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A study on Innovation and Technology Transfer Offices in South of Brazil and their relationship with the Stakeholders of the Regional Innovation System

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Abstract

The capability of generating innovations, which has been identified as a key factor of success or failure of companies and nations, is achieved through the interdependence among actors, users of goods, services and technologies. This paper the objective was to establish a referential framework, thereunto we investigate the interfaces for innovation and technology transfer between Innovation and Technology Transfer Offices (ITTO's) of Southern Brazil and other actors of this Regional Innovation System. We can identify good practices that can help improving ITTO's efficiency and performance. The research is related to the project CESAR (2011), supported by the European Community under the ALFA III international research program. The study was conducted using a qualitative descriptive approach based on a multiple case study. First the theoretical framework is structured, a conceptual framework is proposed based on the concepts in order to link the theoretical with the results related to the specific context of analysis then the data were collected and analyzed, presented only after the referential framework and discussed the applicability of the reference point based on field data. As results, we observed that the field results corroborate and help refine the proposed framework. Not all the interfaces and linkages are currently present among the accessed actors. Nevertheless, although there are obstacles to be overcome, results indicate that the integration of Universities and ITTO's with the actors in the innovation system, and the existence of ITTO's supported by a coherent strategy, exerts an important role in technology transfer in Southern Brazil.

Keywords: innovation and technology transfer offices; technology transfer; regional innovation system; innovation system; interface.

1 Introduction

Innovation is mainly originated in the firms and corroborated by the market, but can be originated from different actors from the society, such as universities, research groups, individuals, government agencies, among others. One of the main reasons why an economy goes out of the equilibrium state and goes in expansion process is the appearance of some innovation: a new product on the market, a new method of production or commercialization, a new feedstock source, or the brake of some monopoly. The profit generated by innovation is the motor of all entrepreneurial activity (Schumpeter, 1961, 1982, 1984). In this sense, one key element to develop innovation is to establish adequate interfaces among the actors who interact to transform ideas into innovation.

In an environment where the entrepreneurial activity is systematized, it is possible to create an atmosphere of regional innovation, which consists of a set of political, industrial and academic institutions that, purposely or not, act in the sense of improving the local conditions for innovation. In this sense, such system shall have the capability of generating innovation based on science and technology, locally, instead of only trusting on technology transfer (Etzkowitz; Leydesdorff, 1996). Nevertheless, in order to do so, it is necessary that the interfaces among the different actors who integrate this system are sufficiently clear and established.

In this paper we investigate the interfaces for innovation and technology transfer between Innovation and Technology Transfer Offices (ITTO's) of Southern Brazil and other actors of this Regional Innovation System. The objective was to establish a referential framework to analyze of the innovation and the technology transfer in the perspective of the ITTO's.

ITTO's aim to promote the interaction of Universities with society and the market by companies, providing knowledge and services resulting from applied research, and technology licensing, for supporting innovation and competitiveness (Toledo, 2009). This interaction, which can be viewed in the perspective of the Triple Helix model, addresses the role of Universities in society, the role of govern and of the public politics, as well the role of industries in the innovation context (Etzkowitz; Leydesdorff, 1996). Therefore is relevant the role of a National Innovation System (NIS) (in Brazil – National Science, Technology and Innovation System) and of the Regional Innovation Systems (RIS's) as sets of institutions whose interaction supports and motivates the innovation performance of a country (Nelson, 1993).

Considering the Brazilian context and the role of ITTO's for the innovation promotion, we understand that analyzing the interface of ITTO's with the academy and the market, we can identify good practices which can help to structure an ITTO improving its efficiency and performance. This research is related to the CESAR Project (2011), supported by the European Community under the ALFA III international research program.

2 Background

2.1 The Innovation System

The term Innovation System (IS) makes possible the understanding of the innovation process (Edquist, 1997). Furthermore, one can say that there are at least three approaches for the understanding or description of the system innovation: a) Regional Innovation System (RIS) (Cooke; Uranga; Etexbarria, 1997); b) Sectorial Innovation System (SIS); c) National Innovation System (NIS) (Nelson, 1993).

A NIS is a set of institutions, which they act making a great influence on technological progress and in such sense it is not possible to reject the government policies role. It is believed that the government expenditures in R&D, education and infrastructure have been determinants in successful models. As most of the studies carried out, with distinct realities in our country, there is difficult and, consequently, it is necessary wariness to the adaption the national reality (Palmeira, 2008).

The Innovation System (IS) can be described considering four environments, each being defined by a set of elements that intervene in innovation processes (Martinez; Lucio, 2011). The Scientific Environment enrolls the knowledge production officers, research groups, universities, public and private agencies of research. The Technological and Advanced Services Environment refers to the development if technologies used in other productive business, grouping the innovation and development units of large companies, equipment and production goods companies, engineers, services of analysis, tests and Technological Institutes. The Productive Environment takes in account innovative goods and services, investment in added value, industrial and services companies (Martinez; Lucio, 2011). Finally the Financial Environment contributes with economic resources to the subsystems for the development of their activities, enrolling private entities (venture capital) and public (innovation spurring) (Martinez; Lucio, 2011). These elements can be seen forward, in Figure 1.

2.2 Innovation in Brazil

In Brazil's the National Innovation System, formerly found in incipient stage – in initial phase of structuring and engagement of their main stakeholders (Albuquerque, 1996) – is can be already being consolidated: systematic meetings of actors, structures public policies (national innovation law, regional innovation laws), and enrolment of civil and government institutions in networks for innovation are some of the elements which indicate some maturity of the NIS and the RIS's in Brazil. Away from being a consolidated subject, Brazil still struggles with the challenge of being competitive in terms of promoting innovation and

increasing the investments in innovation from over 1,2% of GDP (Brasil, 2010). Also, the context in which this research was conducted comprehends a new economy where knowledge is the basis for global competition. In Brazil, the constitution of ITTO's in broad scale is still incipient because many of them were recently created. Consequently few patents deposits and technologies licensing agreements have been concretized (Toledo, 2009).

Until the Second World War, Brazil had not awakened to the reality of innovation. However, in 1930, Brazil began to react to the changing global context and worked their status improving technical-scientific formation. In this context, we can highlight milestones such as the creation of: the University of São Paulo (USP) in 1934; the Brazilian Council for Scientific and Technological Development (CNPq) and Coordination and Improvement of Higher Education Personnel (CAPES) in 1951; the São Paulo Research Foundation (FAPESP), in the same year; the Technology Fund (FUNTEC); and the first Brazilian Development Bank (BNDES) in 1963, later named Research and Projects Financing Agency (FINEP); the Alberto Luiz Coimbra Institute – Graduate School and Research in Engineering in 1963; and the Ministry of Science and Technology (MCT) as the central organ of the national innovation system, to which were tied FINEP and CNPq, in 1985 (Lotufo, 2009).

Nonetheless, the industrialization process occurred in Brazil was not properly linked to the national policy of Science, Technology and Innovation. The characteristics of high trans-nationalization degree of Brazilian economy, and the dynamics of the process of imports substitution, marked the fragility of the entrepreneurial dimension of technology policy in Brazil. And as a consequence, it is possible to register a large gap between local science and business companies, because few companies opt by the development of new knowledge to develop new products and services locally. Most of the innovation is supported by the import of capital goods from foreign countries. Scientific research is focused especially in universities and research institutions, and few business companies have strong R&D programs or areas established (Lotufo, 2009).

In Brazil, Law nº 10.973 of December 2nd 2004, known as National Innovation Law, regulated the subjects related to innovation, as well encouraging innovation and scientific research. The law is the basis for the Industrial, Technological and Foreign Trade Policy of the country and aims to facilitate the development of structured mechanisms for technology aid in the relationship between business companies and research institutions. It also recommends enterprise incubators and technology parks as useful tools in this regard. The term Technological Innovation Office (TIO) is provisioned in the, and can be considered similar to the terms Technology Transfer Office (TTO) or, more broadly, Innovation and Technological Transfer Office (ITTO).

2.3 Methodological Approach

This section summarizes the methodology we proposed to respond to the objectives of this research. Each step is briefly described in the following paragraphs:

Step 1 - Establishment of the Theoretical Framework: With respect to literature involved, Eisenhardt (1989) highlight that an essential feature of theory building is the comparison of concepts, theories, or hypotheses with the existing literature, by asking what is similar, which contradicts, and why. The key to this process is to analyze the literature. For this, we perform searches in databases such as SciELO, CAPES database, Science Direct, EBSCOhost, among others. We surveyed digital libraries of theses and dissertations of UNISINOS and other Brazilian universities, as well as books, websites, conference proceedings and journals. These sources were catalogued, compiled and analyzed in order to provide the adequate background for the research.

Step 2 - Data collection in the field: field notes are comments performed by the researcher or by the research team, and may be an important means to achieve analyzing the data (Eisenhardt, 1989). In this research, we interviewed 12 ITTO's according to the FORTEC registries (FORTEC is a non-governmental association of ITTO's with important representativeness in Brazil). Regarding to officers of the Innovation System, we surveyed by telephone and e-mail, officers appointed by the managers of the accessed ITTO's. The objective was to obtain at least one respondent per ITTO, totaling 20 respondents.

Step 3 - Results analysis of field data: based on the interviews, references and notes, we compiled the collected information and performed simple descriptive statistics to summarize data. The data was tabulated in Excel spreadsheets according to each respondent and each question. These elements served as source for comparison to the information retrieved in Step 1, allowing us to make conjectures and to establish referential elements for the next steps.

Step 4 - Proposal of a Referential Framework: Based on the previous steps we proposed a referential framework, composed by elements that describe the potential interfaces identified by the accessed ITTO's on the RIS of Southern Brazil. This referential framework does not have the intent of being definitive or exhaustive, but to provide a structured way to discuss the subject of this research. The general system characteristics and resources, always according to the cases investigated, also were included.

Step 5 - Discussion of the applicability of the referential framework based on field data: based on the field data, we established an in depth analysis aiming to discuss the applicability of the proposed framework. Each dimension or element identified in the case studies was compared with the referential framework and further discussion was established with the ITTO's representatives.

Step 6 - Final remarks: At the conclusion of the research, the construction has resulted in new discoveries. Theory building, which simply replicates past theory is at best a "modest contribution". Replication is appropriate in theoretical research but in research and theory building, the goal is a new theory. Hence, a study of the robust theory building shows new structures and new contributions (Eisenhardt, 1989). In this sense it is important to note that in qualitative studies, few sources are preferable, but it is essential that quality. In this type of study sample does not have its more usual meaning, as the statistical significance of a given universe, therefore, we used an arbitrary number. It is more connected to the meaning and the ability of the sources has to give reliable and relevant information about the research topic. These results were compiled into research reports, which were presented to the CESAR project group, as well as in the form of book chapters and papers such as this one.

3 Results and Discussion

Regarding to the analysis context of this research, we conducted interviews with the actors of the Regional Innovation System comprehending the states of Rio Grande do Sul (RS), Santa Catarina (SC) and Paraná (PR). The interviews took place during the second half of 2011, personally, by phone and e-mail, with managers of ITTO's, or managers of entities with some interface with these ITTO's. From the actors in the innovation system interviewed, twelve were of ITTO's, and other officers have some kind of interface with these ITTO's. Without the intent of being conclusive in our analysis, we classified the respondents into two categories: private and public, regardless of location. In this sense, we investigated seven private and five public institutions, which could create opportunities some comparisons.

None of those interviewed in this category reported having more than 9 employees, i.e., the structures are lean, however, as they usually are linked to an educational institution, it is important highlight that they use of the macro structure of universities, as a general rule, which converges with literature. It was possible to observe a large number of technicians linked to the actors investigated, whether public or private ITTO's, however the number of technicians in public ITTO's is even greater than in the private ITTO's.

In terms of the ITTO's capabilities, it is important to note that, on the one hand, we are exploring the use of the potential capacities, especially related to ability to relate or to negotiate human resources. And, on the other hand, we distinguish two basic capabilities types: a) skills related to knowledge - the stock of existing knowledge in the university; b) and skills associated with the physical infrastructure of the university (Martinez; Marin; Sanchez, 2011).

Most of the accessed ITTO's was structured between the years 2006 and 2008, just after the Brazilian government instituted the Innovation Law. In Brazil, through the Innovation Law (Nº. 10.973, of December 2nd, 2004), the Brazilian government has formalized that universities should nurture, in isolation or

together with other institutions, a technological innovation office. These ITTO's should assist in the protection of intellectual property, should support the independent inventor and support the institution with regard to contracts, licensing or technology transfer (Carvalho; Mais; Machado, 2010).

The public ITTO's, besides having more technicians, are more mature than the private ITTO's. Exactly 3 of 5 public ITTO's investigated were created just after the approval of the Innovation Law; with respect to the private ITTO's, all the 7 investigated ITTO's were created after the promulgation of this Law.

The major structures, with regard to the interface officers investigated are goods and services business. Possibly, these businesses require a very large team of technicians because unlike the structures linked to large educational institutions, access to teachers, technicians other business or areas, is restricted.

In the model proposed by the project CESAR (2011), the Innovation System elements are embedded in environments. Each is defined by a set of elements that interfere in the innovation processes. Therefore, by analyzing the actors investigated, it is necessary to reflect on the research scope with regard to these environments, as seen in Figure 1.

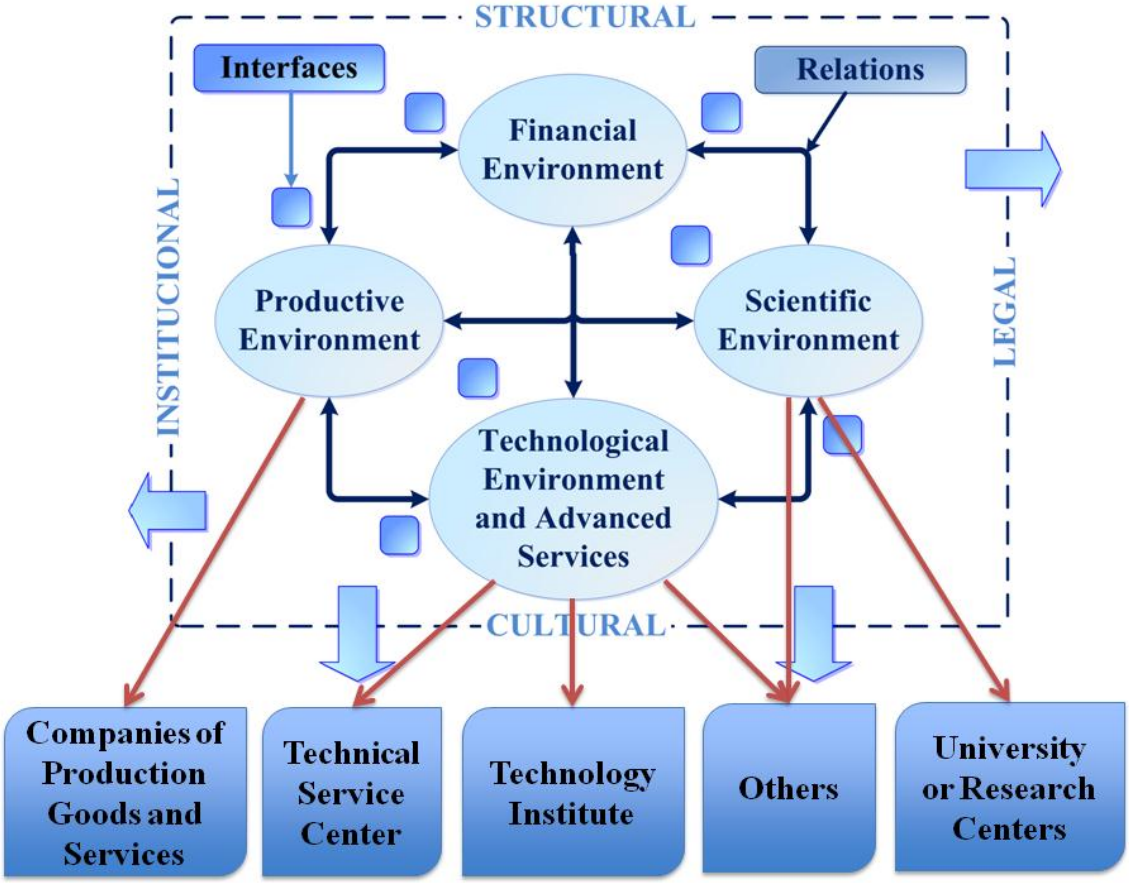

Figure 1: Research scope with regard to these environments. Source: adapted from Martinez and Lucio (2011).

In this sense it is important to note that there were no interviews with the actors of financial environment, however, the vast majority of environments were contemplated, and there were items throughout the analysis which opportunities assessment, this environment, by the ITTO's.

Based on the theoretical background and on the field data, we structured a proposal aiming to describe the main interfaces between the ITTO's and the actors of the RIS. The analyzed data related to the case studies were used for the evaluation and development of the first proposal.

In the innovation process, the relations of interface are considered of extreme importance, as well as the relationships of the actors with their different environments. And to promote these interrelationships and the cooperation among the IS elements, it is important the existence of appropriate mechanisms: a)

interface structures; b) instruments for fostering interrelationship, such as incentives and aids that some institutions offer to other actors of the IS (Martinez; Lucio, 2011).

In our proposal, we represent the ITTO's supported by the National Innovation System (legislation, federal actors, etc.), and especially by the Regional Innovation System (state legislation, associations and networks of ITTO's, state agencies, etc.) where they are inserted. They relate to the other actors of the innovation system by using instruments and providing certain services.

The ability to generate technological innovation is subject to the influence of multiple institutional actors of the generation and assimilation of knowledge, particularly universities, firms and government (Bessant; Tidd, 2009). Such actors are represented in the third disk. Being in the same sphere, we seek to represent that they can organize themselves individually and globally. The relationship of these officers causes a synergistic effect to the technical advances necessary for technological innovation (Pelaez; Szmrecsányi, 2006).

The disks where such elements are presented mean to convey the impression of "Roulette": services, actors and instruments can be combined in different ways, providing different types of interaction with different purposes and expected outcomes.

ITTO's aim ongoing interaction with businesses and local governments, having intensified their activities in the policy development context, and promoting interaction among universities, enterprises and government (Terra, 1999). Since their perspective was used as the main focus of this research, they are positioned in the center of figure. The performance of an ITTO favors technology transfer and knowledge protection. In perspective of an ITTO, this should be the central interlocutor between the private sector and the institution (Lotufo, 2009).

By evolving the data analysis, we identified the need to include data relating to critical factors to the success of an ITTO, and about the knowledge necessary for its proper development. This resulted in Figure 2, which presents the center of the image, the critical success factors and knowledge necessary for the development of a TIC.

4 Conclusion

A number of deficiencies noted at the investigated ITTO's could be enumerated: lack of jobs offers in the universities to work in the ITTO's; lack of legal support for negotiating and drafting contracts; lack of motivation and focus on results aiming generating business from the knowledge generated to protect intellectual property; lack of a well-defined patent management structure; insufficient encouragement and support of the institution's top management; lack of human resources and turnover of trained talent in the ITTO; lack of commercial vision of the outcomes of the researches by most researchers, among others. However, combined with the interviews and the theoretical framework, it is possible to summarize some observations regarding Scientific and Technological Institutions, government, and businesses companies as the main actors of innovation and technology transfer, which can significantly help in the management of these deficiencies. Each of these sectors needs some conditions to foster innovation.

Scientific and Technological Institutions (STIs) require: specialized human resources; basic and applied research of quality; knowledge and know-how; innovative culture; interaction with the society and business companies; institutional policies of intellectual property; and agile management mechanisms. In the case of STIs, there are still internal management factors that may contribute to promote innovation and technology transfer, such as: a) active and concrete top management support, by the establishment of institutional policies, the viability of physical infrastructure and human resources, use of equipment and tools to provide the best performance for the ITTO and other engines of innovation management; b) integration of innovation, intellectual property protection and technology transfer as institutional purposes, provided in its Statutes and the strategies; and c) creating of an environment of innovation, through the articulation of management actions, with incubators and technology parks, to promote the innovation cycle, from research development to the relationship of the STI with market.

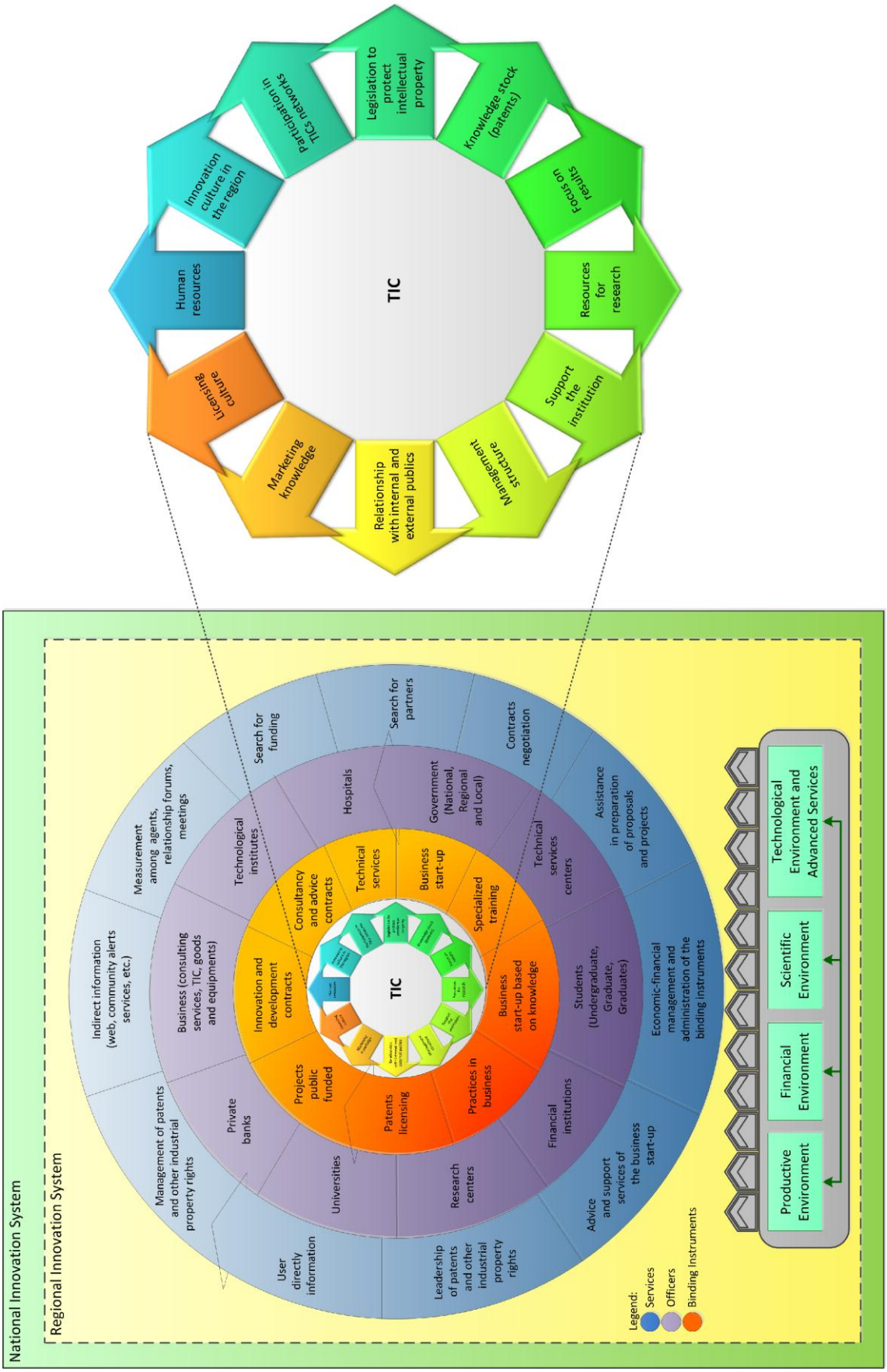

Figure 2: Referential Framework

Source: the authors.

Regarding to the business companies, whether they produce goods and services, knowledge-intensive services (consulting in engineering, testing or analysis techniques), or products services of technologies of information and communication, and manufacturing of machinery and mechanical, electrical and electronic equipment, it is fundamental the openness to innovation. This openness can be called either innovation culture or simply entrepreneur capability. But the key element we refer here is the value of organizational and individual knowledge as an innovation source; the respect for intellectual property; the ability to finance activities of R&D; the fostering of relational competences with ITTO's; and the creation of mechanisms for absorption of technologies generated at the university.

Regarding the government, articulated public policies and government programs aiming at stimulating public-private partnerships, innovation financing, sharing of technological risk, and, especially, remuneration for innovation effort and tax incentives are some instruments which can facilitate the interfaces between ITTO's and other actors of the IS, fostering development.

From the field data, we found that, in the belief of the respondents, there is no distinction from the concepts of innovation and technology transfer, and economic growth, employment and income, competitiveness, wealth creation and insertion of the country on the international scene. This leads to infer that there is an increasing need from managers to innovate on many fronts, including the way they think and organize innovation processes in their organizations, in order to avoid being put away of the market. Therefore, it is essential: a) knowing the research project and the researchers involved; b) knowing the market application of the potential technology; c) understanding about the technology process assessment; d) understanding that innovation and technology transfer involve risks and benefits, and that, therefore, there is no one rule can cover all trades: each case is different.

Finally, it is still possible to discern a wide field of research on the topics covered in this work. This paper intended to present a contribution to the subject of the relation between ITTO's and other actors of the RSI in Southern Brazil. Nevertheless, it is worth noting that further research must be done in order to have more definitive results. For instance, interviews with external experts aiming to provide qualitative validation to the referential framework and to the presented results could be a way to analyze and compare the contents of expert knowledge with the proposed referential framework and refine the obtained results. Also, when performing the field study, we realized the vast potential of the subject for discussion about the structures of the ITTO's and interface officers. Hence, a larger number of respondents, including strategic-level managers, could enrich future research on this subject.

We understand also that is important to highlight the difficulty in obtaining the return of the questionnaires sent. There were ITTO's, which were accessed by their importance in the regional context, but that, even after repeated contacts, did not show interest on participating of the research. In this sense, the response rate was lower than 25%.

Other possibilities identified during this research include:

a) To conduct a quantitative study in the national TICs, to evaluate quantitatively each of the blocks of the conceptual framework;

b) To propose a methodology for structuring TICs that actually have as a core activity the technology transfer;

c) To study networks of ITTO's, conducting an international comparison relating the objectives and results of such association in Brazil and in other countries.

References

ALBUQUERQUE, E. M. Sistema Nacional de Ciência e Tecnologia no Brasil: uma análise introdutória a partir de dados disponíveis sobre a ciência e a tecnologia. Revista da Economia Política, vol. 16, nº. 3 (63), julho-setembro/1996.

BESSANT, John; TIDD, Joe. Inovação e Empreendedorismo. Trad. Elizamari Rodrigues Becker, Gabriela Perizzolo, Patrícia Lessa Flores da Cunha. Porto Alegre: Bookman, 2009.

BRASIL. Ministério da Ciência e Tecnologia. Livro Azul (da) 4a Conferência Nacional de Ciência e Tecnologia e Inovação para o Desenvolvimento Sustentável - CNCTI. Brasília: MCT/CGEE, 2010.

CARVALHO, L. C.; MAIS, I.; MACHADO, D. D. P. N. Inovação? NIT nas Universidades? Entendimento de Pesquisadores de uma Universidade Pública do Sul do Brasil. Revista Eletrônica de Gestão Organizacional, 2010.

CESAR Project. Available at <http://proyectocesar.eu/>. Last access: February 29, 2012.

COOKE, P.; URANGA, M.; ETEXBARRIA, G. Regional innovation systems: institutional and organizational dimension. Research Policy, v. 26, 1997, p. 475–491.

EDQUIST, C. Systems of innovation: technologies, institutions and organizations. London: Pinter; 1997.

EINSENHARDT, K. M., Building Theories from Case Study Research, The Academy of Management Review, v. 14, n. 4, 1989.

ETZKOWITZ, H.; LEYDESDORFF, L. The Triple Helix – University, Industry, Government Relations: A Laboratory for Knowledge Based Economic Development. In: The Triple Helix of University, Industry, and Government Relations: the Future Location of Research Conference. Amsterdam, 1996.

LOTUFO, R. A. A Institucionalização de Núcleos de Inovação Tecnológica e a Experiência da Inova Unicamp. In: Santos, M. E. R.; Toledo, P. T. M.; LOTUFO, R. A (Org.). Transferência Tecnológica: Estratégias para estruturação e gestão de Núcleos de Inovação e Tecnológica. Campinas, SP: Komedi, p. 41-73, 2009.

MARTINEZ, E. C.; MARIN, M. J. A.; SANCHEZ, D. R. La valoración y explotación de los resultados de la investigación. Curso para la Creación e Implementación de ORES. CESAR: 2011.

MARTINEZ, E. C.; LUCIO, I. F. El contexto de las relaciones Universidad - Empresa. Curso para la Creación e Implementación de ORES. CESAR: 2011.

NELSON, R. R. National innovation systems: a comparative analysis. New York: Oxford University Press, 1993.

PALMEIRA, M. I. M; ANTUNES JR, José Antônio Valle; LEIS, Rodrigo Pinto. O Pólo de Inovação Tecnológica da Região Norte do RS à luz dos Sistemas Regionais de Inovação: sua evolução, aspectos facilitadores e limitadores. EnANPAD. Rio de Janeiro, 2008.

PELAEZ, V.; SZMRECSÁNYI, T (Org.). Economia da Inovação Tecnológica. São Paulo: Hucitec, 2006.

SCHUMPETER, J. A. Teoria do Desenvolvimento Econômico. Rio de Janeiro: Fundo de Cultura, 1961.

_____ (1911). A Teoria do Desenvolvimento Econômico. São Paulo: Abril Cultural, 1982.

_____ (1942). Capitalismo, Socialismo e Democracia. Rio de Janeiro: Zahar, 1984.

TERRA, B. R. C. S. S. R. Escritórios de transferência de tecnologia em universidades. 1999. 275 p. Tese (Doutorado em Ciências em Engenharia de Produção) – COPPE, Universidade Federal do Rio de Janeiro, Rio de Janeiro.

TOLEDO, P. T. M. A Gestão Estratégica de Núcleos de Inovação Técnológica: Cenários, Desafios e Perspectivas. Campinas: Agência de Inovação da UNICAMP, 2009.