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Patent bases as a source of technological information in the Engineering area I: evidence from brazilian specialists

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Authors'Notes

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Abstract

Objective: to identify researchers' perception of knowledge about using technological information in patent databases as a source for developing academic research (scientific and technological).

Method: This study surveyed 43 stricto sensu postgraduate programs in Brazil in the Engineering I area, Sanitary Engineering subarea of CAPES.

Originality/Relevance: Much of the technological information available in the world appears only in patent documents, and the originality of this study consists of identifying the use of such information by researchers. Thus, showing the application of this knowledge in academic research can take them to another level of knowledge.

Results: We identified that only 33% of researchers use patent bases as a source of technological information; more than 65% of searches focus on verifying the possibility of patenting. We found that such information is not applied in academic research, with ample space for disseminating and applying such knowledge.

Social/Management Contributions: Expanding the use of technological information will enable academic production to use the most recent technology, products, or processes in the world. From a managerial point of view and the identification of the low use of patent bases, it was observed that there is a need to develop a method or tool that will make the use of patents more user-friendly as a source of technological information.

Keywords: patents, survey, stricto sensu postgraduate studies, technological information, Engineering I

Bases de patentes como fonte de informação tecnológica na área de Engenharia I: evidências de especialistas brasileiros

Resumo

Objetivo: identificar a percepção do conhecimento dos pesquisadores sobre o uso das informações tecnológicas contidas em bases de patentes como uma fonte para desenvolvimento de pesquisas acadêmicas (científicas e/ou tecnológicas).

Método: Este estudo realizou uma *Survey* junto aos 43 programas de Pós-Graduação Stricto Sensu existentes no Brasil da área de Engenharias I, subárea Engenharia Sanitária da Capes.

Originalidade/Relevância: Grande parte da informação tecnológica disponível no mundo consta apenas em documentos de patentes, a originalidade deste estudo consiste na identificação do uso de tais informações pelos pesquisadores. Assim, evidenciar a aplicação desse conhecimento em pesquisas acadêmicas pode leva-las a outro nível de conhecimento.

Resultados: Identificamos que apenas 33% dos pesquisadores utilizam as bases de patentes como fonte de informação tecnológica, onde mais de 65% das buscas foca na verificação da possibilidade de patenteamento, constatamos que tais informações não são aplicadas em pesquisas acadêmicas, havendo amplo espaço para difusão e aplicação de tais conhecimentos.

Contribuições Sociais/Gerenciais: A ampliação do uso das informações tecnológicas possibilitará à produção acadêmica o que há de mais recente em tecnologia, produtos ou processos, no mundo. Do ponto de vista gerencial e a partir da identificação do baixo uso das bases de patentes observou-se a necessidade do desenvolvimento de um método e/ou ferramenta que tornará mais amigável o uso de patentes como fonte de informação tecnológica para os mesmos.

Palavras-chave: patentes, survey, pós-graduação stricto sensu, informação tecnológica, Engenharias I

Las bases de patentes como fuente de información tecnológica en el área de la Ingeniería I: evidencia de especialistas brasileños

Resumen

Objetivo: identificar la percepción de los investigadores sobre el conocimiento sobre el uso de la información tecnológica contenida en las bases de datos de patentes como fuente para el desarrollo de investigaciones académicas (científicas y/o tecnológicas).

Método: Este estudio realizó una Survey entre los 43 programas de Posgrado Stricto Sensu existentes en Brasil en el área de Ingeniería I, subárea de Ingeniería Sanitaria de la Capes.

Originalidad/Relevancia: Gran parte de la información tecnológica disponible en el mundo aparece únicamente en documentos de patentes, la originalidad de este estudio consiste en identificar el uso de dicha información por parte de los investigadores. Así, mostrar la aplicación de este conocimiento en la investigación académica puede llevarlos a otro nivel de conocimiento.

Resultados: Identificamos que solo el 33% de los investigadores utilizan las bases de patentes como fuente de información tecnológica, donde más del 65% de las búsquedas se enfocan en verificar la posibilidad de patentar, encontramos que dicha información no es aplicada en la investigación académica, con amplio espacio para la difusión y aplicación de tales conocimientos.

Aportes sociales/de gestión: La expansión del uso de la información tecnológica permitirá que la producción académica utilice la tecnología, los productos o los procesos más recientes del mundo. Desde el punto de vista gerencial y a partir de la identificación del bajo uso de las bases de patentes, se observó la necesidad de desarrollar un método y/o herramienta que haga más amigable el uso de las patentes como fuente de información tecnológica para ellos.

Palabras clave: patentes, survey, posgrado stricto sensu, información tecnológica, Ingeniería I

Introduction

On the one hand, Brazil dates back to 1809, the first legislation on patents, known as the Alvará de Dom João VI, making the country the fourth nation to establish the topic legally. Among the points it addressed, the document created a system to encourage technological development through the possibility of granting industrial patents (Barbosa, 2003). Since then, legislation has evolved, and today, a robust system is available, which, in addition to patents, provides for several other types of intellectual property.

Using the patent system is strategic for companies, universities, or even independent inventors who wish to protect their creations. The National Institute of Industrial Property - INPI (2021) points out the growth in patent applications: in 2019, patent applications increased by 4.1% compared to the previous year (2018), totaling around 28.3 thousand new applications; in 2021, more than 24,000 new patent applications were filed in Brazil (WIPO, 2022), and despite this increase, the use of such

information is still incipient. In the world, these data are even more representative. According to the *World Intellectual Property Organization* – WIPO (2022), in Portuguese, World Intellectual Property Organization - WIPO, in 2021, 3.4 million patent applications were filed worldwide, representing an increase of 3.6% compared to the previous year.

Although the patent system's primary purpose is to protect intellectual creations of products or processes that meet legal requirements, it offers the world a valuable source of information about different technologies that sometimes end up little explored. On the other hand, universities can generate knowledge and technologies due to their extensive infrastructure and available human capital (Haase et al., 2005). The result of all this work is reflected in Brazil, which stands out on the world stage for producing scientific articles.

Data shows that Brazil increased scientific production by 32.2% in 2020 (almost 80 thousand articles), compared to 2015 (around 55 thousand), a higher average including the global production of articles, which grew 27.1% in the same period. Brazil is responsible for producing 3.2% of world production, ranking 13th (CCGE, 2021).

Stricto Sensu Postgraduate Programs in Brazil. This study aimed to identify researchers' perceptions of knowledge regarding using technological information on patent bases as a source for developing academic research. This identification may allow researchers to develop ways to expand this use. To this end, a survey was constructed to identify the uses and methods for collecting technological information on patent bases and to verify bottlenecks and reasons for not using them.

Concerning social contributions, patent bases can be an important path of information and knowledge, being used to survey the state of the art, seeking to understand the most diverse products and technological processes. Expanding the use of technological information contained in patent bases will enable academic production to obtain the most recent technology, whether products or processes, in the world. From a managerial point of view and the identification of the low use of patent bases by researchers, the need to develop a method or tool that will make using patents as a source of technological information more user-friendly was observed.

The article has five sections, starting with this introduction. We present a brief literature review, identified as 'Patents as a source of technological information,' followed by 'Methodology,' where we present all the stages of construction and collection of the survey carried out with researchers. The results are detailed in the following section, followed by conclusions, acknowledgments, and references.

Patents as a source of technological information

The search for knowledge is the process of developing any research with the capacity for knowledge directly related to economic development. In turn, scientific knowledge is linked to the progress of its productive capacity (Teixeira et al., 2017).

While scientific articles are the result of science, results of high scientific and methodological rigor, patents configure technical discovery, focused on industrial applicability and economic and scientific value due to the solid criteria for their granting (Scartassini and Moura, 2020).

Patents are a title the State provides that guarantees the holder of the technology (a product or process) exclusivity for a certain period (in Brazil, 20 years for invention patents and 15 years for utility model patents). The exclusivity granted refers to the commercial exploitation of the technology throughout the national territory, where, in return, the holder shares access to the technology information, making it accessible to the public (Barbosa, 2003).

For a patent to be granted, it requires three legal assumptions: novelty, considering it non-existent in the prior art; inventive activity, requiring the application of human intellect for its development; and industrial application, being capable of reproduction. The law provides for technologies that may or may not be the subject of patents (see articles 10 and 18 of Law no. 9,279/96) (BRASIL, 1996). As examples of non-patentable technologies, we can mention discoveries, scientific theories and mathematical methods, and scientific works, among others.

Patents primarily aim to promote technological development in the country, as the holder of the technology reveals the details of his invention in exchange for the privilege of economic exploitation. By revealing their invention, they allow third parties to access the knowledge in the document, using it in developing new technologies, subject to their exploratory validity for commercialization purposes.

They present descriptions of scientific and technical concepts, as well as details of processes and products, clear enough for technicians in the field to be able to reproduce the technology in the document since this characteristic is one of the requirements for it to be granted (Mueller and Perucchi, 2014).

Furthermore, by making knowledge available, the patent system allows it to be used in scientific studies and investigations, promoting the dissemination of practical and economic knowledge (Ferreira et al., 2009). In this case, Law no. 9,279/96 clarifies that using such information is permitted for experimental purposes related to scientific or technological studies or research (art. 43, II) (Brasil, 1996).

All this knowledge made available from patent processes, also known as patent literature, is considered technological information, which consists of all types of information associated with the way of making a product, the way of carrying out a process, or providing a service (Ferraz, 2008; Jannuzzi and Souza, 2008). Considering patents as an essential source of information, researchers can search for the state of the art in a given technological area, become aware of alternative techniques, and carry out technological prospecting (i.e., mapping scientific and technological developments, among others), illustrating several development possibilities (Teixeira et al., 2017).

Using patents as a source of technological information makes it possible to identify technologies developed in the most diverse areas, technological routes, and other relevant data for actors in the innovation process (Amparo et al., 2012). Furthermore, by observing patent processes (which can be considered a tool for disseminating information), it is possible to identify the focus and changes in a nation's creative activities and indicate technological changes, including dissemination and penetration of the technologies available (Hirata et al., 2015).

According to Braga and Simeão (2018), a critical connection links technological information and the process of generating value to appropriating new technologies. One of the fundamental characteristics of technological information is the ability to change means of production, enabling development and adapting academic-scientific knowledge to the market (Braga and Simeão, 2018).

Despite the large volume of information and data on technological inventions available in patent banks, few studies have addressed the search for prior knowledge of technologies available (Caviggioli,

2016; Kyebambe et al., 2017). Linares et al. (2019) pointed out that the technological information on a patent database can be accessed through simple searches or even more complex technological prospecting studies.

Since patents are a source of technological information, authors such as Persoon et al. (2020) use them to study the interactions between science and technology. These authors highlighted that patent data is arguably the most extensive and detailed source of technological developments, noting that not all patents lead to a successful technology (Persoon et al., 2020).

In addition to containing data relating to the invention, the patent document has a section called the descriptive report, which contains information relating to existing knowledge, that is, the accumulated knowledge available relating to that technology or technological area. This knowledge mostly refers to other patents, but it can also refer to other knowledge sources, generally from scientific literature, mainly journal articles (Person et al., 2020).

Analyzing patent documents provides the opportunity to identify scientific knowledge and encourages converting them into technological knowledge. Furthermore, it promotes development since patent information is available in free and accessible databases, generating an extensive base of technological knowledge that can be applied to research in different areas, even in sanitary engineering (Menezes et al., 2016).

It is clear, however, that the technological information in patents is still scarcely used by the scientific community, including for publishing their research (Jannuzzi and Souza, 2008). Cunha et al. (2023) also highlighted that the use of information in patents, besides gathering specialized knowledge that is generally more detailed than that available in scientific articles, provides information not available in scientific journals or publications originating from events.

An ideal path for developing projects and academic research is using the information in patent documents to avoid wasting resources and time. In addition to becoming aware of what is most advanced in technological terms, the information contained in patent documents can guide the researcher in the

application of knowledge, highlighting, in particular, the fact that the information contained therein usually is not available in other means (Teixeira et al., 2017).

When applying for a patent application, the applicant must examine what is called the prior art. This is the same principle used in producing a scientific article, where the researcher searches the journal databases for the state of the art in that area of knowledge.

The prior art consists of all information available worldwide prior to the filing date of the patent application (Barbosa, 2003; Brasil, 1996). Since it is necessary to verify the state of the art globally, a considerable amount of technical-scientific knowledge is expected to be present in patent documents (Pimenta, 2017). Pimenta (2017) also highlighted that since the patent must present the technical solutions, it is possible to consult the obstacles to be resolved in the document and the technical solutions. Using this information, research can take advantage of such knowledge and experiences, seeking to expand and develop scientific progress.

Another critical factor in using patents as a source of technological information concerns the fact that, according to the European Patent Office (2007), patents are the most prolific and updated source of information about applied technology. It should also be noted that up to 80% of current technical knowledge is only available in patent documents (EPO, 2007). Hirata et al. (2015) also added that the technological results in patents are rarely replicated in other publication types. In this sense, when observing the growing number of patent applications in recent years, it is possible to see that patents are a valuable source of technological information and can be easily accessed through patent banks (Asche, 2017).

Using patent bases as a source of technological information for scientific and technological development means understanding that the accumulated stock of knowledge already existing in this system allows for gradual and incremental steps toward technological progress (Haase et al., 2005). Added to this is the fact that the patent system makes information available that is not available in other media, both due to its exclusive publication in this media and because it is at the frontier of knowledge,

thus transforming the patent document into a substantial source for the development of scientific research (Pimenta, 2017).

Qi et al. (2023) pointed to patents as *the locus* of more than 90% of the world's recent technical information, allowing researchers to find information unavailable in this system's scientific literature. The authors also indicated that in the case of specific environmental problems, patent analysis can provide new interpretations to resolve such issues (Qi et al., 2023).

Pinto et al. (2017) indicated that in addition to the potential for technological information, patent documents can serve as a methodological tool or a source of bibliographical research for teachers and students. Hirata et al. (2015) pointed out that patents can drive research beyond strict technical investigation. Menezes et al. (2016) also highlighted the encouragement of technological innovation through the patent system, a theme in international agreements. They also added that this incentive directly assists in sustainable development through technologies that focus on reducing the emission of gases and pollutants, waste treatment, and maintaining natural resources (Menezes et al., 2016).

It is observed in the explored context that patents have the potential to serve as a beneficial instrument, whether in the educational sphere or the development of research. Added to these possibilities is that the use of technological information contained in patents avoids rework resulting from the execution of research into technologies already developed, also enabling savings in resources (including waste generation) and time.

Methodology

To understand the use of the state-of-the-art on patent bases, a survey was carried out to identify the perception of knowledge of researchers linked to the themes of sanitary and environmental engineering. The choice to link the researchers with the aforementioned engineering areas arises because the authors are linked to the program in this area. According to Gil (2008), the research adopts an exploratory and descriptive model to expand knowledge about the research problem and describe the characteristics of the population universe, respectively. Similarly, it follows the descriptive study model Ferreira et al. (2009) adopted when statistically analyzing closed questions. The open questions were

interpreted using the content analysis technique (Bardin, 2009). Initially, in July 2021, a search was carried out on the website of the Coordination for the Improvement of Higher Education Personnel – CAPES, through the Sucupira Platform, identifying all Stricto Sensu Postgraduate programs operating in Brazil in the area of evaluation "Engineering I," totaling 128 courses evaluated and recognized. The Sanitary Engineering subarea was defined as an inclusion criterion, considering that it is the same area of the program to which the authors of this work are linked and because we realize the gap in the use of patents in our research.

44 Stricto Sensu Postgraduate programs in the Sanitary Engineering subarea were listed, of which only one was not invited, considering that programs that had not yet received evaluation by CAPES were defined as exclusion criteria. Thus, the remaining 43 programs were distributed as follows: 15 academic master's degrees, 11 professional master's degrees, 03 academic doctorates, and 14 academic master's degrees and doctorates in the same program. It was also observed that considering the country's 27 federative units, only the states of Acre, Amapá, Amazonas, Maranhão, Mato Grosso, Piauí, Rondônia, and Roraima did not have a program in the area. Furthermore, the state with the most programs in the area is the state of Paraná, with six programs, followed by the states of Minas Gerais, Rio de Janeiro, and Rio Grande do Sul, with five each. Finally, the area did not have a program offering a professional doctorate. The postgraduate programs are distributed according to Table 1: Academic Master's (ME), Academic Doctorate (DO), Professional Master's (MP), and Professional Doctorate (DP).

Table 1

Stricto Sensu Postgraduate programs

	Total	ME	DO	MP	DP	FEAR	MP/DP
North Region							
Pará (PA)	1	-	-	1	0	0	0
Tocantins (TO)	1	0	0	1	0	0	0
Northeast Region							
Ceará (CE)	2	2	0	0	0	0	0
Rio Grande do Norte (RN)	1	1	0	0	0	0	0
Pernambuco (PE)	1	1	0	0	0	0	0
Paraíba (PB)	1	0	0	0	0	1	0
Sergipe (SE)	2	2	0	0	0	0	0
Alagoas (AL)	1	1	0	0	0	0	0
Bahia (BA)	1	1	0	0	0	0	0
Midwest Region							
Mato Grosso do Sul (MS)	1	0	0	0	0	1	0
Goiás (GO)	1	1	0	0	0	0	0
Federal District (DF)	1	0	0	0	0	1	0
Southeast Region							
São Paulo (SP)	4	0	1	1	0	2	0
Rio de Janeiro (RJ)	5	0	2	3	0	0	0
Espírito Santo (ES)	2	0	0	1	0	1	0
Minas Gerais (MG)	5	2	0	1	0	2	0
South Region							
Paraná (PR)	6	4	0	0	0	2	0
Rio Grande do Sul (RS)	5	0	0	2	0	3	0
Santa Catarina (SC)	2	0	0	1	0	1	0
Totals	43	15	03	11	0	14	0

Source: Adapted from CAPES by the authors

An average of 10 permanent researchers in each program is calculated, thus considering 430 potential respondents, of which 20% of the population universe was reached. A non-probabilistic convenience sample was used, which, according to Babbie (1999), is used when exact representation is not necessary. Also called intentional sampling, it was selected considering the population's knowledge and the research's objective.

The researchers' contributions were collected using an electronic questionnaire applied through *Google Forms* (Appendix A). Before application, the questionnaire was evaluated and validated by two professional experts: one with experience in using patent bases and a researcher in environmental technology.

The questionnaire was divided into two blocks, the first aimed at researchers using the patent database and the second for those not using it. The identification of the respondent was optional, being requested only in cases where the respondent wished to receive the compiled research results. The average response time for the questionnaire was 5 minutes. The responses were automatically recorded in a database (*Microsoft Excel*) from which it was possible to analyze the information received.

The questionnaire application began in August 2021, when program coordinators were invited by email to participate in the survey and pass it on to all permanent teachers in the programs. In September, contact was intensified when all researchers received an email with an invitation. The coordinators' contacts were initially collected on the Sucupira Platform or the pages of their respective programs. For sending to all permanent lecturers of the programs, electronic email contacts were shared by the coordination or secretariat or collected on the program's website. The questionnaire link was available from August 15th to September 10th, 2021.

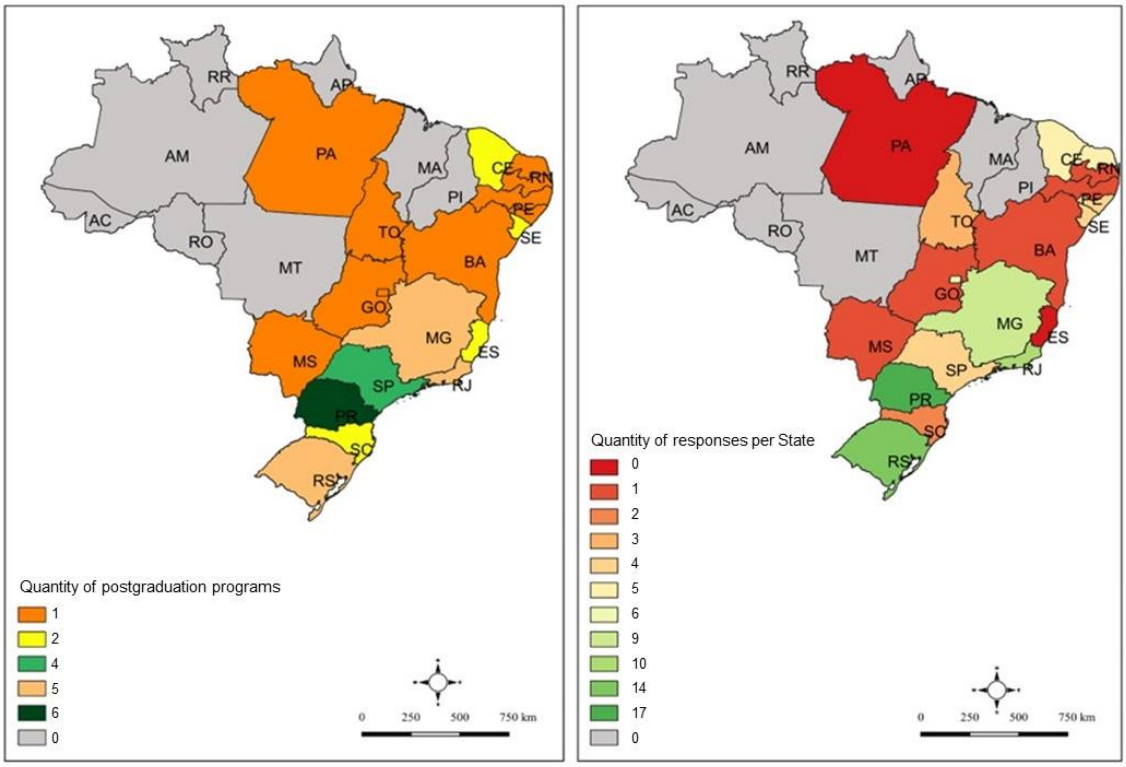
Results and discussions

Eighty-eight responses were received in the electronic questionnaire, where, considering the origin of the respondents' employment, 89.8% are from public universities, while 11.4% are from private or community universities. Of these, 27.3% are Coordinators or occupy another management position in the Program, and 72.7% work as Professor or Researcher.

The states of Espírito Santo and Pará did not have any respondents. The distribution of responses and the location of respondents in the respective federative units can be seen in Figure 1. In the first map of Figure 1, it is possible to check the number of postgraduate programs in the area, while in the second map, the number of responses received in states where there are programs in the area.

Figure 1

Respondent location map and volume of responses received

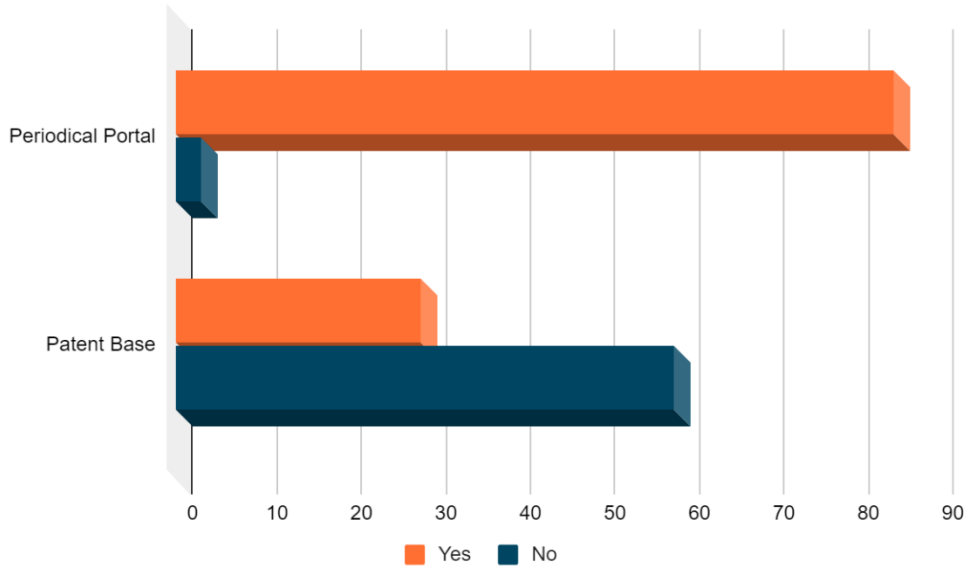


The Brazilian region of respondents that contributed most to the survey applied is the South Region, from where 33 responses were received, while this region is the second with the largest number of programs in the area (13 programs). The second region with the highest participation is the southeast region, which has 23 responses and is the region with the largest number of programs in the area in Brazil (17 programs). The third region that most participated in the volume of responses received was the northeast region, with 21, with nine programs. Finally, the regions with the lowest participation were the northern region, with three responses (2 programs), and the central west, with eight (3 programs).

To check the state of the art of their research, almost all respondents said they used the CAPES Journal Portal, 96.6%, with only 3.4% not using it. However, when asked whether they use patent bases to check the state of the art, 67% responded 'no,' and only 33% said they do, illustrated in Figure 2.

Figure 2

Use of the Periodical Portal and Patent Base



It is evident in Figure 2 that the researchers consulted are in the habit of consulting the Periodical Portal. However, only a minority of them use patent databases for consultation. This result corroborates what was pointed out by Hirata et al. (2015), who indicated that there are few studies on patenting and licensing of technologies. In the same sense, Cunha et al. (2023) pointed out that in all areas of knowledge, using patent documents as a source of scientific or technological information is not very significant in academia, noting that the rate of use is insignificant compared to other types of documents.

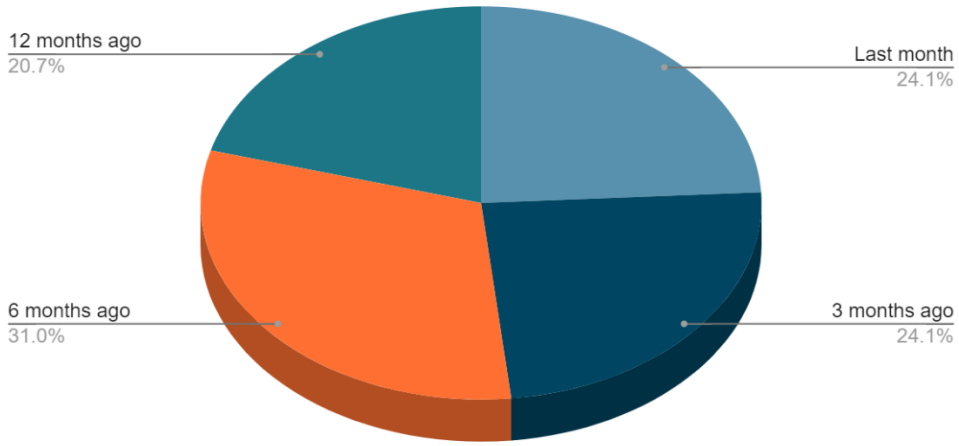
Use of Technological Information in Patent Bases

Seeking to understand the reasons that lead them to use patent databases, the 33% who stated that they used them were taken to the second research stage, aimed only at this profile.

When asked when was the last time they used the patent database for searching, 31% of researchers stated that it was six months before this survey, 20.7% 12 months, 24.1% three months, and 24.1% in the previous month, as illustrated in Figure 3.

Figure 3

Use of the Patent Base



It is possible to observe in Figure 3 that researchers do not use the patent base continuously. Seeking to understand which databases are used, respondents indicated which databases they usually use in their research, with 65% indicating that they use more than one patent database for searching. Figure 4 represents the different research bases cited by the respondents.

Figure 4

Patent bases used

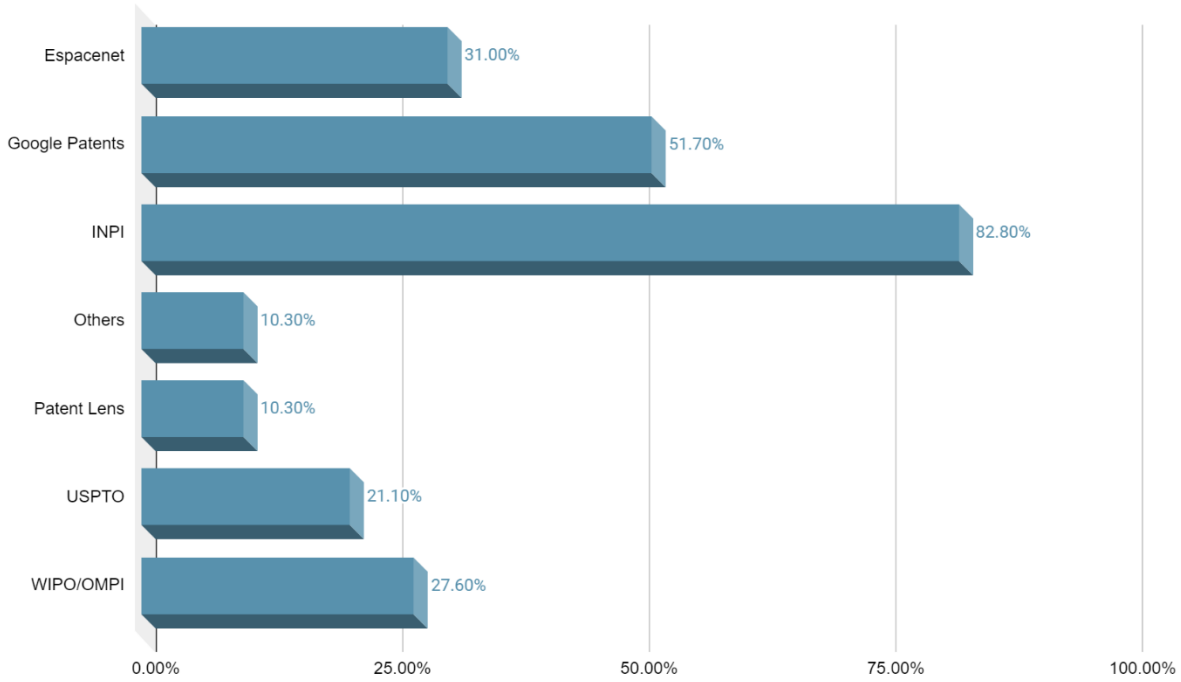
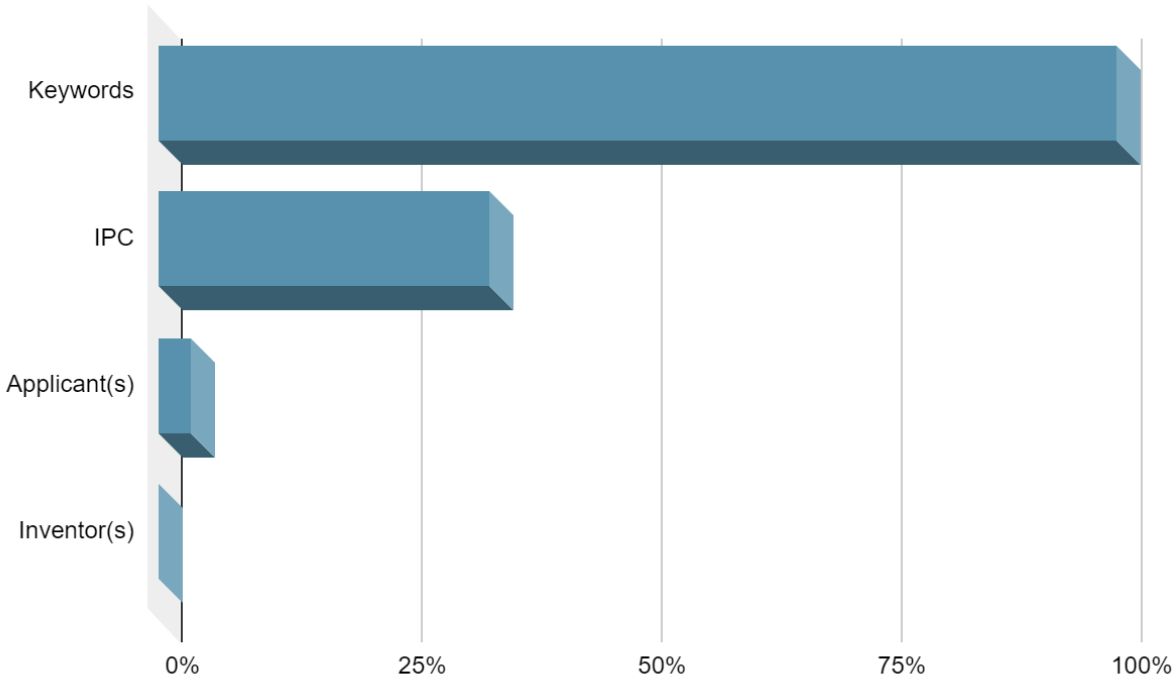


Figure 4 shows that the database most used by researchers is the National Institute of Industrial Property (INPI; 82.2%), followed by Google Patents (51.7%). The INPI database presents results only from patent processes filed in Brazil, making it possible to use several search fields. Google Patents, similar to a traditional Google search, presents results from more than 100 patent offices, including Brazil's. The third most used database is Espacenet, from the European Patent Office (31%), where more than 140 million documents from different offices are available. 27.6% used Patentscope, based on the World Intellectual Property Organization (WIPO), which, in addition to patent processes at various offices, submits applications that are carried out through the Patent Cooperation Treaty (PCT). Finally, 21.1% of the respondents used the United States Patent and Trademark Office (USPTO), which presents processes from the United States, followed by Patent Lens (The Lens; 10.3%), which presents results from more than 95 countries. Furthermore, 10.3% indicated the use of other bases.

It is known that there are several ways to carry out the search, which may still vary according to the patent base. Thus, participants indicated that the techniques they use most are those shown in Figure 5. Interestingly, none of the participants responded that they used inventors as a search method.

Figure 5

Search method in patent databases



Keywords are the most widespread search technique among researchers (Figure 5), a system they are accustomed to using on other platforms searching for state of the art, such as on the Periodicals Portal. Therefore, it seems natural that the search for keywords is the most used criterion. The second position is the International Patent Classification, which classifies patent processes into technological areas and aims to recover documents more effectively (INPI, 2023). Gomes et al. (2019) highlighted that international classification is a powerful tool that facilitates searching and identifying patents in certain areas of knowledge.

The reasons given for accessing patent databases consist of the most diverse. Among those mentioned, the ones that stood out were:

- *Patent mapping*: characterized by the breadth of the search, relating to focus, interest, and intended objectives (Antunes et al., 2018; Caviggioli, 2016).

- *Text mining*: search with this focus allows the discovery of previously unknown knowledge in texts, where discovery operations can be performed based on the list of each keyword that identifies specific knowledge (Suh and Jeon, 2019; Kim and Jun, 2015; Song et al., 2017).

- *Identify technological routes (or citation network/patent family):* focuses on mapping citations contained in each patent document, allowing the analysis of technology development paths and the most promising technological trends (Linares et al., 2019; Suh and Jeon, 2019; et al., 2017).

- *Check freedom to operation*: Research on the freedom to operate aims to ensure that no infringement of valid intellectual property rights of third parties occurs, with an analysis of the technology relating to a specific product or process occurring (Paranhos and Ribeiro, 2018).

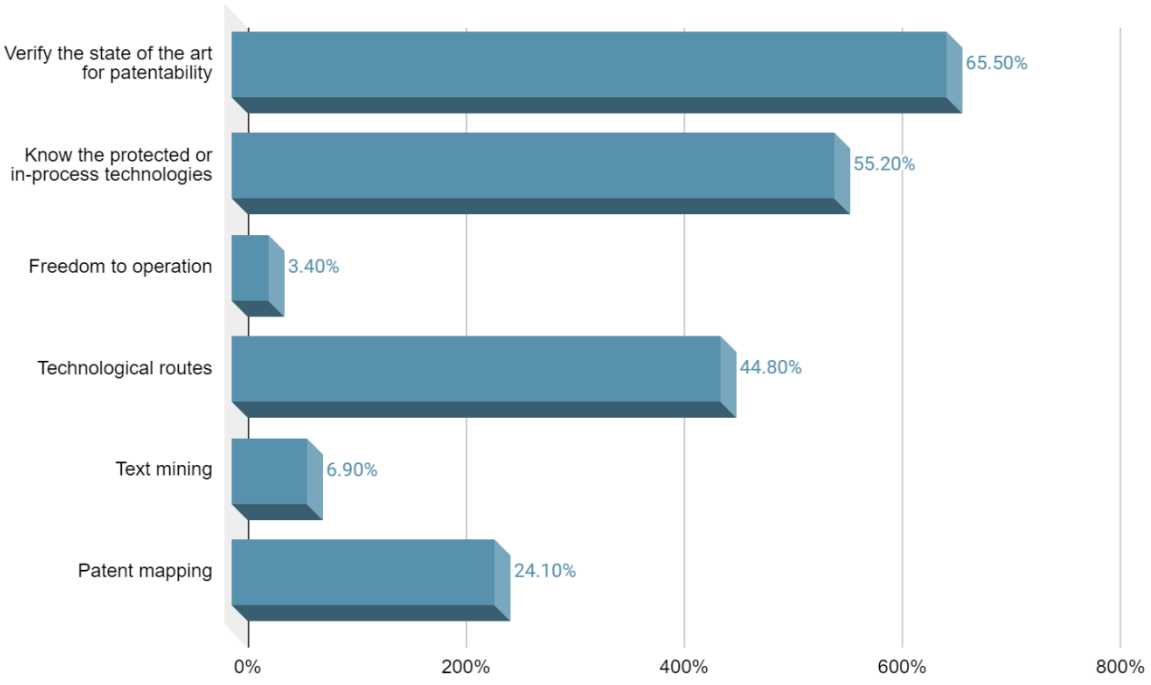
- *Know the protected or in-process technologies*: search the prior art, identifying patent processes that are in progress or have been granted related to the research object.

- *Verify the state of the art for patentability*: also defined as a search for prioritization, the purpose of which is to know and verify the state of the art of all existing products or processes related to a given technology, which, due to their proximity, may be indicated as prioritization, thus preventing until the patent application is granted. In summary, this research aims to determine whether there are patents or other previous publications that would violate the novelty requirement (Paranhos and Ribeiro, 2018).

Figure 6 shows the motivations for accessing patent bases.

Figure 6

Motivations for accessing patent bases

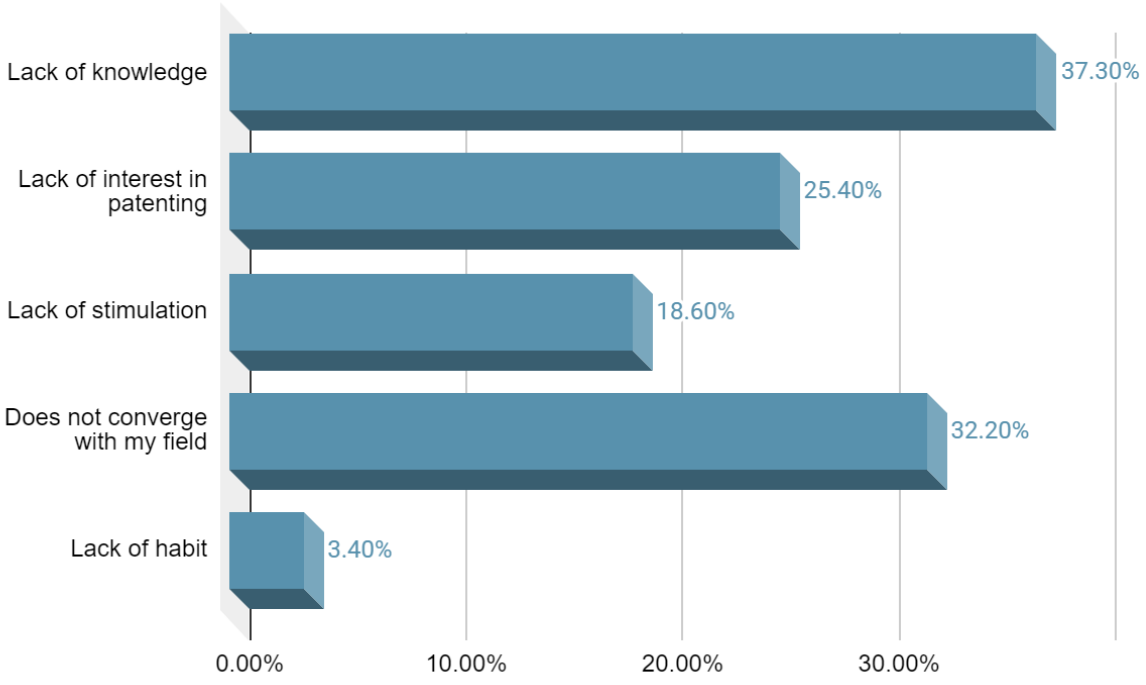


The researchers indicated that the greatest motivation for using the patent database is to verify the patentability of a product or process, that is, to file a patent application (Figure 6). The least mentioned reason is freedom of operation (3.4%), which can be interpreted as a low relationship between research and the market, as this factor is usually decisive for companies.

For respondents who indicated not using Technological Information contained in Patent Bases, the *survey form* directed them to another set of questions. These questions sought to understand why they do not use this set of knowledge. When asked about the reasons for not using it, respondents pointed out the reasons expressed in Figure 7.

Figure 07

Reasons for not using the patent base



Most cited by researchers is the lack of knowledge about the patent system, indicated by 37.3%, followed by the indication that the patent system is not relevant in the researcher's research area, with 32.2%. Following, due to the lack of interest in patenting, the results of their research were also cited as a reason by 25.4%. The lack of stimulation by postgraduate programs or CAPES was also indicated by 18.6%, and the lack of habit was also indicated by 3.4%.

Furthermore, the following factors were mentioned: complexity in the search, focus on academic articles, work carried out only with basic research, exploratory and less technological research, insecurity in using knowledge resulting from patents, patents do not apply to the research carried out, and also, characteristics of training that did not encourage technological research, where each of the items appears once, representing 1.7% each of them. Still, in this group, one respondent indicated that he did not know the reason (also indicating 1.7% of the total).

When describing why they did not use patent bases, we can group them into three groups. The first group, defined as motivation, associates the reasons that are perceived as a personal understanding of the research participant, the second group is the result of lack of knowledge of the topic, and finally, the result of the existing system.

i. *Motivation*: routines aimed at classic academic production and generation of scientific articles; lack of time; lack of interest in knowing;

ii. *Lack of knowledge*: no or little knowledge about patents and the system; difficulty using the bases; believing that patents are bureaucratic; they assume that patent bases are intended only for those who wish to patent; the knowledge generated is in the public domain;

iii. *System*: lack of incentive from the university and CAPES; articles have more value for postgraduate studies; In certain areas, patents have little or no relevance.

In many cases, the reports pointed to factors that can be associated with more than one group, as is the case of this researcher who says, "*My training process as a researcher was based on the search for the state of the art through articles in journals and conferences, with the focus, too, on their production. I understand that this was shaped by the academic assessment modus operandi proposed by CAPES in previous years."* In their speech, it is possible to identify the culture of Brazilian universities, especially in postgraduate studies. From this perspective, Pimenta (2017) associated researchers' lack of interest in patent documents as a source of technological information due to their lack of knowledge about the technical and scientific characteristics available.

The reality of many researchers is translated into the reason given by this respondent: "*I only research patents when I am going to make a patent for work I developed* ." By adopting the use of patent bases only to seek the patenting of some technology, researchers fail to use the great source of knowledge that is the system for application in scientific and technological development, that is, in research and writing scientific articles and academics.

In this sense, Jannuzzi and Souza (2008) highlighted that scientific articles and patents are helpful sources of information for researchers, and their uses are significant for generating and disseminating

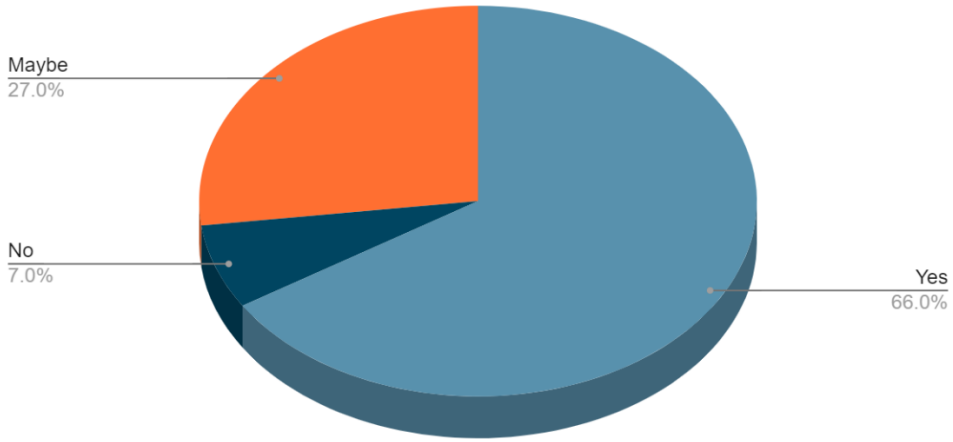
knowledge. Furthermore, we must note that each area of knowledge has its particularities regarding the publication of its research and respective results. Therefore, not all technical-scientific information is available in the scientific literature (articles, scientific events, and academic productions, among others), with part only available on patent bases. What can be seen is that the latter, identified as patent literature, ends up being ignored, as it has an excessively legal presentation or is difficult to understand (Pimenta, 2017).

Information for building a methodology

Research participants were also asked where they would use patent bases as a source of technological information if there were easily applicable methods in clean technologies (answers are shown in Figure 8).

Figure 08

Inclinations to use a new methodology/tool



We observed that most respondents were interested in using a method or tool that would facilitate or make the use of patents as a source of technological information more accessible or user-friendly, and

only a small portion was not interested (7%). Subsequently, we questioned the differences and suggestions for developing this method (Table 2).

Table 2

Criteria to search for technological information in the patent databases suggested by respondents

Search Templates	- Provide a search where it is possible to list the type of process with the keywords; - An interactive method where steps and tips on how to use patent bases were presented. In this sense, many suggested that it should be similar to the journal portal's search tool;
Results	- Possibility of achieving results from national and international databases in the same search; - Possibility of indicating subareas and interdisciplinarity in the area; - Indication of the status of the process, whether patents have been applied and granted; - Search engine that sweeps all other search engines;
Features	- Easy, fast, practical, no bureaucracy to use, free and reliable

Interestingly, a common and recurring point indicated by respondents refers to the need for training and encouragement from institutions to use the method. Finally, they were asked about the existence of assistance from any sector/unit in Universities to carry out searches in patent databases. Of the total respondents, 37.5% responded ‘yes,' 35.2% indicated ‘no,' and 27.3% responded that they did not have knowledge about the service and whether it was made available by universities. Those who receive assistance indicated that this comes from the Innovation Center, Innovation Agencies, or corresponding sectors.

Final considerations

The present work aimed to identify the perception of researchers' knowledge about using technological information on patent bases as a source for research development and under what conditions and for what purposes this occurs. This data collection was possible after applying a survey to all postgraduate programs linked to the "Engineering I" area, a sanitary engineering subarea registered with CAPES.

It can be observed that only 33% of researchers responded that they use patent bases. Of the 67% that do not use them, many are in Bahia, Distrito Federal, Mato Grosso do Sul, Pernambuco, Rio Grande do Norte, and São Paulo. In the states mentioned, all participants responded that they did not use patent databases for consultations. Those respondents indicated unanimous use of the bases, coming from the states of Goiás and Paraíba.

Another point to highlight is the fact that researchers who use patent databases indicated that they do not use the search for inventors. Academic practice often leads to a search for authors in research, and the same type of search could be carried out based on patents to locate technologies in specific research areas.

Generally, researchers who did not use patent bases believe they are only helpful for those who wish to patent. They did not perceive the bases as a source for generating knowledge in scientific production (both for use in articles and academic research).

It is argued that patent bases are an important information and knowledge tool. Their use is not restricted to the interest in patenting a specific technology. They should be used to survey the state of the art, just as the bases of scientific articles are used to understand the most diverse technological products and processes.

Finally, the study contributes to expanding the use of technological information contained in patent bases, demonstrating from data collection that they are still little used and demonstrating that using them means bringing to academic production the most recent in technology, whether products or processes, in the world.

However, like all research, the work has limitations, which in this specific case are associated with the percentage of feedback received in the *survey questionnaire*. On the other hand, this research identifies an important gap in the construction of academic research knowledge in Brazil, especially in stricto sensu postgraduate programs in Engineering I at CAPES, as it demonstrates that the technological information contained in the patent base is little used for knowledge construction.

For future work and as a sequel to this work, a method (methodology or tool) that facilitates using information on patent bases will be developed, especially to assist researchers in sanitary engineering. Another point that could be explored is checking why certain regions may show greater or lesser interest in the topic.

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Appendix A

Information Technological in Search

This poll's initial part of the work "Patents as a source of information technology to improve research in technology area environmental" was carried out by the doctoral student in Environmental Technology at the University of Santa Cruz do Sul - UNISC, Isabel Grunevald.

Professors Dr. Liane Mahlmann Kipper and Dr. Jorge André Ribas Moraes guided the work. The proposal is to identify whether and how access to technological information occurs in patents, proposing a methodology for easy access to such information at the end of the thesis.

The time required to answer this questionnaire is a maximum of 5 minutes.

If there are any questions while filling out, be sure to get in touch via email at isabelgru@hotmail.com or phone/WhatsApp (51) 9XXXX-XXXX.

The research was not submitted to the Research Ethics Committee - CEP, considering the provisions of CONEP Res. 510/2016 in its art. 1st, sole paragraph, item VII, regarding cases where the research is not registered or evaluated by the CEP/CONEP system.

We appreciate your valuable contribution!

The University where I work is:*

If you act in both, check both options.

- ☐ Public
- ☐ Private / Community

What is the name of the Postgraduate Program you are enrolled in?*

Your answer

From the Program above nominated, you are:*

- ☐ Coordinator (or who holds another management position in the Program)
- ☐ Lecturer or Researcher

I work in the state :*

To choose

Do you use the CAPES Journal Portal to check your field's state of the art?*

"State of the art" or "state of knowledge" is considered research of a bibliography for information about academic production in different fields of knowledge. Methodologies include inventories and descriptions of academic and scientific production in different fields of knowledge.

- Yes
- No

Do you use patent bases to verify your research's state of the art?*

For this research, "state of the art" is all knowledge made accessible to the public through the patent process, regardless of its grant status.

- Yes
- No

Uses Technological Information on Patent Bases

Considering the use of the information on patent databases, we request the information indicated below.

When was the last time you used patent bases?*

Choose the most appropriate option.

- In the last month
- Three months ago
- Six months ago
- 12 months ago

Select the bases you usually use:*

Indicate all the bases you usually use.

- INPI - National Institute of Industrial Property
- Espacenet - Office Base European Patent Office
- WIPO/OMPI - Base of the World Property Organization Intellectual
- USPTO - United States Patent and Trademark Office's
- Patent Lens
- Google Patents
- Others

To carry out the research, which search input do you usually use?*

Check which alternative(s) are used.

- Keywords
- Classification Patent International
- Inventors
- Holders
- Other

If you marked "Other" in the previous question, indicate which one(s).

Your answer

Why do you carry out the patent search?*

Indicate all your main reasons.

- Check the state of the art for patentability
- Know the technologies that are protected or in process
- Check freedom to operate (FDO)
- Identify routes technological (or citation network/patent family)
- Text mining
- Mapping patent
- Other

If you marked "Other" in the previous question, indicate which one(s).

Does not use Technological Information contained in Patent Bases

Considering that information on patent databases is not used, we request the information below.

Why do you not use patent bases to search for technological information?*

Check your reasons.

- I do not have knowledge in the area
- I am not interested in patenting my research
- There is no stimulation by CAPES or the Postgraduate Program where I am inserted
- I believe that in my research area, patents are not relevant
- Other

Describe the reasons that led you to indicate the answer(s) to the previous question.*

Your answer

Information for building a methodology

If there was a method easily applicable used for searching on patent bases targeted to your area, Would you use it ?*

- Yes
- No
- Maybe

Justify your response. If you have answered "YES" or "Maybe" in the previous question, what would make a difference? What suggestions would you have for the development of this method?*

Your answer

Do you have assistance from any sector/unit at the university to search on patent databases?*

- Yes
- No
- No, I have knowledge

If you receive assistance in your university, indicate what sector/unit :

Identification

Identification is not mandatory.

Full name:

Your answer

Contact email:

This is a search in development. If you require further information, feel free to indicate your email address, and we will send the material.

Your answer

Use this space for general considerations, if necessary.

Your answer

To send