

THE USE OF PATENTS DOCUMENTATION INFORMATION IN THE ENGINEERING TEACHING AND ACADEMIC RESEARCH

Nunes, Jeziel, jeziel@inpi.gov.br

Oliveira, Luciana, luciana@inpi.gov.br

Barcelos, Sérgio, barcelos@inpi.gov.br

Instituto Nacional da Propriedade Industrial, Praça Mauá, nº 7 Sala 716 – Rio de Janeiro - Brasil

Abstract. *The Patent System, such an important technical source, answers for about 70% of technical publications in the world, but is barely used in professionals' education of Engineering in Brazil. Some initiatives to introduce the knowledge and use of Industrial Property information – IP, in academic environment occurred in Economic and Juridic fields. The present work aims to demonstrate the viability of using technical information contained in Patent Documentation in the Engineering teaching, mainly in disciplines concerned with design, innovation and production, complementing engineer's education with useful knowledge to their Professional acting, as the protection of results of researches. Concerning to academic research, it is possible to identify the protected Technologies, avoiding duplicity of effort, reducing initial costs, discovering unpublished fields for new and original researches, as well as appropriating financial results from the protection. The international context of Research and Development aids the teachers to foresee new technological directions in their fields and aids them to evaluate more accurately these possible changes implications in academic teaching and research.*

Keywords: *engineering teaching, industrial property, patent information, academic research*

1. INTRODUCTION

During the last years the discussion of themes such as Science, Technology and Innovation became a constant in all Country's economical life sections, given its repercussion on the development process of Brazil and other countries of the international community. The current international conjuncture presents intransigent competition among the countries, stratifying them between the ones that develops and sell technologies and those that acquire them and remain dependents.

Brazil has been moving forward in this discussion, but still finds many impediments, most of the time of bureaucratic order, to implant a new mentality that will allow them to get the quality jump capable to put them, definitively, in a more coherent position with that the Country already reached in terms of scientific publications. In relation with this parameter, Brazil is in a comfortable position; he is the 11st position in the international rank, with 1.8% of the world total published articles. However, the correlation between the performance of the scientific publications and the applications of patent applications indicates the existence of great discrepancies between the two protection procedures, as it is verified in the incipient Academy's performance in Industrial Property area in the last 15 years. This situation can be observed in the studies elaborated by Assumpção (1999), and Nunes and Goulart de Oliveira (2007) with some results showed in Fig. 1.

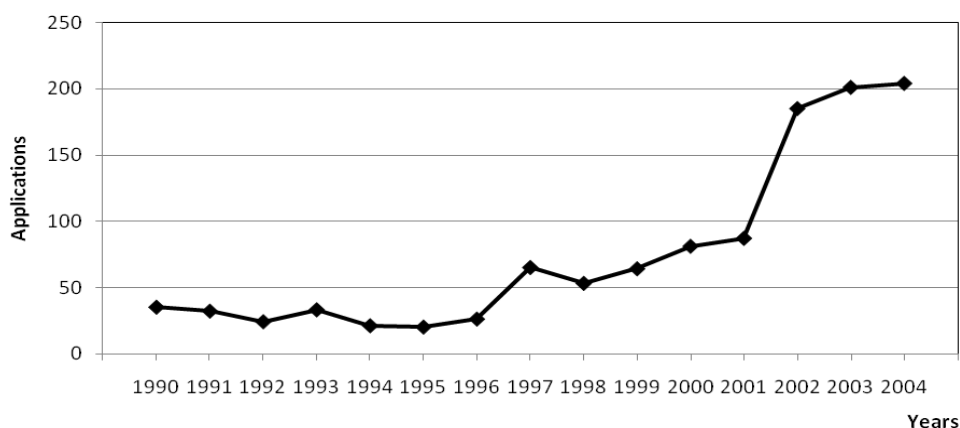


Figure 1. University applications evolution from 1990 to 2004

The repercussion of this disinformation and consequent attitude has two serious components: the first is that the research accomplished in public universities is, in its majority, sponsored by public resources and the developed technology rarely arrives to the Society use. The second is that Brazil's participation in terms of technology purchase is

growing in the last years, having already crossed the figure of 2 billion of U.S. dollars per year (Table 1), a fact that seems senseless in view of Brazilian researcher's qualifications and the work accomplished in the Academy.

Table 1. Technology Acquisition Payments

	2000	2001	2002	2003	2004	2005
Patent License	94	75	59	75	64	193
Knowhow	619	505	485	454	470	646
Technical Assistance	401	429	423	416	292	306
Specialized Technical Service	1.050	1.086	982	1.141	1.379	1.396
Total (US\$ Millions)	2.164	2.095	1.949	2.086	2.205	2.541

Source: INPI, Statistical Report

Exactly this asynchronism between the scientific knowledge developed in the Academy and its technological projection established through granted patents is one of the reasons why changes in the quality of the existent relationship between the Academy and other sections of the society should be rethought.

Another divergent reality found in Brazil, in relation to the most technologically advanced countries, relates to researchers' small mobility in relation to the industry, which harms the assimilation and the development of endogenous technologies by companies (Elias, 2007). Besides, it isn't also found here investments in research being done by the productive section, but especially, it is done by the public sector, what transforms the lack of appropriation of the spread knowledge for the scientific publications a loss of part of the resources invested in the Academy by the Government.

With this detached picture, it doesn't seem strange that the information contained in the patent documentation is practically not used in the teaching and/or in the academic research in Brazil. Even being a source of information that represents about two thirds of all of the technical publications available in the world, (Marmor, 1979), what would turn it desirable in the development of any creative activity in the technical area, because besides supplying unpublished technical information, it eliminates the possible coincidences, representing time and financial resources economy, it can be said that the patent system is not known at the academic environment.

First of all, we tried to understand which reasons could justify this indifference, since for an IP system expert it does not seem logical that this information could be despised, mainly for specialists of the highest intellectual level. However, it is observed that in the academic environment there is considerable resistance in using the Industrial Property system, partly because of cultural or ideological values (Fujino and Stal, 2007), that states for publication and unrestricted use of the research results, but mainly because of the lack of knowledge of the advantages that the use of these information provides, not only to the engineer's education as well as to the academic research.

One may conclude, then, that the theme has never been introduced in a systemic way in Engineering teaching, and, for this reason, the majority of teachers ignore the Industrial Property System, and by consequence the patents. Some initiatives to introduce the use of Industrial Property - IP in Academic environment have been happening in the Economic and Juridic areas (Amorim-Borhe *et al.*, 2007), but are almost inexistent the approaches of technological aspects contained in the Patent documentation. It should be highlighted, however, the important initiatives of Technological Education Federal Center (Centro Federal de Educação Tecnológica - CEFET-RJ), of the Chemistry School of Federal University of Rio de Janeiro (Universidade Federal do Rio de Janeiro - UFRJ), and some other few institutions that have already begin to deal with the problem.

So, it seems to be clear that the first stage to introduce that matter formally in the Academy is to conquer the interest of the teachers, who once knowing and using IP in their activities, could possibly pass this knowledge for their students in such a manner to seduce them.

It is observed that, nowadays, the Engineering teaching has a saturated course content with a tendency of enlargement, situation partly caused by the arising of new technologies that increase demands to the market, asking that this new knowledge is already incorporated to the new Engineering professionals just coming out from universities.

Thus, it seems to be inevitable that at medium term, to comply with these new demand fresh themes in disciplines of professional cycle will be included. In this scenery, there would be the need to balance between the obligatory content and the desirable one, what, probably, would provoke the enlargement of the course content, increasing the period for the engineer's graduation. This reality brings the following effects: the increase of the education cost, the delay in the job market professional's placement, although better prepared and, last but not least, the impossibility of experiencing the study of subjects that could lead to a better understanding of business aspects that encompasses industries activities and realities.

The equation to be solved is how to establish a new discipline in an environment of limited time of duration of the course that already needs expansion, besides being less and less sought. The repercussions of this trend is already felt at the market, where it could be verified the lack of Engineering professionals to assist the Country's demands.

On the other hand, until which point it would be possible to attract the student to participate in learning a strange knowledge to the academic environment, which use is not evident to them at the beginning of their professional life, especially if this student is going to work in the productive sector, that does not usually interact with the innovative process. This reflection, also, could lead to many other discussions, including the deep distance between industrial sector and universities and how prejudicial and restrictive this reality happens to be.

With the Innovation Law, published in 2004 and normatized in 2005, this reality begins to change, though there is still no consensus about its effectiveness (Stal and Fujino, 2005). Although at first dedicated to research, this Law considers some aspects of the Industrial Property in its application, creating an obligation for the Academy to react by taking account of the theme and beginning to participate in the formal inventive process, giving their contribution to the technological development and in the protection for patents of the knowledge that generates. The main repercussion the Law brought is the obligation that the universities take the appropriate measures to create their own Technological Innovation Offices (Núcleos de Inovação Tecnológica – NITs), where all the questions pervading Industrial Property will meet answers and solutions.

The challenge of establishing in Brazil a culture based on innovation is supported by the perception that the knowledge production and the technological innovation started to dictate countries development policies more and more. In this context, knowledge is the central element of the new economical structures that appear in international scenery, and innovation becomes the means of transforming this knowledge into wealth and improvement of life quality to societies.

Due to these considerations and in support to the dispositions of the Innovation Law, the present work does not bring miraculous answers to change this reality, but it seeks a way of discussing the issue, since the introduction of the theme and discussion of performance methodologies are, besides others, an important step in the direction of a possible solution.

There are two approaches which, although extremely interlinked, will be discussed separately: the first of them is the introduction of Industrial Property in Engineering teaching as a regular course and, the other is its use in academic research.

2. A PROPOSAL TO INTRODUCE INDUSTRIAL PROPERTY IN ENGINEERING TEACHING

Two forms are proposed on introducing that matter in the Engineering formal teaching and their consequences for the academic research. The creation of a specific discipline of elective character in order to develop the formal teaching of the Industrial Property, with emphasis on the use of the technological information contained in the patent documentation in the engineer's education will be the first of them.

The main problem of this approach is the inclusion of one more discipline in a course content already so congested due to the enlargement of the formal knowledge basis, added to the fact that this new discipline would compete with others of larger market appeal, by just following the fashion or the real market demands. On the other hand, it should be considered the workload that even for an elective discipline of, for instance, three months, could be considered too much to deal with this subject by the point of view of using the system as proposed. The referred discipline will not be formatted to form Industrial Property specialists; but the use of the information contained in the patent documentation and identification of susceptible to protection matter.

The second form will be to introduce a basic module regarding the use of Industrial Property information in the content of some initial disciplines of the professional cycle, that would be a pre-requisite for the other ones and that content practices related to projects, production and/or innovation. In the subsequent disciplines with the same characteristics, the theme could be introduced gradually, so that in the end of the course the student will gain knowledge about the use of the Industrial Property system.

If only just a part of the teachers understands the system, great contribution could be given to the Country, mainly for those who have a business profile or are able to find opportunities during the study. For this professional, it will be of great importance to have knowledge about the Industrial Property System and their use, in order to begin an enterprising career with innovative vision, competing and even with export propensity.

2.1. Introduction of the theme in the course

During the last two years, the National Institute of Industrial Property – INPI – acquired good experience supplying Industrial Property Courses in several levels: basic, intermediate and advanced, with about 40 hours/class each module. These courses were elaborated to transmit to the students basic concepts about the use of patent documents and they can be adapted to be used in the formal introduction of the theme in the Academy.

For the student to learn the basic knowledge about the industrial property system and use it in the Engineering course will be necessary three modules, containing with the following themes: 1) general notions of the system and of patent documentation; 2) the International Patent Classification and the patent database information search and recovery mechanisms; 3) the use of patent information, how to deal with it and use in Engineering teaching.

In the first module, the student is introduced to the international patent system, focusing the aspects that will be essential for the correct use, such as: the basic Industrial Property legislation, the innovation and inventive activity concepts, the knowledge of what can or not be patented, and protection forms. Then the patent document structure is studied in a more detailed way, once the knowledge of this structure will allow the student to identify in the document the problem that he probably is intended to solve, and the state of the art identification highlights the previous technical solutions already used in the solution of a similar problem. Patent reports are also analyzed, with the detailed

description of the proposed solutions and what innovation they bring regarding the state of the art. An analysis of the schematic drawings that compose the document is also made.

In the second module, the student learns three search mechanisms: classification search, text search and citation search. The first step is to learn the International Patent Classification – IPC, a structured indexation system that allows to look for and to select documents for the specific technology, focusing search result in the interest subject, and avoiding undesirable information. IPC is in the eighth edition and is used for more than 90 countries, allowing the selection of any technology without knowing the referring synonymy or even the idiom in which the document was written. The second step is to learn about the textual search in the patent database. To do so, search techniques are taught in the free access databases available in the Internet by offices of the most technologically developed countries. It is important to understand that the patent documentation search is a learning process in and of itself. This is an iterative process, in which the “searcher” acquires knowledge of searching process, refines his recovery technique and understands the particularities of each database. The search gives to the “searcher” a distinguished vision of the technology of interest, since who makes the search accesses simultaneously almost all of developed solutions proposed by the main actors of the market.

The technique of progressive search is usually used in text search to avoid information losses. It begins with a broad or generic strategy of approaching the problem, using terms that combine the structure with the function of the problem. In a next step, aspects or more specific components are gradually introduced (more focused vision). Afterwards, the obtained result is refined, increasing to the general structure functions or stricter characteristics. Finally, it is combined in the same search, the structure and the specific function. To avoid redundancy, this method requests subtraction of the group of results at each step or search.

Citation searches usually reveal the document relevance in the searched subject, and can include searching backward or forward in time.

It is important to observe that searches should be made using all searching mechanisms together or separately, in order to have minimum information losses. It should be noticed that the classification search do not consider erroneously classified documents and text search is not precise in treating documents with ambiguous or imprecise title.

The third module treats how to obtain and use the information within patent documentation. From this topic the student begins to use, indeed, the information set in a technical and managerial way, looking for to survey what has been developed globally. The first step is the separation, inside the group obtained in the searches, those more relevant documents relatively to the wanted object. This separation is made through reading the abstract and the drawings, followed by the claim, alternatively. Then the following question must be answered: What problem does the invention solve? What is the invention? What does the invention do? Although to answer to these questions may seem simplistic, it will define those documents that can supply the sought information.

2.2 Use of information in Engineering courses

Presuming both teachers and students are already familiarized with the Industrial Property System, it is proposed the development of a methodology for using of this IP system on teaching the Engineering course technical content. So effectively it begins the IP System information use in the complementation of conventional course content acquired knowledge. In the beginning, this information must be applied in the execution of exercises where the student is encouraged to compare the formal solution for the problem with the one available on patent documentation. In a comparative analysis, solutions coincidences can be verified, seeking whenever possible to develop a new solution for the problem, deviating from already existent solutions in the state of the art and exercising the concept of novelty and innovation.

In more practical approaches for the courses proposed, problems should be able to assist to the course formalisms, as to allow the use of Industrial Property in the problem solution. By this method it becomes easier for the student to notice the importance of the information brought by the IP System and of its total suitability to the study and research environment in which he is inserted. In the result evaluation, it should be considered not only the classic aspects of the course, but also those related to Industrial Property, such as novelty, inventive activity and industrial application. These aspects, not usually considered in the student's evaluation, could be part of the composition of the final grade.

An aspect of main importance to the success of the theme proposed also is choosing adequately the phase of the education in which should be initiated the teaching. By acquired experience from INPI, it is suggested to introduce the teaching of the Industrial Property system use in the professional part of the course and preferably, in the last two periods, on final dissertation, scientific initiation or in projects where there comes the need of bibliographical revision or knowing the state of the art. Complementary activities should be stimulated as to help consolidating the new acquired knowledge, such as scientific initiation works, multidisciplinary projects, prototypes development, etc.

In spite of difficulties, it is intended that the proposed changes can gradually be introduced, in consonance with each institution readiness. The important is to begin to do something in that direction, because this type of knowledge is gaining importance in world's everyday life.

Once the student has already acquired the basic knowledge on how to use the information of the system, he is able to use such information in the initial phase of project or work, to elaborate a general survey of existent solutions for the studied problem, to understand the philosophy of each development, and the applied technological basis in the solution.

A free patent public database searching is started and the obtained document set is analyzed; the representative ones are separated; the technical solutions proposed by the inventors and the technological routes already used in the state of

the art are identified. Afterwards, the theoretical approach used in each one of solutions is analyzed; new contributions identified and radical from incremental innovations are separated. Then comes the more relevant phase, when the application of conventional theoretical acquired knowledge is brought together with the acquired from patent documentation in the development of an unpublished solution for the problem, deviating of the state of the art.

3. A PROPOSAL TO INTRODUCE INDUSTRIAL PROPERTY ON ACADEMIC RESEARCH

Along the time, the academic research have been accomplishing their role on enlarging knowledge basis and on looking for solutions for the national problems, in spite of such knowledge are still no publicized and few benefits taken by the Brazilian society.

As previously mentioned, the Academy does not use Industrial Property System also in their researches, and in appropriating their results. In the study elaborated by Nunes and Goulart de Oliveira (2007), it remains demonstrated that patent applications originating from of Academy represent about 1.8% of the residents' filed patents in the Country. Considering that the effective grant profile of Brazil is of just about 24% of this percentage (Fig.2), a very small percentage of these patents will bring benefit to the society.

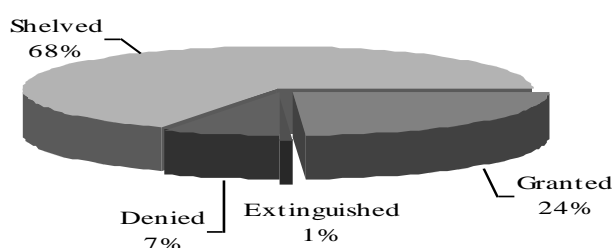


Figure 2. Brazil's decision profile

Among the resulting consequences of the non-use of Industrial Property System by academic research institutions in Brazil, we can point, for instance, the not appropriation of technologies sponsored with public resources; researchers' non recognition for accomplished developments; and researchers' non payment for commercial exploitation of results. Another consequence is that not knowing the technological collection produced by institutions, Brazil has been acquiring foreign technologies and is paying annually more than 2 billion U.S. dollars, over the past years.

Besides, for not knowing the theme, the researcher has no capability to identify which parts or aspects of his research would be susceptible to become a patent and in the most of times he gives publicity to the researched technical matter, making unfeasible its protection and eventual resources generation.

Many people believe that Brazil today already has mechanisms to modify this situation and one of them is the previously mentioned Innovation Law, but others can be mentioned, as the new industrial policy, and the regulations regarding participation of research institutions and their researchers in the resources generated by the Academy's patent.

The Innovation Law n° 10.973, of December 2nd 2004, regulated by the Decree n° 5.563, of October 11th 2005, reflects the need of the Country to count on an efficient legal set to contribute to the establishing of favorable scenery to the scientific and technological development and to incentive innovation.

One of the main features introduced by the Law is that public universities are forced to create their Technological Innovation Office, which is going to manage and run the researchers and students subjects concerning Intellectual Property at the institutions. This procedure will aid on changing reality described previously, in which a lot of research is made and little is appropriate by University, therefore it will be possible to take financial benefit and generate resources for new investments.

This Law contributes also to the current Industrial, Technological and External Trade Policy (PITCE), of the Federal Government, as it promotes, among other objectives, the efficiency improving of the Country's productive chain in a way to technologically qualify them for the competition in the international market.

The law regulation is organized in three branches. The first concerns to the constitution of a favorable environment to strategic partnerships among the universities, technological institutes and companies and this will force the Academy to necessarily use the Industrial Property System. In this sense, the Law contemplates several support mechanisms and incentives to the constitution of strategic alliances and development of cooperative projects among universities, technological institutes and national companies, such as: a) Nets structuring and international projects of technological research; b) Technological entrepreneurship actions; and c) Creation of incubators and technology parks.

It will also create means so that the Science and Technology Institutions (STI) can share, by remuneration, their laboratories, facilities, infrastructure and human resources with companies (even very small companies) and non-profit purposes private organizations, for incubation or researches activities.

The second branch treats of the incentives to Science and Technology institutions to participate in the innovation process. In this branch, the Law allows STI to celebrate technological transfer agreements and patent licensing to sell

specialized consulting services to productive sector, as to incentive their employees' participation in projects where the innovation is the main focus. In order to make the situation above described possible and to manage in a general way the innovation politics of STI, especially in what it plays protection of the knowledge, the Law determines that each STI constitutes a Technological Innovation Office by their own or in association with other STI.

The researchers associated to STI, when involved in the services activities undertaken by their institutions, will be able to, in specific cases, take benefit of the financial result of these services, independently of the remuneration received by the institution. Equally, as inventor, the researcher can receive a portion of the financial earnings gained by the STI, when of the commercial exploitation of his creation.

Also, it allows that the STI government employees receive, as incentive to the innovation, financial support from institution or fomentation agency involved in the activities undertaken in partnership with the institution where he works.

The third branch refers to the incentive to the innovation in the company, through legal statements that look for stimulate larger contribution of the productive sector concerning to the allocation of financial resources in the promotion of the innovation. To do so, the Law foresees the concession – by the Government, STI and fomentation agencies – of financial, humans, materials or of infrastructure resources, to assist national companies involved in research and development activities. By contracts or specific agreements such resources will be adjusted among the parts, still considering the priorities of the national industrial and technological policy.

The financial resources can come under the form of economical subsidy, financing or corporate participation, and in the case of the economical subsidy, the resources should cover just the costing, and compensation of the beneficiary company is demanded.

The support to Research and Development activities that involve technological risk for solution of specific technical problem or product obtaining or innovative process is also supported, as well as the implementation by fomentation agencies of programs with driven actions, especially, to the promotion of the innovation in small companies.

As can be observed, existent Law represents and covers a wide group of actions, whose main objective is to enlarge and to accelerate the transfer of the knowledge created in the academic environment for its appropriation by the productive sector, stimulating the innovation culture and contributing to the industrial development of the Country.

Obviously, this device will only be effective if the Academy will objectively be able to answer to the hopes of the Country and, to do so, it needs to act immediately and with determination before this reality.

It is understood that, in the same way that for introducing the matter in teaching, the first step will be to qualify the researchers for the use of the Industrial Property System in the academic research. Considering these professionals' high level, it will not be difficult and relatively fast. So soon this training is consolidated, the use of the system will be an inevitable consequence.

The research in the patent documentation makes it possible to researcher to obtain fundamental information for the clear and objective definition of the research that he intends to begin. Through this information the researcher accesses to the detailed description of the solutions presented for similar problems, allowing them to decide by the continuity of the research or their redefinition.

Through documentation analysis it is also possible to know: technological routes; radical and incremental innovations; the new actors that enter in the scenery; changes in the strategy of Research and Development of the companies; the most active companies in specific technologies; the technologies protected by each company in Brazil; the core business; technological direction changes; businesses opportunities; the novelty movements; among other possibilities.

The first and maybe more important questioning to be maid on starting a research is to know: The research was ever made; with what inclusion; which reached results. The answer to these questions can avoid resource expense in searching of solutions that were already reached previously. Studies demonstrated that in United Kingdom about 10 million pounds are wasted in the repetition of already existent solutions.

Several other questions can be answered by the IP System, such as: What is in public domain; how mature are the research results; which are the actors acting on the researched sector; who are the new ones incoming in the field; which are the current and future technology trends; which are the countries of origin of the technology and their branches; which are the countries of interest of the companies to applications their patents; which are the main inventors; which businesses can Technology launch; who are the contestants; which patent is more mentioned; etc.

The knowledge of these answers before beginning the research allows to the researcher not only a diagnosis of the technological situation, but also offers specific information to aid the choice of the research theme, the technology, the forecast of investments, etc.

In the last years, some actions have been developed in order to take benefit of this expertise for the production of goods and services of high technological value, by Technological Basis Incubators associated to institutions or through direct partnerships with companies, but they are still very little.

As a result, it is demonstrated how it is possible to identify the origin and the evolution of a given technology, using the information contained in the patent documentation as source of technical reference for didactic use in the engineer's formation. It is also possible to advance which are the technological directions of the several sectors, making it possible to evaluate which would be the insert of these changes in the course content of the courses, aiding in the planning of eventual changes.

It allows a new approach of the technical problem, complementing the theoretical structure of teaching, with the analysis of the solutions adopted by the main actors of the market, once it is possible to access the detailed description

of the solutions presented for the problems, how they were treated by the technique, identifying the used technological routes. It aids the identification of the radical and incremental innovations and their differences, qualifying the student to identify the so-called inventive step. Another important consequence of the use of this information is the identification of radical changes in the lines of the main actors' Research and Development in the international context and the possible implications of these changes in Engineering teaching. Regarding the academic research, it is possible to identify which technologies are protected and by who, avoiding duplicities and exposing the unpublished fields for the new researches.

4. REFERENCES

- Amorim-Bohrer, M.B., Ávila J., Castro A.C. Chamas C. Paulino S., 2007, "Ensino e Pesquisa em Propriedade Intelectual no Brasil", *Revista Brasileira de Inovação*, Rio de Janeiro 6(2), pp. 281-310, julho/dezembro.
- Assumpção, E., 2000, "O Sistema de Patentes e as Universidades Brasileiras nos Anos 90", Instituto Nacional da Propriedade Industrial, Rio de Janeiro.
- Elias, L. A., 2007, "Política de Inovação e Propriedade Industrial", XXVII Seminário Nacional da Propriedade Industrial, Anais, pp.60-68.
- Fujino, A. and Stal, E., 2007, "Gestão da Propriedade Intelectual na Universidade Pública Brasileira: Diretrizes Para Licenciamento e Comercialização", *Revista de Negócios*, Blumenau, v.12,n1,p,104-120, janeiro/março.
- Hunt, D., Nguyen, L. and Rodgers, M., 2007, "Patent Searching Tools & Techniques", John Wiley & Sons, Inc
- Marmor, A.C. *et al.*, 1979, "The Technology assessment and forecast program of the United States Patent and Trademark Office", *World Patent Information*, Munich, vol.1, n.1, pp. 15-23
- Nunes, J. and Goulart, L., 2007, "Universidades Brasileiras - Utilização do Sistema de Patentes de 2000 a 2004", INPI, Rio de Janeiro.
- Stal, E. and Fujino, A., "As relações universidade-empresa no Brasil sob a Ótica da Lei de Inovação", 2005, *Revista de Administração e Inovação*, São Paulo v.2, n.1,p5-19.

5. RESPONSIBILITY NOTICE

The authors are the only responsible for the printed material included in this paper.