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Ribeiro Pardo, Wladimir; Vieira Becker, Grace; Bent Hansen, Peter; Lima Ruas, Roberto;  
Meister Mônico, Henrique  
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# THE RELATIONSHIP BETWEEN THE COMPETENCIES OF A TECHNOLOGY PARK AND THE COMPETITIVENESS OF ITS RESIDENT IT ENTERPRISES: A CASE ANALYSIS AT TECNOPUC

## *A RELAÇÃO ENTRE AS COMPETÊNCIAS DE UM PARQUE TECNOLÓGICO E A COMPETITIVIDADE DE EMPRESAS DO SETOR DE TI NELE RESIDENTES: ANÁLISE DO CASO TECNOPUC*

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Wladimir Ribeiro Pardo<sup>1</sup>

Grace Vieira Becker<sup>2</sup>

Peter Bent Hansen<sup>3</sup>

Roberto Lima Ruas<sup>4</sup>

Henrique Meister Mônico<sup>5</sup>

### ABSTRACT

*Over the years, technology parks have attracted organizations seeking competitiveness through innovation and technological cooperation. The aim of this study was to investigate the relationship between the competencies contained within a technology park, TECNOPUC, and the competitiveness of the Information Technology (IT) firms located within it. A qualitative exploratory study was conducted involving experts on the topic, the Park managers and managers from seven firms located in the Park. The findings reveal the perception that the brand TECNOPUC and the working environment provided by the Park are the competencies that are more closely related to the competitiveness of the firms located within it. The managers interviewed seem to be in the Park in search of business opportunities with large corporations, focusing their actions on reducing costs in order to achieve greater competitiveness. Rather than developing or selling technology, the priority seems to be selling products and services. Thus, actions aimed at encouraging and promoting research, technological development and innovations, such as the implementation of joint projects, for example, are not prioritized.*

**Keywords:** Competencies. Technology Park. Competitiveness.

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<sup>1</sup> Possui graduação em Engenharia Mecânica pela Universidade Federal do Rio Grande, FURG e mestrado em Administração e Negócios pela Pontifícia Universidade Católica do Rio Grande do Sul, PUCRS. Atualmente ministra uma disciplina na Universidade de Santa Cruz do Sul - UNISC e duas disciplinas na Universidade de Lajeado - UNIVATES. Porto Alegre. Rio Grande do Sul. Brasil. E-mail: wladimir@unisc.br

<sup>2</sup> Possui graduação em Administração de Empresas pela Universidade Federal do Rio Grande do Sul, UFRGS, mestrado em Administração pela Universidade Federal do Rio Grande do Sul, UFRGS e doutorado em Administração pela Universidade de São Paulo, USP. Atualmente é professora e pesquisadora do Programa de Pós-Graduação em Administração - PPGAd e professora na Faculdade de Administração, Contabilidade e Economia - FACE da Pontifícia Universidade Católica do Rio Grande do Sul. Porto Alegre. Rio Grande do Sul. Brasil. E-mail: grace.becker@pucrs.br

<sup>3</sup> Possui graduação em Engenharia Mecânica pela Universidade Federal do Rio Grande do Sul, UFRGS, mestrado em Engenharia de Produção pela Universidade Federal do Rio Grande do Sul, UFRGS e doutorado em Engenharia de Produção pela Universidade Federal do Rio Grande do Sul, UFRGS. Porto Alegre. Rio Grande do Sul. Brasil. E-mail: peter.hansen@pucrs.br

<sup>4</sup> Possui graduação em Administração pela Universidade Federal do Rio Grande do Sul, UFRGS, mestrado em Economia pela Université Paris 1 Pantheon-Sorbonne, PARIS 1, França e doutorado em Economia pela Université Picardie Jules Verne, UPIV, França. São Paulo. São Paulo. Brasil. E-mail: roberuas@gmail.com

<sup>5</sup> Possui graduação em andamento em Engenharia de Produção pela Pontifícia Universidade Católica do Rio Grande do Sul, PUCRS. Porto Alegre. Rio Grande do Sul. Brasil. E-mail: henrique.monego@acad.pucrs.br

## RESUMO

Os parques tecnológicos vêm ao longo dos anos atraindo organizações que buscam competitividade por meio da inovação e cooperação tecnológica. Diante disso, este estudo buscou evidenciar a relação entre as competências de um parque tecnológico, o TECNOPUC, e a competitividade das empresas de Tecnologia da Informação (TI) lá instaladas. Realizou-se, para isso, uma pesquisa qualitativa de caráter exploratório, envolvendo *experts* no tema, gestores do parque e gestores de sete empresas lá residentes. Como resultado, evidenciou-se a percepção de que as principais relações entre as competências do Parque e a competitividade das empresas são constituídas pela marca TECNOPUC e pelo ambiente de trabalho proporcionado pelo parque. Os gestores entrevistados parecem estar no Parque em busca de oportunidades de negócios com as grandes corporações, focando suas ações na diminuição de custos para conquistarem maior competitividade. Mais do que desenvolver ou vender tecnologia, a prioridade parece ser a de vender serviços e produtos. Com isso, ações voltadas ao estímulo e à promoção da pesquisa, ao desenvolvimento tecnológico e a inovações, tais como a execução de projetos conjuntos, por exemplo, ainda não são priorizadas.

**Palavras-chave:** Competências. Parques Tecnológicos. Competitividade.

## 1 INTRODUCTION

In recent years, the technology park, as a type of interorganizational arrangement, has attracted organizations seeking to achieve competitiveness through innovation and technological cooperation (PLONSKI, 1995; HANSSON; HUSTED; VESTERGARD, 2004). The focus of this type of arrangement is the generation and dissemination of scientific and technological knowledge through the development of research carried out in partnerships between universities and companies (FUJINO; STAL; PLONSKI, 1999; VEDOVELLO, 2000; BAKOUROS; MARDAS; VARSAKELIS, 2002; COLOMBO; DELMASTRO, 2002). The relevance of this partnership is justified by Casado, Siluk and Zampieri (2012). According to the authors, universities are the most appropriate agents, both by capability and social responsibility, to generate ideas and actions that seek to solve or alleviate situations of different areas and segments of society, from issues relating to the environment and economic and social problems, to issues of educational advances and technological development.

By promoting a culture of innovation, encouraging entrepreneurship and the creation of new businesses, the technological park model has become consolidated as a structure capable of producing competitive advantage for the organizations located within or associated with it (LINDELÖF; LÖFSTEN, 2004; FERGUSON; OLOFSSON, 2004; ZENG; XIE; TAM, 2010; DABROWSKA, 2011). Technology parks are also responsible for fostering relationships that transform isolated economies into an interconnected network, which is certainly a key factor for the competitiveness of companies in the current environment (AMATO NETO, 2000). In this sense, Lobosco, Moraes and Maccari (2011) emphasize that the participation of researchers affiliated with Universities along with companies installed in the technology parks, especially those which operate in intensive activities in research and development, may be an important factor for the increase in the number of registered patents, as per experiences observed in other countries. Therefore, companies located in technology parks can expect to obtain significant gains over those located outside such arrangements (MALAIRAJA; ZAWDIE, 2008; SÁNCHEZ; CRIADO; VALENTÍN, 2011).

The issue driving the above-mentioned studies is essentially a concern with demonstrating the influence that a park has on the performance of a business, an industry, or, more broadly, of a region or nation. Several studies have been conducted to this end (LÖFSTEN; LINDELÖF, 2002; SIEGEL; WESTHEAD; WRIGHT, 2003; BIGLIARDI; DORMIO; NOSELLA; PETRONI, 2006; MALAIRAJA; ZAWDIE, 2008; GAINO; PAMPLONA, 2014).

Nevertheless, a closer look at the literature suggests there are a number of authors who take a more critical line and highlight the weak points in the contribution that technology parks make towards their businesses (COLOMBO; DELMASTRO, 2002; SIEGEL; WESTHEAD; WRIGHT, 2003; HANSSON; HUSTED; VESTERGAARD, 2005; MALAIRAJA; ZAWDIE, 2008). In view of the points raised, and with the aim of broadening this discussion in the Brazilian scenario, this paper aims to analyze the relationship between the competencies of a technology park and the competitiveness of the information technology (IT) companies located within it (which we refer to as its resident companies).

The competency approach has gained importance in business management due to its ability to explain what organizations know how to do best in order to ensure a certain level of market competitiveness (PRAHALAD; HAMEL, 1990; BARNEY, 1991). Seamlessly understanding and developing this cooperative expertise between the park management and its resident companies seems to be a relatively recent discussion, the importance of which has grown due to expansion of this type of arrangement in recent years.

According to the International Association of Science Parks - IASP (2010), a park must have certain basic characteristics in order to promote the economic development and competitiveness of the resident companies. To further this discussion, the present study focuses on the competitiveness of companies within a park considering the main models used to analyze business competitiveness discussed by Dornelles (2011). This author has developed a set of references geared for the analysis of competitiveness in the IT industry, specifically in software development business.

This paper focuses on the case of the Scientific and Technological Park of the Pontifical Catholic University of Rio Grande do Sul - TECNOPUC, considering in particular the IT firms in the Park because of the strategic importance this area has gained in TECNOPUC and its significant position in the organizational environment (ALBERTIN, 2004; GEIT, 2011). In view of these considerations, this paper aims to provide a better understanding of the effectiveness of the actions undertaken to promote the competitiveness of its resident companies.

## 2 TECHNOLOGY PARKS

Technology parks originated in the United States in the 1950s, mainly with the rise of Silicon Valley, based at the Stanford Industrial Park, which aimed to promote innovation through the link between Stanford University and the region's industrial sector (FORMICA; TAYLOR, 1998). The success of this venture encouraged the creation of new parks in the United States, and Europe (BAKOUROS; MARDAS; VARSAKELIS, 2002) and, since then, the model has expanded around the world (GARGIONE; PLONSKI; LOURENÇÃO, 2005). In Brazil, the concept of parks began to spread in 1984, initiated by the National Council for Scientific and Technological Development - CNPq, through the creation of Technological Innovation Centers in research institutions and universities nationwide (MEDEIROS; STAL; SOUZA NETO, 1987). However, it is only as from 2000 that projects in this area begin to gather strength, as a means to promote scientific and technological development (ANPROTEC, 2007, 2008).

In relation to the concept of parks, there still seems to be a lack of consensus regarding the definitions of the term (VEDOVELLO, 2000; LINDELÖF; LÖFSTEN, 2004). Despite the obvious differences in these definitions, there is convergence regarding a certain concept related to technology parks: that these arrangements are focused on the generation and dissemination of scientific knowledge through the development of scientific and technological research conducted

in partnerships between universities and companies (FUGINO; STAL; PLONSKI, 1999; VEDOVELLO, 2000; BAKOUROS; MARDAS; VARSAKELIS, 2002; COLOMBO; DELMASTRO, 2002). Accordingly, for Solleiro (1993) a science park is an urbanized bounded physical area, designated to technology intensive companies, which is established near or in a university or research center, with the aim of using the scientific and technical capacity of the researchers and their laboratories. For Lalkaka and Bishop Jr. (1997, p.64), the technological park is an “outstanding real estate development that takes advantage of proximity to a significant source of intellectual capital, supportive environment and shared infrastructure.” Based on the above ideas, the present research considers a technology park to be: a physically bounded area located adjacent to a higher education institution, where a structure involving companies, research bodies, government, a university and the community, interacts synergistically and based on a management model in order to promote a culture of innovation and competitiveness, increased business training, the transfer of knowledge and technology and to increase the production of wealth in a region.

### 3 THE COMPETENCIES OF TECHNOLOGY PARKS: IDENTIFYING THE ATTRACTIVENESS FACTORS AND CRITICAL SUCCESS FACTORS OF PARKS

Influenced by the Resource-Based View, a group of authors argues that the concept of competence encompasses the notion of resources and the ability to mobilize them and integrate them (GRANT, 1991; LJUNGQUIST, 2007). One can see then, the result of the simultaneous joint action of several components, where the resulting synergistic effect is different from the individual characteristics of each resource. Thus, the collective character becomes a *sine qua non* condition of organizational competencies, which are established by the integration of the skills, processes and technologies of the firms (PRAHALAD, HAMEL, 1990).

In view of what is understood as collective, one can also highlight the recent studies currently in progress in the construction of one of the dimensions of the so-called collective competencies, specifically in terms of inter-company relationship, i.e., inter-organizational collective competencies. Under this approach, the construction of this type of collective competencies begins with the articulation between competencies of managers and professionals of the companies involved and may extend through the composition of organizational competencies of these companies (Mendez; Mercier, 2006; Defelix, 2011). Following the same logic, the competitive advantage of this organizational setting would originate in the action and interaction of professionals and managers of participating companies.

Another group of authors places great emphasis on the impacts of competence on the environment outside the organization, highlighting the concept of competence being linked to the company's ability to do something well (MILLS et al., 2002), the company's ability to achieve its objectives and respond quickly to opportunities and threats in the environment (SANCHEZ; HEENE; THOMAS, 1996; TEECE; PISANO; SHUEN, 1997), or highlighting the ability to meet the demands presented by the actors with whom the company interacts (AWUAH, 2007). The authors Fernandez, Fleury and Mills can also be included in this group, as they claim that organizational competence is related to the key success factors of one company in relation to its competitors. In order for this relationship to exist, the competency must provide superior performance as well as a key success factor: if the company is strong, for example, in the product mix, and the client is only interested in quality, it cannot be characterized as a relevant competency (FERNANDES;

FLEURY; MILLS, 2006). Similarly, it is understood that the attractiveness factors are also relevant in the construction of the concept of park competencies, because they indicate decisive aspects affecting the decision of companies to set up business or not in such environments.

Therefore, the studies that address critical success factors and factors of attractiveness of parks (Figure 1) served as inspiration for the establishment of basic references for identifying the competencies of technology parks, and more specifically of TECNOPUC.

Categories	References concerning critical factors and factors of attractiveness of Parks
Infrastructure	Adequate infrastructure for technology-based companies including buildings, utilities, IT infrastructure, environmental preservation areas, sanitation, etc.; Easy access and proximity to highways, airports and urban centers, easy transport. Availability of security infrastructure; Communication infrastructure; and Physical location of the park: and industrial diversity of the region, offering value-added services, the existence of technology-based companies, etc.
Specialized/technical services	The presence of specialized technology and innovation centers; Training and qualification of labor; Business and management training; Availability of access to new technologies: Service and technical support for the industry; Presence of personnel specializing in structuring technological development projects via support agencies and sector funding.
Park management	Governance mechanisms that allow autonomy in decision-making; Professional management models with the use of quality indicators for the performance of services provided by the park; The area of the park should provide suitable conditions for its installation and activities.
Economic and financial	Competitive prices charged for the park infrastructure, creating economies of scale in their use; Economic and financial viability of the park, generating returns for the investors; Fundraising via governmental agencies and sector funding; Access to government tax incentives; The existence of public policies conducive to business development; Low transaction cost in the region; Labor Costs; Access to venture capital institutions; Economic stability.
University-industry interaction	Internationalization of the technology park with the presence of transnational companies with R&D centers; Access to researchers, teachers and labor from the university, Access to a broad knowledge base; Formal policies of university-industry interaction.
Marketing	Business opportunities; Presence of a consumer market and interaction tools between company and consumer; and Proximity to suppliers.

Figure 1. Critical factors and attractiveness factors of technology parks

Source: Adapted from Vedovello (2000), Audy, Moschetta and Franco (2003), Zouain (2004), Gargione, Plonski and Lourenção (2005), Figlioli (2007), Manella (2009) and Dabrowska (2011).

The work of Telechea et al. (2012) is also noteworthy; the authors, in their analysis of the contribution of companies located in the Park in relation to its competencies, in one stage of their research identified the competencies of TECNOPUC as being: (1) Infrastructure available: TECNOPUC's ability to provide infrastructure that favors the companies installed, making the work environment pleasant and enhancing the quality of life; (2) Encouraging and promoting research and technological development: TECNOPUC's capacity to provide resources, solutions, alternatives and opportunities to promote research and technological development of the companies; (3) Credibility of the brand: TECNOPUC's capacity to provide an image related to credibility and recognition of its products and services' quality; (4) Management Model: TECNOPUC's ability to reconcile and com-

bine the needs of the businesses and the university, building and developing long-term relationships; (5) Capacity for Innovation: ability to learn, incorporate and apply new knowledge, ideas or methods that generate potential contributions to the competitiveness of the resident enterprises, in terms of cost, quality, productivity, etc. It should be noted that the competencies identified by Telechea et al. (2012) have served as the main reference for this study since, besides being in line with research on critical success factors and factors of attractiveness in parks, they represent the TECNOPUC's specific reality, the technology park investigated in this study.

## 4 THE INFLUENCE OF TECHNOLOGICAL PARKS ON COMPANY COMPETITIVENESS

The recent focus on technology parks and the forms of supporting their implementation are based on the expectation that the companies that establish themselves in this type of structure will achieve significant results. Such results are seen mainly in the form of innovative products and processes and research and development (SÁNCHEZ; CRIADO; VALENTÍN, 2011), as well as higher rates of productivity and market share, quality of products and services and competitiveness in terms of costs (MALAIRAJA; ZAWDIE, 2008). Essentially, these studies attempt to demonstrate the influence of a park on the performance of a business, an industry, or, more broadly, of a region or nation. Several studies have been carried out along these lines (LÖFSTEN; LINDELÖF, 2002; SIEGEL; WESTHEAD; WRIGHT, 2003; BIGLIARDI et al, 2006; MALAIRAJA; ZAWDIE, 2008, DABROWSKA, 2011).

On the other hand, in their study, Hansson, Husted and Vestergaard (2005) identified the failure of technology parks to attract and develop high-tech companies, thus failing to fulfil their expected role as a catalyst for regional economic growth. Siegel, Westhead and Wright (2003), according to their preliminary research evidence, suggest that the 'returns' from new technology-based companies, due to their location in technology parks can even be considered negligible. Moreover, Malairaja and Zawdie (2008) highlight the different interests of universities and industry, especially in relation to determining the type of research and adjustment to needs.

In general, definitions of competitiveness are based on the capabilities of an organization in relation to the competition with their competitors. This view, according to the authors, sees competitiveness from a static perspective, i.e., grounded on organizational efficiency, or based only on technical factors relating to the environment, thus limiting the notion of competitiveness to business excellence and results that can be measured economically (FEURER; CHAHARBAGHI, 1994; MACHADO-DA-SILVA; FONSECA, 1996). In this sense, competitiveness is a constant attempt to tailor strategies for business strategies to the patterns of the existing competition (CHIKÁN, 2008), through interaction between the characteristics of the environment and the business strategies (FERRAZ, KUPFER; HAGUENAUER, 1997), thus obtaining a return on the resources employed (ESTERHUIZEN; ROOYEN; D'HAESE, 2008).

Another approach to competitiveness, developed over recent decades, has focused on it being the result of the internal aspects of companies, the structural aspects of the type of industry in which they operates and broader aspects related to culture, region or even the country. In this context, some authors have explored the theme and proposed structures to analyze how this condition develops, whether at the firm, industry or country level. Of particular note are: (i) Porter's Five Forces Model; (ii) Porter's Diamond Model (PORTER, 1980); (iii) the Model proposed by Coutinho and Ferraz (1995), (iv) Systemic Competitiveness (ESSER et al. 1996); and (v) the FADIAC Model (CONNOR, 2003). While recognizing the existence of these models, the present study has used a model designed specifically to analyze the factors of competitiveness in software de-

velopment companies proposed by Dornelles (2011), as shown in Figure 2.

Dimensions	Categories	Variables
Internal factors	Management Strategy	Managerial competence, corporate strategies, management practices, attitudes and values, financial capacity.
	Capacity to innovate	Market knowledge, ability to adapt to market specificities; innovation management.
	Productive capacity	Quality of services, process management productivity, integration with technological networks; integration between suppliers, producers and consumers.
	Human Resources	Quality and productivity of human resources, the firm's learning and responsiveness, individual skills, behavioral aspects, customer perception. Labor qualification, education policies and HR training, labor policies and social security, mastery of English.
Structural factors	Features of the consumer market	Geographic distribution, requirements imposed on the services; opportunities to access international markets; predominant forms and costs of marketing; time zone.
	The Industry Setting	Potential for alliances with suppliers, users and competitors, degree of vertical integration and diversification within the industry; pace, origin and direction of technical progress. Availability, quality and cost of energy, transportation, telecommunications and technology services. Monetary, fiscal, tax, technology and trade policies.
	Competition	Rules defining the conduct of business, the environment and competitors, taxation on industrial operations, import and export practices.
Systemic factors	Macroeconomics	Exchange rate, credit supply, interest rates.
	Political - Institutional	Tax policy and tariff rules that define the use of the purchasing power of the State; technological risk support schemes; policies protecting industrial property, environmental preservation anti-trust and consumer protection.
	Infrastructural	Availability, quality and cost of energy, transport, telecommunications and technological services.
	Social	Qualification of labor, human resources education and training policies, labor policies and social security, degree of consumer demand.
	International	Trends in world trade, international capital flows, investment risk and technology, relations with multilateral organizations, international agreements, foreign trade policies.
	Technological	Technological readiness; integration with technological networks.
	Financial and fiscal	Monetary and fiscal policy, public finance; viability of the financial sector, financial market sophistication.

Figure 2. Analytical model of competitiveness factors of software development companies  
Source: Dornelles (2011).



## 5 RESEARCH METHOD

This is an exploratory, qualitative cross-sectional study “based on a small sample that provides insights and understanding of the context of the problem” (MALHOTRA, 2006, p.155).

The TECNOPUC Park, which is the focus of the study, was chosen because its activities have recently been highlighted in Brazil (GESTÃO, NEGÓCIOS e CIA, 2010).

The research has three phases: (1) validation of the Park’s competencies, (2) validation of the competitiveness factors of the IT companies and (3) identification, characterization and analysis of the relationships between the competitiveness factors and competencies of the Park.

In the Park’s competencies validation phase (1), three PhD professors who occupy strategic positions in the INOVAPUC system (structure of actors, including the TECNOPUC, which represents the entire network of innovation and entrepreneurship at the Pontifical Catholic University of Rio Grande do Sul) were interviewed: the Director of TECNOPUC, the Director of the Agency for Technology Management (AGT) and the Coordinator of the Network of Innovation and Entrepreneurship (INOVAPUC). The questions put to these professionals were intended to capture their thoughts regarding the competencies identified by Telechea et al. (2012). In validating the competencies presented by Telechea, the respondents suggested compiling them: the specific competencies to be compiled are “the Encouragement and Promotion of Research and Technological Development” and “Innovation Capacity”. Furthermore, they suggested changing the name of the competency “Infrastructure” to “Work Environment” because, according to the interviewees, the term infrastructure refers to the question of resources and not to capacities. Thus, this study adopts the following competencies: (a) Work Environment: TECNOPUC’s ability to provide infrastructure that favors the resident firms, making the work environment pleasant and with a high quality of life, (b) the Encouragement and Promotion of Technological Research and Development and Innovation: TECNOPUC’s ability to provide resources, solutions, alternatives and opportunities to promote the technological research and development of the firms and (c) the credibility of the TECNOPUC brand: the ability to provide a Park to ensure an image of credibility and recognition for the quality of the products and services offered.

In the competitiveness factors validation phase (2), the objective was to validate, totally or partially, Dornelles’ (2011), model, which in turn served as the basis for organizing the interviews with managers of the IT firms. In this stage, three experts on the subject were interviewed: two teachers on the post-graduate program and a Master’s student nearing completion of their dissertation on the topic competitiveness in technology parks. The main changes made to Dornelles’ model refer to the exclusion of the “systemic factors”, which the respondents considered factors outside the control of the firms and the Park itself, as indicated in the studies by Coutinho and Ferraz (1995). Thus, the factors used for the analysis of competitiveness were the Internal and Structural Factors, while those of a Systemic nature were disregarded.

Following the validation of the Park and the competitiveness factors of the firms, these two perspectives were compared and related, in a matrix form, (Phase 3). The main source of data consisted of in-depth interviews conducted with seven managers or directors of IT firms located in TECNOPUC. All the IT firms in the Park were contacted via emails and telephone. Eight companies responded to the initial contact and seven agreed to participate. The companies surveyed represent about 30% of the IT companies present in the Park, and include small, medium and large companies, according to the IBGE classification (2011). Furthermore, the group of surveyed companies represents different business segments such as made-to-measure software, software for mobile telephones, IT monitoring programs, software exclusively for retailing, radiofrequency controllers,

among others. Due to its numerical representativeness and the diversity of its profile in terms of size and business, the group of companies surveyed was considered appropriate to attain the objective.

The data collection and data analysis instruments were developed based on the Matrix Relations (MOURA, 1994), with the aim of identifying the relationship between two or more data sets. To systematize the evidence obtained, the data were transcribed and organized in the form of text and then classified through thematic analysis, which requires the formation of categories and subcategories of analysis based on parts of the text and the frequency with which they appear (BARDIN, 2007).

## 6 CHARACTERIZATION OF TECNOPUC AND THE FIRMS PARTICIPATING IN THE STUDY

TECNOPUC was inaugurated in 2000. The aim of the Park is stated as being to “insert PUCRS directly within the process of the technological, economic and social development of the region and the country” (SPOLIDORO; AUDY, 2008, p.79), by attracting companies focused on research and development as well as research and development projects in general, promoting the creation of new technology-based firms, stimulating innovation between companies and the university and working in coordination with governmental spheres.

Today, TECNOPUC is considered one of the most important centers of scientific and technological development in Brazil, and a reference in Latin America. At the time of the study, in 2012, TECNOPUC’s focus was on information technology and it housed 97 organizations, 77 companies, 8 associations and 12 PUCRS research structures. Of the 77 companies, 22 were from the IT sector, the focus of analysis in this study. Below, the seven IT companies that participated in the survey are profiled.

**Firm A** has been in existence for six years. It came about as the result of the initiative of friends who were technology consultants for the State Government of RS. Initially, besides developing software the company sold “boxed”, i.e. ready for the market, software. However, with time, they realized that its expertise lay in providing services and software development. Today, it caters to different market niches and has 26 employees. The company adopts a reactive strategy, because it believes that the market demand is large, and so does not invest in an aggressive policy of acquiring new customers.

**Firm B** creates solutions and services in radio frequency controllers, based on the development of hardware and software. Today, the company has been in the market since 2000 and currently has 50 employees. Its strongest feature is the ability to adapt the technology to the customer’s needs. Its expertise is in developing, designing and marketing of mobile solutions using radio frequency identification systems. The company has several projects in different locations in the country, while it has not yet focused on the international segment.

**Firm C** was one of the first to join TECNOPUC. It develops mobile computing systems, for example, for the sale of remote order transmission. Previously it worked with the Windows Mobile system and, over time, came to adopt the Android platform. It develops management systems that are adapted to the needs and requirements of its customers. With 15 employees, the firm represents a small business in the IT industry. The international market is still not a strategic priority for the company.

**Firm D** decided to set up business in TECNOPUC in order to be near and provide services to one of the Park’s anchors. It provides IT services to the customer, but also sells “boxed products.” However, the company’s the strongest feature is service. The company is divided into busi-

ness units that serve different customers. While it was founded as a training company in 1987, it now provides services in several countries. It currently has 16,500 employees spread throughout all its units. Only one company unit is located in the Park.

**Firm E** is a result of a spin-off from a large group in the retail sector. The firm has operated within TECNOPUC since its inception in 2004. Being linked to a university is one of its strategic pillars. The company provides software solutions through ready for retail products. It supports employee development by sponsoring the continuous training of its professionals in the university where TECNOPUC is located.

**Firm F** has been operating in TECNOPUC for four of its ten-year history. The company started as a consulting service. However, realizing there was a strategic market for the sale of software and IT monitoring services, it has changed its focus to the development of customized software. It currently employs 30 staff and only operates in the domestic market.

**Firm G** has been in existence for 19 years. It moved to the Park in 2004 with the idea of establishing a closer relationship with PUCRS, through the elaboration of projects, which had already occurred prior to its insertion in TECNOPUC. The company is strong in the retail, services and financial areas. The main product is software that is 'tailored' for the customer. With 150 employees, it has a matrix structure, which is characteristic of the sector. Below, Figure 3 presents a table showing the characteristics of the firms included in the survey.

Firm	Founded	Installed in the Park	Nº of employees	Position of the Manager	Internationalized?
A	2006	2006	26	Director General - Partner	Yes
B	2000	2004	50	Director General - Partner	No
C	2002	2004	15	Director General - Marketing	No
D	1987	2003	120	Business Manager	Yes
E	2004	2004	130	Director/founder	Yes
F	2002	2002	30	IT Manager	No
G	1992	2004	150	Director	No

Figure 3 - Characteristics of Firms Surveyed  
Source: Elaborated by the authors

## 7 ANALYSIS AND DISCUSSION OF THE RELATIONSHIP BETWEEN THE COMPETENCIES OF TECNOPUC AND THE COMPETITIVENESS FACTORS OF THE RESIDENT IT FIRMS

The analysis of each company generated a relationship matrix that reflects the specific situation of each organization from the point of view of the interviewed managers. Figure 4 shows a compilation of all these matrices.

When conducting the analysis, an attempt was made to take into account the response concentration in each relation using the frequencies obtained for each Competitiveness Factor and each Competency on the total score. For example, the number 5 shown in the relation between "Strategy and Management" and "Work Environment in the Park" indicates that five managers reported the existence of that relation.

Competencies of TECNOPUC	Work Environment	Encouragement and Promotion of Technological Research and Development and Innovation	The Brand 'TECNOPUC'	Frequency by the Competitiveness Factor
Competitiveness Factor of Resident Firms				
Management Strategy	5	2	6	13
Capacity to innovate	3	0	1	4
Productive capacity	4	2	1	7
Human Resources	7	4	4	15
Features of the Consumer Market	1	2	4	7
Industry Configuration and Government Policies	0	1	0	1
Competition	1	0	0	1
Frequency by Competency	21	11	16	48

Figure 4 – Compilation of the matrices, Competencies of TECNOPUC X the Competitiveness Factors

Source: Elaborated by the authors based on the survey

Figure 4 shows that the competency with the highest relation to the competitiveness factors, considering the data acquired from the managers, is “Work Environment in the Park”, as indicated by Monck et al. (1988), who point to the infrastructural support and the ability to share it among the companies (LALKAKA; BISHOP Jr, 1997) as one of the main features of a park. With regards to this competency, two relations stand out from among Organizational Competitiveness Factors: “Strategy and Management” and “Human Resources”. The responses indicate that providing employees with a safe, clean location, with plenty of options for food, where they can work and study, is a strategic point for the firms, facilitating management. In this sense, the points considered by the respondents relate to motivation, quality and productivity of the workers. “Today we cannot imagine the company, nor any of its subsidiaries, not standing next to a university,” said the director of a company. Another respondent pointed out that “... the Park makes workers’ lives easier. It is harder for workers who are not studying at PUCRS to commute here.” This finding is in line with the arguments put forward by Feurer and Chaharbaghi (1994), which highlight human resources as an important aspect of competitiveness.

What can also be taken from these results, though less tangible, but in our view more importantly, is the confirmation that the Park environment encourages different ways of sharing among professionals from different companies. In this sense, Parolin and Albuquerque (2011) argue that informal communication, exchange of information and data, messaging and verbal and nonverbal symbols between professionals from different companies, in a common environment, favor the development of insights and perceptions, which are important processes in innovation generation.

The managers also reported a notable difficulty in recruiting and retaining qualified staff. This reinforces the survey data from SOFTEX (2010) with respect to the difficulty of IT companies in recruiting individuals with the desired profile, as well as keeping them after they have been selected and trained. On the other hand, besides the demand for skilled professionals, the Park’s environment, characterized by a concentration of firms in the IT sector among others, provides strong competition for experienced professionals and even for undergraduates. Despite having little representation, it is noteworthy that the relation between the competency “Work Environment” and the competitiveness factor “Features of the Consumer Markets” is perceived, especially when it comes to customers from other countries, which, according to some manag-

ers, show a greater interest in the firm when it confirms that it is located in a park.

Those surveyed, especially from the smaller firms (A, C and F), while not recognizing the relation between the competency “Work Environment” and the competitiveness factor “Industry Configuration and Government Policies”, stressed the importance of networking among the organizations in the Park. This integration, arising from the physical proximity of the firms in TECNOPUC, is evident in varying degrees, from a simple exchange of ideas about business, to the execution of joint projects or even the formation of partnerships. The managers at the smaller companies attribute the responsibility of fostering such alliances to the Park, unlike the larger firms. The director of firm G, for example, points out that the formation of alliances often occurs on the initiative of the managers themselves, and does not depend on the actions of the Park. According to the interviewee, relationships come about due to the arrangement itself, which provides, among other things, the capacity for the proximity of companies.

Although not highlighted by respondents as a possible relation in the matrix (Figure 4), the establishment of alliances designed to compensate for some deficiency or augment competencies, such as participating in bidding for contracts, for example, is a notable fact among the smaller companies. According to one interviewee, until a few years ago the small firms competed among themselves and ended up losing good business opportunities. Gradually, they began to approach one another and realized that the best strategy would be to come together in bidding processes in which there was no conflict of interest. This is provided by proximity, as they are living within a ‘known’ neighborhood where everyone knows what the others do and what opportunities are available. One of the respondents said: “... one day I realized I could just cross the hall and knock on the front neighbor’s door and see what we could do together”.

The culture of innovation, with a view to the production of shared knowledge, even with a strong body of research previously developed, is still a particular challenge for organizations. This challenge is no different even in environments governed by innovation, such as technology parks, for example (ZENG; XIE; TAM, 2010). Having the reality of parks in China as a source of observation, the authors point out the lack of cooperation between companies, universities and research institutions as the main barrier in establishing this culture. The notion of “participatory interdisciplinarity” by O’Brien, Marzano and White (2013) adds important elements to this reflection. The authors state that the implementation of new models of knowledge production involves the integration of different content, often arising from contrasting paradigms, and the meaningful participation of stakeholders. Therefore, importance is given to a plurality of ideas, synergy of players involved and the search for holistic solutions. Considering these references, as well as the comments of managers interviewed, we realize there is still much to be done in TECNOPUC in this sense.

Contrary to expectations, the ability to “Encourage and Promote Research, Technological Development and Innovation” was the competency with the lowest representation in relation to the competitiveness factors. Fostering technological development, establishing a culture of innovation and promoting and disseminating research are fundamental pillars indicated in the factors of success and attractiveness of technological parks according to the literature. Managers at four of the seven firms participating in the research stressed that the decision to set up business in the Park was related to interaction with the university, providing the opportunity for proximity to a center of knowledge. Thus, the intention on the part of the companies to take advantage of the competency of the Park to “Encourage and Promote Research, Technological Development and Innovation” is clear, because, moreover, these elements are central to IT companies.

Although a strong relation was expected between the competitiveness factors “Capacity to Innovate” and “Productive Capacity” and the competency of the Park “Encouraging and

Promoting Research, Development and Technological Innovation”, this was not emphatically confirmed by the interviewees. Highlighting some of the actions taken by the Park to stimulate innovation and the productive capacity of the firms, one of the respondents reported some events promoted by TECNOPUC. However, such events are of an informative nature and not designed or organized to provide debates or discussions between the firms and the Park management in the search for opportunities or joint assessment of processes and systems.

Another initiative from TECNOPUC mentioned by the interviewees is the existence of a compulsory investment on the part of the firms to carry out research projects in partnership with the university. This approach is in line goals of technology parks, which are focused on the generation and dissemination of scientific knowledge through the development of scientific and technological research carried out in partnerships between universities and companies (FUGINO; STAL; PLONSKI, 1999; VEDOVELLO, 2000; BAKOUROS; MARDAS; VARSAKELIS, 2002; COLOMBO; DELMASTRO, 2002). However, of the seven surveyed firms, only firms D, F and G have joint research projects with the university. Regarding this, certain managers highlighted some difficulties in this process, mainly emphasizing differences in interests, objectives and pace between companies and the university in the development of joint projects, as reported by Malairaja and Zawdie (2008) and Steiner, Cassim and Robazzi (S/D). “We want results for the market, while the university wants to publish articles to score with CAPES”, said one of the respondents. In the same vein, Steiner, Cassim and Robazzi emphasize that the profile of the companies that are attracted into a park should be convergent with the profile of the scientific expertise (areas and lines of research) at the university and/or research institutes involved in the project. Based on the view of the respondents from the smaller businesses, while these partnerships are occurring, perhaps they are not occurring at the intensity and with the results desired by the managers.

The challenge is to strike a balance between market objectives and those of the academics. According to the manager of firm G, finding the point of balance should not only be the Park’s concern, but also that of the firms. The manager said that “the Park and the companies must seek new ways to increase cooperation and synergy” (INTERVIEWEE FROM FIRM G). This analysis shows that most of the companies do not demonstrate they know how to go about directing their actions towards developing innovation projects. One can assume that this is not their focus, but instead to remain ‘alive’ in a highly competitive market. Perhaps for this reason they expect so much support from the Park.

Differences in strategic guidelines may cause a feeling that the roles of those involved are not being satisfactorily played. In this regard, the alignment between the management of the Park, of the INOVA PUCRS network, which is the structure where it is inserted, and of the university is noteworthy. The existence of a vision targeted at a Sustainable Entrepreneurial university strengthens a proactive stance by PUCRS, to turn the knowledge generated into economic and social added value (AUDY; FERREIRA, 2006). The very identification of the ability to “Encourage and Promote Research, Technological Development and Innovation” as one of the Park’s competencies, shows that this guidance is incorporated by the managers. The unfolding of this competence into actions that allow companies to increasingly adhere to this guidance is set into a possible path to be followed.

In the relation of the competency “Encourage and Promote Research, Development and Technological Innovation” with the competitiveness factor “Strategy and Management”, it should be noted that firms A and F, having been discharged from the RAIAR (TECNOPUC’s business incubator) incubator and integrated into the Park after being “emancipated”, indicated a feeling of “abandonment” in the post-incubation period. According to the managers, it is “as if they were left to their own devices” (INTERVIEWEES FROM FIRMS A and F). McKelvey and Lassen (2013) em-

phasize that the key lesson for entrepreneurs is the necessary expertise in three knowledge areas: technology, business and market. An imbalance of expertise in any of these areas could cause the venture to fail (McKELVEY; LASSEN, 2013). In this sense, there is, on the part of these managers, an expectation of continued support for the operational and strategic management of their business, even after the end of the incubation process. "... We have a very good technical knowledge of our industry, but we confess we have little experience in the administrative matters of a company" (INTERVIEWEE FROM FIRM F) states one of the managers, thus confirming the findings of Oliveira, Zanella e Giordani (2011). The balance between the three areas of knowledge, "can be achieved by learning, matching members and opportunities, forming an appropriate team, or partnering with others outside the firm (McKELVEY; LASSEN, 2013, p. 264). The conditions set by the Park encourage the managers of the organizations to guide their efforts in these actions; however, the comments indicate that the Park has not been meeting this expectation, or at least not with the intensity the companies expect.

With regard to this competency, the strongest relationship again appears to be the competitiveness factor "Human Resources". The statements from the managers are emphatic in that they note that the actions by the Park aimed at stimulating research, technological development and innovation directly affect the qualification and motivation of professionals in the firms. The profile of these professionals is quite sensitive to this stimulus, and participation in innovation projects is seen as an opportunity to develop professionally. This development means turning a youngster who is dedicated to unlocking computer resources into a professional specializing in the field of information technology. In the words of a respondent: "... we have many computer enthusiasts here; they are youngsters who have been dealing with computers since they were teenagers or children. They are self-taught. Academic knowledge and experience come later to enhance that."

Moreover, considering the competency "Encouraging and Promoting Research, Technological Development and Innovation", in relation to the competitiveness factor "Industry Configuration and Government Policies", there is a notable feeling among the respondents, especially those from small firms, of the absence government support, at least in a more active and evident form, among the firms. There is an expectation among the organizations of a strong relationship with the government, because the management structure at TECNOPUC is inspired by Etzkowitz's (1998) Triple-Helix - university-business-government - model. With regard to this, the respondents mentioned the 'Computer Law'. The reduction in the IPI (Manufactured Goods Tax) which is provided by this law only benefits the companies considered anchors in the Park, namely, those companies that manufacture or produce hardware.

Finally, we stress the importance of the competency "The TECNOPUC Brand" among the competitiveness factors of the companies involved. According to the respondents, this is due to the fact that the TECNOPUC Park already has a history in the national and international scene. In the interviews, the brand was shown to be an instrument for disseminating the firms located there. Being in TECNOPUC, for those firms that want to establish themselves in the market, means being part of an environment of technological development, innovation and research, and provides close proximity to the Park anchor companies like Dell, Microsoft and HP, which have demonstrated their ability to succeed in its market. Even though there are still many opportunities for improvements in the Park and in its relationships with the other actors, the brand name - TECNOPUC - has proven to be a differential for the surveyed firms.

The relation between the ability of the Park to provide an image of credibility and recognition for the quality of the products and services offered and the competitiveness factor "Strategy and Management" showed the highest concentration of responses in the matrix (Figure 4).

The respondent from firm G highlighted that the brand TECNOPUC is already linked to the large international companies located within it and this undoubtedly brings benefits to the smaller organizations when presenting their products to the consuming public. The same manager even cited cases of international clients who insisted on visiting the university premises when they found out the firm was based in the Park. The manager of Firm A said that the brand TECNOPUC is part of the organization's marketing strategy and the interviewee from Firm G added that to be in the Park and take advantage of the brand TECNOPUC is a means of accruing credibility for the business. The interviewee from firm C said that the customer is impressed to learn that the company is part of a technology park, even without knowing exactly what TECNOPUC is.

The relation of the competency "The TECNOPUC Brand" and the competitiveness factor "Human Resources" indicates, according to the view of the managers, the brand TECNOPUC suggests the existence of skilled labor in the companies located there. However, the downside of this is the high turnover, or loss of skilled labor to other companies, an issue that was highlighted by the respondents.

Four managers also identified the relations of the competency "The TECNOPUC Brand" with the competitiveness factor "Features of Consumer Markets". With respect to this, they pointed out the issue of internationalization of the firms and their access to international markets especially in view of the reality of small and medium enterprises in emerging economies. In international expansion, these companies face a number of challenges, such as limited human resources, the law, trust in the relationship with partners and risks related to the loss of industrial or technological secrets (McKELVEY; LASSEN, 2013). For the manager of Firm D, the fact that an organization is located in a park is very much appreciated by foreign customers and foreign partners, mainly for imparting a higher trust level to relationships. He said that global companies seek partners located near Universities. However, he points out that this culture is still not widespread in Brazil. This is because the installation of parks in the country is a relatively recent compared to the situation in other developed nations. It is very difficult to measure the impact of the brand TECNOPUC in the markets. However, the majority of managers in this sample have experienced this impact on the local and international clients.

## 8 FINAL REMARKS

In general, it can be said that the dimension 'internal factors' of competitiveness is influenced much more by the competencies of TECNOPUC than the dimension 'structural factors'. This may be because the Park is more able to influence the internal aspects of the firm than issues related to the structure of the economic sector and the market itself (MELLO et al., 2012). It may also be related to the fact that companies attach greater importance to the operational and tactical aspects, focused on management, processes, productive capacity and the skills of its professionals, than to the strategic aspects, targeted to the market, industry configuration and competition (MELLO et al. 2012).

The effective relation of the competencies with the competitiveness factors of the enterprises, according to Figure 4, is perceived by less than half the managers from the resident firms. Regarding the Park, this may be mainly related to the continuous expansion of its activities. This expansion is perceived both in relation to the diversity of the sectors that have established themselves in TECNOPUC in recent years as well as the growing number of resident firms, creating a diverse and growing set of demands that need to be met. Add to this, the complexity of actions required to achieve competitiveness in each sector and of the Park itself in dealing with and catering to the interests of different spheres, such as the university and the government, among others.



Regarding the companies, it can be seen that, at least among the managers interviewed, they do not yet enjoy the full potential that the Park can offer. It is seen that the firms use, although to a limited extent, some elements provided by the Park, such as the work environment and the TECNOPUC brand that are independent of the efforts towards interaction, negotiation and mediation between the actors involved, making it clear that in some situations there is a lack initiative on the part of the firms to negotiate solutions that meet their specific demands.

It is important to emphasize that the characteristics of the participating companies, such as size, motivation to move to the Park, time in existence, time established in the Park, among others, are variables that influence how the companies perceive the competencies of the Park and the competitiveness factors. Essentially, the interviews showed the organizations established in the Park conform to three profiles: (i) those that want to get closer to a center of excellence in research, (ii) those that only seek to harness the infrastructure and increase their networking, and (iii) those that only want to associate their name with the brand TECNOPUC.

The firms seem to be in the Park in search of business opportunities with large corporations, and focus their actions on reducing costs in order to gain greater competitiveness. Rather than developing or selling technology, the priority seems to be to sell products and services. Thus, actions aimed at encouraging and promoting research, technological development and innovations, such as the implementation of joint projects, for example, are not prioritized.

The companies expect the Park to be more proactive in this process and initiate interaction among those involved. In this sense, the understanding seems to be that the Park, in the figure of its managers, is better able to act as the great organizer and mediator of the different demands of the spheres that compose it. That is because it is the Park that holds the global knowledge with respect the peculiarities of each of the actors involved, whether that regards the needs of organizations located there, the interests of the Research Institutes, Faculty members and university staff, or government policies, in terms of tax incentives and research grants. Thus, one priority should be the definition of a clear and consistent policy on the selection and admission of companies into Parks, in order to try to establish some convergence of expectations among the actors involved.

The triple-helix approach, based on the integration among Universities, Companies and Government, has been demanding a new role from these players, encouraging a review of the relationship between university and society. The establishment of a new orientation is thus outlined: Entrepreneurial University. From this perspective, in addition to its traditional focus on teaching and research, the university adds a "third mission", i.e., its direct intervention in the economic, social and cultural development process of society (AUDY, 2006). This movement, in its scope, depth and complexity, appears as the second revolution in the academy. The reflections of the first and second revolutions still have consequences and challenges at the present time (AUDY, 2006). Moreover, there are arguments pointing to the emergence of a new mission for the university, focused on co-creation towards sustainability (TRENCHER et al, 2014).

Among other mechanisms, Technology Parks are created to materialize the relations of partnerships among University-Company-Government, aiming to establish a culture of innovation and increased competitiveness (LÖFSTEN; LINDELÖF, 2002; SIEGEL; WESTHEAD; WRIGHT, 2003). In view of the university's movements of reflection and repositioning, as presented above, a constant presence of its managers is required, whether permanently revising the objectives of these mechanisms, reevaluating their contributions or establishing other which are more adherent to the new orientation.

Competitive analysis implies an integrated and multidimensional approach, considering social, cultural, economic, institutional and political aspects. In the definition of an analytical model for competitiveness, if on the one hand the efforts on organization, targeting and system-

atization of information are facilitated, on the other hand there is the risk of simplification and reductionism of reality. The fact that this study was developed with a view to a single reality, e.g., TECNOPUC, also stands out as a limitation. Thus, despite the significant explanatory power of the case, in view of the representativeness of the Park in the Brazilian scenario, its potential for generalization to other parks is limited. These points bring the main limitation of the study.

As a proposition for future studies, we suggest to conduct similar research related to the environments studied herein, in order to clarify whether there is, in the perception of the companies participating in the technology parks, a clear understanding of their role as a vehicle for local and regional competitive development, convergently with the approach of the authors and studies of this area of knowledge. Specifically in relation to TECNOPUC, we suggest that the time variable as longitudinal studies is considered in future research. Given the dynamic nature of competitiveness and the movement of expansion of the Park and growth of its policies and practices, an analysis from a temporal perspective allows a viewing of the factors that influenced, at every stage, the setting of goals and strategies, review of roles of each of the players involved and the impact of these influences on the results achieved by the park and by the companies. Finally, we also suggest that similar research is conducted on a national level, involving other technological parks, assessing the results in light of economic and social peculiarities of each region of the country.

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