KNOWLEDGE FLOW IN UNIVERSITY-INDUSTRY RELATIONS: AN ANALYSIS OF COMPANIES ESTABLISHED AT A TECHNOLOGY PARK IN BRAZIL

Dalmarco, G.a, Silveira, L.M.b,c, Kronbauer, E.R. b

a Business School, PUCRS, Brazil
b Graduate Program in Business Administration, PUCRS, Brazil
c IFRS - Instituto Federal do Rio Grande do Sul, Brazil

Abstract

The objective of this study is to analyse the knowledge flow in joint projects between universities and companies located in a technological park – a favourable environment for this type of interaction. In addition, technological maturity levels were examined through the TRL (Technological Readiness Level) scale for further analysis of projects studied. The research method adopted was the single case study, through seven projects between companies and professors from different departments of one university. Results showed that according to company's market strategy, a specific type of knowledge was transferred through the flow. Companies whose focus was on incremental improvements have established projects in which the application was more tangible. In turn, companies that focus on the development of new products have focused their research activities on identifying technological novelties that could be used in their products. Finally, this study contributes to the literature on university-industry relations, broadening the discussion beyond the actors and channels of knowledge transfer and demonstrating that similar channels can be used for knowledge flows with different levels.

Keywords:
University-Industry Interaction; Science and Technology Parks; Knowledge Flow; Brazil.

1 Introduction

Innovation is a key element for national and international competitiveness. A company's innovation capacity is directly related to its performance, mainly improved through the application of new technologies. To leverage their assets, companies look for universities aiming for the application of state-of-the-art knowledge into products and processes (1). This movement
is commonly known as university-industry (U-I) relations, described by the knowledge transfer between a knowledge creation agent (here characterized by universities and research centres) and a knowledge application agent (here described by companies) (2; 3). There is also a third agent – the government – who plays an important role on the establishment of policies to stimulate these partnerships aiming for innovative solutions (4).

The knowledge transfer between university and companies is a reality in developed countries. This interaction is one of the fundamental mechanisms to enhance competitiveness, development and dissemination of technologies, helping consolidate a modern and entrepreneurial economy (5). However, in emerging economies, where the development of new technologies is still incipient, the transfer of scientific knowledge from universities to industry may be one of the main instruments for new high-tech products and processes, leading to socioeconomic development and innovation (6).

At both developed and emergent countries, one of the propositions to ease partnerships between the knowledge creation agent and the knowledge application agent is through the creation of Science and Technology Parks (7). The main benefit of tech parks is the available knowledge of companies and academic laboratories that flow freely among institutions. The dynamic network-oriented environment of Science and Technology Parks stimulates knowledge spill over not only through university-firm partnerships, but also firm-firm partnerships (8; 9; 10).

Science and Technology Parks are considered as part of an innovation ecosystem that also includes other stakeholders as entrepreneurs, investors, academic researchers and technology transfer offices (11; 12). This movement is described by the concept of Triple Helix and entrepreneurial university (13), which is guiding the strategic planning of most universities worldwide, and is considered part of a university’s innovation role (14). Universities that foster entrepreneurial activities are considered to be more efficient when it comes to the commercialization of scientific knowledge, mainly through patents and licenses, or through the development of business incubators and Science and Technology Parks (15; 16).

Recent studies discusses the application of the Triple Helix approach through the roles of actors and channels of knowledge transfer (17; 18; 19; 20), and the influence of Tech Parks on these partnerships (21; 22; 23; 24; 25), but fail to address the content of knowledge – basic or applied – transferred being transferred in university-industry relations in which companies are located at the university’s technology park. Adding to this, Vásquez-Urriago et al. (26) reinforces the necessity to analyse Science and Technology Parks in emergent countries, since most studies focus on developed countries that have a similar innovation development model.

Therefore, this study aims to characterize the content of the knowledge flow between university and the companies in science and Science and Technology Parks. We argue that the flow of basic scientific knowledge is more likely to stimulate innovations (27), while the flow of applied knowledge is easily absorbed by companies (28).
The results obtained from scientific research tend to benefit all actors involved (29). Thus, we chose to analyse joint projects between the university (represented by the teaching staff) and companies (usually represented by members who are research and development managers). Benefits, gains and barriers found in the interaction between academia and industry were also analysed.

2 Theoretical Framework

The establishment of university-industry relations through local networks and partnerships are usually analysed by the role of agents and the external alternatives to companies who develop open innovation strategies (13; 30). However, it can be observed that the pattern of such partnerships is changing, mostly by the dynamic environment of local technological clusters and the entrepreneurial movement of universities (31). Universities are primarily responsible for the creation of scientific knowledge that, even if not directly applied, can play an important role in the development of new technologies (5; 32). Companies, in turn, are responsible for the development of new market solutions, having scientific knowledge as technological source (33). The government, for its part, is responsible for establishing a fertile environment for innovation development through policies that encourage research activities between agents (4).

The relations between universities and companies are mainly established through three ways: (i) interests related to basic research; (ii) applied research projects supported by academic research; (iii) research projects that develop joint basic and applied research through multiple funding sources, called strategic research (13; 34). The main advantages for universities in such partnerships is to raise additional resources for the development of basic research, to qualify and updated researchers and professors, interact with researchers from companies, to update its awareness about market needs, and to raise the possibility of employment for students, among others. Companies, by its turn gain, have the advantage to develop new solutions based on high-level knowledge, knowledge exchange with academic researchers, and access to laboratories and equipment, among others (35). Government joins the university and industry to improve the country's technological development (36).

The agglomerations of firms, universities and other knowledge-intensive organizations are beneficial for the generation and utilization of knowledge (37; 38). For this reason, national governments have stimulated the development of different types of technology parks (such as science parks, science and technology parks, technopoles, innovation centres, research parks, science-based industrial parks, and university research parks, among others) as a component of public policy to stimulate innovation (26). These initiatives can be encompassed by the broad category of Science and Technology Parks (STPs) since they are all policy-driven and have a main common objective to promote cooperation and technology transfer, especially between firms and knowledge providers such as universities and research institutes (7; 39).
Based on these three agents – university, industry and government, interactions may take place through different knowledge transfer channels, intended to stimulate and promote a certain knowledge flow among university and companies (Table 01) (40).

The relevance of each channel used is determined by the characteristics of the knowledge itself – basic or applied – and the individual and organizational characteristics of those involved in the process (17; 41). While for companies characterized for high levels of R&D expenditure, certain channels can contribute to the generation of new knowledge, for low R&D spenders the same channels may facilitate technological imitation and catching up. Channels like consultancy and joint research, for example, can be used for both develop new technologies and to solve technical problems (2). Informal contacts, another knowledge transfer channel, or matchmaking workshops promoted by the university, can be stimulated by geographical proximity (42), being one of the advantages for companies who are established at STPs. Summing up, since one channel of knowledge transfer can be used for different purposes, or different channels used for the same purpose, it will be analysed here different not only the channel of knowledge transfer used, but also the knowledge content – basic or applied – that was transferred.

**Table 01: Main knowledge transfer channels**

<table>
<thead>
<tr>
<th>Channels and workshops</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Conferences and workshops</td>
</tr>
<tr>
<td>- Informal meetings, talks, communications</td>
</tr>
<tr>
<td>- University graduates as employees</td>
</tr>
<tr>
<td>- Licensing of university patents</td>
</tr>
<tr>
<td>- Joint publications</td>
</tr>
<tr>
<td>- Lectures/training</td>
</tr>
<tr>
<td>- Contract research and consulting</td>
</tr>
<tr>
<td>- New firm formation by university members</td>
</tr>
<tr>
<td>- Joint R&amp;D projects</td>
</tr>
</tbody>
</table>

Adapted from Zawislak & Dalmarco (2011)

In addition to the channel of knowledge transfer, the maturity of a certain technology may influence the type of partnership aimed by university and industry. A scale called Technology Readiness Level (TRL) was developed to improve technology assessment and transfer, describing the maturity level of technology development (43; 44). The authors sustain that TRL is based on a 1 to 9 scale in which #1 describes the observation of basic principles of scientific research while #9 is a technology that has already succeed when applied on market systems or products.
Table 02: Analytical framework

<table>
<thead>
<tr>
<th>Type of Knowledge</th>
<th>Description</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basic Knowledge</td>
<td>Observed as research activities originating from basic science. Uses channels such as papers, patents or conferences. It is based on technology maturity levels ranging from TRL 1 to 3.</td>
<td></td>
</tr>
<tr>
<td>Strategic Knowledge</td>
<td>Observed on joint projects involving university and industry which tests results of basic science on certain applications. Uses channels such as joint R&amp;D projects or papers. It is based on technology maturity levels ranging from TRL 4 to 6.</td>
<td>2; 17; 40; 43; 44; 45; 46.</td>
</tr>
<tr>
<td>Applied Knowledge</td>
<td>Observed on research projects directed to a specific need with determined results. Uses channels such as recruitment of students by the company, informal contacts and consultancy (if research is required). It is based on technology maturity levels ranging from TRL 7 to 8.</td>
<td></td>
</tr>
<tr>
<td>Available Knowledge</td>
<td>Observed on projects that only require the rearrangement of knowledge already available at the university. Uses channels similar do applied knowledge, as contract research and consulting, but here there is no further development on knowledge available at the university. It is based on technology maturity TRL 9.</td>
<td></td>
</tr>
</tbody>
</table>

Observing different kinds of scientific research, Stokes (34) discusses the spectrum between basic and applied scientific research, adapted to three categories: pure basic research, use-inspired basic research and pure applied research. Pure basic research refers to research activities originating from basic knowledge (34), usually done without practical purposes in mind. However, it is the forerunner of technological progress. Some business sectors are inspired by basic research to develop their products, keeping close ties with universities (17). Use-inspired basic research, the second category, is basic knowledge content with consideration of use (34). Dalmarco, Zawislak and Karawejczyk (2) discusses that this kind of knowledge may be observed on joint projects involving university and industry, where the first starts the research and,
following some practical results, development is undertaken by the industry. The third category is described as pure applied research, which is research directed to a specific need (34). This type of research requires specific solutions, such as research agreements or market consultancy (2).

To expand the spectrum of possibilities in university-industry relations, it could be observed that in certain situations the type of knowledge companies is looking for is something that was already developed by the university (45). In this case, the knowledge transferred is based on routine activities, with lower complexity and sophistication (46). Consequently, the scientific knowledge available at the university is often "downgraded" to solve problems characterized by a low degree of uncertainty and technological development (45).

To observe the different types of knowledge transferred through the knowledge flow, four types of knowledge content will be used as an analytical framework (Table 02). These four categories were mainly based on the channel of knowledge transfer, technology maturity and the kind of scientific research conducted to develop the technology transferred, as described in the literature review.

In order to complement the discussion on actors and channels, the knowledge flow seeks to characterize the content of the knowledge flow between university and companies that are established inside university’s tech park. Thus, the research method described in the next section was adopted.

3 Research Method

To understand and characterize the knowledge flow between companies established at Science and Technology Parks and universities, it was conducted an exploratory study at a technology park located in the southern region of Brazil. This park is considered one of the best tech parks in Brazil, being recognized as such on a contest organized by ANPROTEC, the Brazilian Association of Science Parks and Business Incubators. It is also nationally recognized its policies that stimulate local companies to establish partnerships with its Host University. It has approximately 110 organizations established, among those 80 companies.

The research was conducted by a single case study as defined by Yin (47). This method was used because it is a strategy that tries to examine a phenomenon in its real life context (47), and allows a more flexible analysis of the results (48). Considering the characteristics of the knowledge content in university-industry relations is still not fully described by the current literature, we considered that an exploratory case study be more appropriate to reach our objectives.

The case selection was directed to a list of projects that companies established the tech park had with researchers of the Host University. The projects selected had the objective of developing a new technology, while projects that aimed financial support for research infrastructure or
scholarships were discharged. It were identified eight projects with companies from 2010 to 2014, but only seven were analysed because both company and academic researchers were still at the technology park/university (Table 03). It were interviewed the professors responsible for those research projects, who also indicated the company’s manager assigned to the project.

**Table 03:** Profile of the projects analysed

<table>
<thead>
<tr>
<th>Project</th>
<th>Budget (R$)</th>
<th>Length (months)</th>
<th>Researchers involved</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>40,000.00</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>85,000.00</td>
<td>30</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>320,000.00</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>300,000.00</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>500,000.00</td>
<td>12</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>50,000.00</td>
<td>24</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>3,000,000.00</td>
<td>36</td>
<td>11</td>
</tr>
</tbody>
</table>

Two data collection procedures were defined: in-depth interviews and secondary analysis. In-depth interviews were conducted with company’s researchers and professor participating or having participated on each project. In total it were conducted 17 interviews in which were used semi-structures questionnaires validate by two academic experts. In addition to interviews, secondary data such as reports and technical forms were used as input data. All interviews were recorded and transcribed, while the reports were already on digital format (pdf or word). All information was organized by qualitative data analysis software, and categorized through content analysis. According to Gagnon (49), content analysis allows different text associations that may improve the analysis, organization and integration into theoretical hypothesis. The description of each research project, and the interviewed subjects, was organized in table 4.
<table>
<thead>
<tr>
<th>Project Number</th>
<th>Company Segment</th>
<th>Company Foundation</th>
<th>Respondents</th>
<th>Time at the company</th>
<th>Area of Knowledge</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>Medical Equipment</td>
<td>2008</td>
<td>Company Manager</td>
<td>6 years</td>
<td>Electrical Engineer</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Academic Researcher</td>
<td>15 years</td>
<td>Doctor in Space Physiology</td>
</tr>
<tr>
<td>#2</td>
<td>Nuclear Medicine</td>
<td>2008</td>
<td>Company Manager</td>
<td>6 years</td>
<td>Physicist</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Academic Researcher</td>
<td>12 years</td>
<td>Doctor in Physics</td>
</tr>
<tr>
<td>#3</td>
<td>Information Technology</td>
<td>2000</td>
<td>Company Manager</td>
<td>4 years</td>
<td>Doctor in Physics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Academic Researcher</td>
<td>5 years</td>
<td>Doctor in Computer Science</td>
</tr>
<tr>
<td>#4</td>
<td>Information Technology</td>
<td>2000</td>
<td>Company Manager</td>
<td>7 years</td>
<td>MSc in Information Systems</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Company Account Manager</td>
<td>6 years</td>
<td>MSc in Software Engineering</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Company Program Manager</td>
<td>11 years</td>
<td>MSc in Computer Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Academic Researcher</td>
<td>15 years</td>
<td>Doctor in Computer Science</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Academic Researcher</td>
<td>18 years</td>
<td>Doctor in Information Technology</td>
</tr>
<tr>
<td>#5</td>
<td>Multimedia Communication</td>
<td>2011</td>
<td>Company Manager</td>
<td>3 years</td>
<td>MBA in Project Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Academic</td>
<td>14 years</td>
<td>Doctor in Social</td>
</tr>
</tbody>
</table>
4 Results

Companies established at technology parks do not always interact with the Host University. This is the main challenge faced by tech park managers who want to create an environment that promote knowledge spillover. In this sense, our effort was to analyse documents that described the objective and characteristics of each established partnership, identifying those that were aligned with our analytical framework. Many companies established at the chosen tech park are ICT companies, who are beneficiary of the Brazil’s Informatics Law (50). As mentions the researcher involved in project #3: “Informatics Law allows companies to invest in training of their own employees. Consequently they invest mostly in training, and not on research projects”. Therefore, to observe different characteristics of the knowledge flow, we looked only for projects that aimed to develop new technologies, independently if it was something new for the company, the sector or the world (according to the characteristics of innovation presented by the Oslo Manual [51]). After this previous analysis, interviews were conducted to identify the importance of university-industry relations, motivation and barriers to joint university-industry projects, and the characteristics of the knowledge flow on each research project.

Regarding the importance of universities to companies, the interviewees mentioned that the university is perceived, in most cases, as a source of new ideas for projects. It is also considered a partner to meet the demands already established by the company. Interviewee from company 7 says that: "The Host University has always been a partner, but I think that is true because the timing is different. Researcher have time to test new ideas, scientific concepts, and that is very important for us". This highlights the importance that companies established at the technology park gives to academic research. Even though the academic timing is a bit slower when compared...
to companies, particularly when dealing with internal bureaucracy, in most cases they see the university as a great ally in joint research projects.

Analysing the importance of companies to academic researchers, interviewees highlighted that an efficient communication among partners, confidence and mutual respect are strong features of the relationship, influencing the knowledge flow. Researcher of project #1 said that: "Communication is very fast. (...) There is no formality any longer. We were able to establish trust, and a direct bridge, thanks to the success of the project". It could be observed that, in general, at the beginning of the project the company is sometimes afraid of the partnership. However, as soon as the first results are presented, the trust of the partner raises, favouring the flow of information. This reinforces the advantages of establishing joint research projects between academic researchers and companies established at a technology park close to the university. Knowledge spill over is almost natural in such environments, since academic researchers and company managers end up having occasional meetings at cafeterias and restaurants, outside company’s formal environment.

The view of actors allows us to identify the existence of barriers and facilitators faced by both agents. Characteristics such as the prestige of the university; involvement of academic researcher with market issues; open relationship between university and company; and easy access to research laboratories, are seen as favourable. The proximity of company to the university was highlighted as one of the most important facilitators. Interviewee from company #4 says “The fact that we are located in the technology park of the university makes interaction a lot easier. Nothing is far away, everything is close by, and many companies do not have this culture of interaction with the university”. Agrawal, Kapur & McHale (52) and Garcia et al. (42) refers that geographical proximity enables the transfer of knowledge between researchers and the industry, generating a positive impact on the success of a product launch. For instance, the advantage of being located at a STP is stressed by limitations on company’s technology development process. Location incentive relies on the type of ownership and corporate control the firm features, since partnerships are determined/limited by the sole headquarters. If the local unit has responsibilities on the initial stage of product development, then it will focus on innovation creation (24). In this case, the firm may come up with product variation fostered by partnerships with the university.

Analysing the barriers face by the agents on establishing partnerships, bureaucracy was the most relevant factor described by the interviewees. Interviewee of company #6 mentions that “it is very annoying, the paperwork to fill out, we need a simpler system, able to multitask, a system that unites the group that will work”. Siegel et al. (53) corroborate this view, arguing that the university’s bureaucracy and inflexibility are barriers in the interaction process, creating dissatisfaction among researchers and company members, often having informal and consultancy interactions. Adding to bureaucracy, other barriers were also described as the usual gap between
academic interests and company’s result-oriented goals; research time difference for each agent – companies requires agility while university works on academic schedule; frequent changes of company’s R&D managers, as well as research objectives were also mentioned as an specific issue of companies.

It is important to highlight that even though communication is constantly mentioned as a facilitator between actors, bureaucracy (an important barrier described by the interviewees) seems to be related to communication processes. Thus, communication for project alignment and formalization of processes that involve university-industry relationship could be more transparent, with a better communication system. Project developed is also penalized by the different deliveries that each agent expects, demanding better time management.

Describing the knowledge flow observed between the Host University and companies established at the technology park, we were able to identify different types of knowledge content according to the project analysed. Projects characterized by transfer based on the content of Basic Knowledge - projects #1, #3 and #4 - are in line with basic research activities, since they are mostly guided by theoretical and experimental research. As mentions the researcher involved in project #4: “We cannot say that we generated a product, they were prototypes. Plus, our goal was not development, it was research”. The researcher involved in project #3 adds that “we get the whole scientific development part. They gave us some ideas, but the results were scientific, such as papers”. Interviewee of company #1 complement saying that: “We’ve been in this partnership for three years. In the first year we managed to register a patent on a technology”. These projects are in line with the strategy of the two companies: to develop high tech products. Project one was conducted by a start-up company, who develop R&D activities to a bigger company, and has awarded several innovation prizes. By its turn, projects #3 and #4 are part of the innovation strategy of a big multinational company who takes advantage of being close to the university to upgrade their technology level.

Project #2 and #6 were identified by a knowledge flow based on Strategic Knowledge, since these projects were based on basic knowledge but with consideration to be explored for a specific use. The researcher involved in project #2 mentions that: “He will add value to an internal process and will enhance the value of his company in the market. He is developing a methodology to optimize his service”. Interviewee of company 2 says that “This project was part of my Master thesis. We are discussing the application of a certain concept to justify a process optimization”. Describing project #6, the academic researcher mention that “We were able to show the efficiency of the research, we validated tests, had good results, and the company was able to sell the product [for which] we developed the technology”. These two projects, developed by start-up companies, highlight the innovative opportunity of technology parks. While looking for new scientific outcomes, researchers and entrepreneurs were able to apply the research results to improvements in their product and process.
The category Applied Knowledge was observed on projects #5 and #7, as they are characterized as projects directed to a specific need, with the purpose of obtaining new knowledge. The interviewee of company #5: “During the project we needed to conduct a study to evaluate whether this technology worked as well as other similar equipment on the market. We didn’t have expertise to develop such a study, so people from the university were involved to determine the evaluation methods”. Describing project #7, the academic researcher interviewed mentions that “For me the best result is the opportunity to apply in practice. To carry out the applied research and apply the results of what I do”. Such results are in line with the scope of activities of both companies, mainly focused in services. Even though they have different sizes and nationality, their strategy for local and national market is mostly based on the improvement of services offered, with small margin for innovative improvements.

Describing the category Available Knowledge, none of the projects were based on something that was already developed. This category was only mentioned by the interviewee of company #1 as a possibility of also using the results of project #1 into other applications than those previously foreseen: “We are planning to develop new products using the technology that has already been developed for project #1”. This is also one of the possibilities of companies when interacting with universities. The development of joint research projects may result in secondary technologies that can be used into other applications or even portfolio products.

Summing up, even though companies are geared towards market demands, and university to academic research, it is relevant to understand how this interaction takes place. Various authors present university-industry interaction, especially those promoted by the proximity of tech parks to universities, as a source of innovation (2; 3; 6; 31; 54; 55). The actors involved, and the channels of knowledge transfer, are recognized by the university as a way to facilitate this interaction. However, as observed on the projects analysed, the company’s strategy and the university’s knowledge base open a range of possibilities for different kinds of knowledge flow – from basic to applied knowledge. Having a technological park with companies willing to promote innovation facilitates the access of university researchers.

5 Conclusion

Science and technology parks are considered the locus of innovation in emergent and developed countries, since the geographical proximity between companies and universities (who in most cases host the STP) may stimulate the knowledge flow among institutions. However, in emergent countries like Brazil, where the interaction between companies and universities does not happen naturally, it is necessary to establish specific policies to promote such partnerships. At the tech park observed, companies who want to move into the STP must interact with the university. In this scenario, our objective is to characterize the content of the knowledge flow between university and the companies established at the science and technology parks. We
wanted to observe if companies were doing the bare minimum of R&D activities just to be established there, or if they were taking advantage of the geographical proximity to develop high tech products. Apparently the last one is the main objective of the observed cases.

Regarding facilitators and barriers observed in university-industry relations, the geographical proximity to the STP was considered the main facilitator to the partnerships. Companies consider the Host University, including researchers and students, as a highly qualified and easy to access team available to attend their needs. On the other hand, the bureaucracy to meet demands, whether to begin a project or purchase materials and equipment, was identified as a barrier. The gap between the company’s view (result-oriented) and the university’s (research-oriented) ends up having positive effect on the projects identified here, since most of them focus on the development of new technologies. Companies consider that being established in the STP is a strategic advantage since it provides both relevant joint research and qualification of company employees.

With respect to the knowledge content transferred by the flow, basic knowledge is the most common content observed on the cases, mostly due to the incentives provided by the Informatics Law. Strategic knowledge and applied knowledge were less frequent, usually associated with basic knowledge. Available knowledge was found in two projects that used a technology previously developed in partnership with the university. This is an important finding since the transfer of available knowledge is associated to partnerships that don’t look for the development of new technologies. In this case, however, it is based on a previous technology developed with the same company, who foresaw a new application for it.

The theoretical contribution of this article was to complement the current discussion about university-industry relations on a broad perspective, proposing an analytical framework that allows to observe the content of knowledge being transferred. Not only observing actors and channels, the knowledge flow improved the analysis of the cases described. Most of them used the same channels of knowledge transfer, but established partnerships with different results – from new technologies to improvements in products and services.

The main managerial contribution of our research is directed to technology park managers, who must align demands and expectations of companies and academic researchers. We are aware that innovation is not a strategic movement of most Brazilian companies, but those who establishes offices at tech parks are usually more aware of the academic procedures, thus more open to establish joint partnerships. The challenge here is to find academic researcher who can attend companies’ restraints and expectations, delivering high quality projects in short term to open possibilities to establish long term research on a second moment.

One of the main limitations of this research, and of university-industry relations in Brazil, is that we only identified eight projects of technology development. Considering that all companies established at the observed tech park should have some kind of partnership with the

81
Host University, 90% of the projects are directed to academic training or other types of interaction. Many companies have in-house R&D units and, instead of opening their innovative activities to academic researchers, they focus on internal activities and limit their interaction to hiring and training students who are also their employees. This strategy restrains the interaction between agents.

In the future, the analyses developed in this study could be expanded and deepened by including other companies and researchers in order to analyse the knowledge flow in different types of Science and Technology Parks, as well as compare with joint projects of university researchers and companies outside the park.

References


(20) Battke B.; Schmidt T. S.; Stollenwerk S. and Hoffmann V. H., “Internal or external spillovers: Which kind of knowledge is more likely to flow within or across technologies”, Research Policy, Vol. 45, 2016, pp. 27-41.


Correspondence
Dalmarco, G., Business School, PUCRS, Brazil. Email: gustavo.dalmarco@pucrs.br
Silveira, L.M., Graduate Program in Business Administration, PUCRS, Brazil. ‡ IFRS - Instituto Federal do Rio Grande do Sul, Brazil. Email: lisilene.selveira@hotmail.com
Kronbauer, E.R., Graduate Program in Business Administration, PUCRS, Brazil. Email: evelyn.kronbauer@gmail.com