes the duty to protect industrial property, as indicated in art. 5th, item XXIX, ensuring temporary privileges for their inventions to industrial inventors. Thus, the constitutional legislator prioritized the preservation of the country's fundamental principles over technological advancement, avoiding conflicting positions between collective well-being and other legally stipulated criteria (Paranaguá; Reis, 2009).

The Industrial Property Law (n. 9279/96) establishes an intrinsic link with the Brazilian Federal Constitution, reflecting the legislator's concern with harmonizing the imperatives of technological development and protection of national prerogatives related to the matter.

This interconnection also respects the fundamental principles outlined in the Constitution, emphasizing the appreciation of national needs and the safeguarding of social interests. Thus, the Industrial Property Law materializes an approach that balances technological advancement with the maintenance of sovereignty and the common good, reaffirming the coexistence of these dimensions within the normative context outlined by the Constitution.

From this perspective, the Industrial Property Law presents the protection of rights relating to industrial property regarding the granting of invention and utility model patents, registrations of industrial designs, trademark registrations, repression of false geographical indications, and unfair competition.

In this sense, the link between economic development and the expansion of innovations through patents remains clear, and countries that have a structured system to support their respective deposits experience rapid financial growth, protecting intellectual property rights and the increased sales prospects and profits derived from new technologies (Rapp; Rozek, 1990).

In the Brazilian scenario, patents have a crucial role in leveraging innovation, economic development, and competitiveness. By protecting intellectual and technological creations, patents stimulate research and scientific progress, encouraging companies and individuals to invest in new solutions and products. Furthermore, patents provide a favorable environment for disseminating knowledge and technology, promoting partnerships between academic and business sectors (Barbosa, 2009).

From this angle, patents are conceptualized based on the principles of Rousseau's social contract, proposing an agreement between the inventor and society, considering that the State grants a monopoly on the invention, providing it with the property and exclusivity to exploit the new product or process in force within a certain period established by law (Macedo; Barbosa, 2000).

Given all the importance of intellectual property as a form of protecting assets, its participation in the Institutes of Science and Technology (ISTs) in the innovation process can be seen, albeit recently, in Brazilian public research institutions. In this circumstance, it is important to demonstrate the relevance of the Innovation Law, its legislative evolution, and its application in the technological scenario.

2.2 Innovation Law

The Brazilian Innovation Law (no. 10,973/04) has as its main scope to promote and encourage scientific development, research, and technological training, enabling development in Institutes of Science and Technology (IST), as demonstrated in articles 218 and 219 of the Brazilian Federal Constitution from 1988, which expressly deal with promoting and encouraging scientific development, research, scientific and technological training, and innovation.

Given this, the Innovation Law promotes and encourages scientific development, research, and technological training to enable the development of the national academic and commercial sector. This stimulus becomes clear when placing more competitive products and services on the market, generating jobs, and enabling the sharing of infrastructure, equipment, and human resources, both public and private, to new companies.

There are several forms of collaboration between public entities and corporations, and the three main interactions are: the company develops a product originating from academia, the external product incorporates academic knowledge for

improvement, or the university itself creates a commercial product and exploits the asset, many times through a new company (Etzkowitz, 1998).

From this perspective, it is guaranteed that ICTs have administrative prerogatives to sign technology licensing agreements, being able to grant them to public or private entities, both nationally and internationally. In addition, they can establish contracts to provide research, product, and process services. They are also allowed to assign their creation rights, as long as they do it explicitly and substantiated, with financial or economically measurable compensation, allowing the respective creator to exercise these rights in their name and with full responsibility, following the legislation.

Therefore, TICs must contain minimum competencies to monitor the processing of requests and the maintenance of the institution's intellectual property titles so that it is possible to leverage technology and inventions within the institutions and, thus, demonstrate the importance of stimulating innovation and competitiveness available for the country's technological development.

On January 8, 2016, the Brazilian Science, Technology, and Innovation Code (S, T&I) was established, resulting in a safer and more stimulating regulatory environment for the innovative scenario in the country. The law promotes the recognition of private Institutes of Science and Technology (ISTs), expansion of the role of TICs, reduction of obstacles to import inputs for research and development (R&D), and formalization of incentive grants for innovative activities, among other nuances (Rauen, 2016).

It is observed that public universities in Brazil follow a pattern concerning the generation of knowledge that differs from the private sector. They concentrate their efforts on creating lines of research that generate results, such as producing scientific articles or investigations without immediate industrial application. In this context, the Legal Framework for Innovation plays a significant role in promoting and improving

people's quality of life by enabling the stimulation of the connection between the research conducted and the sharing of technology with the private sector. It implies enabling society to have access to new technologies developed (PALUMA; TEIXEIRA, 2019).

Given this, there is no doubt that the Science, Technology, and Innovation Code is based on the premise of interaction between ISTs and companies in Brazil to offer infrastructure and specialized knowledge to contribute to universities and research institutions as a means of collaboration for developing and leveraging research in the country. In this circumstance, a legal environment conducive to promoting and developing innovation in various areas, including frugal innovation, is established. The details of this will be seen in the following topic.

2.3 Frugal Innovation

Frugal innovation tends to discover new business models, reconfigure value chains, and redesign products to serve consumers and users from different economic sectors who face extreme accessibility situations in a scalable and sustainable way, providing functional solutions through low resources and directing them for those with little means (Batthi, 2011).

The term frugal innovation represents a tactical change in the business scenario, considering the principle of simplicity. It aims to address the concerns of government, employees, and customers to create affordable, sustainable, and high-quality offerings by targeting innovation specifically for resource-limited consumers in emerging markets (Puffal, 2014; Radjou; Prabhu, 2013; Zeschky; Widenmayer; Gassmannhart, 2011).

More specifically, for Bhatti and Ventresca (2013), frugal innovation is a means of doing more with fewer resources. Given this, frugal innovation is mainly addressed in emerging economies, providing access to innovations for a large part of their

consumers. This way of innovating began mainly in India and, later, in China on a smaller scale. However, it has been spreading among organizations that are increasingly aware of the need to innovate with limited resources, seeking to guarantee consumer satisfaction (Rao, 2013).

It is worth highlighting that Frugal Innovation does not have the same meaning as Jugaad Innovation because the first delimits the mental set found in people who develop it, being a set of actions from human resources, and the second will be the object resulting from thought based on the mental set (Mazieri, 2016).

Frugal innovation refers to creating simple, accessible, and low-cost solutions that meet the needs of emerging markets or that seek to maximize efficiency and accessibility. In this context, the Science, Technology, and Innovation Code facilitates collaboration between universities, companies, and society, encouraging the transference of knowledge and technology. This can open doors for adapting and developing frugal solutions, which often require creative and effective approaches to solving challenges in resource-limited environments.

Thus, competition in the market between companies that do not adopt the frugal approach and those that incorporate it is evident. This is leading to a highly competitive global trade scenario, which makes it difficult to attract customers for organizations that are not modernizing their operations in this regard. It is worth highlighting the breadth of impact that frugal innovation has had on the market, as the ability to produce with more limited resources and commercialize in large volumes has become a critical consideration for corporations (Sarafim; Sousa, 2022).

According to the observations of Fujita and Fogatti (2021), Frugal Innovation is associated with the concepts of effectiveness and minimization of expenses, which are crucial to meet the demands of low-income consumers in emerging economies. The combination of simple technology, quality, and cost reduction brings to mind the

concept of frugal innovation. Furthermore, it is related to initiatives with social impact to reduce inequalities, combat poverty, and consider environmental conservation.

From this perspective, there is a need to ensure the protection of technologies that adhere to the concept of frugal innovation through intellectual property, specifically through patent protection.

Likewise, it is noteworthy that new technologies, qualified as frugal innovation, that meet the requirements of novelty, inventive activity, and industrial application can obtain state protection for a determined period.

3 Methodology

The procedure method was monographic. As an instrument to conduct the investigative process, documentary and bibliographic techniques were used, supported by normative instruments and national and international legislation, mainly Brazilian and bibliographic sources, such as commonly read books, publications, and journals. In addition, reference or consultation books, informative and cross-referenced (catalogs), databases, documents that have not received any analytical treatment, and documents already analyzed in some way, such as research reports and patent databases for patent consultation (technical documents).

Due to the need to promote projects developed with a focus on frugal innovation by TICs – through this project in conjunction with public higher education institutions in Minas Gerais – it was sought to analyze qualitative and quantitative information related to products with patents filed, granted, or rejected.

Initially, a patent analysis was conducted, observing productions that fit the concept of frugal innovation. Thus, the free database of the Brazilian National Institute of Industrial Property (INPI) was used, focusing on patent applications related to administrative process numbers provided by the Technological Innovation Centers of public higher education institutions in Minas Gerais.

However, dealing with this tool in search of data mining has become discouraging, as no class refers to frugal technologies in the International Patent Classification (IPC), which is the classification accepted worldwide and focuses mainly on technological domains. Thus, it was not possible to find definitions that determine or approximate "functions of low-cost social technological products," for example.

It involves a significant manual effort and neglect of patents by institutions and companies because they do not have recognition of their technologies in the light of frugal innovation (Altgilbers; Walter; Moehrle, 2020), that is, many are unaware of this concept and its applicability. When the search was based on the keyword "frugal" (alone), it was not possible to find any patents on the INPI platform, and it can be argued that, according to Altgilbers, Walter, and Moehrle (2020), the search for the keyword "frugal" offers patents that go against the context to be applied.

Thus, it is necessary to demonstrate that there is no possibility of searching for frugal technologies in the INPI database, given that such perception comes from the analysis conducted by employees allocated to each TIC, that is, realizing what each one in its individuality understands as frugal innovation, based on what was developed as technology and presented as patent applications to the authority responsible for granting this service.

To meet the needs of this study, a sample survey was conducted, in which 16 public institutions that worked with research in the state of Minas Gerais were selected: the Federal University of Juiz de Fora (UFJF), the Federal University of Triângulo Mineiro (UFTM), the Federal Institute of Southeast of Minas (IF Sudeste), the Federal University of Ouro Preto (UFOP), the Federal University of Vale do Jequitinhonha and Mucuri (UFVJM), the Federal University of Minas Gerais (UFMG), the Federal University of Itajubá (UNIFEI), the Federal University of Viçosa (UFV), the Federal Institute of Minas Gerais (IFMG), the Federal University of Lavras (UFLA), the Federal University of São João Del Rei (UFSJ), the Federal Center for Technological Education of Minas Gerais

(CEFET), the Federal Institute of Northern Minas Gerais (IFNMG), the Federal Institute of Southern Minas Gerais (IF Sul de Minas), the Federal University of Uberlândia (UFU), and the State University of Montes Claros (UNIMONTES).

When inspecting the websites or public consultation systems of institutions in the search for patents, it was found that, for the most part, it was not possible to locate any information.

Another point to highlight was the lack of standards regarding the understanding of the concept of frugal innovation in technologies filed as patents, as, during the searches, some doubts were identified, such as: "Would it be a social and low-cost innovation?" This information was not found, nor was it possible to view, on bases made available by the TICs, their respective technologies as technological showcases.

Therefore, for better reliability in the data, standard questions were sent to the Technological Innovation Center (TIC) of each Institution, being essential to analyze all the information collected, that is, multiple and ambiguous cases, increasing the security of the research.

In this way, some necessary questions were created to evaluate, prepare, and understand the information stored by the TICs, as shown below: "How many patents have been granted since the opening of the TIC? Are there requests filed with the INPI and subsequently rejected? If yes, how many? Does TIC file patents aimed at frugal innovation? If so, what are the patent numbers? If there are frugal patents filed, have any of them become "public domain" yet?" These questions and their answers are presented in the appendix of this article.

The concept of frugal innovation was used as a parameter, "technologies that were created or optimized faced with a shortage or even a masterpiece considered

'modest' or low cost to meet a certain social need," following the works analyzed and understood in the construction of the reasoning that develops this study.

The proposed study refers to basic research whose operational logic is based on the deductive method and qualitative approach. In this sense, the research starts from the general analysis of the patent system, followed by the analysis of its particularities, especially concerning the protection of frugal innovation technologies, using the keywords used in Orbit Intelligence® ("patents," "frugal innovation," and "Minas Gerais").

The Orbit Intelligence® system database was also used to construct the graphs and capture accurate and updated information regarding the general framework of patents filed by public higher education institutions in Minas Gerais in an up-to-date manner, considering that there is a failure regarding the consultation of this information in INPI's database, and it is not possible to verify the information in its entirety in all investigations.

Regarding the questionnaire, the 16 public institutions interviewed returned the questions answered in their entirety.

The nature of possible associations between the institutions that answered the questions was studied through analysis of the proportion of the corresponding data to identify the patents granted or that holds the concept of frugal innovation present in their technologies, constructing patent graphs to allow better identification and description of the data.

In the end, it is intended to demonstrate the presence of technologies related to the concept of frugal innovations produced and deposited by public institutions in Minas Gerais, demonstrating the possibility of presenting innovations to society from the perspective of low-cost.

4 Results and Discussion

4.1 Data collected

Homogeneous data analysis is verified using the principle of transparency and equality between public agencies regarding the data collected. In this way, it was possible to understand legislative evolution as a facilitator of intellectual property, such as technological management in public higher education institutions; the perception of frugal innovation concepts within higher education institutions; the importance of TICs in the Brazilian technological sector; the presence of technologies that use these concepts; and the main reasons for not exploiting these technologies en masse within the public institutions observed.

It was possible to conduct this homogeneous analysis based on the information collected in the TICs of public higher education institutions in Minas Gerais, corroborating the legislation and strictly respecting it. To this extent, the role of TICs within universities as a facilitator of legal compliance and managers of intellectual property becomes clear while using this protective perception to enable the ownership and exclusivity of technologies deposited with the INPI.

Given the analysis of the information collected, the need to protect assets through patent deposits by the Technological Innovation Centers (TIC) was observed, as well as the presence of frugal innovation in the technologies developed by the institutions' faculty and students. Because of this, the responses collected from the institutions will be demonstrated below, one by one, for a better understanding of the data collection.

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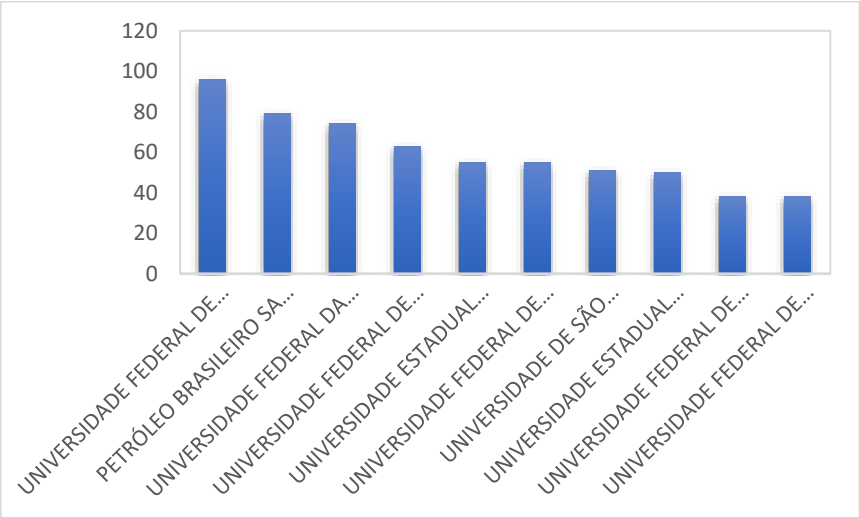
4.2 Analysis of patent filing in the Brazilian scenario

The first ten institutions allocated in the ranking of resident patent applicants and their respective positions were observed, as well as the number of technologies presented and made available for access.

From this analysis, it can be seen that the Federal University of Campina Grande leads the ranking with 96 patents filed, followed by Petrobrás with 79 patents filed, the Federal University of Paraíba with 74 patents filed, the Federal University of Minas Gerais with 63 patents filed, the State University of São Paulo "Júlio de Mesquita Filho" (UNESP) with 55 patents filed, the Federal University of Pernambuco with 55 patents filed, the University of São Paulo with 51 patents filed, the State University of Campinas with 50 patents filed, the Federal University of Pelotas with 38 patents filed, and the Federal University of Uberlândia with 38 patents filed. Thus, the importance and representativeness of public higher education institutions in Minas Gerais are verified in terms of the number of patents filed.

Figure 1 – Ranking of patents filed by residents in 2020.



Source: National Institute of Industrial Property – INPI (2021).

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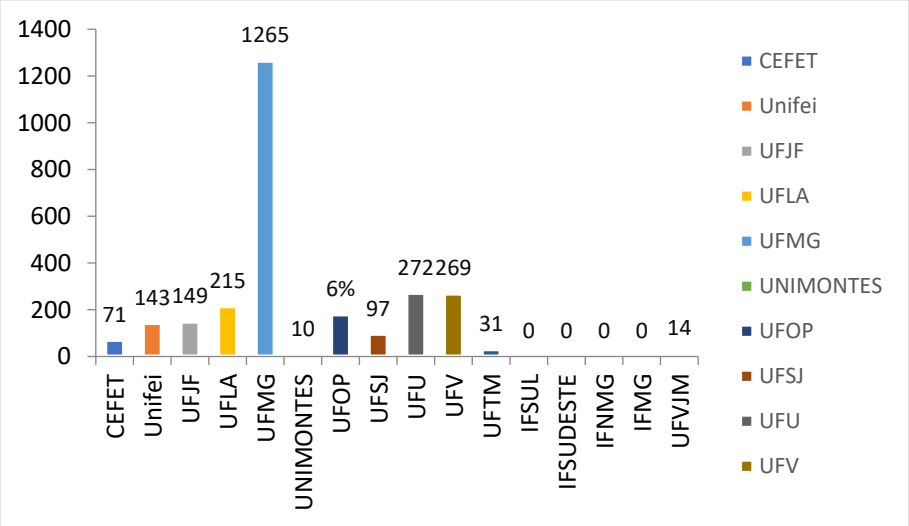
4.3 Number of patents filed by the institutions interviewed in Minas Gerais in *Orbit Intelligence*®

Before starting the data analysis in a detailed, systematized, and separate way, observing the institutions in their individuality through the Orbit Intelligence platform, the scenario was verified in its macro amplitude of public institutions in Minas Gerais to diagnose the number of patents filed in their entirety.

It can be seen in Figure 2 that the State University of Minas Gerais has 1267 patents filed under analysis, granted, and rejected, presented to the INPI. Next comes the Federal University of Uberlândia with 272 patents filed, the Federal University of Viçosa with 269 patents filed, the Federal University of Lavras with 215 patents filed, the Federal University of Ouro Preto with 181 patents filed, the Federal University of Juiz de Fora with 149 patents filed, the Federal University of Itajubá with 143 patents filed, the Federal University of São João Del Rei with 97 patents filed and other institutions that do not fit the parameters of this research.

Figure 2 – Patent applications filed by public institutions in Minas Gerais



Source: Questel Orbit Intelligence from Axonal® (2022).

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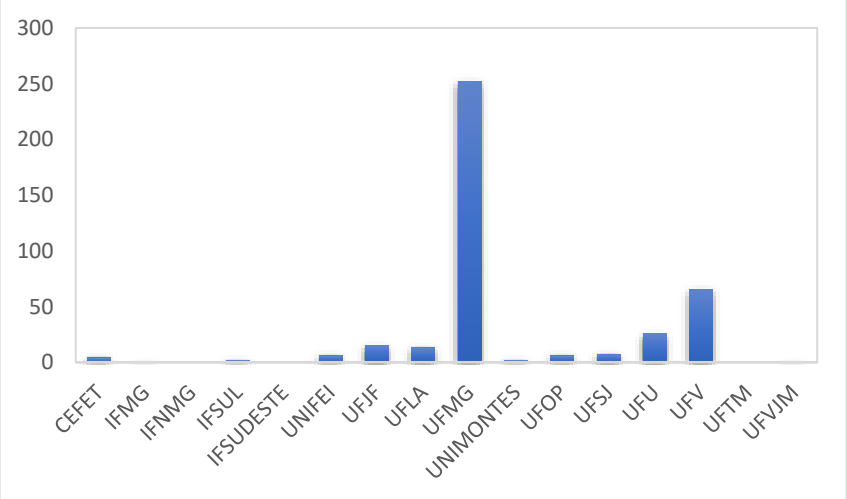
In agreement with the numbers mentioned in Figure 1, it can be seen that the Federal University of Minas Gerais, in addition to being among the institutions that deposit the most in Minas Gerais, is ranked among the 10 resident depositors in the country, being in 4th place with 63 requests submitted to the INPI, followed by the Federal University of Uberlândia, now positioned in 10th place with 38 requests submitted to the authority in 2020 (INPI, 2020).

4.4 Number of patents granted and rejected by the institutions interviewed in the state of Minas Gerais

In analyzing the information collected, as shown in Figure 3, it is possible to see that the majority of Technological Innovation Centers were established between the last 10 (ten) and 27 (twenty-seven) years and, despite the vast amount of time, the number of national patent applications granted as holder or as co-holder is not high, compared to the expectations. Thus, even if the information captured is partial, the following scenario can be seen:

Figure 3 – Patent applications filed and granted to public higher education institutions in Minas Gerais.



Source: UFVJM, UFTM, UFV, UFU, UFSJ, UFOP, UNIMONTES, UFMG, UFLA, UFJF, UNIFEI, IF SUDESTE, IFSUL, IFNMG, IFMG, CEFET (2022).

It is evident that the time of institution does not match the number of deposits made, considering that UFVJM has one patent granted, UFTM did not verify this information, UFV has 65 patents granted, UFU has 26 patents granted, UFSJ has seven patents granted, UFOP has six patents granted, UNIMONTES has two patents granted, UFMG has 252 patents granted, UFLA has 13 patents granted, UFJF has 15 patents granted, UNIFEI has six patents granted, the IF SUDESTE does not have patents granted, IFSUL has two patents granted, IFNMG does not have patents granted, IFMG has one patent granted, and CEFET has four patents granted (Figure 3).

For better visualization, Table 1 shows the number of patents granted until the moment of the collection of the information.

Table 1 – Patent applications filed and granted to public higher education institutions in Minas Gerais

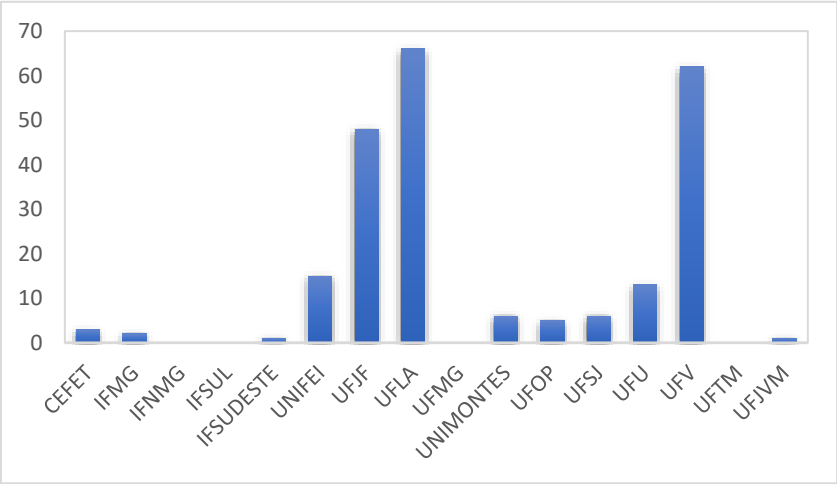
Public Institutions	**Granted**
Federal Center for Technological Education of Minas Gerais	4
Federal Institute of Minas Gerais	1
Federal Institute of Southern Minas Gerais	2
Federal Institute of Northern Minas Gerais	0
Federal Institute of Southeast Minas	0
Federal University of Itajubá	6
Federal University of Juiz de Fora	15
Federal University of Lavras	13
Federal University of Minas Gerais	252
State University of Montes Claros	2
Federal University of Ouro Preto	6
Federal University of São João Del Rei	7
Federal University of Uberlândia	26
Federal University of Viçosa	65
Federal University of Triângulo Mineiro	Not determined
Federal University of Vale do Jequitinhonha and Mucuri	1

Source: UFVJM, UFTM, UFV, UFU, UFSJ, UFOP, UNIMONTES, UFMG, UFLA, UFJF, UNIFEI, IF SUDESTE, IFSUL, IFNMG, IFMG, CEFET (2022).

However, Figure 4 shows the opposite scenario, that is, patent applications that were rejected.

When analyzing this data, it appears that UFVJM has one rejected patent, UFTM did not verify this information, UFV has 62 rejected patents, UFU has 13 rejected patents, UFSJ has six rejected patents, UFOP has five rejected patents, UNIMONTES has six rejected patents, UFMG did not verify this information, UFLA has 66 rejected patents, UFJF has 48 rejected patents, UNIFEI has 15 rejected patents, IF SUDESTE has one rejected patents, IFSUL does not have a rejected patent, IFNMG does not have a rejected patent, IFMG has two rejected patents, and CEFET has three rejected patents (Figure 4).

Figure 4 – Patent requests filed and rejected at public higher education institutions in Minas Gerais



Source: UFVJM, UFTM, UFV, UFU, UFSJ, UFOP, UNIMONTES, UFMG, UFLA, UFJF, UNIFEI, IF SUDESTE, IFSUL, IFNMG, IFMG, CEFET (2022).

The number of patents rejected from each of the 16 institutions under study is shown below (Table 2).

When observing the information provided by the Federal University of Minas Gerais in Table 2, given what was answered in the questionnaire, it is noted the lack of

consolidation of information related to patents rejected in procedural steps by the National Institute of Industrial Property.

UFMG presented as a search tool for its patent deposits the electronic address of its technological showcase of the university, which is available at http://www.ctit.ufmg.br/vitrine-tecnologica. However, not all requests, regardless of the stage, are available on the showcase, considering that this tool aims to expose some technologies to bring the university closer to other universities or companies from the perspective of generating technology transference.

Table 2 – Patent requests filed and rejected at public higher education institutions in Minas Gerais.

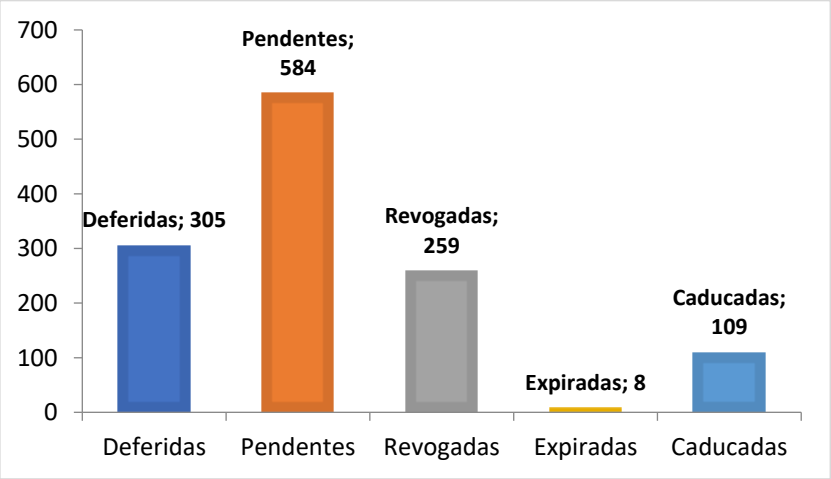
Public institutions	**Rejected**
Federal Center for Technological Education of Minas Gerais	3
Federal Institute of Minas Gerais	2
Federal Institute of Southern Minas Gerais	0
Federal Institute of Northern Minas Gerais	0
Federal Institute of Southeast Minas	1
Federal University of Itajubá	15
Federal University of Juiz de Fora	48
Federal University of Lavras	66
Federal University of Minas Gerais	Not determined
State University of Montes Claros	6
Federal University of Ouro Preto	5
Federal University of São João Del Rei	6
Federal University of Uberlândia	13
Federal University of Viçosa	62
Federal University of Triângulo Mineiro	Not determined
Federal University of Vale do Jequitinhonha and Mucuri	1

Source: UFVJM, UFTM, UFV, UFU, UFSJ, UFOP, UNIMONTES, UFMG, UFLA, UFJF, UNIFEI, IF SUDESTE, IFSUL, IFNMG, IFMG, CEFET (2022).

Therefore, to obtain precise information on what is deposited and publicly accessible, a search was conducted in the Orbit Intelligence® system (Figure 5).

Figure 5 shows that 1265 patent applications were found submitted to INPI, and within the patent applications that are public at UFMG, 46% are pending for analysis, 20% are revoked, 8% are expired, and 24% are granted. Therefore, the information collected about granted requests and rejected requests was compared.

Figure 5 – Patent requests filed and rejected by the Federal University of Minas Gerais



Source: Questel Orbit from Axonal® (2022).

From the information collected, it was possible to notice that 400 patents were granted, around 40% of the total, and 596 requests were rejected, approximately 60% of all requests (Figure 6).

Checking the numbers of rejected patents, it is possible to see some possibilities for this fact, namely the absence of novelty, inventive activity, or industrial application, following Article 8 of the Industrial Property Law (nº 9279/96).

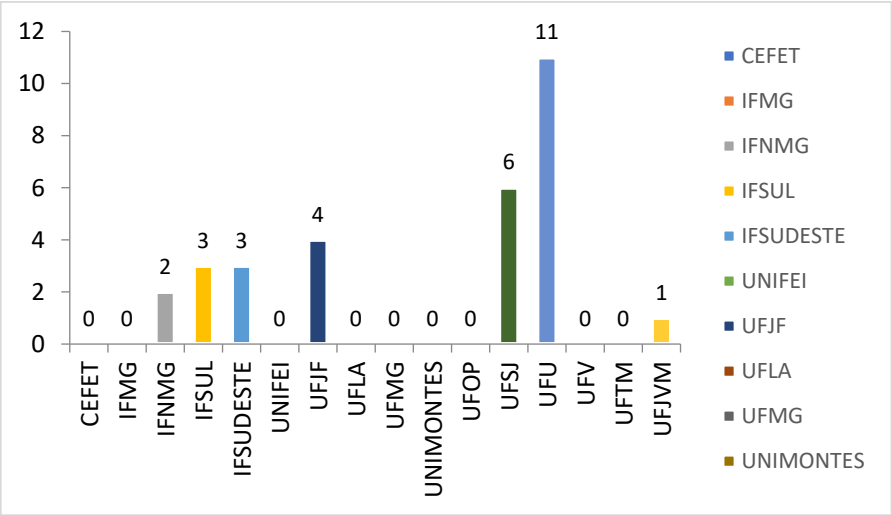
When observing the information collected, indubitably, there is a need for prior analysis of the patent applications filed, as the majority of them were rejected, resulting in 596 refusals. In other words, examine the viability of the technology deposited at the

INPI through prior research in its database and search and preliminary opinion on patentability, now made available as a service by the authority itself.

4.5 Frugal solutions deposited by Technological Innovation Centers (TIC)

Another relevant point that needs to be observed is requests related to technologies that can be classified as frugal solutions. The only Technological Innovation Centers that measured the number of frugal solutions filed as patent grant applications were the following: UFVJM has one frugal patent, UFU has 11 frugal patents, UFSJ has six rejected patents, UFJF has four frugal patents, the IF SUDESTE has three frugal patents, IFSUL has three frugal patents, and IFMG has two frugal patents. The other institutions interviewed do not have patents with frugal innovation characteristics deposited at the National Institute of Industrial Property, as shown in Figure 6.

Figure 6 – Frugal patent applications filed by public higher education institutions in Minas Gerais.



Source: UFVJM, UFTM, UFV, UFU, UFSJ, UFOP, UNIMONTES, UFMG, UFLA, UFJF, UNIFEI, IF SUDESTE, IFSUL, IFNMG, IFMG, CEFET (2022).

4.6 Frugal technologies that are in the public domain

Also, it was noted that only the Federal University of Uberlândia signaled the presence of 2 frugal patents in the public domain. The other institutions do not have technologies that fit this characteristic.

5 Conclusion

While conducting this study, the importance of Technological Innovation Centers in higher education institutions in Minas Gerais was acknowledged as managers of assets related to intellectual property and as intermediates in requesting patent applications for technologies from the National Institute of Industrial Property.

As for the patents filed, there is a need for preliminary analysis under the circumstance of a large number of process rejections, that is, to examine the viability of the technology deposited at INPI through prior research in its database, utilizing the technical committee-specialized within each TIC, and search and preliminary opinion on patentability, available as a service by the authority itself.

Another issue was the absence of products related to frugal innovation, noticing the move away from institutions with an academic bias towards developing low-cost technologies with high social contribution.

Therefore, when dealing with the development of frugal technologies, there is a need to make them available to society following their main characteristic, that is, low cost. Therefore, after the due deposit of these technologies through patent protection, the best path to follow is processes in the public domain so that society, in general, can explore and benefit from them, removing aspects related to licensing and assignment.

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Contribution of the authors:

Allynson Takehiro Fujita – Project coordinator, active participation in data analysis and review of final writing.

Jhansley Ferreira da Mata – Project coordinator, active participation in data analysis and review of final writing.

Larissa Campos Sousa – Responsible for data collection, data analysis, study on the topic, and writing the text.

Reviewed by

Nova Geração Serviços Editoriais

cirlenenovageracao@gmail.com