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# The influence of innovation environments in R&D results

## *A influência dos ambientes de inovação nos resultados de P&D*

## *La influencia de los ambientes de innovación en los resultados de I+D*

Serje Schmidt [a,*], Alsones Balestrin [b], Raquel Engelman [a], Maria Cristina Bohnenberger [a]

[a] *Universidade Feevale, Novo Hamburgo, RS, Brazil*

[b] *Universidade do Vale do Rio dos Sinos (UNISINOS), São Leopoldo, RS, Brazil*

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**Abstract**

In Brazil, as well as worldwide, incubators and science and technology parks (ISTPs) are continually used to foster regional development. However, the incongruence between the growing number of ISTPs and the inconclusiveness of their results raised preoccupations regarding their effectiveness and doubts on how they promote innovation. In spite of the growing possibility and need for quantitative research, few studies have adopted this methodological perspective. The objective of this study is to analyze the influence of resources promoted by ISTPs on the results of their tenant's R&D projects. A quantitative cross-sectional design was used in this study. A higher specificity in the observation and analysis of ISTPs contributed to the advance of literature, so that a taxonomy of resources promoted by ISTPs was proposed and the key resources associated to R&D results could be identified.



*Keywords:* Incubators; Science and technology parks; Innovation; Resources

**Resumo**

No Brasil e no mundo, incubadoras e parques científico-tecnológicos (ISTPs) são continuamente adotados para fomentar o desenvolvimento regional. Entretanto, a incongruência entre o crescente número de ISTPs e a inconclusividade dos seus resultados motivam preocupações quanto à sua efetividade e suscitam questionamentos sobre como ocorre o processo de inovação nesses ambientes. Apesar das indicações da crescente possibilidade e necessidade de pesquisas quantitativas para o estudo desses habitats, poucas investigações adotaram essa abordagem. O objetivo deste trabalho é analisar a influência dos recursos promovidos por ISTPs nos resultados de P&D das organizações por eles hospedadas. Foi realizada uma pesquisa quantitativa, composta por um levantamento de corte transversal. O maior grau de especificidade na observação e análise do ambiente empírico contribuiu para o avanço da literatura no sentido de propor uma estrutura para classificação dos recursos promovidos pelas ISTPs e identificar que tipos de recursos estão associados aos resultados de projetos de P&D.



*Palavras-chave:* Incubadoras; Parques científico-tecnológicos; Inovação; Recursos

**Resumen**

En Brasil y en el mundo, incubadoras y parques científicos y tecnológicos (IPCTs) son continuamente adoptados para fomentar el desarrollo regional. Sin embargo, la incongruencia entre el creciente número de IPCTs y la inconclusividad de sus resultados produce preocupaciones en

* Corresponding author.
*E-mail:* serjeschmidt@gmail.com (S. Schmidt).

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cuanto a su efectividad y cuestiones sobre cómo ocurre el proceso de innovación en estos ambientes. Aunque haya indicaciones de que estudios cuantitativos son posibles y necesarios para el adecuado análisis de IPCTs, en pocos trabajos se adoptó este abordaje. El objetivo en este artículo es examinar la influencia de los recursos promovidos por IPCTs en los resultados de I + D de las organizaciones hospedadas. Se llevó a cabo un estudio cuantitativo con análisis de sesgo. El mayor grado de especificidad en la observación y análisis del ambiente empírico contribuye al avance de la literatura en el sentido de plantear una estructura para clasificación de los recursos de IPCTs e identificar qué tipos de recursos están relacionados con los resultados de proyectos de I + D.


*Palabras clave:* Incubadoras; Parques científicos y tecnológicos; Innovación; recursos

## Introduction

The development of incubators and science and technology parks (ISTPs) as mechanisms of promotion of innovation emerged in the Silicon Valley and Route 128 in Boston in the 1970s (Lahorgue, 2004) and continues to inspire similar initiatives around the world. The International Association of Science Parks (IASP) defines a science and technology park as "an organization managed by specialized professionals, whose main aim is to increase the wealth of its community by promoting the culture of innovation and the competitiveness of its associated businesses and knowledge-based institutions".[1] In Brazil and around the world, ISTPs have continually been adopted as mechanisms for regional development.

However, the features related to the identity of these habitats and the results of their institutional objectives bring uncertainties. Researchers question not only the fact that there are professionals who are expert in their management (Westhead & Batstone, 1999), but also the production of innovations (Lee & Yang, 2000; Radosevic & Myrzakhmet, 2009; Westhead, 1997). While some studies indicate significant contributions of ISTPs for the innovation of businesses (Lee & Yang, 2000; Lindelof & Lofsten, 2003; Squicciarini, 2009; Tan, 2006; Yang, Motohashi, & Chen, 2009); other ones have not confirmed this proposition (Chan, Oerlemans, & Pretorius, 2010; Massey, Quintas, & Wield, 1992; Radosevic & Myrzakhmet, 2009; Westhead, 1997). Conflicting results can also be observed in other related dimensions such as knowledge, learning and synergy between the companies. Massey, Quintas, and Wield (1992) are especially skeptical about the role of ISTPs in the socioeconomic development in some regions of the United Kingdom. They argue that public policies that support these institutions are deeply problematic. These authors suggest that the parks result in fragmented social structures, distorted economic and geographic development and even technological stagnation. These uncertainties lead some authors (Lahorgue, 2004; ex.: Massey et al., 1992) to propose that the institutional justification for their proliferation is mimetic isomorphism (DiMaggio & Powell, 1983) – or "fads". Another explanation for this may be related to different understandings with regards to the role of ISTPs and to the resulting management models that are chosen.

The incongruity between the growing number of incubators and STPs in the world and the inconclusiveness of empirical researches motivates concerns about their sustainability and the questioning about how the process of innovation happens in these environments. Admitting that generating innovation is fundamental to the economic development of regions and that ISTPs are a potential way to promote regional development through innovation, these institutions should – in theory – fulfill their role. Thus, although the literature deals very thoroughly with the innovation background in several empirical environments, the contribution of ISTPs for organizational innovation still lacks a clearer direction. These innovation habitats are permeated by institutional elements whose effects may be related less directly to innovation, such as culture, trust, willingness to collaborate, and others (Hwang & Horowitt, 2012).

In academic environments, case studies have predominated as a methodological approach, but few studies proposed to examine ISTPs quantitatively, despite indications of the growing possibility (Etzkowitz & Leydesdorff, 2000) and need (Balestrin, Vargas, & Fayard, 2005) of quantitative studies. Among these, the comparison between businesses that are internal and external to these environments, assuming the homogeneity of internal resources among ISTPs, dominates as an epistemological conception. The idiosyncrasies of these habitats, however, contradict this assumption, which, added to the difficulties of obtaining internal and external samples that are statistically comparable, leads to the need for new approaches.

This research aims, through a quantitative survey, to contribute to the study of the innovation background in these environments, considering the infrastructure and services promoted by ISTPs as resources that facilitate the research and development of new products and services. In other words, it is not only sufficient that the incubators and STPs exist and accommodate businesses for the R&D process to take place and produce innovation. There are actions that must be developed in order for this to happen, such as facilitating access to collaboration and research support mechanisms, promoting appropriate environments for social exchanges, among others.

The overall objective of this study is to analyze how the resources promoted by ISTPs influence the R&D results of organizations hosted by these environments. Therefore, a more specific level of analysis is adopted than in previous quantitative studies, thus supplementing those and stimulating the debate on ISTPs, in order to understand them as active developers of the innovation process.

The results of this research can assist the allocation of efforts regarding the management of these spaces, the businesses located in ISTPs, universities and government. ISTPs managers

[1] Extracted from http://www.iasp.ws/. Accessed on June 1st, 2016.

can prioritize areas of action to encourage R&D processes, such as seeking and disseminating calls for proposals for funding, or getting closer to the companies in order to better understand their existing skills. Universities, which sometimes act as managers of these habitats, can guide the allocation of teachers, researchers and students to the companies. Companies may conduct the search for mechanisms to generate new products and services by selecting incubators or parks that offer resources that effectively contribute to this process or demand these resources from the environment where they are located. The government, in turn, can allocate public policies, for example, in the form of criteria for granting funds to innovation habitats that provide access to certain resources for businesses. Projects of new ISTPs can consider the results presented here for the allocation of areas for social activities, laboratories or technical and scientific training. In general, this research intends to contribute to the actors involved in this processes.

This study is organized as follows: an exploration of literature concerning the innovation background is presented in the next section. The methodological procedures used to obtain data on the resources promoted by ISTPs and those with which we intend to verify the model developed in the empirical environment are described in the following section, followed by the analysis of the results and conclusions.

## Innovation background

The elements which facilitate and the barriers to innovation are considerable and have been extensively explored in the literature. In a summary of publications, Crossan and Apaydin (2010) explored the innovation determinants, grouping them into three distinct theoretical meta-constructs: innovation leadership, managerial levels and business processes. Each of these constructs can be sustained by a different theory: the innovation leadership by the upper echelon theory (Hambrick & Mason, 1984), the managerial levels by the dynamic capabilities theory (Teece, Pisano, & Shuen, 1997) and the business processes by the process theory (Van De Ven & Poole, 1995). The innovation determinants, according to the authors, lead to innovation both as a process and as an outcome. The first and the third meta-constructs will be briefly described below in order to provide a better adhesion to the object of study in question and the proposed level of analysis, followed by the management strategies and the dynamic capabilities theory.

The determinants of innovation related to the upper echelon theory were grouped by Crossan and Apaydin (2010) in: individual (CEO) and group (Top Management Team and Board Governance). At the individual level, factors such as tolerance of ambiguity, self-confidence, openness to experimentation, independence, proactivity, among others, were identified as determinants of organizational innovation. At the top management team level, the following factors were related: diversity of background and experience of the group members, ties with organizations in other industries, the educational level, among others. At the board governance level, elements such as board diversity, the proportion of directors from other industries and institutional shareholding incorporate the innovation determinants. In a review of the Hambrick and Mason's original study (1984), published twenty years later, Carpenter, Geletkanycz, and Sanders (2004) suggest that innovation is still a strategic choice resulting from cognitive characteristics and values provenient from the strategic level.

At the business processes levels, Crossan and Apaydin (2010) emphasize the importance of understanding the meaning of the term "process". Among its possible meanings, the authors understand that it is "a category of concepts of organizational actions, such as rates of communication, work flows, decision making techniques or methods strategy creation" (Crossan & Apaydin, 2010, p. 1173). The theory of organizational processes advocates that if similar inputs processed by similar processes lead to similar outcomes, then there are certain constants and necessary conditions for the outcomes to be achieved. It is possible that this understanding excuses, in a way, the systemic and nonlinear character of innovation, as discussed above. The analysis categories that constitute this construct represent the main processes that result in innovation. These processes were grouped by the authors as follows: initiation and decision (recognition of the need to innovate and the decision relating to this), development and implementation, portfolio management for innovation, project management and commercialization. van der Borgh, Cloodt, and Romme (2012) used the Process Theory (Van De Ven & Poole, 1995) as the basis for in identifying standards for value creation in business ecosystems. The authors concluded that ecosystems facilitate the innovation process in individual organizations and create innovation communities. Van der Borgh et al. (2012) also stress the contribution of the study to the understanding of innovation environments, such as ISTPs.

The dynamic capabilities (Teece et al., 1997), which backs the theoretical meta-construct relating to the managerial levels, analyzes the innovation at the firm level and originates in a dynamic strain of the resource-based view (Barney, 1991). It applies, therefore, to the analysis of innovation resources at the firm level and provides a possibility of a consistent theoretical framework for analyzing the role of ISTPs regarding innovation in tennant companies. This construct was subdivided by Crossan and Apaydin (2010) in five types of managerial levels, as shown in Fig. 1.

Crossan and Apaydin (2010) report, among the results of their meta-analysis, that studies dedicated to exploring innovation as a process do not verify their impact on innovation outcomes, mainly exploring the overall outcome of the firm as a dependent variable. On the other hand, researches that treat innovation as a result bring to the scrutiny distinct independent innovation variables. For example, the dynamic capabilities theory (Teece et al., 1997) was explored in the empirical field by Lichtenthaler and Lichtenthaler (2009) in a case study of Rolls-Royce. The authors identified the dynamic capabilities, in the context of innovation, as a supplement to the absorptive capacity. The authors point out the strategic control and financial commitment as conditions that are necessary, but not sufficient, for the innovative firm. Innovation also depends on learning and organizational integration to create a habitat that encourages the participation of people in the innovation process.

| Type of managerial level | Description |
|---|---|
| a) mission, goals and strategies | Explicit innovation strategies and innovation goals that match this strategy. |
| b) structures and systems | Specialization and formalization degrees, decision centralization, number of employees, organization complexity, among others. |
| c) resource allocation | R&D intensity, resources flexibility and turnover and commitment to differentiated funding. |
| d) organizational learning | Tolerance of failed ideas, support for experimentation, university linkage, costumer contact time and frequency, among others. |
| e) organizational cultures | Autonomy, trust climate, risk-taking culture, among others. |

Source: adapted from Crossan and Apadyn (2010)

Fig. 1. Management levels for innovation.
*Source*: Adapted from Crossan and Apaydin (2010).

The managerial levels approach seems more appropriate to the study proposed here, as innovation is analyzed at the organizational level and in a systematic way, from the context in which the organizations are located. Thus, both the theory of strategic levels, which adopts a more individual perspective, as the theory of organizational processes, which is based on a linear assumption, lose relevance. The resources promoted by ISTPs, namely, their services and infrastructure, were classified according to the types of managerial levels. Next, in the section on the methods of this research, the way this classification has occurred and other procedures adipted in this study will be described.

## Methods

This research is characterized as quantitative, consisting of a cross-sectional survey. As the literature on ISTPs does not classify or organize the resources provided by these environments in a systematic way, a preliminary survey was performed so as to list and classify them. Books and national and international journals which have with incubators or science and technology parks as objects of study were considered, as well as the websites of several Brazilian ISTPs. The keywords used in the databases EBSCO, ScienceDirect and Scielo were extracted from those appointed by the IASP as synonyms of Technological Parks. The search terms were: "*Science Park(s)", "Technology Park(s)", "Technopolis", "Technopole", "Technology Precinct" and "Research Park(s)"* or their respective Portuguese terms. In these papers, we sought to identify the services and infrastructure promoted or facilitated by ISTPs to the tenant companies, categorizing them according to the managerial levels proposed by Crossan and Apaydin (2010). The search was stopped when the services and infrastructure which were found became redundant in relation to the list that had already been obtained, providing the completeness of the survey. Referrals to services and infrastructure were analyzed, summarized and organized, resulting in the resources depicted in Fig. 2.

The following text, exposed in the questionnaire before the resource list (Fig. 2), guided the answers: "Please indicate how much the fact of being located in the incubator/park contributed to the access to these resources". An ordinal scale of four points was on the right of each resource for the answers. The options were: "not applicable" = null, 0 = "did not help", 1 = "contributed a little", 2 = "contributed reasonably" and 3 = "contributed a lot".

The dependent construct was explored in order to address the results of innovation projects conducted by tenant companies. This variable was adapted from Blindenbach-Driessen, Van Dalen, and Van Den Ende (2010) with the following measurement items: (a) "This project fully met the expectations of our company"; (b) "The project has resulted in new products, services or processes"; (c) "Our company has gained competitiveness with the result of this project"; (d) "The project has contributed greatly our corporate image"; (e) "We have had great financial results with this project"; and (f) "We have internalized a lot of knowledge from this project". The scale used for the answer was a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree" without an option of null answer, which has forced the respondent to take a position on each item.

The answers were oriented to the managers of innovation projects of tenant companies, rather than to the managers of ISTPs. This was adopted as a measure to prevent possible common method biases (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). The average of the answers was attributed to the innovation environment in which the business is located. The data collection process began with the procurement of a list of ISTPs on the website of the National Association of Entities Promoting Innovative Enterprises (ANPROTEC – Associação Nacional de Entidades Promotoras de Empreendimentos Inovadores). Each of the 269 incubators and parks were contacted by telephone and asked to provide a list of tenant companies. This process resulted in a directory of 1004 companies. Each company was also contacted by phone and the person responsible for the R&D projects was invited to participate in the survey by providing their personal. Only 6% of the invitees did not agree to participate. A previous notice confirming acceptance was sent followed by an email a few days later with the online survey link. More than half (61%) of the emails sent resulted in effectively answered questionnaires, with a total of 264 respondents from tenant companies. Computing the average for every ISTP, a total sample of 84 ISTPs was achieved.

## Results and discussion

The geographical profile of the sample, shown in Table 1, indicates a concentration of respondents in the south and

| Type of managerial level | Resources provided by ISTPs (name of the variable in brackets) | References |
|---|---|---|
| a) mission, goals and strategies | • [Strategic Planning] Business strategic planning<br>• [Management Diagnosis] Management diagnoses<br>• [Company Structuring] Assistance in the structuring of the company | (Ku, Liau, & Hsing, 2005; Lahorgue, 2004; Massey et al., 1992; Radosevic & Myrzakhmet, 2009) |
| b) structures and systems | • [Legal Assistance] Legal assistance for drafting contracts<br>• [IP Assistance] Assistance on intellectual property mechanisms<br>• [Commercial Feasibility] Commercial feasibility study<br>• [Market Research] Assistance on market researches<br>• [Logistics Study] Study of distribution channels and logistics<br>• [Pricing Assistance] Assistance for the formation of prices | (Hansson, Husted, & Vestergaard, 2005; Ku et al., 2005; Lahorgue, 2004; Massey et al., 1992; Radosevic & Myrzakhmet, 2009; Watkins-Mathys & Foster, 2006) |
| c) resource allocation | • [Call for Proposals] Participation in calls for proposals for funding<br>• [Scholarships] Allocation of scholarships for the promotion of innovation<br>• [Investors] Contact with prospective investors<br>• [Laboratories] Research/prototyping laboratories<br>• [Equipment] Assessment/metrology/calibration instruments | (Hansson et al., 2005; Kihlgren, 2003; Lahorgue, 2004; Radosevic & Myrzakhmet, 2009; Watkins-Mathys & Foster, 2006) |
| d) organizational learning | • [Students] University students (scholarships, internships, undergraduate thesis, etc.)<br>• [Professors and Researchers] University professors and researchers<br>• [Professionals of Partners] Professionals from partner institutions<br>• [Consultants] Consultants from technical and scientific areas<br>• [Research Institutes] Professionals from research institutes<br>• [Classrooms] Classrooms and auditoriums<br>• [Audiovisual Equipment] Audiovisual equipment<br>• [Distance Learning] Distance learning | (Bakouros, Mardas, & Varsakelis, 2002; Etzkowitz, Mello, & Almeida, 2005; Hansson et al., 2005; Ku et al., 2005; Lahorgue, 2004; Massey et al., 1992; Westhead & Batstone, 1998) |
| e) organizational cultures | • [Social Areas] Restaurants, shops and leisure areas<br>• [Sports Areas] Areas for sport activities<br>• [Events Area] Area for cultural and corporative events | (Hansson et al., 2005; Lahorgue, 2004; Watkins-Mathys & Foster, 2006) |

Source: Compiled by the authors.

Fig. 2. Managerial levels for innovation and resources provided by ISTPs.
*Source*: Compiled by the authors.

southeast regions of Brazil. This concentration, however, seems to be relatively proportional to the distribution of ANPROTEC members in these regions, suggesting that the sample is considerably representative geographically.

For the data analysis, the developed constructs were first tested for their validity and reliability in order to identify to what extend the data of the variables obtained in the empirical environment really measure the respective constructs. Since the independent variables are not constituted of constructs that have already been developed and validated in the literature, they were analyzed by exploratory factor analysis (EFA).

Despite the fact that the measure of adequacy of the sample has returned satisfactory (KMO = 0.795), in a first EFA some variables showed low commonalities and were excluded. They were: professionals of partners, IP assistance and distance learning. A new EFA was performed indicating the adequacy of this analysis to explain the correlations between variables (KMO = 0.798, total explained variance of 74.4%). The matrix

Table 1
Geographic profile of the respondents and of ANPROTEC members.

| Region | State | Respondents | | | | ANPROTEC members | |
|---|---|---|---|---|---|---|---|
| | | N. Businesses | % | N. ISTPs | % | N. ISTPs | % |
| North | Amapá | 2 | 0.8 | 1 | 1.2 | 2 | 0.7 |
| | Amazonas | 12 | 4.5 | 2 | 2.4 | 4 | 1.5 |
| | Pará | 1 | 0.4 | 1 | 1.2 | 6 | 2.2 |
| | Sum | 15 | 5.7 | 4 | 4.8 | 12 | 4.5 |
| Northeast | Alagoas | 4 | 1.5 | 2 | 2.4 | 8 | 3.0 |
| | Bahia | 2 | 0.8 | 1 | 1.2 | 3 | 1.1 |
| | Ceará | 6 | 2.3 | 3 | 3.6 | 7 | 2.6 |
| | Paraíba | 1 | 0.4 | 1 | 1.2 | 7 | 2.6 |
| | Pernambuco | 2 | 0.8 | 1 | 1.2 | 8 | 3.0 |
| | Rio Grande do Norte | 3 | 1.1 | 1 | 1.2 | 4 | 1.5 |
| | Sum | 18 | 6.8 | 9 | 10.7 | 37 | 13.8 |
| Midwest | Distrito Federal | 7 | 2.7 | 1 | 1.2 | 5 | 1.9 |
| | Goiás | 2 | 0.8 | 1 | 1.2 | 6 | 2.2 |
| | Mato Grosso do Sul | 1 | 0.4 | 1 | 1.2 | 7 | 2.6 |
| | Sum | 10 | 3.8 | 3 | 3.6 | 18 | 6.7 |
| Southeast | Espírito Santo | 2 | 0.8 | 2 | 2.4 | 5 | 1.9 |
| | Minas Gerais | 29 | 11.0 | 12 | 14.3 | 28 | 10.4 |
| | Rio de Janeiro | 24 | 9.1 | 8 | 9.5 | 29 | 10.8 |
| | São Paulo | 48 | 18.2 | 19 | 22.6 | 58 | 21.6 |
| | Sum | 103 | 39.0 | 41 | 48.8 | 120 | 44.6 |
| South | Paraná | 20 | 7.6 | 6 | 7.1 | 27 | 10.0 |
| | Rio Grande do Sul | 62 | 23.5 | 14 | 16.7 | 34 | 12.6 |
| | Santa Catarina | 36 | 13.6 | 7 | 8.3 | 21 | 7.8 |
| | Sum | 118 | 44.7 | 27 | 32.1 | 82 | 30.5 |
| | Total | 264 | 100.0 | 84 | 100.0 | 269 | 100.0 |

*Source*: Compiled by the authors.

rotated by the Varimax method returned a latent data structure that can be compared to that proposed by Crossan and Apaydin (2010) on the types of managerial levels.

Table 2 shows similarities and differences between the empirical data and the structure of the managerial levels proposed by Crossan and Apaydin (2010). It is possible that the differences observed are related to the environment in which the original structure had been proposed. On the one hand Crossan and Apaydin (2010) suggest that the innovation background comes from a range of internal resources of the organization. On the other hand, the goal here was to study the innovation background relating to ISTPs, referring not only to internal resources, but also to the complementary resources provided by these habitats. The dependent construct was not included in the exploratory factor analysis, as its conception is notably distinguished from independent constructs. Its inclusion would influence the factor loading of other constructs, artificially inflating the convergent and discriminant validities of the model. Thus, for parsimony issues, EFA was only performed with the independent constructs.

Observing the obtained factor loadings and analyzing them in relation to the model proposed by Crossan and Apaydin (2010), it is possible to delineate an underlying structure of services and infrastructure that corresponds to the data obtained and that can be further validated in other samples. The first EFA component converges with variables related to the allocation of human resources to assist the tenant companies in relation to various areas of management. Thus, both strategic managerial levels and those concerning the structure and systems are brought together. This component can be called "management assistance". The second component includes the necessary infrastructure to promote learning and education. Areas for events, initially associated with cultural elements can also be seen as resources that contribute to learning. This component can be called "learning". The third component encompasses variables that are related to financial resources to which ISTPs can facilitate the access of companies. It should be noted that the "investors" variable, despite obtaining high factor loadings in three components, was maintained in this construct due to its greater analytical adherence. Interestingly, students whose representative variable converged to this construct, may have been understood by the managers of R&D projects more as affordable resources for basic R&D services to be performed than as resources that result in learning. "Financial resources", therefore, was adopted as the third component name. The fourth component gathers both variables related to R&D and social areas, indicating the coexistence of these two dimensions. This result indicates that ISTPs managers may see the social areas as complementary resources necessary for the proper development of the research, following, somehow, models of innovation environments inspired in the Silicon Valley (Lahorgue, 2004). This component was named "R&D and socialization". Finally, the fifth component gathers specialized resources that potentially complement the knowledge basis of companies to generate innovations, such as professors and professionals from research institutes. To this component, the name "specialized human resources" was given.

Table 2
Rotated EFA matrix.

| Type of managerial level | Variable | Components | | | | |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 |
| StrucSist | Market research | 0.873 | | | | |
| Strat | Strategic planning | 0.851 | | | | |
| StrucSist | Pricing assistance | 0.849 | | | | |
| Strat | Management diagnosis | 0.838 | | | | |
| StrucSist | Commercial feasibility | 0.836 | | | | |
| StrucSist | Logistic study | 0.771 | | | | |
| Strat | Structuring of the company | 0.734 | | | | |
| Learn | Consultants | 0.696 | 0.369 | | | |
| StrucSist | Legal assistance | 0.656 | 0.305 | | | |
| Learn | Classrooms | | 0.890 | | | |
| Learn | Audiovisual equipment | | 0.755 | 0.379 | | |
| Culture | Areas for events | 0.311 | 0.722 | | 0.302 | |
| Resources | Investors | 0.430 | 0.520 | 0.402 | | |
| Resources | Call for proposals | | | 0.882 | | |
| Resources | Scholarships | | | 0.855 | | |
| Learn | Students | | | 0.625 | | 0.440 |
| Culture | Social areas | | | | 0.857 | |
| Culture | Sports areas | | | | 0.819 | |
| Resources | Equipment | | | | 0.556 | 0.374 |
| Resources | Laboratories | | 0.396 | 0.411 | 0.446 | |
| Learn | Professors and researchers | 0.360 | | | | 0.825 |
| Learn | Research institutes | 0.350 | | | | 0.782 |

Extraction method: analysis of main components.
Rotation method: Varimax with Kaiser normalization.
Obs.: for legibility questions, only factor loadings higher that 0.3 or lower than −0.3 are presented in the table.

The variables were then regrouped according to each resulting EFA component to form the constructs for analysis. The four variables with the highest factor loading in each component were used. The constructs were then specified in a Partial Least Squares (PLS) model.

As the Structural Equation Modeling (SEM), the PLS allows the use of multiple dependent and multiple independent constructs. In this technique, smaller samples can be used, and there is less sensitive to multicollinearity and low multivariate normality. Thus, it is more suitable for exploratory research. One of the drawbacks in using PLS is the difficulty of interpreting the loadings of independent constructs, as they are not based on factor loadings and their distribution properties are not known (Garson, 2012). Nevertheless, PLS seemed suitable, given its adherence to the purposes of the present study and to the profile of the collected data, and was adopted to carry out the analysis.

Hair, Sarstedt, Ringle, and Mena (2012), in a review of the use of PLS in marketing studies, used a general rule for the sample size for this technique, which the sample should be greater or equal to ten times the number of paths that point to any construct of the outer model (number of formative variables per construct) and of the inner model (number of paths directed to a specific construct). Hair et al. (2012) indicate that 93.39% of marketing studies published since 2000 in qualified journals meet this rule, in which the present research also fits. The PLS model is shown in Fig. 3.

The model calculation returned the indicators of validity and reliability of the constructs shown in Table 3.

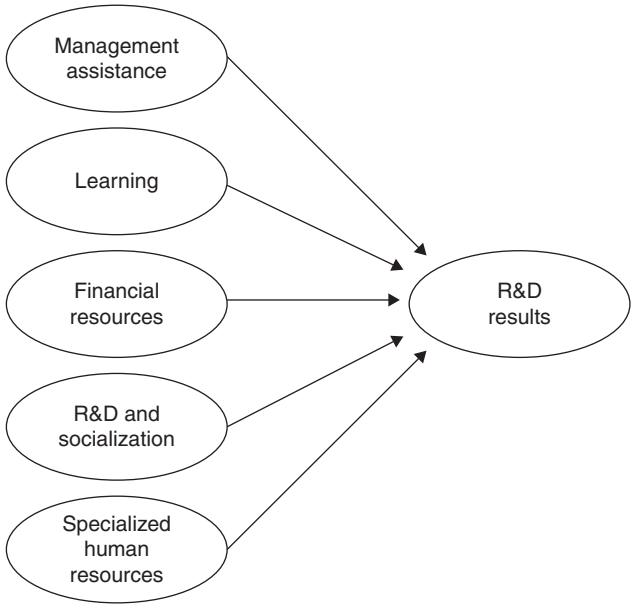


Fig. 3. PLS model.

The constructs presented, overall, adequate reliability and convergent validity. The discriminant validity was analyzed by comparing the average variance extracted (AVE) to the square correlation between the constructs. All constructs showed a higher AVE than the square correlation, which also indicates an adequate discriminant validity (Fornell & Larcker, 1981).

Table 3
Adjustment indicators of the PLS model.

| | Cronbach's alpha (>=0.6) | Composite reliability (>=0.6) | Average variance extracted (>=0.5) |
|---|---|---|---|
| Management assistance | 0.888 | 0.916 | 0.733 |
| Learning | 0.801 | 0.722 | 0.498 |
| Financial resources | 0.801 | 0.872 | 0.635 |
| R&D and Socialization | 0.736 | 0.691 | 0.434 |
| Specialized HR | 0.775 | 0.899 | 0.816 |
| R&D results | 0.806 | 0.873 | 0.632 |

*Source*: SmartPLS output.
*Note*: levels of acceptance according to Hair et al. (2009).

Table 4
Path coefficients and *t* values.

| Construct | Path coefficient | *t* value |
|---|---|---|
| Management assistance | −0.095 | 0.922 |
| Learning | 0.037 | 0.338 |
| Financial resources | 0.355 | 3.370 |
| R&D and socialization | 0.029 | 0.391 |
| Specialized HR | 0.005 | 0.067 |

*Source:* SmartPLS output.

After assessing the adjustment of the PLS model, the relationship between the constructs ought to be analyzed for significance values. In this sense, Garson (2012) proposes that the significance level can be calculated using the bootstrap algorithm, which results in values for the *t*-test of the proposed correlations. The *t* values should be greater than 1.96 to be considered significant. These results are shown in table 4.

Financial resources were significantly associated with the results of R&D projects. These resources refer to the assistance of the incubator or park in obtaining scholarships, participating in processes for funding and accessing investors, and are appointed by the literature as one of the key elements that support innovation, particularly in regards to high-tech start-ups (Lahorgue, 2004; Watkins-Mathys & Foster, 2006). The findings of this study corroborate the literature in this regard. Radosevic and Myrzakhmet (2009) mention the access to external funding sources and the low rent paid by tenants as a pretext for their location in ISTPs, which complements the financial motivation argument for innovation. On the other hand, the literature also indicates limitations that are worth mentioning. Westhead (1997), for instance, suggests that the expenditure of companies on R&D in parks bears no relation to innovation results, and Negassi (2004) states that public funding for innovation and collaboration produce less results than private funding, arguing that public funding is targeted to low profitability areas and, therefore, has low interest from private investors. Possibly, these limitations are related to the fact that the reasons that drive companies to participate in R&D projects are more associated with the internalization of financial resources than to innovation or competitiveness (Kihlgren, 2003).

The call for proposals for funding originated from innovation environments and the participation of companies in these cases may induce the allocation of technical and scientific competences, R&D infrastructure and financial resources for funding R&D processes. Once the project is submitted and approved, teachers and researchers are allocated, laboratories are built and scientific equipment is purchased. Thus, the key actors of the process play specific roles needed for an innovation strategy, within a Triple Helix model (Etzkowitz & Leydesdorff, 2000): while the government induces contractual relationships that contribute to stable interactions to exchange knowledge, the university acts as a source of knowledge and technology and industry is constituted as the *locus* for technology production. The induction of collaborative R&D projects, in this sense, would not be performed directly by innovation habitats, but institutionally by public policies oriented to innovation.

The absence of significant connections among other independent constructs and the dependent construct points, in part, toward the permanence of ambiguity that has already been addressed in the literature and exposed in the introduction. Assistance to management, learning, R&D and socialization and specialized HR were not significantly related to the results of R&D projects. Each of these constructs is discussed below.

Management Assistance: possibly, the efforts of ISTPs to assist the management of incubated businesses or tenants are broader, covering market issues, strategic planning, and logistics, among others. Although innovation is often addressed as a strategic issue, innovation projects may not have been included in this assistance.

Learning: the resources that contribute to learning are basically constituted of physical infrastructure resources (rooms, areas for events, etc.). In the surveyed ISTPs, these areas are possibly not being used at all or, if they are, their use may not have been related to innovation processes. This happens, for example, when these resources are employed in courses in the areas of management, intellectual property, etc.

R&D and Socialization: this construct includes both those variables that seem to be indirectly related to innovation such as social areas that facilitate proximity and collaboration among the actors, as those that contribute more directly to the generation of new products and services, such as equipment and laboratories. Both the first and the latter are constituted of physical infrastructure elements and depend on the how they are used so as to generate innovation. As they do not present a significant relation with the results of R&D projects, these resources are possibly not being used for the purpose of facilitating innovation.

Specialized HR: professors, researchers and research institutes professionals are included here. The facilitated access to these professionals should, in theory, contribute directly to the results of R&D projects. Areas of allocated professionals may not be adhering to the demands of the companies, or that the researchers' interests are more focused on scientific publications than on the production of innovations. The reasons that explain why this relation was not found in the empirical environment could be the subject of future research.

Some of the results obtained in this study are corroborated and some are contrary to the ones presented in the literature. Among the studies that differ from the results obtained here, Vedovello (1997) suggests that companies located in parks do

| Innovation background in ISTPs | Result obtained in this study | Recommendation to the managers of ISTPs |
|---|---|---|
| Financial Resources | Positively associated to the results in R&D projects | Foster the granting of scholarships, the participation in calls for proposals for funding and the access to investors |
| Management Assistance | Relations that are not relevant to the results | Identify the importance attributed to R&D projects in the assistance to the management of the companies |
| Learning | | Verify the good use of the learning areas, orienting them toward the processes that are related to innovation |
| R&D and Socialization | | Investigate if the use of laboratories, equipment, and social areas is in accordance with innovation objectives |
| Specialized HR | | Verify the alignment of interests and competences and foster new studies on this issue |

Source: Compiled by the authors

Fig. 4. Summary of results.
*Source*: Compiled by the authors.

not have a higher allocation of researchers than companies that are outside the ISTPs. Bakouros, Mardas, and Varsakelis (2002) also indicate similar results in Greece. These authors point out that the three parks researched by them do not use the allocation of researchers or the sharing of research laboratories as synergy elements for the development of companies.

Other more recent studies, however, reinforce the benefits of the allocation of university resources to R&D processes. Hansson, Husted, and Vestergaard (2005) suggests that the main difference between traditional parks and the "second generation" parks is that the former has an emphasis on the commercialization of the researches that are produced, while the latter emphasizes the production of marketable research. After all, it is the entrepreneur, not the researcher, who produces innovation (Roberts, 2005). Löfsten and Lindelöf (2005) corroborate this issue in suggesting that spinoffs from the universities have more difficulty in channeling R&D investments for better results than company-originated spinoffs.

The results obtained here are in agreement with a less recent line of thought: the allocation of specialized HR to R&D projects of companies, supported by the required physical and financial infrastructure, does not seem to contribute to R&D projects. The access to these resources outside ISTPs may be occurring at a level that is very similar to the internal environment of these habitats, thus annulling the differences between them.

Fig. 4 summarizes the results discussed and the guidance for managers of incubators and science and technology parks.

The results indicate that the influences of ISTPs in R&D results addressed in this paper are limited to Financial Resources. The conclusions of this research will be constructed considered these results. Other variables or characteristics of those environments may be explored and facilitate future studies should also be considered.

## Conclusions

The relations between the results found in this study and what is presented in the literature are limited mainly by the differences in the level of analysis, which confers an exploratory character to this study. The object of analysis in this study is composed of the access to services and infrastructure facilitated by the fact that the companies are located in innovation habitats. On the other hand, the literature deals, mainly, with a broader level, one that considers the incubator itself or the park as the research focus. The structure of managerial levels proposed by Crossan and Apaydin (2010) in the context of innovation was adapted to organize and associate the resources promoted by ISTPs to the results of R&D projects.

The greater degree of specificity in the observation and analysis of the empirical field proposed by this research contributed to the advancement of literature in order to propose a framework for classification of the resources promoted by ISTPs and, through a quantitative approach, identify which types of resources are associated with the results of R&D projects.

The results of this research indicate that it is the financial resources, whose access is facilitated by ISTPs, that significantly influence the results of R&D projects. The participation of companies in calls for proposals for funding programs that foster innovation induces the allocation of resources from universities and investments in laboratories. Thus, the main effort of the incubators and parks aimed at promoting innovation in companies in R&D projects seems to be the focus on the articulation of companies and universities to submit proposals to these calls.

The phenomenon of innovation, however, transcends the theoretical and conceptual framework built here and deserves the continued attention from researchers, indicating that future studies may help in understanding this issue. Variables present at the institutional level of ISTPs or in broader contexts could also

be considered. In Greece, for example, Bakouros et al. (2002) believe that the low innovation levels are due to the small size of the science and technology parks, to the fact that they have been implanted only recently and to a policy for hosting companies that is too open, resulting in very diversified companies being accepted as tenants in these environments. In Brazil, Raupp and Beuren (2009) also indicate limitations on the participation of companies in R&D projects, in the sense that the access to researchers and the exchange of experiences with other companies were cited as facilities offered by incubators for as little as 6.25% of respondents. Comparing these results with success case studies, as Silicon Valley (Saxenian, 1994) and other cases gathered during the literature review, institutional variables may in fact be related to R&D processes.

Similarly, at the inter-organizational level, variables that are external to this research, as the density of the network (Powell, Koput, & Smith-Doerr, 1996), the diversity of businesses in the same innovation environment, (Tötterman & Sten, 2005), the cognitive distance (Nooteboom, Van Haverbeke, Duysters, Gilsing, & van den Oord, 2007), a history of conflict among the authors, the lack of reliability or differences of power (Gray, 2008), the criteria for the selection of companies (Bakouros et al., 2002) or the services provided by these habitats, which have not been addressed here, may also influence the results of R&D projects.

At the organizational level, it is possible that coordination structures for R&D related to market or hierarchy issues give the impression of lower transaction costs for the actors involved in this research than for intermediate structures based on collaboration, which would limit the benefits of R&D projects in clusters. Oakey (2007), for instance, compares various forms of clusters and their impact on the R&D management in small high-tech companies. Based on this, the author indicates that the ability to work internally in heavily focused groups, namely, in a hierarchical structure, is the main reason for the success related to R&D of the companies located in innovation environments, rather than the geographical proximity provided by these habitats. Even if the informal cooperation can be beneficial, the author states that the most important collaboration occurs formally in intensely competitive markets. Other organizational variables such as legitimacy, reputation (Human & Provan, 1997), skills in leading partnerships (Powell et al., 1996), perceived loss of control or support or internal conflicts (Gray, 2008) and absorptive capacity (Cohen & Levinthal, 1990) may be influencing the collaborative R&D process. The results seem to corroborate those found by Kihlgren (2003) in Russia:

> It seems that in Russia firms might find science parks attractive not because the local scientific milieu is important for their operations, but because these places offer a range of services and good quality accommodation. (Kihlgren, 2003, p. 75).

In addition to organizational, inter-organizational and institutional levels, the temporal dimension also lends subsidies to the understanding of the R&D processes in ISTPs. The short time of existence of these innovation habitats in Brazil may be responsible for the absence of more favorable institutional conditions that are developed in the long term, as a culture of innovation, predisposition to collaboration, trust, among others. These may influence, even if indirectly, the results of innovation projects. In a way, it is possible that Brazilian ISTPs are still "first generation". As this research mainly encompasses new businesses, building relational experiences that support their reputation as to reduce uncertainty among potential partners – and that, therefore, open space for trust among them – may be incipient (Ahuja, 2000). Zollo, Reuer, and Singh (2002) suggest that organizations that lack relational experiences benefit more from capital-based partnerships such as joint ventures. The long time normally necessary for this type of partnership, however, vis-à-vis the size of the companies present in ISTPs and the dynamics essential to R&D processes can derail capital-based partnerships. Hu, Lin, and Chang (2005) reinforce this point, suggesting that collaboration on STPs happens occasionally, rather than continuously. This indicates the need for temporary networks to promote innovation. In this sense, the continuity of the relationship allows the construction of a relational experience that upholds the reputation necessary to the formation of new relations (Axelrod, 1984; Powell et al., 1996). This recursion provides a challenge to innovation in these habitats, especially for incubators, where the necessary dynamics to R&D processes requires relations of a more temporary character.

Therefore, the low relational experience inherent to firms in incubators, the relatively recent emergence of STPs in Brazil and the low interdependence necessary to R&D processes may indicate the existence of lower density networks. A barrier to collaboration in R&D is noticed, which sets aside any facilitating elements present in these environments. The need to develop relationships with other firms to learn, foster skills and develop innovation (Chesbrough, Vanhaverbeke, & West, 2006; Nooteboom, 2008) seems to find in previous relational experiences and reputation, preconditions for their fulfillment.

In addition to the relational experience, the idiosyncrasies of each innovation habitat and the complexity with which collaborative R&D projects are formed and developed (Etzkowitz, Mello, & Almeida, 2005) may indicate the existence of path dependencies and make it difficult to check generalizable propositions that explain these phenomena. According to Etzkowitz et al. (2005),

> the process is more complex than simple organization and technology transfer. The same organizational mechanism can play a completely different role in innovation, depending upon the actor(s) that promote its introduction and the context into which it is introduced. (Etzkowitz et al., 2005, p. 422).

The time dimension may also influence the perception of managers about the results of the same R&D projects. Should the results of these projects eventually be converted into innovations in the future, the perception about them will be different. In this analysis, financial resources may have been the exception as they refer to projects funded by the government, which generally have a shorter deadline for execution.

These results seem to have important implications for academic researchers, executives of the ISTPs, companies and for

the State. For the academic field, this study contributes to the understanding of the characteristics and results of ISTPs by providing elements that stimulate an ongoing debate, constituting an important step toward the understanding of the innovation process in these environments.

Regarding the management of ISTPs, it can give support to the executives based on the knowledge about the resources and infrastructure that enable a more effective fostering of the results of R&D projects. Knowing that these resources can assist decisions on where to concentrate efforts and how incubators and parks can design their own strategies in order to promote better management practices. Applied in different cultural and social contexts, the operationalization of the proposed framework can assist in the comparison of different innovation habitats.

In terms of public management, the proposed framework brings elements for creation and development of ISTPs potentially stimulating self-sustaining innovation processes and regional development. The results of this study can guide public management tools to stimulate the participation of companies, universities and ISTPs in R&D projects. Moreover, the understanding that these environments can influence the results of these projects lays on them an instrumental perspective, so that these institutional mechanisms can be used to foster innovation cultures and develop the poor areas of these processes.

Companies, then, may draw on these results to select innovation habitats that are better suited to their strategic goals. Services and infrastructure offered by ISTPs are necessary, but not sufficient, to promote R&D processes. Calls for proposals for funding induce better results in R&D projects, but in order to have synergy among the actors, other characteristics of ISTPs which were not covered in this study are required.

Furthermore, in order to contribute to the advancement of literature, certain limitations should be considered. Epistemologically, one should admit that the mere fact that IPCTs facilitate access to these resources does not mean that they are used, nor whether the use is appropriate. One must note that the methodological option for measuring the ease of access to resources provided by the incubator or park, instead of its actual use, was adopted due to the understanding that this reflects the role of IPCTs this process more clearly, since these resources are available and also used outside these environments. At the same time, the questionnaire would be more easily understood by entrepreneurs. This option is clearly limited in cases in which the resources are available but are not used or are not used properly. The starting point was the assumption that such cases would be rare. After all, why would a company be part of an IPCT if not to have access to these resources and use them in their innovation process? Apparently, the results make this assumption worthy of a new challenge in future studies.

Another limitation is the sample size. Searches with a larger sample size might assist the verification of the significance levels obtained in this study, eventually by using multivariate statistical methods of a more verifiable character, such as the Structural Equation Modeling. Furthermore, one cannot, from the results, assume a causal relationship between the constructs, since the conditions relating to this are beyond the scope of this study. The consideration of these limitations in future research may to bring supplemental results to those produced here.

Finally, we consider that this work has responded satisfactorily to the proposed research hypothesis and that its propositions, results, difficulties and limitations encourage the search for new questioning horizons. We hope to have contributed to the advancement in the understanding of this empirical field that still lacks more conclusive results.

## Conflict of interest

The authors declare no conflicts of interest.

## References


Ahuja, G. (2000). The duality of collaboration: Inducements and opportunities in the formation of interfirm linkages. *Strategic Management Journal*, *21*(3), 317.

Axelrod, R. M. (1984). *The evolution of cooperation*. Basic Books.

Bakouros, Y. L., Mardas, D. C., & Varsakelis, N. C. (2002). Science park, a high tech fantasy? An analysis of the science parks of Greece. *Technovation*, *22*(2), 123.

Balestrin, A., Vargas, L. M., & Fayard, P. (2005). O efeito rede em pólos de inovação: um estudo comparativo. *RAUSP – Revista de Administração da Universidade de São Paulo*, *40*(2)

Barney, J. B. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, *17*(1), 99–120.

Blindenbach-Driessen, F., Van Dalen, J., & Van Den Ende, J. (2010). Subjective performance assessment of innovation projects. *Journal of Product Innovation Management*, *27*(4), 572–592. http://dx.doi.org/10.1111/j.1540-5885.2010.00736.x

Carpenter, M. A., Geletkanycz, M. A., & Sanders, W. G. (2004). Upper echelons research revisited: antecedents, elements, and consequences of top management team composition. *Journal of Management*, *30*(6), 749–778. http://dx.doi.org/10.1016/j.jm.2004.06.001

Chan, K.-Y. A., Oerlemans, L. A. G., & Pretorius, M. W. (2010). Knowledge exchange behaviours of science park firms: the innovation hub case. *Technology Analysis & Strategic Management*, *22*(2), 207–228. http://dx.doi.org/10.1080/09537320903498546

Chesbrough, H., Vanhaverbeke, W., & West, J. (2006). *Open innovation: Researching a new paradigm*. New York: Oxford University Press.

Cohen, W. M., & Levinthal, D. A. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128–152.

Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*, *47*(6), 1154–1191. http://dx.doi.org/10.1111/j.1467-6486.2009.00880.x

DiMaggio, P. J., & Powell, W. W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American Sociological Review*, *48*(2), 147–160.

Etzkowitz, H., & Leydesdorff, L. (2000). The dynamics of innovation: from National Systems and Mode 2 to a Triple Helix of university–industry–government relations. *Research Policy*, *29*(2), 109–123. http://dx.doi.org/10.1016/s0048-7333(99)00055-4

Etzkowitz, H., Mello, J. M. A. d., & Almeida, M. (2005). Towards meta-innovation in Brazil: The evolution of the incubator and the emergence of a triple helix. *Research Policy*, *34*(4), 411–424. http://dx.doi.org/10.1016/j.respol.2005.01.011

Fornell, C., & Larcker, D. F. (1981). Structural equation models with unobservable variables and measurement error: Algebra and statistics. *Journal of Marketing Research*, *18*(3), 382–388. http://dx.doi.org/10.2307/3150980

Garson, G. D. (2012). *Partial least squares: Regression and path modeling* Blue Book Series, S. A. Publishing (Ed.).

Gray, B. (2008). Intervening to improve inter-organizational partnerships. In S. Cropper, M. Ebers, C. Huxham, & P. S. Ring (Eds.), *The oxford handbook of inter-organizational relations*. Oxford Press: New York.

Hair, J., Sarstedt, M., Ringle, C., & Mena, J. (2012). An assessment of the use of partial least squares structural equation modeling in marketing research. *Journal of the Academy of Marketing Science*, *40*(3), 414–433. http://dx.doi.org/10.1007/s11747-011-0261-6

Hair, J. F., Jr., Black, W. C., Babin, B. J., & Anderson, R. E. (2009). *Multivariate data analysis* ((7 ed.). USA: Prentice Hall.

Hambrick, D. C., & Mason, P. A. (1984). Upper echelons: The organization as a reflection of its top managers. *Academy of Management Review*, *9*(2), 193–206. http://dx.doi.org/10.5465/amr.1984.4277628

Hansson, F., Husted, K., & Vestergaard, J. (2005). Second generation science parks: From structural holes jockeys to social capital catalysts of the knowledge society. *Technovation*, *25*(9), 1039–1049. http://dx.doi.org/10.1016/j.technovation.2004.03.003

Hu, T.-S., Lin, C.-Y., & Chang, S.-L. (2005). Technology-based regional development strategies and the emergence of technological communities: A case study of HSIP, Taiwan. *Technovation*, *25*(4), 367–380. http://dx.doi.org/10.1016/j.technovation.2003.09.002

Human, S. E., & Provan, K. G. (1997). An emergent theory of structure and outcomes in small-firm strategic manufacturing network. *Academy of Management Journal*, *40*(2), 368–403.

Hwang, V. W., & Horowitt, G. (2012). *The Rainforest: The Secret to Building the Next Silicon*. Regenwald.

Kihlgren, A. (2003). Promotion of innovation activity in Russia through the creation of science parks: The case of St. Petersburg (1992–1998). *Technovation*, *23*(1), 65.

Lahorgue, M. A. (2004). *Pólos, Parques e Incubadoras*. Brasilia: Anprotec/Sebrae.

Lee, W.-H., & Yang, W.-T. (2000). The cradle of Taiwan high technology industry development – Hsinchu Science Park (HSP). *Technovation*, *20*(1), 55.

Lichtenthaler, U., & Lichtenthaler, E. (2009). A capability-based framework for open innovation: complementing absorptive capacity. *Journal of Management Studies*, *46*(8), 1315–1338. http://dx.doi.org/10.1111/j.1467-6486.2009.00854.x

Lindelof, P., & Lofsten, H. (2003). Science park location and new technology-based firms in Sweden – Implications for strategy and performance. *Small Business Economics*, *20*(3), 245.

Löfsten, H., & Lindelöf, P. (2005). R&D networks and product innovation patterns-academic and non-academic new technology-based firms on Science Parks. *Technovation*, *25*(9), 1025–1037. http://dx.doi.org/10.1016/j.technovation.2004.02.007

Massey, D., Quintas, P., & Wield, D. (1992). *High tech fantasies: Science parks in society, science and space*. London: Routledge.

Negassi, S. (2004). R&D co-operation and innovation a microeconometric study on French firms. *Research Policy*, *33*(3), 365–384. http://dx.doi.org/10.1016/j.respol.2003.09.010

Nooteboom, B. (2008). Learning and innovation in inter-organizational relationships. In S. Cropper, M. Ebers, C. Huxham, & P. S. Ring (Eds.), *The Oxford handbook of inter-organizational relations*. Oxford Press: New York.

Nooteboom, B., Van Haverbeke, W., Duysters, G., Gilsing, V., & van den Oord, A. (2007). Optimal cognitive distance and absorptive capacity. *Research Policy*, *36*(7), 1016–1034. http://dx.doi.org/10.1016/j.respol.2007.04.003

Oakey, R. (2007). Clustering and the R&D management of high-technology small firms: In theory and practice. *R&D Management*, *37*(3), 237–248. http://dx.doi.org/10.1111/j.1467-9310.2007.00472.x

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: A critical review of the literature and recommended remedies. *Journal of Applied Psychology*, *88*(5), 879–903. http://dx.doi.org/10.1037/0021-9010.88.5.879

Powell, W. W., Koput, K. W., & Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, *41*(1), 116–145.

Radosevic, S., & Myrzakhmet, M. (2009). Between vision and reality: Promoting innovation through technoparks in an emerging economy. *Technovation*, *29*(10), 645–656. http://dx.doi.org/10.1016/j.technovation.2009.04.001

Raupp, F. M., & Beuren, I. M. (2009). Programas oferecidos pelas incubadoras brasileiras às empresas incubadas. *Revista de Administração e Inovação*, *6*(1), 83.

Roberts, R. (2005). Issues in modelling innovation intense environments: The importance of the historical and cultural context. *Technology Analysis & Strategic Management*, *17*(4), 477–495. http://dx.doi.org/10.1080/09537320500357384

Saxenian, A. (1994). Lessons from Silicon Valley. *Technology Review (00401692)*, *97*(5), 42.

Squicciarini, M. (2009). Science parks: seedbeds of innovation? A duration analysis of firms' patenting activity. *Small Business Economics*, *32*(2), 169–190. http://dx.doi.org/10.1007/s11187-007-9075-9

Tan, J. (2006). Growth of industry clusters and innovation: Lessons from Beijing Zhongguancun Science Park. *Journal of Business Venturing*, *21*(6), 827–850. http://dx.doi.org/10.1016/j.jbusvent.2005.06.006

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533.

Tötterman, H., & Sten, J. (2005). Start-ups: Business incubation and social capital. *Incubación de Empresas y Capital Social*, *23*(5), 487–511. http://dx.doi.org/10.1177/0266242605055909

Van De Ven, A. H., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of Management Review*, *20*(3), 510–540. http://dx.doi.org/10.5465/amr.1995.9508080329

van der Borgh, M., Cloodt, M., & Romme, A. G. L. (2012). Value creation by knowledge-based ecosystems: Evidence from a field study. *R&D Management*, *42*(2), 150–169. http://dx.doi.org/10.1111/j.1467-9310.2011.00673.x

Vedovello, C. (1997). Science parks and university–industry interaction: Geographical proximity between the agents as a driving force. *Technovation*, *17*(9), 491.

Watkins-Mathys, L., & Foster, M. J. (2006). Entrepreneurship: The missing ingredient in China's STIPs? *Entrepreneurship & Regional Development*, *18*(3), 249–274.

Westhead, P. (1997). R&D 'inputs' and 'outputs' of technology-based firms located on and off science parks. *R&D Management*, *27*(1), 45.

Westhead, P., & Batstone, S. (1999). Perceived benefits of a managed science park location. *Entrepreneurship & Regional Development*, *11*(2), 129–154. http://dx.doi.org/10.1080/089856299283236

Yang, C.-H., Motohashi, K., & Chen, J.-R. (2009). Are new technology-based firms located on science parks really more innovative? Evidence from Taiwan. *Research Policy*, *38*(1), 77–85. http://dx.doi.org/10.1016/j.respol.2008.09.001

Zollo, M., Reuer, J. J., & Singh, H. (2002). Interorganizational routines and performance in strategic alliances. *Organization Science*, *13*(6), 701–713.