

ABSORPTIVE CAPACITY DIMENSIONS ANALYSIS IN TECHNOLOGY PARKS.

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Abstract:

The objective of this research is to analyze how the dimensions of the absorptive capacity are evidenced, from the processes of environmental scanning, because it is important to understand the mechanisms that are determinant for these evolutions. In order to validate the interview script, a pilot test was provided with a manager of Barcelona's La Salle Technova. After that was carried out interviews with managers of five Tech Parks in Brazil, one in Spain and one in South Africa. The results show a positive influence of the surveyed dimensions on the absorptive capacity of the technology parks.

Key-words: Technology Parks; Environmental Scanning; Absorptive Capacity.

1 INTRODUCTION

The technology parks history began in the late 1950s in the United States from initiatives such as Standford Industrial Park, Triangle Research Park, and Route 128. These clusters of technology-based companies emerged as a result of a series of orchestrated actions by the American government, academia and local industry (Lunardi, 1997). Innovative products developed in companies located on these environments have spread their businesses globally and contributed to the development of one of the world's largest and most pulsating technology hubs.

Since then, successful models such as Silicon Valley have influenced cities, states and countries and impacted the development projects of their respective governments (Castells and Hall, 1994). From the point of view of public policies, technological parks are naturally considered as instruments of local competitive advantage (Annerstedt, 2006). And that is why

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it can be observed an increase in the number of these environments around the world in the last decades, turning into an international phenomenon (Phan, *et al.*, 2005; Annerstedt, 2006).

At the forefront of these changes are the technology-based companies, and the entire ecosystem in which they are embedded. In this way, it is only natural that technological parks have evolved in their models to meet the market demands, from physical spaces for the installation of spin-offs originated in universities, to interactive spaces that offer diversified services, where the focus is on the innovation activities based on two-way knowledge, and information flow among ecosystem participants (Gyurkovics and Lukovics, 2014). This creation of synergy and networking between companies and between companies and research institutions is one of the main objectives of technology parks (Hassink and Hu, 2012).

Discussions on this new concept are based on the "Learning Villages" theory (Sanz, 2001) that combines business spaces with educational centers and residential areas, places where it is possible to work and live in a society based on knowledge economy (Nikina and Pique, 2016).

In October 2017, the International Association of Science Parks and Areas of Innovation (IASP) asked their associates, through an online survey, which were the main competitors of technology parks when it comes to attracting entrepreneurial ventures and projects. Most of the respondents (70%) identified the hybrid spaces designated as innovation areas and central areas of the city as the main competitors of the parks. Coworking spaces also pose a threat to 23% of respondents. Only 13% of respondents identified other technology parks as competitors (IASP, 2017).

The absorptive capacity was presented by Cohen and Levinthal (1990) as the firm's ability, based on prior knowledge, to recognize the value of new information, assimilate it and apply it for commercial purposes. Since then, researches have pointed out that the absorptive capacity is an important factor in the innovation process and in the creation and maintenance of competitive advantage. Zahra and George (2002) contributed to the academic literature of the absorptive capacity, bringing a more processual perspective of the construct. The authors divide the absorptive capacity into potential and realized, defining the dimensions of acquisition, assimilation, transformation and exploitation of knowledge, as the main capacities that influence the results of organizations.

In this context, this research aims to verify how the dimensions of the absorptive capacity are evidenced in the technological parks, from the environmental scanning processes, in order to cover a gap in the literature.

2 THEORETICAL REFERENTIAL

2.1 ENVIRONMENTAL SCANNING

Environmental scanning is the acquisition and use of information about events, trends and relationships in the environment outside the organization, and the knowledge in which management relies on planning future actions (Choo, 2001). Organizations scan the environment to reduce blindness, avoid potential surprises, identify threats and opportunities, gain competitive advantage, and improve long-term and short-term planning (Albright, 2004; Choo, 2001).

Scanning and analyzing the environment helps the company to find technological and market opportunities and trends increasing the ability of companies to enter new domains (Daft et al., 1988). According to Choo (2001), scanning not only improves organizational performance, but also increases the level of communication between employees and impacting several areas of the organizations, from the strategic point of view to management and shared vision communication.

There are several ways of scanning the environment. The use of a specific source of information by managers is often related to their accessibility to this information, and that is why external networks and personal contacts are the primary sources of information (Choo and Auster, 1993). The process of collecting and analyzing information from a company's external environment includes social, regulatory, technological, political, economic and industrial areas, and is mostly performed through face-to-face interaction (Daft et al., 1988).

2.2 ABSORPTIVE CAPACITY

Cohen and Levinthal (1989) originally introduced the term absorptive capacity in their seminal paper as the company's ability to identify, assimilate, and exploit environmental knowledge. A year later, Cohen and Levinthal (1990) redefine the construct as a company's ability to recognize the value of new external information, assimilate it, and apply it for business

purposes. According to the authors, the purpose of the absorptive capacity is to increase the innovative performance of a company in an uncertain environment through the process of recognition, assimilation and application of knowledge.

“The importance of informal relationships with service providers to strengthen the absorptive capacity of IT areas, which are typically strapped by small budgets and tight time frames, as was the case of the companies investigated (Moreno *et al*, 2019)”. At the same time those authors found that there is a relative degree of translation this into an effective innovation, depends on the alignment between the absorptive capacity and the business internal area.

In their research Ferreira and Ferreira (2017) collected data from companies that took place between October 2015 and January 2016. It was obtained the return of 273 companies, of which 241 were considered family firms. The relationships developed and supported by the empirical part support the results of Zahra and George (2002) which is that the absorptive capacity helps the extent of innovation.

2.2.1 Antecedents of Absorptive Capacity

Based on this reconceptualization of the concept, many researchers have devoted their studies to the validation of the construct of the absorptive capacity and its dimensions, developing hypotheses, variables and validating antecedents through the models in their own studies. In this section, the main antecedents that were validated by the researches, and that are adherent to the environment of technology parks are presented, following the dimensions proposed by Zahra and George (2002).

Acquisition: According to Flatten *et. al.* (2011), the acquisition dimension of the absorptive capacity is related to the acquisition of external information through various sources, mainly market-related information, through environmental scanning.

Camisón and Forés (2010) analyzed the potential absorptive capacity of acquisition from the knowledge of competitors, openness with the environment (trends and opportunities) and cooperation with institutions, universities and companies.

Assimilation: According to Cohen and Levinthal (1990), the intensity of individual exposure of a company member to prior knowledge is critical in the development of absorptive capacity, and companies with a diversified history of knowledge more readily relate prior knowledge with new knowledge. Without prior knowledge, organizations are not able to

assimilate the new information and, thus, will have more difficulty absorbing it. (Cohen and Levinthal, 1990; Zahra and George, 2002; Todorova and Durisin, 2007).

Transformation: According to Zahra and George (2002), the gap between potential and realized absorptive capacity is reduced using social integration mechanisms. These mechanisms contribute to the assimilation of knowledge and may be informal, such as social or formal networks. Informal mechanisms work while exchanging ideas, while formal mechanisms allow a more systematic integration of knowledge. With formal mechanisms of social integration, information can be effectively distributed within the company, interpretations can be collected, and trends can be identified (Zahra and George, 2002).

Multidisciplinary work groups, delegation of responsibilities, and a system for collecting employee proposals are some of the practices that influence the transformation in the absorptive capacity of firms (Cohen and Levinthal, 1990; Daghfous, 2004; Jansen, **et al.**, 2005; Vega-Jurado **et al.**, 2008)

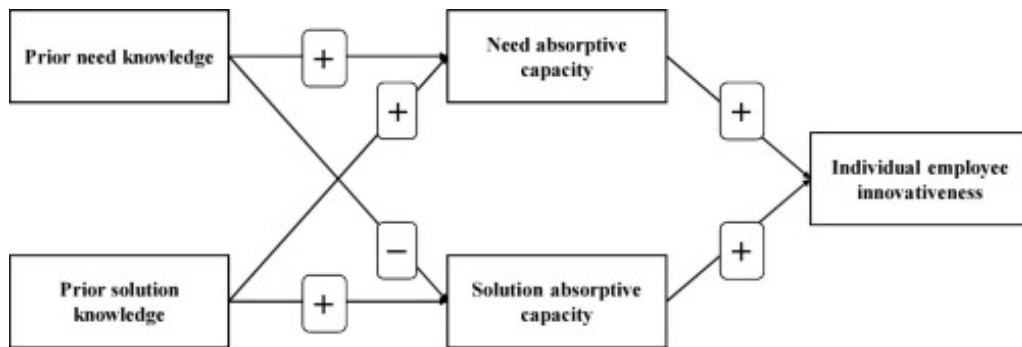
The study of Jansen **et al.** (2005) revealed the importance of organizational mechanisms related to socialization capacities that strengthen the organizations' absorptive capacity. Socialization mechanisms build the necessary connection between people in an organization to develop joint knowledge or share and integrate knowledge from different parts of the organization or the external environment (Jansen **et al.**, 2005; Lewin **et al.**, 2011).

Exploitation: The exploration dimension denotes an organization's ability to improve, expand and use its existing routines, skills, and technologies to create something new based on transformed knowledge, converting knowledge into new products to improve performance and competitive advantage (Flatten **et al.**, 2011). The ability of organizations to respond to market demands through new products was also validated by Camisón and Forés (2009) for the exploration dimension in their measurement instrument.

The registration of information, the documentation of information made available periodically, the easy access to this information, as well as the responsibility for its use, are part of the exploitation of knowledge (Tu **et al.**, 2006; Jiménez-Barrionuevo **et al.**, 2011).

Schweisfurth, and Raasch (2018) found in their study the importance of absorptive capacity “as a mechanism to explain how external need knowledge is identified, assimilated, and applied for product innovation in firms (p. 695)”. Need knowledge and solution knowledge are known to be two necessary prerequisites for innovation as it is shown on figure 1.

Figure 1 – Knowledge and Absorptive capacity relations.



Source: Schweisfurth & Raasch (2018).

The main antecedents identified in the literature are summarized in table 01:

Table 01 – Summary – Evidence of Absorptive Capacity Antecedents in Technology Parks

Absorptive Capacity Dimensions	Antecedents of Absorptive Capacity	Theoretical Basis
Potential Absorptive Capacity (Acquisition)	Environmental Scanning	Cohen e Levinthal (1990); Daugfous (2004); Tu et. Al. (2006); Camisón and Forés (2009); Flatten et. al. (2011); Lewin, Massini and Peeters (2011)
	Cooperation with other organizations	Cohen e Levinthal (1990); Tu et. Al. (2006); Camisón and Forés (2009); Flatten et. al. (2011)
	Participation in Decision Making	Cohen e Levinthal (1990); Daugfous, 2004; Jansen, Van den Bosch e Volberda (2005)
Potential Absorptive Capacity (Assimilation)	Employee Education Level	Cohen and Levinthal (1990); Tu et. Al. (2006); Vega-Jurado et. al. (2008)
	Training and Development Programs	Daugfous (2004); Jansen et. al. (2005); Tu et. Al. (2006); Camisón and Forés (2009) Murovec and Prodan (2009);
	Communicaton	Cohen and Levinthal (1990); Daugfous (2004); Jansen et. al. (2005); Flatten et. al. (2011); Lewin et. al., (2011)
Realized Absorptive Capacity (Transformation)	Job Rotation	Cohen and Levinthal (1990); Daugfous (2004); Jansen et. al. (2005)
	Socialization	Daugfous (2004); Jansen et. al. (2005); Flatten et. al. (2011)
	New knowledge application, idea generation	Daugfous (2004); Jansen et. al. (2005); Flatten et. al. (2011).
Realized Absorptive Capacity (Exploitation)	Formalization Tools	Tu et. Al. (2006); Jansen et. al. (2005); Jiménez-Barrionuevo et. al. (2011).
	Generation of new products and services	Camisón and Forés (2009); Flatten et. al. (2011)

Source: Elaborated by the authors (2020).

3 RESEARCH METHODS

The multiple case study method was chosen as a research methodology for the present study, that sought to find evidence of the dimensions of the absorptive capacity in technological parks from environmental scanning processes.

According to Yin (2009), a case study investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly defined. The method chosen is appropriate since it is difficult to separate the context from the absorptive capacity on technology parks related to the environmental scanning processes from the wider context in which these capabilities are developed.

The choice of multiple cases was since it shows similarities and differences between the cases studied and allows identifying the complementarities between one case and another, in order to enrich the analyzes so that other parks can improve their perspectives on the development of the absorptive capacity.

The cases selected for the study were TECNOPUC, Tecnovates, São José dos Campos Technological Park (PqTec), Porto Digital, Cartuja Science and Technology Park (PCT Cartuja) and Johanneberg Science Park (JSP). The selected cases met the following criteria: 1) consolidated parks in phase of operation; 2) parks affiliated to the IASP; 3) availability of management for participation in research.

The primary data were collected through in-depth interviews with the technology park managers, supported by a semi-structured script, conducted personally by the researcher and complemented by direct participant observation. In order to conduct the interviews for the study, a script of questions was elaborated by the researcher, based on the theoretical conceptual base.

The interview script was based on the main studies on the absorptive capacity, selecting elements with a positive influence on the absorptive capacity of the organizations, as evidenced by statistical studies. The researcher identified important elements for the development of the absorptive capacity to compose the categories that guided the elaborated questions.

In order to validate the interview script, a pilot test was carried out with a manager of a technology park that met the criteria established in the research. The selected park was Barcelona's La Salle Technova, whose manager is also the president of IASP.

The methodology uses to describe and interpret the content of the interviews was the content analysis, which allows a reinterpretation of the messages with the objective of reaching a deeper understanding, besides a simple reading. According to Bardin (1995), content analysis still enriches the exploratory attempt, increasing the propensity to discovery.

After conducting the interviews with the managers of the selected parks, a literal transcription of the interviews was carried out generating a volume of 65 pages. The next step was careful reading of all the transcribed material. The categories were defined based on the theoretical basis and the results described and interpreted according to the theory.

4 RESULTS

This study does not intend to compare the results of the technology parks, but to discuss the evidences found in the organizational dynamics of each park and that refer to the development of the absorptive capacity during the process of environmental scanning.

4.1 POTENTIAL ABSORPTIVE CAPACITY – ACQUISITION.

Environmental Scanning: From the interviewees' report, it is noticed that the environmental monitoring is carried out by the analyzed parks, from different activities. National and international forums were pointed out by the managers of Tecnovates, TECNOPUC, PqTec and JSP as sources of information, mainly for benchmarking of best practices related to the environment of technology parks and incubators.

Cooperation with other organizations: Cooperation with other institutions and companies was mentioned by all the interviewees as a source of acquisition of new knowledge and exchange of information, both in national and international networks. At Tecnovates, despite the current international agreements focused mainly on the exchange of information at management level, the park is working to intensify the exchange of people, promoting a more enriching exchange of experiences and knowledge.

In addition to the cooperation and agreement with other parks and sectoral clusters, with which there is a constant exchange of information, the PqTec interviewee also mentions the importance of the relationship with the Brazilian Industrial Development Agency (ABDI) and the Brazilian Agency for the Promotion of Exports and Investments (APEX).

In general, the interviewees' discourse shows great importance to the openness of the environment referenced by Camisón and Forés (2010), and to the relationship and cooperation with other institutions in the search for information, new knowledge and tendencies (Zahra and George, 2002; Daghfous, 2004).

Participation in decision making: The shared decisions were mentioned mainly by two parks, TECNOPUC and Porto Digital. For the TECNOPUC interviewee, the shared decision with the team members is a way to promote the engagement and the feeling of belonging.

In Porto Digital, Tuesday's formal meetings are the main moment of sharing between the team, and where everyone can contribute with suggestions regarding mainly internal processes. Regarding the issues that involve the biggest deliverables of the Digital Port for the ecosystem, decisions are made at management level, but with the contribution of the respective teams.

The interviewee of Tecnovates reports that when issues arise that require decision making, they are already accompanied by a proposal from the stakeholders. In this way, as far as possible, the decision is made according to the suggestions brought by the team.

This result shows that the greater participation of the employees in the decision-making process has turned them into prospective "receivers" of new information (Cohen and Levinthal, 1990; Jansen *et al.*, 2005).

4.2 POTENTIAL ABSORPTIVE CAPACITY – ASSIMILATION

Employee Education Level: Although it does not have a team specifically trained to manage innovative environments, Tecnovates works with a highly qualified team of technicians to assist the park's laboratory structures, and especially professionals qualified to meet the communication needs between researchers and companies.

PTC Cartuja and JSP also claim to have a qualified team and point out the diversity of formal education as one of the positives aspects of their team composition. At PqTec, employees are recruited in an organized formal process that bases the hiring at the required technical level according to the demand and profile of each position, from the direction to the trainee, and the formal knowledge is widely valued.

The interviews show that the parks have teams with a diverse knowledge base, and that the level of education and technical knowledge of the employees is high and diversified,

facilitating the assimilation of external information acquired (Cohen and Levinthal, 1990; Zahra and George, 2002).

Training and Development Programs: Regarding training and development activities, Tecnovates and PCT Cartuja showed the qualification of the team as a consolidated organizational process. At PCT Cartuja, a development plan is constructed for everyone every year, according to the personal needs. At Tecnovates, the development plan is carried out by the people development sector of the University, that have innovation capabilities as a strategic area of development.

Communication: The results show that the means of communication adopted by most of the researched environments, for the dissemination of the information captured in the external media, is through meetings that happen regularly.

At PqTec, although some meetings are only at the board level, once a week meeting take place with all coordinators involving all programs and actions. According to the interviewee: *"At these meetings, feedback is also given on all the activities being developed, and participation in forums, events and trips are always reported to everyone who is attending to the meeting."*

4.3 REALIZED ABSORPTIVE CAPACITY – TRANSFORMATION

Job Rotation: In relation to the rotation of functions, the Digital Port incorporated the activity as a preparation within the career plan. According to the interviewee, the evolution within the organization depends on a more macro view of the business, and the rotation of positions and functions is the most appropriate way for this vision to be developed.

The interviewees' reports show that the rotation of functions is not an established practice in most of the studied parks, happening informally or on demand. Rotation of functions in Porto Digital has an impact on professional motivation, collaboration among employees, and contributes to the search for personal and organizational knowledge, increasing the ability to associate new knowledge with existing knowledge. (Cohen and Levinthal, 1990; Daghfous, 2004, Jansen *et al.*, 2005).

Socialization: The JSP team recently moved from office, since the former did not meet the growth need of the group. At the moment, the team is sharing a large and open space with another company, which, according to the interviewee, had positive points in terms of comfort, but had a negative impact on the communication of the team. The highlight was the loss of the

small kitchen, the point of socialization of the team, and where communication was more informal. The Cartuja park interviewee also mentioned the space as an informal and relaxed meeting place, where both the park staff and entrepreneurs gather to share information and socialize.

New knowledge application and idea generation: At Tecnovates, the generation of new ideas is part of the culture in the institution, which motivates employees to participate with ideas, applying their knowledge. The interviewee mentioned the Inova Univates event, which works as a "Startup Weekend" marathon. The event is aimed at employees of the institution and focused on generating ideas for challenges related to it. The winners of the 2017 event were rewarded with a trip and will participate in the ANPROTEC Annual Conference in Rio de Janeiro.

The interviewees' reports refer to what we observe in theory in relation to the factors that positively influence the transformation of knowledge through an open organizational climate to the proposition of new ideas (Daghfous, 2004; Jansen **et al.**, 2005; Flatten **et al.**, 2011)

4.4 REALIZED ABSORPTIVE CAPACITY – EXPLOITATION

Formalization tools: At Tecnovates, the main tool used to keep track of all the information and knowledge gained by park staff is through reports. The interviewee commented that there is a sharing tool, however, the focus of this tool is in the sharing of indicators and goals that are established for the park, so that everyone has access and can feed the information needed.

Tecnovates and JSP, have more fragile routines for the storage of information and acquired knowledge, which may hinder the recovery of knowledge already internalized for later application for too much members of the organization (Jansen **et al.**, 2005). The other parks studied have more structured information systems, facilitating the access to the information and accumulated knowledge, facilitating the exploration and application of the same for the other members of the team (Jansen **et al.**, 2005; , Jiménez-Barrionuevo **et al.**, 2011).

Generation of new products and services: All the parks interviewed mentioned the development of projects, the creation of services and products that could be linked to the activities related to environmental scanning: “[...] everything we do originated in a

benchmarking action. If it is not a model itself, it is an inspiration an appropriateness to our possibility.” (Tecnovates).

Finally, we can identify in the technological parks surveyed the ability to explore new knowledge, respond to changes in the environment, apply experience to create new products and services, and improve the capacity to meet market demands (Camisón and Forés, 2010, Flatten **et al**, 2011).

Table 02 shows the summary of main results from the interviews with the Techpark managers, organized by the absorptive capacity antecedents identified in each dimension, according to the literature.

Table 02 – Summary – Evidence of Absorptive Capacity Antecedents in Technology Parks

Absorptive Capacity Dimensions	Antecedents of Absorptive Capacity	Theoretical Basis
Potential Absorptive Capacity (Acquisition)	Environmental Scanning Participation in: forums, innovation networks, benchmarking activities. Networking with industry; media channels; market research.	Cohen e Levinthal (1990); Daugfous, 2004; Tu et. Al. (2006); Camisón and Forés (2009); Flatten et. al. (2011); Lewin, Massini and Peeters (2011)
	Cooperation with other organizations Cooperation with research institutes; joint projects with other institutions; relationship with governmental institutions.	Cohen e Levinthal (1990); Tu et. Al. (2006); Camisón and Forés (2009); Flatten et. al. (2011)
	Participation in Decision Making Shared decisions; collective construction; participation on strategic decision making.	Cohen e Levinthal (1990); Daugfous, 2004; Jansen, Van den Bosch e Volberda (2005)
Potential Absorptive Capacity (Assimilation)	Employee Education Level Formal education is valued; diverse teams; especialization focused on project management.	Cohen and Levinthal (1990); Tu et. Al. (2006); Vega-Jurado et. al. (2008)
	Training and Development Programs Career development programs; traning on demand.	Daugfous, 2004; Jansen et. al., (2005); Tu et. Al. (2006); Camisón and Forés (2009) Murovec and Prodan (2009);
	Communicaton Face to face meetings; e-mails; WhatsApp; newsletters.	Cohen and Levinthal (1990); Daugfous, 2004; Jansen et. al., (2005); Flatten et. al. (2011); Lewin et. al., (2011)
Realized Absorptive Capacity (Transformation)	Job Rotation Job rotation program for career development; informal job rotation	Cohen and Levinthal (1990); Daugfous, 2004; Jansen et. al., (2005)
	Socialization Shared spaces dedicates to team socialization; comon areas for socialization with companies; special moments for socialization activities	Daugfous, 2004; Jansen et. al., (2005); Flatten et. al. (2011)
	new knowledge application, idea generation Mechanisms to encourage the generation of ideas (awards); favorable culture for the implementation of ideas (freedom and trust)	Daugfous, 2004; Jansen et. al., (2005); Flatten et. al. (2011).
Realized Absorptive Capacity (Exploitation)	Formalization Tools Reports; information system networks; personaziled information systems; document sharing on cloud.	Tu et. Al. (2006); Jansen et. al., (2005); Jiménez-Barrionuevo et. al., (2011).
	Generation of new products and services Evidence of the generation of products, projects and services resulting from environmental scanning activities such as benchmarking and networking with stakeholders (L.O.U.Co -; Pitching for Funding; Embraer certification.)	Camisón and Forés (2009); Flatten et. al. (2011)

Source: Elaborated by the authors (2020)

5 FINAL CONSIDERATIONS

The objective of this study was to analyze how the dimensions of the absorptive capacity are evidenced in the technological parks, from the processes of environmental monitoring.

In order to do so, this work has sought, together with the literature, studies on the construct absorptive capacity, since its original proposition and its improvement in the last decades, identifying the main contributions of the studies especially with regard to the antecedents that positively influence the absorptive capacity in organizations.

As a result of the interview analyzes, evidence of the development of the absorptive capacity was found in all the studied parks. Analyzes show that parks, regardless of location or size, maintain a dynamic of environmental monitoring with similarities as sources of information, benchmarking, partnerships with other organizations, participation in forums and association with networks. However, when it comes to monitoring trends and new technologies, only one of the parks mentioned the university as a source of information.

This found was in according to the Schweisfurth and Raasch (2018) study', in which they increase their “understanding of absorptive capacity in knowledge domains other than technological solutions, specifically in the need knowledge domain, and to analyze its principal antecedents and consequences for innovation” (p. 694).

In relation to the assimilation of acquired new knowledge, the parks focus on face-to-face interaction, with team meetings being the main communication instrument identified. What attracted attention was the fragility of some parks regarding structured programs for the training of their employees, mainly because they are organizations closely related to academic institutions.

The transformation of externally acquired knowledge is facilitated by support for the generation and implementation of ideas, and the provision of spaces and activities for social interaction in all the studied environments. Job rotation, though instituted in some settings, is not a consolidated practice in most parks. This observation presents itself as an opportunity to be worked by the parks, as a way of instigating the interaction between areas, increasing the capacity to transform the new knowledge from the association with the existing knowledge.

Concerning exploration of acquired new knowledge, the parks have shown, with some peculiarities, the existence of processes or tools to formalize and store the acquired information. In addition, all parks have demonstrated the ability to create new products and services, from

information acquired in environmental monitoring, and for the purpose of renewing and evolving their innovation environments.

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