

The Experience of Structuring an Innovation Environment Based on a Model of Networked Organizations in Brazil

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This paper presents a model of a networked group of organizations supported by offices and administrative structures that supports the creation of an innovation environment and the deployment of an entrepreneurial culture in a region lacking development initiatives. This study focuses on the Western region of Santa Catarina, in Southern Brazil. In recent years, this region has generated a series of initiatives associated with the establishment of technology parks and incubators. In 2012, the Science and Technology Park Chapecó@ was launched, representing an instrument to organize and operate local innovation. This technological park began by creating a network structure aiming to initiate a set of related actions to support the operation of a complete innovation environment. This study will present the elements that compose this networked structure and the results obtained through its creation.

Keywords: innovation, network structure, technological parks, regional development

Introduction

This paper presents a structured innovation environment comprising administrative units operating in a network. The goal of the deployed network was to provide the agents of the Triple Helix with a unique atmosphere, including several offices, to provide services related to innovation development. The first challenge was to establish a societal understanding of the importance of technological innovation as an instrument for generating economic growth and regional development. It should be noted that the studied region consists of companies linked to an array of agribusinesses with low potential for added value, such as commodity-producing industries in the area of production of animal protein.

The topic of network organization is relatively new, and there is no single model for establishing innovative environments offered in the literature; rather, there are numerous proposals addressing different areas worldwide. What we find from the existing models is that local characteristics and conditions tend to interact with the proposed structures of these environments, generating outcomes dependent on local conditions and the deployment scenario.

In this study, it is possible to observe highly satisfactory results from the creation of an innovation network structure. This innovation network, launched in 2013, used existing structures, created other units to integrate results, and completed the required set of actions to encourage and establish an environment of innovation. The following units were created: The Office of Projects and Services, the Municipal Office, and

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the Office of Business and Entrepreneurship. The following existing structures were used: A technology incubator (INCTECh), the Office for Innovation and Technology Transfer, and Science Technological Park Chapecó@. The findings illustrate the formal organization of an innovation network structure that supports knowledge management and promotes linkages in the productive sector, resulting in the capture of public and private resources, the management of intellectual property issues, the provision of services, and the development of new projects.

An Environment of Innovation Based on the Triple Helix Model

The term Triple Helix, created by Henry Etzkowitz, introduced an innovation model based on government-university-industry relationships. This environment is understood to result in innovation generated by relationships between experience, science, technology, and research and development in universities, companies, and government. Currently, the Triple Helix has evolved from a theory to a model of innovation (Etzkowitz, 2010).

While society is becoming more knowledge-based, companies are modifying their characteristics, and the job market is becoming more competitive and knowledge-intensive in terms of technology differentials (Audy, 2006).

The university is particularly conducive to innovation, because its basic functions deliver a flow of human capital in the form of students as potential inventors. The university is a natural incubator, providing structural support that allows teachers and students to start new ventures: intellectual, commercial, and joint (Etzkowitz, 2003).

The government can also promote technological innovation, offering incentives to the private sector to develop and spread ideas and articulating a political, economic, and institutional environment aimed at motivating companies to invest in science, technology, and research.

The presence of the Triple Helix, in terms of inducing innovation, depends on the manner of acting and the formalization of its constitution. Therefore, a network model can be a structure for proactively organizing this possibility.

Networks are a thriving environment for innovation, but they represent only one of the elements that favor creative capacity and the planning and construction of new ideas. Therefore, innovation is not an action networks can take; they need to identify the relevant institutional bodies or ways to engage with the innovative process (Fagerberg, 2004; Nonaka & Takeuchi, 1997).

Here, institutional bodies refer to universities, companies, and government, which together forms what has been understood as the Triple Helix model. The Triple Helix is becoming an important mechanism for transforming the scientific knowledge, produced in academia, into something that can be socially assimilated, so that universities are not engaging in the pursuit of knowledge alone (Mowery & Sampat, 2004).

For Chaimovich (1999), knowledge, innovation, and the need to be globally competitive are current concepts reflected in Brazilian companies. The final link of adding value to the product focuses on innovation in production. Production innovation does not depend on the nature of the product, which is essential to the introduction of a successful product or to changing a traditional product. Production innovation occurs within the company.

Ferguson (2004) explained that one of the indicators most widely used for analyzing competitiveness is the innovation process, noting that the results are linked to the ability to adapt in the creation, development, and

occupation of new markets. In this way, the creation of an environment favorable to the development of technological innovation is essential for the growth of a particular region. Hatcheries act in this context, providing conditions that allow micro and small businesses to develop innovative products and services oriented to achieve results and market positioning.

Focus is also given to another type of organization with great importance for the economic, social, and innovative development of the regions where they are deployed: technological parks. These organizations meet demands for regional development, combining the efforts of those actors comprising the assembly of science, technology, and innovation.

According to the definition of Anprotec (2008),

Technological parks are examples of economic and technological development aimed at promoting knowledge-based economies, integrating scientific and technological research, businesses and companies, organizations, as well as providing space for knowledge-based businesses. (p. 8)

The International Association of Science Parks (IASP, 2007) supported the premise that establishing a technological park in a particular region/city stimulates and generates knowledge and the development of technology across universities, research institutions, companies, and markets, promoting the creation and development of innovative companies.

It should be noted that the development of networks and alliances is a key factor for the success of the organizations that comprise technology parks. According to Amaral, Lima, Motta, Fagundes, and Schocair (2017), consensus among researchers who create innovative solutions through partnerships within the Triple Helix is the most effective way to integrate the corporate and academic worlds.

Structuring an Innovation Environment

In recent decades, the most effective innovative environments developed have supported the need to add value to products and processes, a critical factor in the knowledge economy.

In Brazil, especially within universities, technological innovation centers have emerged through the provision of law 10.973/2004. These centers consist of one or more technological scientific institutions and serve to manage innovation policies, encourage research, and support the institution in relation to contracts involving technology and innovation, essentially assuming the role of middleman between company, university, and government.

The emergence of the National Institute of Technology (NITT) has provided a more secure environment as relates to the organization of contractual relations and concerns about property rights for the inventions and innovations produced, whether in the private sector or at universities.

Similar to universities, innovation enables companies of all sizes to address their concerns with procedures linked to R&D. According to Reis (2008, pp. 139-142), to fit a new world reality that consists of a globalized market and falling barriers to trade, companies should incorporate increasingly more innovation. Technological knowledge is already part of the reality and needs of small and medium-sized enterprises, and their interest in innovation reflects their recognition that innovation is the key to competitiveness.

Cross and Baird (2000, p. 11) noted that:

The concept that the applied research and development necessary for the creation of technological innovation and competitiveness must occur in the enterprise is still incipient in Brazil. It turns out that, because almost all research activity

that occurs in Brazil takes place in an academic environment, common sense tends to the conclusion that it would be normal for only universities to carry out research and development.

Reis (2008, p. 142) noted that universities, as actors that have educational structures and encourage innovation, engage in the process of national economic development of the country and in teaching and research, two other pillars of these institutions.

This is not to ignore another engine of growth, the public sector. Indeed, innovation is observed to be present in every sector of the economy, including services provided by public administrations, such as in education and health. This claim is supported by the Oslo Manual (2005, p. 16), which highlighted the still little-explored theme that "innovation is important for the public sector".

The Network Management Model and Governance Structure

The presented innovation network context is a networked organizational structure comprising a set of services offered by the university to collaborate in the search for competitive advantage through knowledge sharing and to promote regional development.

There are several reasons for celebrating alliances to support innovation. Almost all innovations require some collaborative arrangement for their development or marketing. Participation in innovation networks can help companies generate new ideas and creative combinations, and they can promote the opening of new productive territories that allow knowledge sharing (Tidd, Bessant, & Pavitt, 2008). As a result, it is important that a management model for innovation in networks facilitates the connection between all actors, creating lasting ties and collaborations to promote the success of the innovation network.

According to Tidd et al. (2008), the success of innovation depends on two basic ingredients: technical resources (corresponding to human resources, equipment, knowledge, and financial resources) and the organizational competencies to manage them.

The innovation network promotes, coordinates, and manages interactions between the university, the productive sector and the government. For Wilkinson and Young (2006), a networked structure must be composed of a group of people recognized by network members as experts in their fields. With this in mind, the innovation network is composed of an interdisciplinary team, favoring the exchange of knowledge and dialogue between members and the community.

An innovation network is created to increase the transfer of knowledge produced at the university, to bring the university closer to the productive sector, allowing the generation of new products, processes, and businesses, and to develop the network's local region. Such organizational structure is essential to effectively manage the knowledge produced in this innovation environment.

In addition to providing an organizational structure, since its inception, the innovation network has developed a culture of innovation and knowledge sharing and has disseminated an understanding of the importance of intellectual property rights protection, so that knowledge flows throughout society, attracting regional development.

The Structure of the Innovation Network

The Western region of Santa Catarina's main productive matrix primarily includes agribusinesses, including the production of animal protein, particularly industrialized production of meat from pigs and poultry. The city and the entire region of Chapecó has undergone a visible transformation from an industry-based economy to an industrial economy based on the service sector, including education and health, which requires the organization of local knowledge-based structures. To maintain and increase the potential of knowledge and competitiveness in this region, we sought to structure a proactive innovation environment, born of a strategy established by the Community College of Chapecó and incorporating various local actors of the Triple Helix.

To promote interaction between local agents, we sought to apply the Triple Helix concept, triggering the creation of the Unochapecó innovation network.

The innovation network, established in 2013, is a framework to support knowledge management, promote articulation of the productive sector, and support network members through public and private funds to invest in academic activities and in the development of new products and production processes (see Figure 1).



Figure 1. Innovation network (Source: http://bell.unochapeco.edu.br/pctchapeco/rede-de-inovacao/).

The innovation network was established to foster links between the agents of the Triple Helix to promote innovation, thereby generating results and increasing regional development. The network aims to strengthen academic production to identify solutions for the regional community, develop advanced technical knowledge through the M.Sc. and Ph.D. programs, develop productive activities based on innovation, strengthen knowledge-based enterprises, generate high value-added products, and promote entrepreneurship and innovation as the main instrument of regional development.

It is important to highlight that the innovation network is fully integrated with the university, with a physical structure of laboratories and highly qualified operational staff, forming a large network of cooperation. This network is composed of a set of services that provide the university and the community with access to public funds to invest in innovative projects aimed at the improvement of processes, products, marketing, and organizational systems. The network is composed of the following sectors:

- (a) Scientific and Technological Park CHAPECÓ@;
- (b) Office of Projects and Services (EPPS);
- (c) Office of Business and Entrepreneurship;

- (d) Office of Municipalities;
- (e) Office for Innovation and Technology Transfer (NITT);
- (f) Technology Incubator (INCTECh);
- (g) Software Residence Center (CRS);
- (h) Specialized Laboratories.

The Scientific and Technological Park CHAPECÓ@. The Scientific and Technological Park Project Chapecó@ was developed to promote transformation in the local region by serving as a reference for scientific and economic development. As one productive chain, agribusinesses supplying meat and derivatives, dominated the region, the need to establish an environment of innovation was noted. Innovation can diversify productive arrays and increase the production and dissemination of knowledge, adding value to local products, developing human resources, and focusing on innovation and technology. The Scientific and Technological Park Chapecó@ is divided into four cores that constitute its operational structure.

Chapecó@bio. The environment core encompasses projects that develop environmental solutions that can be applied in the restoration, preservation, and monitoring of ecosystems, including fauna and flora. Additionally, it includes innovations directed at family agriculture, organic farming, and technologies for small properties.

Chapecó@health. In the area of health, the Scientific and Technological Park Chapecó@ will feature programs and projects that increase awareness of prevention and will develop research into processes and effective methods to promote health and prevent and treat diseases.

Chapecó@social. This core includes programs and social projects aimed at inclusion, empowerment, and the generation of jobs and income. The INCTECh, the incubator of popular cooperatives (ITCP), has examples of actions that have contributed to the development of the region.

Chapecó@*TIC.* This core includes technological innovation and focuses on the development and implementation of innovative projects that can promote entrepreneurship and the emergence of solutions for society.

Office of Projects and Service (EPPS). The EPPS is responsible for the planning and control of fundraising projects, supporting researchers through the use of appropriate tools to help prepare and manage projects that contribute to the development of the Western region of the State of Santa Catarina.

The mission of EPPS is to integrate best practices in the development and project management of scientific knowledge and to offer preparation techniques, project management, and supervision to optimize and centralize project management and the provision of services. The services provided include the following:

1. Mapping of needs from the main sources of regional, national, and international funding, whether public or private, to identify opportunities for framing concepts and research developed in the institution;

2. Offering advice and support for the development of project submissions for these edicts, including the monitoring, analysis, and subsequent submission of proposals;

3. Providing advice and support for fundraising and regarding the methods and means of obtaining resources and partnerships;

4. Providing support and management control of project implementation, as well as guidelines and help with accountability.

Another development activity relates to providing technological consulting for micro and small businesses, farmers, and individual entrepreneurs.

Office of Business and Entrepreneurship (ENE). The ENE is the business support office for local region and an academic laboratory dedicated to promoting entrepreneurship in the academic community and in the region. The new ventures generated within the university go through the ENE for a feasibility analysis and assistance in developing and implementing a business plan, so that the enterprise can obtain better results.

The activities in the ENE constitute the following:

1. Stimulating entrepreneurship through actions targeting the academic community and the productive sector;

2. Providing consulting services for companies and for projects within the university;

3. Supporting the establishment of companies, including financial consulting for new businesses;

4. Supporting the creation of micro and small enterprises;

5. Conducting market research for the consolidation and restructuring of businesses;

6. Training and offering public training courses.

Office of Municipalities (EM). The EM was created to undertake partnerships with state departments, municipal administrations, and entities aimed at promoting regional development. The EM provides these public agencies with technical and scientific support, and thus, promotes a strong relationship between the university and public authorities. Further, it enables the development of research and solutions for public management.

The EM's purpose is to identify areas where the provision of technical and scientific advisory services is needed, to research and develop qualification programs for agencies of the public administration.

The EM's activities are the following:

1. Managing Unochapecó partnerships with regional public authorities to promote sustainable regional development;

2. Integrating the best management practices into public projects, allied to the scientific knowledge produced by Unochapecó, to promote the socio-economic development of the region;

3. Monitoring edicts, public calls, subsidized loans, and other sources of funds for the development of technical-scientific projects and providing professional qualification for public managers;

4. Assisting in the preparation and management of projects;

5. Providing research and technical assistance to local governments to formulate and evaluate public policies and to prepare local development and other plans;

6. Organizing and coordinating qualification programs for public servants.

Office of Innovation and Technology Transfer (NITT). The NITT is responsible for managing the production and technological transfer of developed scientific knowledge, as well as for managing any intellectual property generated within the academic environment. Furthermore, it seeks to strengthen relationships within the region, involving government agencies, companies, and other organizations in a strategy for the production and transfer of knowledge to develop a scientific, technological, economic, environmental, and sustainable region.

NITT's mission is to support preparation and management actions that address, as their foundation, technological innovation in all segments of science and technology. NITT's job is to manage cooperation agreements with institutions and companies for research and technological development.

Its main goals and activities are the following:

- 1. Disseminating a culture of intellectual property;
- 2. Managing the rights and obligations associated with intellectual property protection;
- 3. Managing referrals and the registration and maintenance of patents;

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4. Promoting scientific-technical partnerships between the productive sector and educational institutions;

5. Encouraging research and innovation within the institution and in the region;

6. Promoting events that integrate society, companies, and academics and scientific institutions to debate the importance and results of innovation in the local, regional, national, and international contexts.

Technological Incubator (INCTECh). The INCTECh is an incubator program that supports the creation of new technology-based businesses and local economic development. It also provides a mechanism for transferring technology innovations developed through research projects at the university.

INCTECh's mission is to promote and support regional socio-economic development, promoting the creation of innovative, environmentally responsible technology-based companies. It acts as a catalyst for projects to be developed by the Triple Helix.

INCTECh's activities are geared mainly as follows:

1. Assisting to develop business plans for the incubator companies;

- 2. Promoting training techniques for incubator companies;
- 3. Developing projects for funding;
- 4. Analyzing and monitoring incubator businesses;
- 5. Providing legal, technological, and financial consulting, accounting, marketing, and software;
- 6. Providing a organizational structure for incubator enterprises.

Center of Residence in Software (CRS). The CRS is an academic laboratory for software development. It was created to provide student with a more professional experience in addition to constituting a qualified field for internships. The various objectives of the CRS include the following:

- 1. Development standards and consolidated methodologies in software engineering;
- 2. Enabling scholars to interact with major steps in the software development cycle;
- 3. Consolidating and strengthening software testing and software quality;

4. Strengthening and expanding existing partnerships directly with technology-based companies or through their representative organs or entities.

The CRS is home to labs for software development, software testing, and software engineering.

Specialized laboratories. *Software Testing Lab (LTS)*. The LTS was created to promote access to academic knowledge in the area of computer technology, particularly as applies to software engineering/software testing for software developers.

The LTS was accredited by the Brazilian government to test application programs for issues of tax coupons and software developers for tax companies. From this accreditation, the LTS went on to issue technical opinions based on research into the characteristics of applied tax systems on the market.

Food Analysis Laboratory (LAA). Deployed to meet the demand for analyses of agro-industries in the region, the LAA currently performs quality control analyses and process monitoring by means of the microbiological analysis of food and water for regional industries, according to the legislation in force, in addition to training workers in agricultural industries. In 2015, the LAA met the accreditation process at National Institute of Metrology Standardization and Industrial Quality (INMETRO) for the certification of microbiological tests according to the norm ABNT ISO/IEC 17025:2005.

Results Obtained Through the Structuring of This Innovation Network

The results obtained demonstrate the feasibility of the successful implementation of this innovation network

structure. Given its survival rate over a short time, this network already demonstrates viability and fruitful expectations for the future of its local region.

Table 1

Innovation Network and Its Main Results

Innovation network	Main results
Scientific and Technological Park Chapecó@	The Scientific and Technological Park Chapecó@ obtained public investment of approximately R\$ 7.3 million reais.
Office of Projects and Service (EPPS)	By the end of 2014, EPPS had collected approximately R\$ 3.4 million reais by submitting projects to several funding agencies and through partnerships with the productive sector.
Office of Business and Entrepreneurship (ENE)	ENE is responsible for structuring business plans for pre-incubation businesses in addition to consulting for the restructuring of companies. Through strategies, such as the Marathon of Innovation, Startups, and Startup Weekend, among others, it is responsible for creating a culture of innovation.
Office of Innovation and Technology Transfer (NITT)	In a short period of time (as this structure was assembled in 2013), the NITT has filed two patent applications, and three more are currently under review.
Office of Municipalities (EM)	The EM has formalized partnerships with municipalities, municipal administrations, and the Santa Catarina Municipalities Federation.
Technology Incubator (INCTECh)	INCTECh has been responsible for the development and creation of 23 formalized ventures, eight of which have graduated from the incubator, in addition to currently supporting 27 incubator companies.

Note. Source: Produced by authors.

Scientific and Technological Park CHAPECÓ@. The scientific and technological Park Chapecó@ has a physical structure of more than 3,700 m^2 available for companies and organizations that promote regional development through innovation.

Office of Projects and Service (EPPS). By the end of 2014, EPPS was responsible for the submission of 94 projects with funding of approximately R\$ 3.4 million reais. It succeeded in the adoption of 34 proposals and had 18 other projects awaiting results. In addition, it provided technological services, generating approximately R\$ 645 thousand reais.

Office of Business and Entrepreneurship (ENE). In 2015, the ENE develop internal policies, develop the "Business Plan Software Project" (software designed to facilitate ENE procedures), support and participate in events related to the innovation network, engage in activities related to the promotion of entrepreneurial culture, such as the Marathon of Innovation, Startup, Startup Weekend, and others, and assess referrals of business plans and incoming projects that will be absorbed into the innovation network. These incoming projects will be planned using the CANVAS methodology.

Office of Municipalities (EM). In 2014, the EM deepened its relationships with municipal associations in the Western region of the state of Santa Catarina. It also started offering training courses for employees in the areas of health and education, which are identified areas of interest to the public administration.

Office of Innovation and Technology Transfer (NITT). In 2014, the NITT formalized technical-scientific cooperation agreements with companies in the region, held the II International Congress of Open Innovation in the Food and Beverage Industry and the III South Brazilian Innovation Seminar, became the first organization in the history of the university to submit two patent applications (which well represents the importance of the innovation network), and continued progress in other projects that will possibly require intellectual protection.

Technology Incubator (INCTECh). The results obtained by the INCTECh Incubator are social and

economic. For example, through the promotion of innovative entrepreneurship, it reached an audience of over 5 million people in the last three years by participating in fairs and exhibitions, supporting the Synapse Program, and conducting the Innovation Marathon through specific academic extension courses. INCTECh is currently responsible for 23 formalized ventures, eight of which graduated from the incubator, and currently has 27 incubator companies.

Conclusion

The achieved results demonstrate that this network of management units created to assist in building an innovation environment has been effective. Although its launch occurred in November 2013, i.e., less than two years ago, the necessary elements for an innovation environment, acting jointly and in network, produced significant results that would not have been achieved without this organized structure.

Based on this structure, other potential gains exist, such as promoting partnerships between research institutions and the productive sector, enhancing and disseminating the role of universities and research institutions through scientific and technological cooperation with the public and private sectors, and disseminating the expertise within technology parks to generate growth in the regional economy. Public managers are thus confronted with the challenges and opportunities of innovation in terms of both its scope and the range of possibilities from future earnings for the management of intellectual property.

It can also be noted that the entrepreneurial culture is continuing to form, for example, the university has launched a Master's Program in Technology and Innovation Management, to promote the development of research and scientific production associated with innovation.

The major difficulties that can be noted relate to the existing organizational culture, which reflects a condition of hierarchical decisions and needs to be improved when using this model. In many instances, the operation of the innovation network confronted uncertainty in how to assign responsibility for particular referrals. Currently, a significant breakthrough has already been seen, as now any demand received by the network follows the procedures used for a project, which allows for the involvement of all network drivers necessary for management and to achieve success.

One can observe that the results achieved to date confirm the specific strategy used to develop the innovation environment. The volume of funds raised for this innovation environment, close to R\$ 3.4 million (over 1 million dollars), not including the capture of the physical structure of Chapecó@ Park, which gained over 7.3 million reais (more than 2 million dollars), is significant, taking into account the weather and conditions in the region. In addition, another important result is that the proactive nature of this environment has established the potential to file patents, with three R&D projects aiming for new applications and a technology transfer conducted as a result of this action. In conjunction with these results, a culture of innovation has been created through a series of events to change the local understanding and through the incorporation of an innovative culture. This project provides a way to achieve sustainable regional development.

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