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MANAGEMENT OF TECHNOLOGY TRANSFER OFFICES: LESSONS FOR BRAZILIAN UNIVERSITIES

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Introduction

During the last decades, university-industry relationships have become a central subject, due to the essential role played by technological progress in the economic development of the countries.

The development of an innovative system based on the interaction of academy with industry has promoted different ways to optimize the link between science, technology and economic development.

In this context, the association between universities, industries and government constitutes one of the best ways to establish links between technology and economic development.

From the theoretical point of view, the linkage of these three agents - university, industry and government - has been the object of different analyses, ranging from the macro perspective to the establishment of conceptual models of technology transfer from the university to industry.

The system established by this joint, has as its primary target the complementarities between the agents: universities, as producers of the scientific and technological knowledge; industries, as promoters of the development and innovation of new technologies; and the government, acting as regulator and promoter of such relation. The complementarity of these three agents provides stability to the system and realizes the information potential generated by each one of its parts (Etzkowitz, 1996).

In sharp contrast to the situation of innovations based on the contribution of individual inventors, the need to increment institutional relationships is a result of the increasing

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complexity of research and of innovative activities, which demand the creation of formal structures and a more propitious atmosphere for the production of innovations (Dosi, 1988).

As a starting point for enhancing their participation in these institutional arrangements, specific mechanisms have been devised by universities, such as Technology Transfer Offices (TTOs), created with the objective to stimulate and to facilitate their interrelation with the other two agents of the innovation systems: industries and government.

In Brazil, although the creation of this mechanism represents the institutional recognition of the importance of incorporating technology transfer as a formal function, the introduction of new routines, that are "imported" from private sector practices, in the academic environment has not been fully accepted, due to different perceptions from the university community about the university's mission as well as to a lack of capabilities to deal with business activities that are new for universities' managers. Those institutions where such offices have been adopted assign them the duty of administrating all the services related to the interaction activities, including management of intellectual property and licensing.

Within this context, this paper analyzes the importance of the role performed by Brazilian university TTOs, from the point of view of their organization, policy and performance. The diagnosis carried out has the purpose of determining: a) the main functions of the offices, (b) the position they must have within the university structure and (c) it's the pattern of internal relations and withthe market. With the purpose of strengthening this diagnosis of Brazilian offices and drawing recommendations for their sound management, the case of the Office of Interaction and Technology Transfer (EITT) of the Federal University of Rio Grande do Sul (UFRGS) is presented.

1. The Technology Transfer Office Model

The technology transfer office constitutes an institutional mechanism created with the aim of promoting interaction of the university with the productive sector, especially with companies, and the government. The setting-up of TTOs derives from the necessity to improve the effectiveness of university performance in order to better correspond to social demands, particularly through research results transfer and licensing of proprietary technologies and know how.

According to Solleiro (1993), management of university services includes development and establishment of common objectives that serve as a guide for the interaction process.

In a general way, activities developed by this institutional mechanism are similar in most institutions, with small variations depending on the emphasis that orients their creation (Dos Santos, 1990; Albornoz, 1993; Solleiro, 1993; Cunha, 1998).

In this section the main concepts involved in the subject will be presented.

1.1 Concept

Before defining the TTO model, it is necessary to draw some considerations about the concept of technology transfer, because the more precise the concept, more focused will be the activities developed by the TTO.

1.1.1 Concepts of technology transfer and their implications in the concept of TTOs

Initially, it is necessary to establish the basic assumption that the primary mission of the university must be education and research, and that technology transfer can be used to support this primary mission (Mejía, 1998). Technology transfer is not a new phenomenon in universities. Historically, research universities have transferred technology using traditional methods, like publications, student education and extension programs. Technology transfer through intellectual property and know-how licensing added a new educative dimension and research opportunities to professors and students (COGR, 2000, p.3).

Thus, technology transfer is made through several ways: oral communication, physical transfer of a tangible research result or through the licensing of intellectual property. Under this point of view, technology transfer, for Parker and Zilberman, " is any process by which basic understanding, information, and innovations move from a university, an institute or a governmental laboratory to individual or firms in the private and quasi-private sectors" (Parker and Zilberman, 1993, p. 89). For these authors, the scope of the definition is based on the essence of the university mission as creator of public good and includes information transfer (conferences and publications), educative activities and qualification, consultancy, patenting, licensing of innovations and creation of start-up companies.

For Berneman and Denis (1998), the immediate goal of technology transfer is to facilitate the movement of academic research discoveries from the laboratory towards the market, aiming public benefit. Observing cultural differences between the university and the company, the authors define technology commercialization as a bridge that links both cultures through university-company interaction.

Thus, the institutions, which adopt a narrow concept of technology transfer, based on the commercialization of intangible assets, the offices activities are centered in commercialization of intellectual property. The definition of TTO adopted by OECD expresses this conception:

> "Technology transfer or technology licensing offices are those organizations or parts of an organization which help the staff at public research organizations (PRO) to identify and manage the organization's intellectual assets, including protecting intellectual property and transferring or licensing rights to other parties to enhance prospects for further development. A PRO may have a single centralized TTO, it may have several TTOs associated with it(e.g. for different schools or departments), or it may outsource to an external TTO which has several clients organizations " (the OECD, 2003, p. 80).

Under this definition adopted by the OECD, we can identify TTO's which operate since the second half of the XXth century: the TTO of the Fraunhofer Society of Germany was created in 1952 and those from the University of California, in the United States, in 1926.

Nevertheless, these are exceptional cases, because most of the TTOs are young, having an average of 12 years in the United States, and less than 10 in the other countries of the OECD, according to the referred reports.

The most diverse TTOs experiences can be identified in different parts of the world, from offices that are inserted in the university organizational structure itself to those which constituted independent instances and put into practice a technology transfer process in the university's name.

The OECD concept points out that the main activity of the TTO is intellectual property and the activities related to its disclosure, protection, and licensing operations.

Rogers et al. (2000) defines technology transfer as a process that consists of several stages, from the invention disclosure until patent licensing. It can take several years, after a technology is protected, until the university receives royalties (income obtained by the sale of products) originated by the licensed technology. For that reason, to measure the efficiency of technology transfer, it is important to consider all stages, and not only one.

Also considering technology transfer as a process, Friedman and Silberman (2003), define it as "a process whereby invention or intellectual property from academic research is licensed or conveyed through use rights to a for-profit entity and eventually commercialized" (Friedman and Silberman, 2003, p. 18).

Siegel et al. share this same concept, when they argue, "the primary motive of the TTO is to protect and market the university's intellectual property. Secondary motives include promotion technological diffusion and securing additional research funding for the university, via royalties, licensing fees, and sponsored research agreements" (Siegel et al., 2003, p.31).

The adoption of these strict concepts has characterized most of the TTOs. Nevertheless, as it will be observed ahead, in some universities, the role played by the TTOs is not restricted to the activities related to the management of the intellectual property only, but it is characterized by broader objectives, including the management of projects and technological consultancy.

It has also been observed in the Brazilian experience, as appointed by Terra (2001) in the analysis of the role of the university offices in technology transfer to the market. She identifies a multiplicity of ways that universities carried out technology transfer, as for instance, through the results of applied or experimental research, the dissemination of information, consultancy, training and continuous education, support to supervised practices, start-up companies, business incubators, development centers, technological parks and tecnopolis (Terra, 2001, XVII).

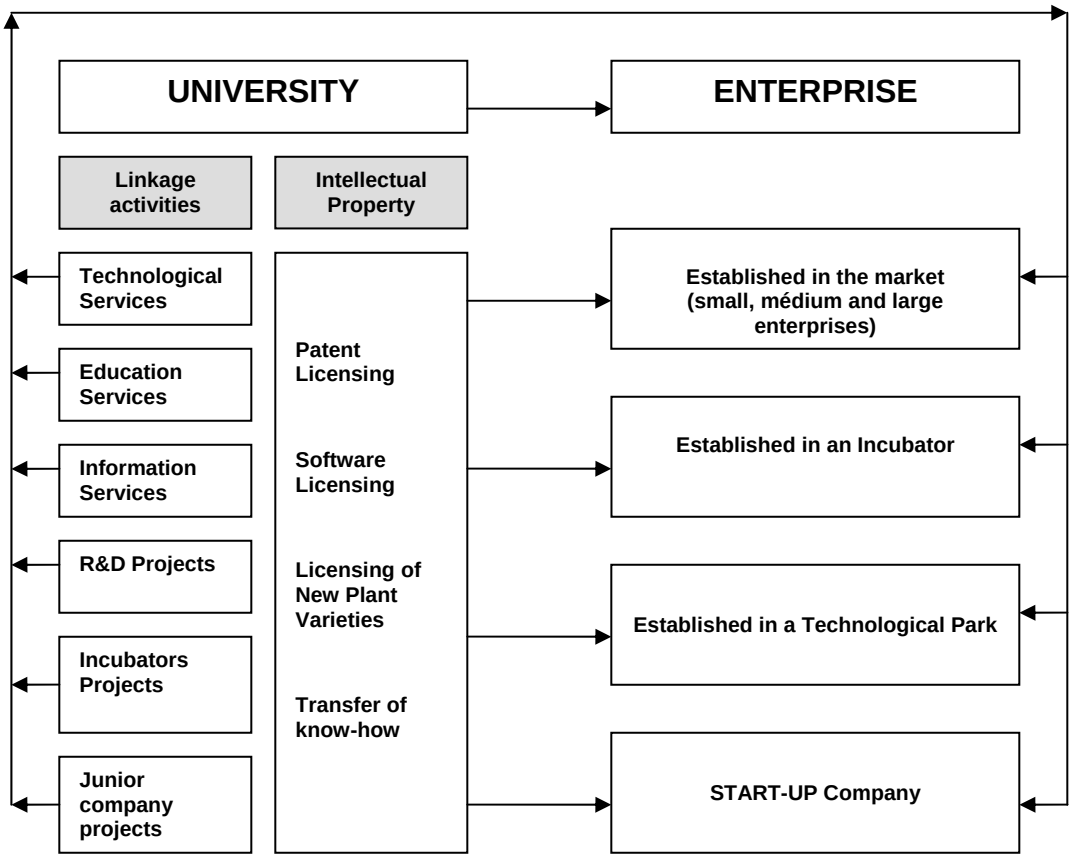
Thus, considering the diversity that characterizes TTOs in Brazilian universities, management of intellectual property is an activity that has only recently been incorporated to the other ways adopted by the university institutions to put technology transfer activities into practice. So, the concept of technology transfer adopted in this study expresses these elements, including this diversity of ways in which the interactions happen. Under this point of view, technology transfer cannot be centered exclusively on intellectual property matters, as it has been observed in TTOs of developed countries (OCDE, 2003), because that would constitute an analytical bias, not considering other ways of technology transfer predominant in the Brazilian scenery and necessary to address domestic industry's needs.

In this specific context, we understand the technology transfer as the process characterized by the passage of knowledge generated by the university to a company, allowing it to innovate and extend its technological capacity, making possible to obtain a competitive advantage in the market. Thus, technology transfer from the university to an enterprise includes (see Figure 1 below):

1) Interaction activities: a) technological services - technical analyses, calibrations, measurements, certification of conformity, tests and verifications, consultancies and

others; b) education services: courses "in company", seminars and qualification, among others; c) information services: searches in national and international patent databases, technological information in general; d) R&D projects: basic research, applied research, experimental development and others; e) projects carried out by companies in incubators; f) projects of junior companies[3]: consultancy and services. 2) Knowledge transfer through intellectual property licensing: patents, software, and others, and transfer of know-how (non-protected knowledge) to companies already established in the market or in incubators and technological parks or through the creation of start-up companies.

Figure 1 - The university-enterprise technology transfer process



In this perspective, the creation of an office in a Brazilian university has to take into account the diversity of forms in which technology transfer happens, in order to fit it the

[3] A junior company is a non-profit consultancy company that provides services to companies, through an academic unit, at a low cost. The management of this kind of company is done by the students themselves, and the technical support is provided by academicians.

university's necessities and local conditions. Mainly, the adopted concept must be reflected in the objectives and the activities that will be carried out by the TTO.

2. TTOs in Brazil: a brief history

The precursor university was the Federal University of Rio de Janeiro, which created, in 1971, the COPPETEC, the Technology Transfer Office of COPPE - Coordination of the Graduate Engineering Programs:

"The preoccupation with the full time regime and the certainty that the institution would have to participate in the process of development of the country, led COPPE to create a structure oriented to the management of studies and technological projects, with the objective to constitute itself in the exclusive channel of interaction with the productive sector." (Institutional Presentation of COPPE, www.coppe.ufrj.br/coppe/apresentacao-c.htm, consulted 04/03/04)

Later, in 1990, the State University of Campinas – UNICAMP created its TTO – the "Escritório de Transferência de Tecnologia – ETT". The main objective of ETT was to organize and to disclose the potential of scientific and technological knowledge of the University, in order to transfer products and processes and to provide services. Some years later, the name of ETT changed to "Office of Diffusion and Technological Services" (EDISTEC), and more recently it changed again, adopting the designation of Agency of Innovation - INOVA, with a strong link with the business world. Putting into practice a market-oriented strategy, INOVA has hired professionals with industry-related experience, with the aim to reinforce the licensing activities.

Another important example is the University of Sao Paulo (USP), which created, in September 1991, the service "Disque-Tecnologia" (Call-Technology), with the purpose of taking care of consultancies of micro and small companies that, in general, do not have internal conditions for R&D. Years later, this program originated the Executive Coordination of University Cooperation and Special Activities (CECAE), who acted as a liaison office attending the demands of companies, interested in university services. More recently, USP followed the UNICAMP example and creates its Agency of Innovation. The objective of the Agency is to transfer the knowledge generated in the University to the society, in order to stimulate the social and economic development.

Following the initiatives of USP and UNICAMP, several Brazilian institutions have created their TTOs: the "Coordination of Innovation and Technology Transfer (CT&IT) " of the

Federal University of Minas Gerais, the "Regional Center of Innovation and Technology Transfer (CRITT) ", of Federal University of Juiz de Fora, CERTI Foundation (Federal University of Santa Catarina), the "Office of Technology Management (EGT)", of University of Rio dos Sinos Valley - UNISINOS; the “Interaction and Technology Transfer Office (EITT)", of the Federal University of Rio Grande do Sul, among others.

In the Brazilian universities, the TTOs have been created, in general, in a centralized model tied to Extension and Graduate Studies Vice-Presidency. According to Dos Santos (1990), the main advantage of the centralized offices is that they can have a general follow-up of all technological research projects carried out by the university in collaboration with industries. Nevertheless, this does not occur in all cases. Given the complex nature of the university, in which researchers and employees, far from constituting a “sprit des corps”, form a set of individual autonomies, the control of activities can only be made if the office has institutional legitimacy.

The situation is still more complex in those universities, mainly the public ones, which have created foundations, in order to simplify and make the bureaucratic proceedings more agile. In these cases, information control becomes more difficult due to the autonomy of the foundation in managing the research resources.

Also a great ambiguity is observed about the role performed by the TTOs. Brisolla et al. (1998), in a study carried out in UNICAMP, considered the performance of the TTOs very low. It seems to be a non-exclusive situation of Brazil, because, as stated by Dierdonck et al., analyzing the Belgian experience: "there is no clear definition of the role of the offices in contracts and in the university’s research strategy, and there is no consensus on the tasks that they must carry out" (Dierdonck et al., apud Brisolla et al., 1998, p. 427).

For the Brazilian case, the great responsibility that TTOs have to overcome the gap that separates them from their international pairs contributes to this lack of definition, having to act as promoters of the university-enterprise interaction, and, at a same time, as managers of intellectual property, including the patent licensing activities and other forms of technology commercialization. All these activities have to be put into practice in a not very favorable environment, where consensus is still far from being reached.

3. Method

The data were collected through a survey that involved 143 Brazilian universities[4], which answered a questionnaire to collect detailed information about the established TTOs, their form of operation and their main activities. With a return rate of 18%, 25 TTOs in operation in the Brazilian universities were identified. Table 1 shows the list of institutions that answered the questionnaires.

Table 1 – List of Brazilian University TTOs

Name of University	TTO	Date of creation
Federal University of Rio Grande do Sul (UFRGS)	Interaction and Technology Transfer Office (EITT)	03/03/1997
University of Rio dos Sinos Valley (UNISINOS)	Technology Management Office (EGT)	18/09/1997
Pontifícal Catholic University Católica of Rio Grande do Sul (PUCRS)	Technology Management and Intellectual Property Agency (AGT)	13/09/1999
Universitarian Center of FEEVALE (FEEVALE)	Bureau of Inovation and Technology Transfer (BITT)	01/03/2002
Federal University of Santa Maria (UFSM)	Nucleous of Intellectual Property (NPI)	05/03/2001
University of Santa Cruz do Sul (UNISC)	Office of Technology Transfer (ETTEc)	20/04/1999
Catholic University of Pelotas (UCPEL)	Nucleous of Projects Support (NAPI)	19/12/1991
Federal University of Santa Catarina (UFSC)	Intellectual Property Management Coordination (COGEPI)	25/06/2002
State University of West of Paraná (UNIOESTE)	Nucleous of Technological Innovations (NIT)	01/03/1991
State University of Londrina (UEL)	Nucleous of Technological Innovation (NIT)	27/10/1987
University of São Paulo (USP)	Executive Coordination of University Cooperation and Special Activities (CECAE)	24/07/1986
Federal University of São Paulo (UNIFESP)	Nucleous of Intellectual Property (CMI-NUPI)	03/05/2000
State University of Campinas (UNICAMP)	Office of Diffusion and Technological	28/08/1990

[4] The set of institutions was obtained from the registers of the Brazilian National Universities Presidents Association (Associação Nacional de Dirigentes das Instituições Federais de Ensino - ANDIFES) and from de Council of Brazilian Universities Presidents (Conselho de Reitores das Universidades Brasileiras -CRUB).

	Services (EDISTEC)	
Federal University of São Carlos (UFSCAR)	Nucleous of Extension UFSCar-Enterprise (NUEMP)	01/09/1996
University of Paraíba Valley (UNIVAP)	Vice-Presidence of University-Society Integration (UNIVAP-PRIUS)	02/12/1992
Fluminense Federal University (UFF)	Office of Knowledge Transfer (ETCO)	30/07/2001
Federal University of Rio de Janeiro (UFRJ)	Coordination of Projects, Researches and Technological Studies Foundation (COPPETEC)	12/03/1993
State University of Rio de Janeiro (UERJ)	Office of Technology Transfer (ETT)	23/09/1996
Pontifical Catholic University of Rio de Janeiro (PUCRJ)	Development Office of the Technical-Scientific Center (ED do CTC)	03/01/1994
Federal University of Minas Gerais (UFMG)	Transfer and Technology Innovation Coordination (CT&IT)	16/06/1997
Federal University of Viçosa (UFV)	Permanent Comission of Intellectual Property (CPPI)	19/10/1999
University of Salvador (UNIFACS)	Research and Extension Coordination	03/01/2000
Federal University of Pernambuco (UFPE)	Innovation and Entrepreneurship Directory (DINE)	01/01/2000
Federal University of Ceará (UFCE)	Scientific and Technological Diffusion Coordination	08/08/1981
Federal University of Pará (UFPA)	Technology Transfer and Intellectual Property Sector (SPI)	01/03/1999

Beyond the 25 TTOs described, three others have been identified - the Technology Transfer Office – ETT, University of Caxias do Sul (UCS), the Innovation and Technology Transfer Regional Center– CRITT, Federal University of Juiz de Fora (UFJF), and the Technological Development Center – CDT, University of Brasília, that did not answer the questionnaire and, therefore, did not participate in the survey.

In order to have a clearer understanding, the concepts used in this study are defined as: a) Segment - group to which the university belongs: federal public universities - sponsored by the federal government; provincial public universities - sponsored by the provincial government; private universities – privately funded institutions of higher education, sponsored by the fees paid by its students; communitarian universities - private institutions

of higher education; b) Agency to which is subordinated –includes the instance to which the TTO is hierarchically subordinated in the structure of the institution; c) Budget - indicates if the TTO is maintained by the institution's budgetary resources; d) Own resources - they are the resources generated by the TTO itself in the performance of its activities (through technical services, projects or percentage of the royalties obtained in licensing activities); e) Centralized structure - it indicates if the TTO acts in a centralized way or if it is the only instance designated by the institution to interact with the productive sector and to put the technology transfer process into practice; f) Support Organism - informs if the OTT uses the services of a support organism, like a foundation, to manage the projects; g) Projects management - it indicates if the TTO uses some mechanism of projects management, including some type of projects evaluation.

On the other hand, the activities carried out by the TTOs were analyzed, including: a) Attention to technological demands; b) Management of technological services; c) Negotiation of technological projects; d) Elaboration of agreements and contracts; e) Intellectual property register; f) Technologies and patent licensing; g) Training of human resources; h) Technological diffusion events.

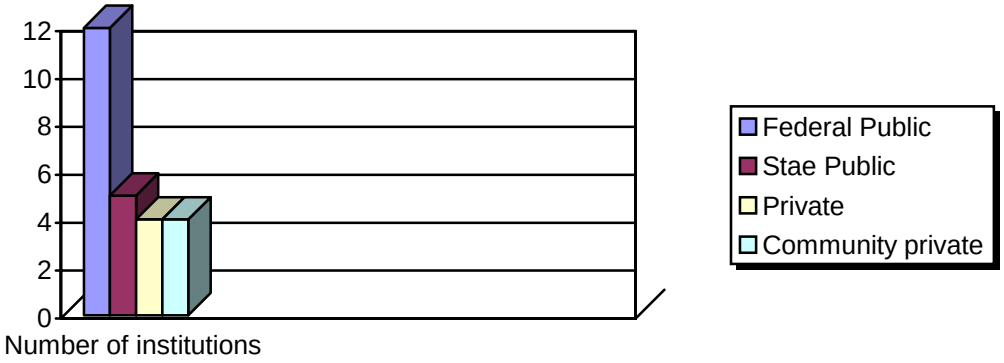
4. Data Analysis

In order to analyze the main surveyed aspects, the same sequence adopted in the questionnaire will be used, which included the creation of the offices, the organizational structure, staff, budget, and services.

4.1. Creation of the TTOs

The first aspect analyzed was related to the segment to which the 25 identified TTOs belong. It was observed (see Figure 2) that there is a predominance of TTOs in public universities (68%). This fact is not a surprise, since it is exactly in the public universities where the greater volume of Brazilian scientific investigation is concentrated (MCT, 1992), and the accomplishment of research in the institution is an indispensable condition to promote technology transfer, once the research results are the main inputs of a TTO.

Figure 2 – Segment to which the Brazilian TTOs belong



It was also observed that most of the TTOs were created during the 90s, in tune with the international trend. As appointed in a OECD study (OECD, 2003) most of the recently created TTO are, in average, 12 years old, in the United States, and less than 10 in the other countries of the OECD.

As to the designation of the structures found in the universities that fulfill the functions of a TTO, several different designations have been observed, from nuclei, coordination, agencies and offices themselves. This may be explained by the lack of a federal legislation similar to countries such as the United States and Spain, where the legislation induces to a homogenous designation – TTOs in the American case, and Oficinas de Transferencia de Resultados de Investigación (OTRIs), in the Spanish case -. Consequently, the TTOs have been created by decision of each individual institution, from its own perceptions on the need and relevance of an instance with such purpose.

With respect to the hierarchic subordination, the TTOs are, in general, linked to a Research and Graduate Studies Vice-Presidency. There are few TTOs linked directly to the Presidency of the University, and neither of them constitute an autonomous entity.

Concerning the budget, of the 25 TTOs, only 7 can count on their own budget. The other 18 depend on resources of the university budget. Only 28% of the TTOs generate their own resources through services or percentage on projects or royalties obtained by technology and patent licensing. In those cases, the greater volume of income obtained by the TTOs comes from services and returns generated by the projects. The amounts obtained by royalties through licensing activities are still insignificant, which demonstrates the gap between Brazilian TTOs and their equivalents in developed countries.

4.2 – Organizational Structure

We have also verified a great diversity in the organizational structure:

In 60% of the institutions the structure is not centralized, and there are other instances that fulfill the same function in managing university-enterprise projects;

In only 20% of the institutions the structure is centralized. In those cases, TTO is the only instance in charge of the formalization of the university-enterprise and intellectual property activities;

In the other 20%, the structure is centralized only for some activities.

Although this diversity can be associated, in the Brazilian case, to the indefinite role that most TTOs play in the whole organizational structure, or to a lack of institutional legitimacy to perform their functions, the analysis can lead to a different interpretation if compared to their pairs in an international context. A great diversity also been observed in the institutional adjustments adopted by universities in the OECD countries, where it has been identified: (i) TTOs dedicated to identify, to protect, and to operate intellectual property; (ii) administrative departments whose main function is not intellectual property management; and (iii) external (public or private) providers of intellectual property management services (OECD, 2003). Therefore, the diversity noticed by this study, more than a local characteristic, reflects the lack of clarity in the understanding of such activities both in the university scope and in a broader context as well.

The investigation revealed that the great majority of the institutions rely on a support foundation for managing their activities (76%). This data informs the need of agile and flexible procedures, once bureaucratic routines are incompatible with technology transfer processes. Only 52% of the TTOs use project evaluation mechanisms, indicating the still incipient preoccupation with the effective institutionalization of university-enterprise interaction activities.

4.3. Staff

From the staff's point of view, our investigation reported that the TTOs present a very small structure. The smallest identified structure was formed by only one person performing all the activities, and the largest staff had sixteen professionals. The average number in the Brazilian TTOs is similar to their equivalents in USA and OECD countries, that is 3,5 workers.

As far as the staff specialization is concerned, some points deserve to be underlined. A specialized staff either in a technological or in a management area, in which they develop a specialized knowledge, characterizes the majority of the TTO professionals. Nevertheless, in the Brazilian case, the TTOs staff is still far from specialization or expertise. The presence of a high number of temporary workers (scholarship holders) reveals the difficulty to constitute a professional staff. The temporary character of the personnel work hinders the consolidation and improvement of the activities performed by the TTOs, and slows down potential advances that a better trained staff would certainly promote.

Different from what we can observe in the international experience, where the TTOs are managed by professionals, in Brazil there is a significant number of professors in the coordination of TTOs. On the one hand, this means that there is an institutional recognition of the importance of the role performed by the TTO, since professors are the professionals with the greatest prestige and status in the university; but, on the other hand, it may hinder the professional performance required for the management of the interface with the productive sector. However, due to excessive burdens that professors carry in accomplishing the tasks of teaching and researching, it certainly becomes hard, on top of that, to manage a TTO with the required professionalism and commitment.

4.4 – Activities performed

The activities performed by TTOs, are, in general, very similar. The activity that presented the lowest performance was patent licensing. Although 16 TTOs are mostly in charge of patent licensing, only 5 institutions have, indeed, succeeded in this activity, summing a total of 14 licensed patents.

Considering the lack of specialized staff in the technology transfer management, around 80% of the offices are also involved in educational activities, such as courses and seminars, with the aim of training their staff in intellectual property and technology transfer matters.

The data presented and analyzed in this study leads us to the conclusion that diversity is the main characteristic of the Brazilian TTOs. Although such diversity may result from the institutional need of adjustment to the local conditions, it may reflect a relative incomprehension of the specific functions of a TTO. Those functions are not always very clear. Some of the TTOs described as such do not fit into this category, proving that the specificity of the TTOs is not clearly understood by the other instances of the university.

Although the variability in the denomination of the TTOs can be seen as a smaller question, if analyzed comparatively with the experience of other countries, for instance, United States and Spain, the uniform designation reflects an underlying governmental policy - in the American case, the Bayh-Dole Act, and in the Spanish case, by the National Plan of R&D. Thus, what we propose here is not a uniform denomination, but the necessity of a governmental policy to endorse, legitimize and define the role that these structures must fulfill in the context of the Brazilian universities. A much stronger exchange of technology transfer experiences among universities would be necessary to advance towards a Brazilian model of good practices that would establish procedures and useful tolls to increase TTO's effectiveness.

Related to the activities developed by the TTOs, there are some gaps as perceived by Terra: "the Brazilian TTOs act not like managers of the valuation of the generated knowledge, but like administrators of contracts of academic services" (Terra, 1999, p. 171). Nevertheless, through the data collected in this study we can perceive the reconfiguration of this scenery, with the introduction of intellectual property management. We cannot be unaware of the advances obtained by some offices in their aim to protect and license their patents, mainly those inserted in universities with a greater volume of research results. It demonstrates their effectiveness in the valuation of intellectual capital and the knowledge generated by the Brazilian researchers.

At the moment, the Brazilian TTOs perform a triple function: 1. Management of university-enterprise interaction activities; 2. Intellectual property register; and 3. Technology transfer through technologies and patent licensing. With respect to the first two functions, it is possible to state that the universities have taken great steps. Nevertheless, the greatest challenge lies in the third one. Some universities have been able to generate funds through patent licensing activities. Others, however, although they produce a reasonable volume of research, are still in a very incipient stage towards the licensing of research results and need a great institutional effort to put the technology transfer processes into practice.

In this context, the next section will present a case analysis – the TTO of the Federal University of Rio Grande do Sul, describing and analyzing how a Brazilian Public University TTO put into practice its activities, comparing its particular performance to the general ones. The analyzed case of the TTO of the Federal University of Rio Grande do Sul demonstrates, among other aspects, the importance of institutional technology transfer

strategies, and shows how the institution put its experience into practice, following a *learning by doing* method.

5. Case Analysis

The Federal University of Rio Grande do Sul – UFRGS is a federal, public university, founded in 1934. It is located in Porto Alegre, the capital of the State of Rio Grande do Sul, and is the largest university in southern of Brazil, with around 30,000 undergraduate and graduate students. Today, it is also one of the most outstanding research institutions in Brazil, carrying out almost 3,000 research projects in around 900 different areas.

More than 400 laboratories and about 500 research groups express the research capacity of UFRGS. The excellence of its graduate programs can be measured by the national evaluation realized by CAPES[5], in which UFRGS is ranked as the second best university in the country, in terms of the quality of its courses, and constitutes the only Brazilian university that did not have any of its programs reproved.

The management of technology transfer and university-enterprise interaction is carried out, mainly, through the support foundations and by the Secretariat of Technological Development, to which the Office of Interaction and Technology Transfer (EITT) is linked since October, 2000.

5.1 TTO Antecedents

The Office of Projects Consultancy – the previous name of EITT – was created in March, 1997, as a strategic option of the University to improve its relationships with society as established in its institutional policy. Besides, the creation of this office attended to a commitment that UFRGS had assumed with FINEP (Financier of Studies and Projects), through the FINEP-TEC Program, to "maintain a permanent structure for management of R&D Projects with enterprises" (Agreement nº 8.6.95.0323.00).

The core business of EITT was projects management, and for this reason the interface with enterprises was seen as a result of the faculty activities. It was, in fact, a linear management model, in which the role played by the University was limited to its research and education functions. Besides, the proposal of interaction with society was too timid, limited to the organization of seminars, courses and workshops. It did not include, for

[5] Coordenação do Aperfeiçoamento do Pessoal de Nível Superior - CAPES is the organism that, in Brazil, is responsible for the evaluation of the graduate education.

instance, the promotion of sponsored research projects, technology transfer, and intellectual property licensing.

Due to the amount of research projects and the increasing number of contracts, a dynamic was established that didn't fit to this Office model. It was necessary to create a "tailored made" model, putting new emphasis in the connection of the University with the market.

On the other hand, the configuration of a new national scenario in the technology transfer , particularly, the new intellectual property Laws – Industrial Property (9.279/96), New Plants Varieties (9.456/97), Software (9.609/98), Copyright (9.610/98) and, more specifically, the Decree n^{o}. 2.553/98, that regulates the sharing of the economic profits derived from licensing activities, instituting, as a prize, the limit of 1/3 to the researchers - imposed new requirements to universities, in terms of internal procedures, in order to integrate these new activities to the institutional context.

These combined factors – the opportunity of new national legislations and the necessity to change the office's focus – did create better conditions for the performance of the EITT as the main institutional mechanism to manage university-enterprise interactions and to put into practice technology transfer and intellectual property procedures. As well as the institutional mechanisms created based on the concept of the Triple Helix (Etzkowitz, 1996), the nucleus of EITT activities is to join science, technology and economic development, stimulating and facilitating the interaction of UFRGS with enterprises and government.

The fact of having been the first university technology transfer office in the State of Rio Grande do Sul imposed several challenges to its organization, specially due to the lack of references to follow. Everything was new, because there was no sector in the institution that performed, at least, some of the office's proposed functions. The references were from foreign institutions and the very few national experiences were inserted in other contexts that dit not always fit to the local conditions.

Thus, the internal endorsement by the different instances in the university administration, and the external recognition expressed by the financial support, created the necessary conditions for EITT to start working.

5.2 Main functions

To carry out its activities, the EITT adopted a very simple structure that put the institutional policy and mission into action. In addition to administrative support and legal consultancy,

there is an ad hoc Committee, which has the purpose to support the decision making process in matters concerned with the office's activities.

The main functions of EITT are divided in three areas: Intellectual Property, Business Division and Technological Diffusion.

The Intellectual Property area takes care of all the steps involved in the protection of intangible assets, from the invention disclosure to the patenting and licensing. A monitoring system is used to accompany all the processes and to assure the fulfillment of dates in all stages.

The Business Division encloses the negotiation of sponsored research projects, as well as the elaboration of technology transfer agreements and contracts. The Technology Licensing Sector does, among other activities, market and economic valuation of the technologies to be licensed; identification of potential licensees; elaboration of licensing contracts; supervision of technical assistance involved in the technology transfer process. The Technological Consultancies is another sector in the Business Division and has the purpose to mainly attend the demands of SMEs. Theses consultancies can include from simple technological services to more complex research projects.

The Technological Diffusion area plays a double role: internally, it constitutes an information channel about technological research projects opportunities; externally; its role is to spread the university technological products, as well as the specialization of its faculty members, and the technical resources that are available in the institution. With this aim, the Information System Sector keeps a database with the main institutional competences in different areas of knowledge carried out by its more than 400 laboratories. The Divulgation and Events Sector is responsible for promoting events with the aim to approximate the internal community with external partners, looking for partnership opportunities.

Despite the formal structure EITT has, with clearly defined functions, it is important to point out that the staff is small, and for this reason, the sectors are mostly defined by the activities than by the limits that the organizational configuration can suggest. There is a permanent connection among the team members.

5.3 Position of EITT in the University structure

From 1997 to 2000, the EITT was hierarchically subordinated to the Research Vice-Presidency, as an administrative department. Since October 2000, it was integrated in

the Secretariat of Technological Development, which was created as an organ of the Presidency of the University.

In order to give agility and to make possible its technology transfer activities, the EITT contracts the services of the University foundation.

In spite of being recognized as the institutional instance responsible for technology transfer activities, the attributions of EITT are not formally described in the University Statements. There is only an Administrative Act, signed by the President, creating the office.

This lack of formality brings advantages and disadvantages. The main advantage is linked to the flexibility that it confers to effectuate changes, especially because of the dynamism inherent to technology transfer. On the other hand, the disadvantage is related to the weak institutional legitimacy due to the "nonofficial" character of its actions. For this reason, the office can become very fragile, because it strongly depends on the leader who is governing the University.

The autonomy in the decision making process is limited to routine matters or to the subjects that the office has exclusive competence. Subjects like hiring specialized professionals are strongly limited by the bureaucratic procedures of the University. This is a very important restriction in the Brazilian context that has to be faced by offices like EITT.

Therefore, even when it is considered strategic for the university to keep an office, there are many obstacles to be faced by the managers to put daily activities into practice. In EITT's case, these limitations have been punctually identified and the most important is that until now the high administration has given the needed support and has allowed some advances that situate EITT among the most important Brazilian technology transfer offices.

5.4 Relationship with the market

The portfolio of services of the EITT has always been conditioned by the internal capacity of attention to the demands. This fact has determined the adoption of a "step by step" strategy for services supply, that is, the supply has been extended as soon as the office gets the technical requirements to do it.

The EITT is oriented by a differentiation strategy, supplying services that are not done by other instances inside the University. So, there is a concentration in intellectual property management services, area in which only EITT has worked. As a conclusion, we can say

that the intellectual property management is the window of opportunity of EITT. Here is situated its “internal market monopoly”, and, therefore, its main source of legitimacy.

Externally, the action of EITT aims to stimulate partnerships with different sectors of the productive sector, through different institutional arrangements. So, many activities are addressed to this objective as, for instance: a) Participation in specific networks, as the Intellectual Property and Technology Commercialization Network (Rede de Propriedade Intelectual e Comercialização de Tecnologia – REPICT), of Rio de Janeiro; b) Participation in international committees, as the Technological Development Committee, created in the context of the Montevideo Group Universities Association (Asociación de Universidades do Grupo Montevideo- AUGM); c) Participation in Industrial Forums, linked to the Regional Industrial Federation, in specific groups like the Technology Group at the Federation of Industries of the State of Rio Grande do Sul (FIERGS) and the Technological Committee at the Chemistry Industry Syndicate.

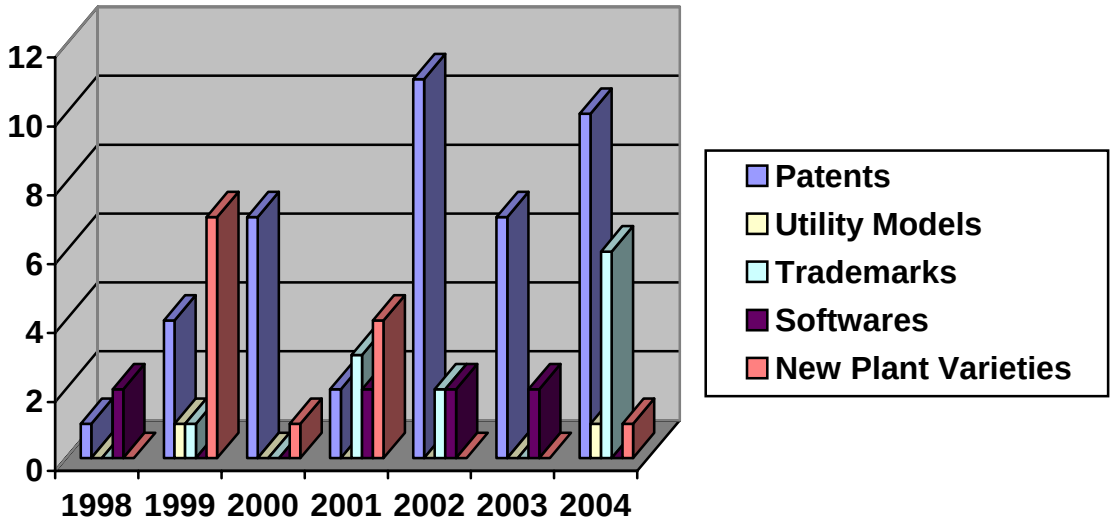
Related to the negotiation strategy with its partners, the EITT adopts the win-win approach and trust is considered the fundamental element for a successful relationship.

5.5 Results

The EITT is oriented to results. In this context, time is a very important variable, because, in general, a technology transfer task becomes fruitful only after a long time and involves some factors that do not depend directly on EITT’s action. Therefore, a prudence strategy has been adopted and constant evaluation in order to allow, if necessary, a change of route.

So, after seven years, EITT has presented some results, which reflect its performance. In terms of intellectual property management, Graphic 1 shows some data related to this subject.

Graphic 1 – Applications on intellectual property, by year.



As shown in Graphic 1, from 1998 to 2000 there was a regular increase in patent files , followed by an abrupt decrease in 2001, which was compensated in 2002. From this year on, an annual average of 6 filed patents was kept.

Among the reasons of the observed decline can be appointed the adoption of more rigorous criteria in the patent file decision making and a systematic procedure of searching for novelty in patent databases.

These quantitative indicators totalize, in December 2004, 44 filed patents, 8 requested trademarks, 8 issued software and 12 new plant varieties registered. It is necessary to emphasize that 3 (three) patents were also filed abroad - in South Africa, France and Uruguay, having already been issued in the first two. In Brazil, only 2 patents are issued to date.

Another area in which EITT has acted very intensively is in the professional training in intellectual property and technology transfer management. The courses and seminars carried out by EITT, have allowed around 150 people to be trained per year, not only from UFRGS but also from other academic institutions and local and regional companies.

The technology licensing activities have demanded a great effort of EITT's staff. Despite this fact, the results are not significant, in term of licenses as well as in the amount of royalties that until December 2004 was around US$ 50,000. Nevertheless, the impact of this activity is inexpressive, considering the high potential of the institution.

Meanwhile, is worthy to consider that the most important result can be measured not by the quantitative impact, but by its qualitative results in terms of the learning process, allowing a better knowledge about companies' practices and also a clearer perception of the complexity involved in the technology transfer process. Despite the importance of quantitative indicators in the performance measurement, in the case of EITT the qualitative aspects surpass the quantitative ones. The promoted changes in the University, related to an adequate valuation of the intellectual patrimony and the creation of better conditions for the university-enterprise interaction, constitute the main results obtained by EITT.

In order to evaluate its performance, in 2003 a survey was carried out in order to measure the EITT customer's satisfaction. The results of this survey indicate that the majority of the customers are completely satisfied with the services supplied by EITT. However, it is important to point out that as important as it is to survey the internal client's opinion is also to know what are thinking the external clients, especially the companies.

The qualitative evidences of this case give support to the idea that the organizational performance is the result and reflection of the way people put activities into practice. In the case of EITT, although the great effort has been done in terms of training, and the great motivation of the staff in order to "do the right things" and "do the things right", the technology transfer tasks are still developed in an amateur way. To keep a motivated staff is essential, but good will is not enough when we have to face such a complex subject as technology transfer.

6. Conclusions

It is important to point out that the success of technology transfer activities at universities depends, fundamentally, on the way they are inserted in the institutional context. It is essential that university's top management perform a visible leadership in the conduction of the policies and the operation of the programs of interaction with enterprises, in order to guarantee the necessary institutional resources for its execution.

Surely, the most important condition for advances in this area is the need that the university explicitly assumes its participation in the economic development, adopting the idea of the technological management with all its consequences thoroughly, i.e., not only in the institutional policy but also in matters related to the infrastructure and the managerial practices, including fund raising. It is of fundamental importance that the university leaders, including the President and the first level of the administration, assume their commitment with university-enterprise-government interaction, as a function of the university. In the

present stage of development of the majority of Brazilian institutions, this is still an objective to be reached.

Unfortunately, the advances that many offices have been able to obtain result from individual initiatives, more than from institutional commitment with the subject, a fact that may eventually jeopardize the maintenance and consolidation of the experiences. The institutionalization of the matter, thus, stands out as an urgent issue. Fortunately, on the other hand, after the Technological Innovation Law has been signed, some advances towards the legal recognition of the nuclei of technological innovation can be foreseen, as an institutional mechanism for the management of the innovation policy in scientific and technological institutions.

Nevertheless, it is necessary to point out that the legal devices alone are not enough to guarantee that the advances will be reached. Governmental policies only reach their objectives if accompanied by mechanisms that induce to cultural changes in the university community and to the deepening of their understanding on the role of the university in the innovation process.

A more professional approach to technology transfer is needed to achieve a greater degree of effectiveness. Conformity with a model of good practices based on WAITRO's proposal (WAITRO, 1997) would integrate a set of functions conducive to success as it was confirmed by the authors of this paper through the analysis of the sample an the case study.

The role of informal relations should also be underlined as a very important variable in the process of diffusion of technology transfer practices in the country, fundamental for identifying opportunities of cooperative projects with companies, and for exchanging ideas among TTOs managers.

Finally, it is important to emphasize that, in spite of the difficulties inherent to their incipient conditions, the TTOs are gradually introducing a cultural change in the technology transfer processes, open to the innovations that must be integrally explored.

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